Facilities Business and its Management

Kauko Tulla

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Facilities Business and its Management

Edited by

Kauko Tulla
Technical Research Centre of Finland

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Preface

This book highlights facilities management and its business experiences from four continents as they were presented in an international CIB 2005 Helsinki Symposium. The book containing 57 papers is divided in six chapters each describing highly interesting topics of built facilities and their management.

The changes and recent developments in facility management industry have been very efficient: new knowledge and solutions are widely used and business is coming more and more globalise. Those who can successfully interpret changes happening in the construction and facilities businesses can achieve significant gains. Business environments are constantly changing thereby providing new opportunities for innovative firms.

Emerging solutions for defining end products, relying heavily on the preferences of users to guide all services are clearly providing a mind shift from supply-driven to end-user-driven attitude. The needs and expectations of customers and end users are highly ranged.

Today's businesses and working life demand highly usable workspaces and flexible spaces and buildings and also versatile new facility management services. Present needs cannot be extrapolated over decades. Active, innovative research and development work is needed all the time.

Also facility management needs sustainability. Sustainable concepts, sustainable buildings and infrastructure are affecting facility industry and business, its management and the underlying knowledge, methods and solutions.

Also new concepts, methods and solutions for explaining built environment quality, safety and functionality are covered by this book.

We hope this book finds interest among practitioners and researchers willing to implement and develop further the facility management as an independent service industry and business area.

Kauko Tulla

VTT - Technical Research Centre of Finland

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Section I

Facilities management business

Development of Strategic Stock Management System for Public Building Facilities

Nozomu KIUCHI Dr.
National Institute for Land and Infrastructure Management
(email: kiuchi-n92ta@nilim.go.jp)
Naoji HASEGAWA
National Institute for Land and Infrastructure Management
(email: hasegawa-n92iw@nilim.go.jp)
Masaki MUTO Dr.
National Institute for Land and Infrastructure Management
(email: mutou-m92p5@nilim.go.jp)

Abstract

In Japan, long use of social capital stock is now our crucial task in terms of both fiscal issues and global environmental problems. "Strategic Stock Management Method" that we developed is a group management method of social capital stock, and in the sphere of building, it consists of, a) simplified evaluation method, b) combination of various types of building life prolongation technologies, and c) impact analysis of management schemes to various social and environmental aspects. This paper examines the problems for stock management that confront us and presents our concept of "Strategic Stock Management", and taking public buildings of a city as objects of case study, show its effectiveness to our problems.

Keywords: Public Building Facilities, Group Management of Facilities, Stock Management, Asset Management, Simplified Evaluation Method

1. Building and Infrastructure Stock Management in Japan

In spite of scrapping and building of massive buildings and infrastructures Japan has undergone during the rapid economic growth and social transitions, long use of housings and social capitals are now our crucial task in terms of both fiscal issues and global environmental problems (Figure 2 - 5).

Owing to the rapid development of Japanese economy and accumulation of construction activities, massive stock of buildings and infrastructures has been formed, but the progress of time and the development of living environment have invited the rapid obsolescence of its function in the both terms of soft and hard. As for publicly managed housing and social capital under the present severe financial conditions of public investment reductions, the maintenance and the replacement cost for the voluminous stock is estimated to leap in the near future, and new building and construction investments will be even harder.

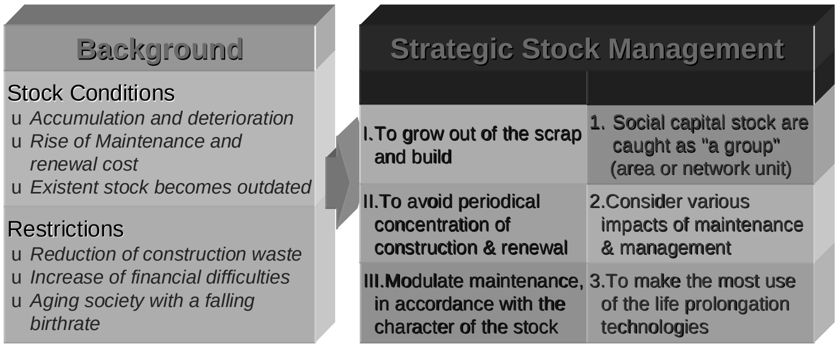


Figure 0: Backgrounds and Conditions of Strategic Stock Management

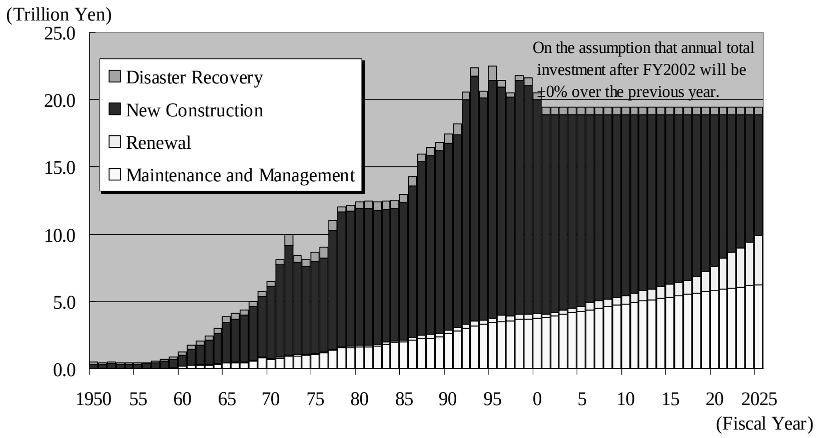
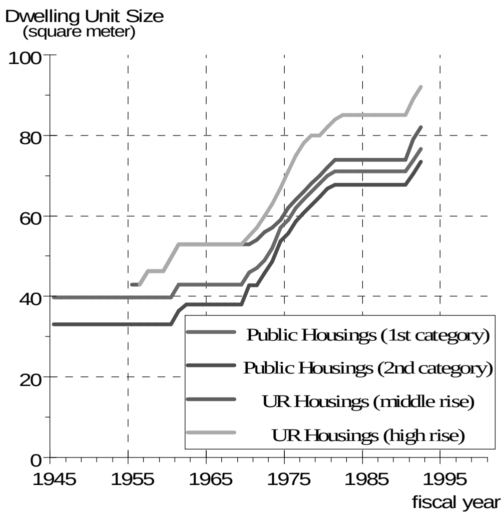


Figure 0: Estimates for Investment of Social Capital Stock in Japan (by MLIT 2002)



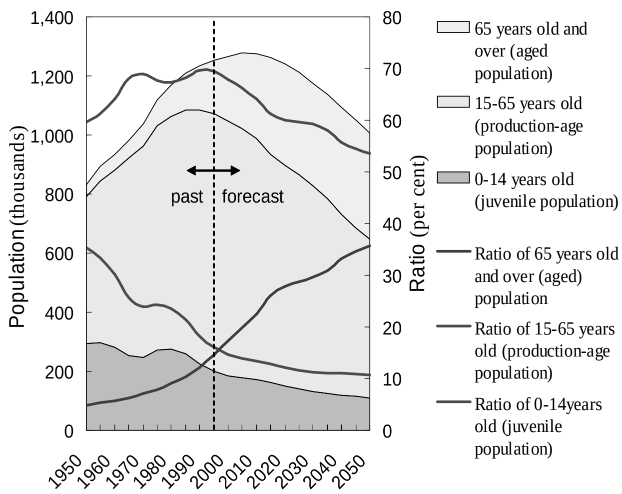


Figure 3: Outdating of Existing Stocks *Figure 4: Change of Social Conditions (Population)*

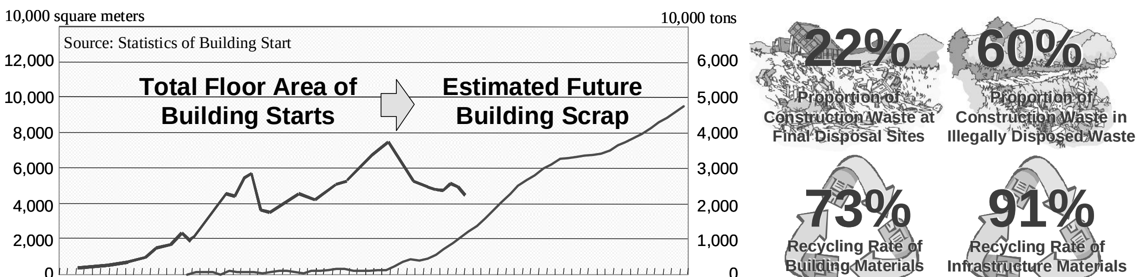


Figure 5: Necessity to Control Production of Building Waste

On the other hand, with the issue of global warming focused on, the decrease of waste and global warming gasses from building and construction activities is demanded.

What we must do, along with developing and making use of technologies to extend the service life of individual buildings and infrastructures is to develop technologies to control the life span of all social capital to adjust the peak demand for renewal. It is for this context that our institute is conducting studies into the 'Development of Asset Management Technology for Housing and Social Capital' (2001-2004), with the objective of developing a "Strategic Stock Management" method that will enable us to maintain, manage, operate and renew multiple facets of our social capital in a planned, strategic manner (Figure 1).

2. The Concept of Strategic Stock Management

The concept of "Strategic Stock Management" at our start point can be described as following.

If we are to make more effective use of housing and social capital, it is vital to have a grasp of the conditions of each facility and manage each appropriately. To allow selection of the most appropriate for maintenance and management depending on facility conditions and functions, evaluation of the characteristics and effectiveness of separate technologies are required. According to the diagnosis of the degree of facility deterioration, we can extend facility service life that will ensure the required functions for the necessary periods through repair and reinforcement, or extend service life by converting use of the facility.

As we evaluate the effects of these technologies, it will make possible to formulate and evaluate maintenance and management plans for each separate facility -- plans with comprehensive perspectives including environmental impact, costs, and user convenience. Specifically, we compare the different plans in comprehensive ratings that consider cost and environmental impacts in order to choose the best plan. Here is an example of how selection would be made from among plans A, B, C, and D (Figure 6). Plan A calls for maintenance of the facility in a way that makes it possible to maintain its performance consistent with its original purposes until it reaches the end of its life span. Plan B call for maintenance to be carried out at lower levels than are required by Plan A, but schedules major scale repair work at some future point. Plan C would convert use of the facility before the end of its designed life span and would maintain the facility in a way to support its expected performance until the target date. Plan D would retain the facility even after the end of its designed life span by converting facility use in a manner different from Plan C.

However, formulating the best maintenance and management options for individual facilities is not sufficient to formulate appropriate plans for maintenance, management, and renewal that cover the overall inventory of the stock. To that end, we have to, in a certain management unit, overlook the whole facilities, estimate the change of necessity and coordinate maintenance and management plans of each facilities so as to maximize the function, minimize the environmental load, average financial expenditure of the facility as a group (Figure 7).

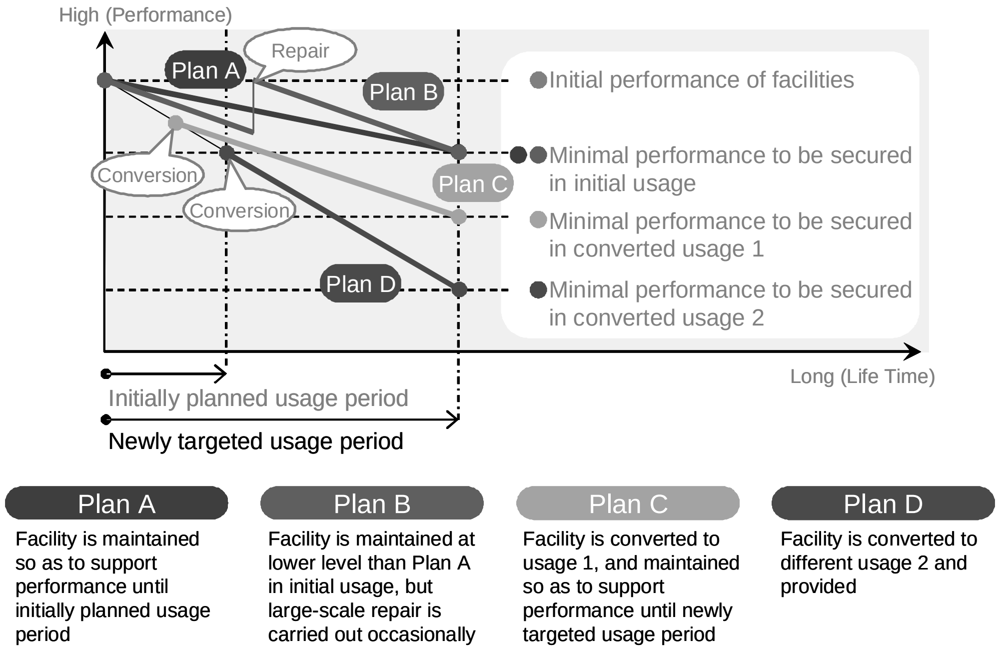


Figure 6: Planning of an Optimum Management Plan during the Usage Period

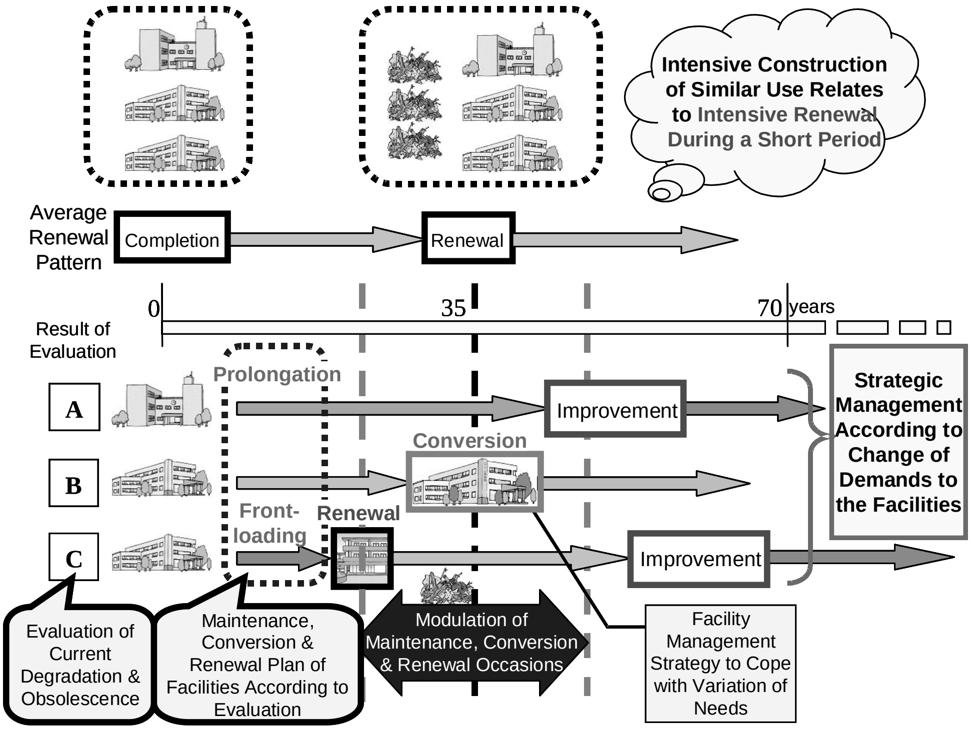


Figure 7: Approach to Group Management of Facilities in Strategic Stock Management

In brief, what we tried to achieve through the development of an overall strategic stock management system is to establish the comprehensive technology to manage and operate more than one facet of housing and social capital, i.e., ‘stock’, in a certain area by making the best use of technologies to extend life spans, repair, enhance functions or convert facility use with consideration for social aspects such as financial conditions, asset value, the impacts on global environment, effects on communities, historical value, and perhaps, preservation of scenic beauty.

3. Developing Evaluation Methods of a Building

The actual research and technology development were executed targeting public buildings of small and medium size local governments (municipalities). Through questionnaires the characteristics of building stocks and their management in these bodies has been identified as the followings.

- They have many building stocks, which are comparatively old, and of various use. The local government owns 780 thousand buildings and 500 buildings in average, while the national government owns 150 thousand buildings. Schools and public housings account for 2/3 of the buildings, and in total, their variety of use is 28 categories. Approximately 60% of the buildings are more than 20years old, and 55% are built before the new earthquake-resistant design method came in to effect (1981).
- The facilities are managed by each department in charge, and not by a single facility managing department who manage the whole stock. Building engineers occupies only 1.5% of the whole employee, and engineers play only a small part in facility management. Data accumulation for management is insufficient and there isn't a common form of facilities register in most municipalities let alone taking of maintenance and repair record.
- Despite inspections of building elements and equipments take place, diagnosis and examination of a whole building is rare. Only corrective maintenance is done only coping to troubles after they become obvious and preventive maintenance or long-term repair program rarely takes place. Because of financial difficulty, seismic rehabilitation remains undone.

Thus the situation in these municipalities are that, despite the amount, variety, deterioration and outdating of their building stocks, they do not have a comprehensive plan to cope with, lack accumulation of inspection data to support the necessary decisions, and are short of persons of talent who make the steps forward.

To solve these problems, we have developed an evaluation system of the buildings that are simple; not time and money consumptive, understandable, and can be carried out by in-house non-expert. To do this we have prepared filling sheets, by checking the items of which, a rough evaluation is executed. There are three types of evaluation and there are filling sheets for each type.

The first is for understanding and evaluating the present condition and function of the building. By checking the 32 sub-items they will be summarized to 15 main items or 5 categories of performance level as of Table 1, and the elements and the details which need repair and improvement is clarified.

Table 1: Performance Evaluation Categories and Items of Existing Buildings

Category	Main Item	Subitem (Performance or Alternative Characteristics)
I. Safety	1. Safety of Building Frame	1-1. Completion year of the building
		1-2. Execution of seismic strengthening and structural resistance
		1-3. Deterioration of the building frame
	2. Safety of External Facing	2-1. Waterproofing of the roof
		2-2. Leak from the external facing
		2-3. Deterioration of exterior materials
	3. Disaster Prevention Safety	3-1. Indication items by fire inspection
		3-2. Evacuation safety
		3-3. Problems of fire protection and crime prevention equipments
II. Function	4. Spatial Extent	4-1. Story and ceiling height
		4-2. Size of the rooms and convenience
		4-3. Deterioration of interior materials
	5. Indoor Environment and Faciity Functio	5-1. Performance of air conditioning, sanitation, sound, and light
		5-2. Performance of equipment machines and convenience
		5-3. Equipment capacity and crime prevention performance
	6. Barrier Free	6-1. Response of the building
		6-2. Response of the equipment
	7. Information Capability	7-1. Wiring space (OA floors)
		7-2. Reliance of information equipments against disasters and crime
III. Environmen	8. Decrease of Environmental Load	8-1. Energy and resource conservation response
		8-2. Longevity response
	9. Environmental Conservation	9-1. Consideration for the surrounding
		9-2. Ecomaterial, waste removal
IV. Sociality	10. Landscape	10-1. Contribution to landscape
	11. Locality	11-1. Consideration for local history, culture and climate
	12. Capacity	12-1. Floor area per user
	13. Utility	13-1. Utilization factor
		13-2. User satisfaction level
V. Economy	14. Maintenance Costs	14-1. Annual cost (electricity, gas and water supply)
		14-2. Operational cost prospect (per life-cycle)
	15. Asset Value	15-1. Residue value
		15-2. Service level of the facility

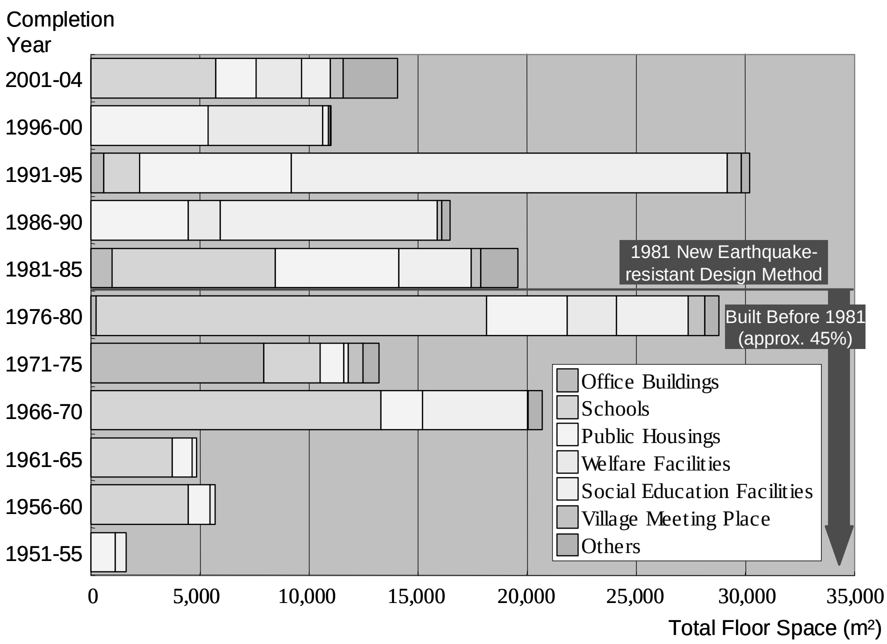


Figure 8: Building Stock of I-City by Completion Period

The second is improvement evaluation, and by filling in the sheets using cost sheets, you can estimate in rough the cost to raise the performance that is evaluated as inferior by the present condition evaluation.

The third is use conversion evaluation, which will be carried out for buildings that were considered low performance under the current use. Probability of converting to another use will be evaluated by checking the filling sheets.

4. Case Study of Evaluation in I-city

I-city was chosen as a case study of Strategic Stock Management. I-city is situated 70km from megalopolis and has a population of approximately 50,000, which recently is slightly decreasing. Revitalization of the city center, and coping with the aging population combined with the diminishing number of children, like in most of the local cities are of the main issues of local government policy that relates to facility management.

Figure 8 shows the building stock owned by the city, by use and completion period. The total floor area sums up to 167 thousand sq meters, of which 57 thousand sq. meters (34%) are schools, 44 thousand sq. meters (26%) social education facilities and 34 thousand sq. meters (20%) public housing. There are few old public buildings over 50 years of age; mostly wooden public housings that sums up to 1600 sq. meters (1%). However, nearly half (45%, 75 thousand sq. meters) are built before the new earthquake-resistant design method came in to effect (1981) and their earthquake resistance are doubtful. The description of chapter 3 applies to the situation of stock management of the city.

Figure 9 shows in radar chart the result of performance evaluation trial for 6 facilities that are taken up for group management in chapter 5, out of 13 facilities where evaluation is carried out. Through the evaluation trial, evaluation by the filling sheets has shown effect in the following points and proved to be practical.

- The whole public building stock of the municipality can be evaluated. By evaluation of administrative staff member team themselves, grasping and solving of the problem of the whole concerned with the facilities becomes possible.
- A specialist was asked separately spending time and expenses so far, but as for this method, where a specialist are found to be necessary, they can be asked and examined afterwards.
- Evaluation of whole of the facilities which was difficult so far can be carried out in comparatively short time and quantitative data accumulation, building index preparation and similar example comparison become possible by carrying it out once every five years, and they can be set up as a bench mark.
- Efforts to renovation and conversion will become easy.

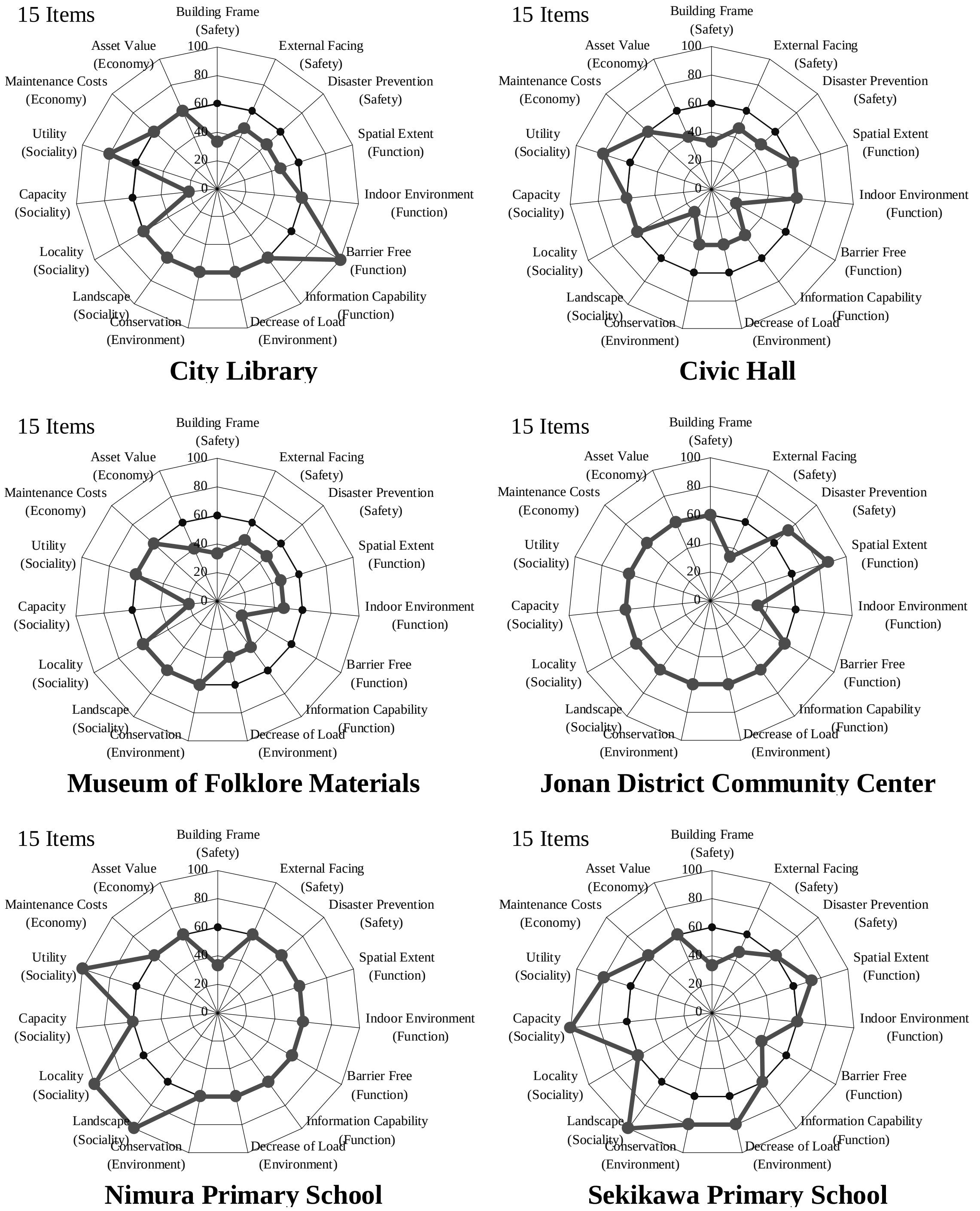


Figure 9: Performance Evaluation of I-City Public Buildings

5. Case Study of Group Management in I-city

After each public building has been evaluated, group management of the facilities will take part. The objective of group management is to examine and compare the change of function level and the social impacts of a set of management plans; maintenance, repair, conversion, rebuilding and new construction; of facilities in the management unit, and to choose the best according to higher policy.   Generally, consideration of group management will take the following steps.

A. Preparation
   (i) Sort out of the present condition of the facilities
   (ii) Sort out of the presuppositions and scenarios of the group management
   (iii) Evaluation of the buildings that are considered in the scenarios
   (iv) Population forecasting
B. Examination of each scenario
   (i) Arrangement of public facilities improvement plan of the area
      a) Review of public facilities improvement plan
      b) Consideration of future maintenance and renewal of facilities
   (ii) Estimation and levelling of future financial burden for maintenance and renewal
      a) Estimation of future financial burden
      b) Levelling of future financial burden
   (iii) Cost benefit measurement and impact analysis of the scenario
      a) Economic ripple effect measurement
      b) User benefit (level of service) measurement
      c) Environment load measurement
      d) History and culture consideration
C. Comparison of scenarios

In the case study of I-city we have examined 3 cases of group management, but hereafter, the first and second will be referred to.

The first case is rearrangement of facilities triggered by a large scale cultural facility. The existing city library of I-city was built in 1980. Despite the floor area of 1,521 sq. meters, it was originally planned to shelve 500 thousand books, whereas at present the collection is 1,500 thousand.   The City's original plan to cope with was to build a new cultural complex with a new library which can shelve 3,000 thousand books, under the circumstances then that the City will amalgamated with other 3 adjacent municipalities.   The reality now is that the amalgamation is with only another, and there is need to consider optional plans.

Under the circumstances, we have set up 3 scenarios (Figure 10):   1. Repair and prolongation of the present library.   2. Enforcement of the complex cultural facility plan and use conversion of buildings after removal.   3. Control and distribution of demand level to the present facilities (only the southern part of the city is studied).

Figure 11 and 12 shows the occasion, details, and expenditure (excluding subsidies for new facility) of maintenance and management for relational facilities of each scenario after the levelling process.   Including the results of social impact evaluations, the conclusion was that by utilizing present facilities, with as much cost as for improvement of present library, and far less than for a new one, improvement of user benefit, high level of local economic ripple effect measurement and decrease of environmental load will be possible.

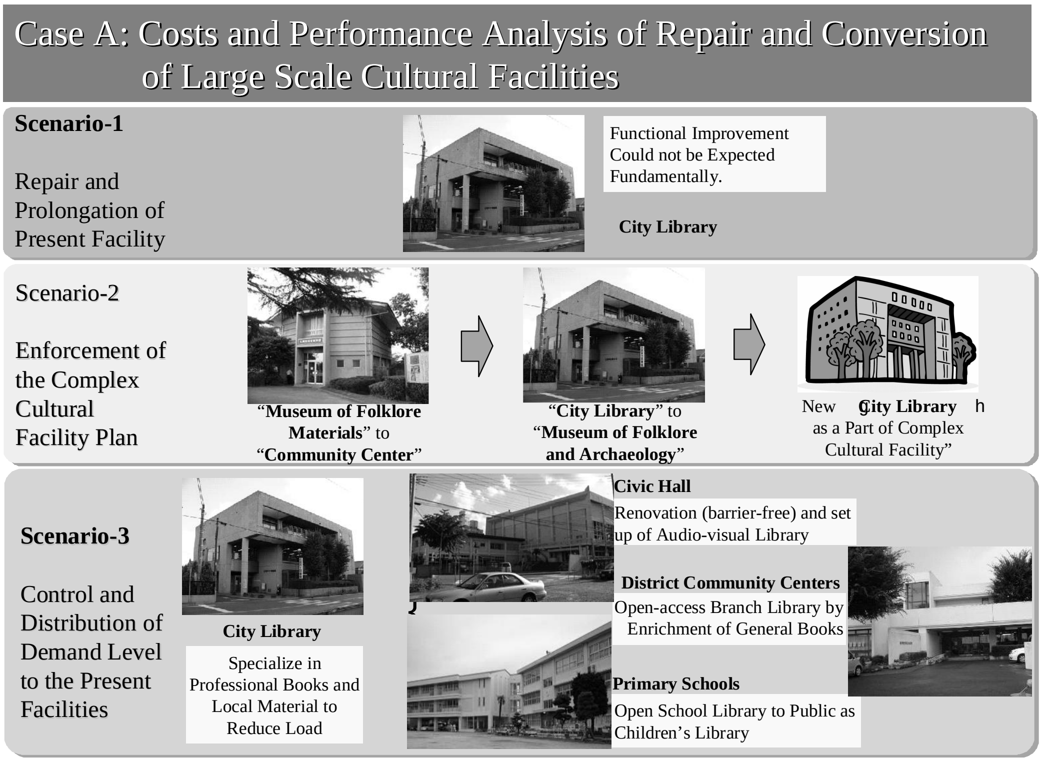


Figure 10: Group Management Scenarios of Case A

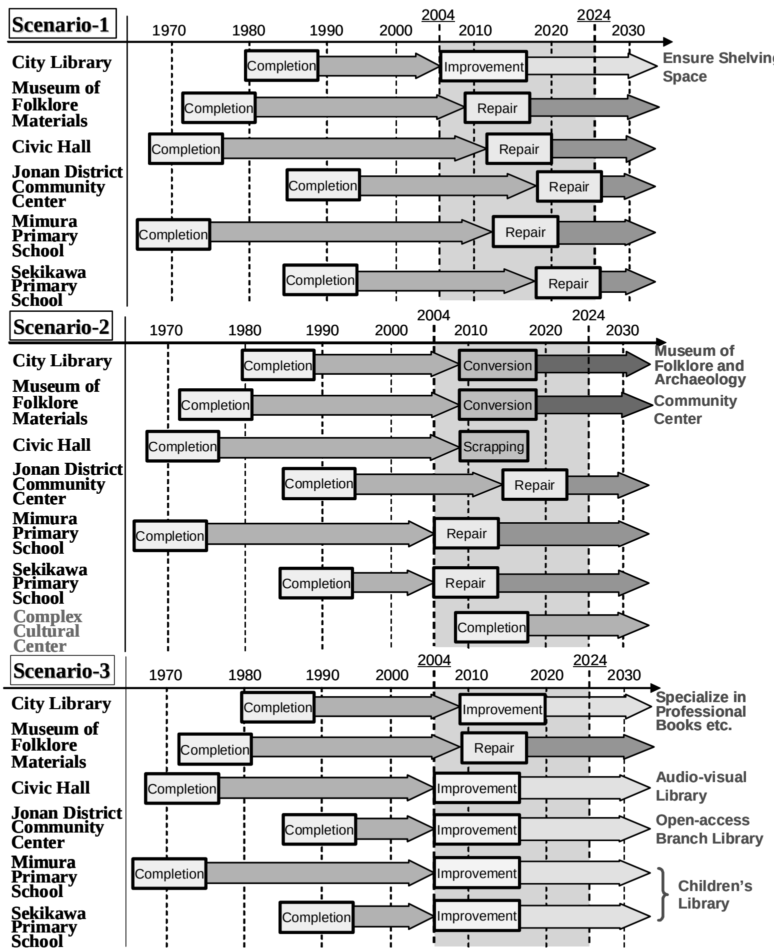


Figure 11: Maintenance & Management in Case A

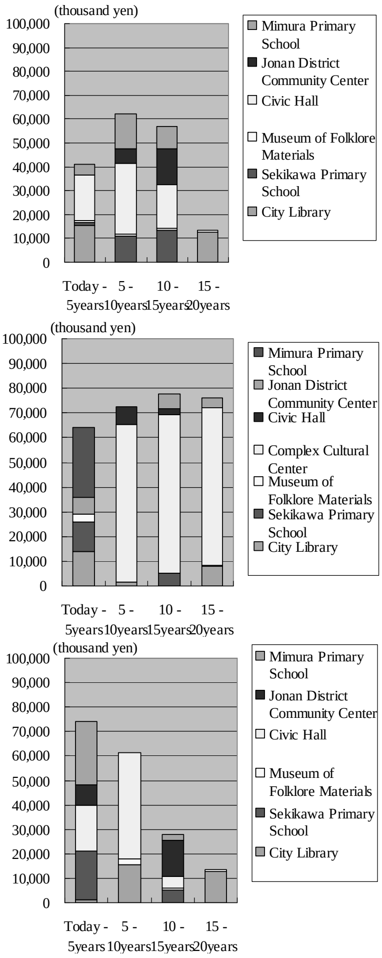


Figure 12: Expenditure of Case A

The second case is preparation of small-size close-to-life day-care welfare facilities. Under the progress of nationwide aging society and increase of nuclear families, the need for elder care facility is growing. The traditional provision of the facilities were, construction of a large scale multifunctional welfare center, whereas need for small-size close-to-life welfare facilities to support home nursing care is increasing. In I-city too, a large scale facility has been built in a northern rural part of the City, and there is growing need for smaller ones.

For this case, we decided to study about the southern part of the City and we have again set up 3 scenarios (Figure 13), including the traditional style: 1. Construction of large scale multifunctional welfare center. 2. Construction of (two) new regional welfare facilities. 3. Distributed welfare service by utilizing present community centers.

Figure 14 and 15 shows the occasion, details, and expenditure of maintenance and management for relational facilities of each scenario after the levelling process. Including the results of social impact evaluations, the conclusion was that utilizing present facilities (scenario 3), was a little costless than the others, the local economic ripple effect measurement was higher, and decrease of environmental load was greater, and by utilization, improvement and repair of village community centers will be possible as a public project (else left to the community).

6. Conclusion

Targeting small and medium size local governments whose building stocks, under the financial and manpower problems, are not well utilized effectively, we have developed a method to evaluate present performance level, upgrading of performance by improvement and its cost, and possibility to convert to use of more demand, of the buildings by in-house staff members simply. Another development is, using the result of the evaluation, and a group of facilities in the area as an object, methods to design a number of optional maintenance and management plans, guided by higher plan and change of socio-economic conditions, and evaluate and compare the upgrading of facility's performance by improvement, cost and spending and social impacts under the plans, and to choose the adequate one, which in total will facilitate optimization of total cost, environmental load, and service level. The case studies in I-city has given its concrete example, and proved to be effective.

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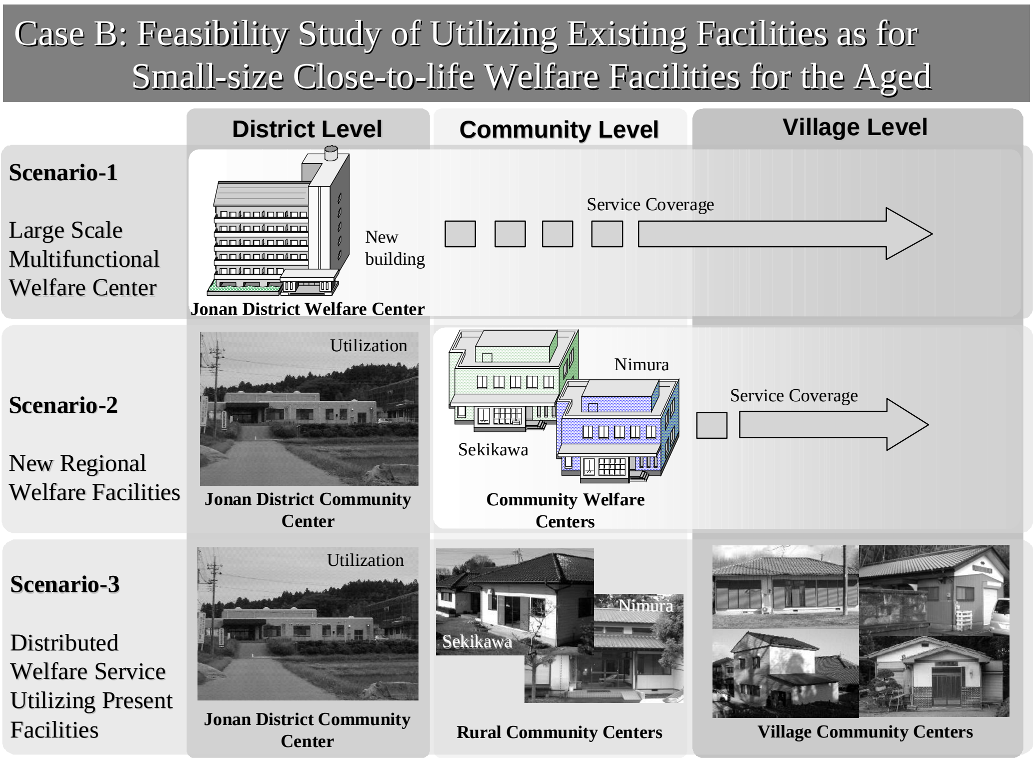

Figure 13: Group Management Scenarios of Case B

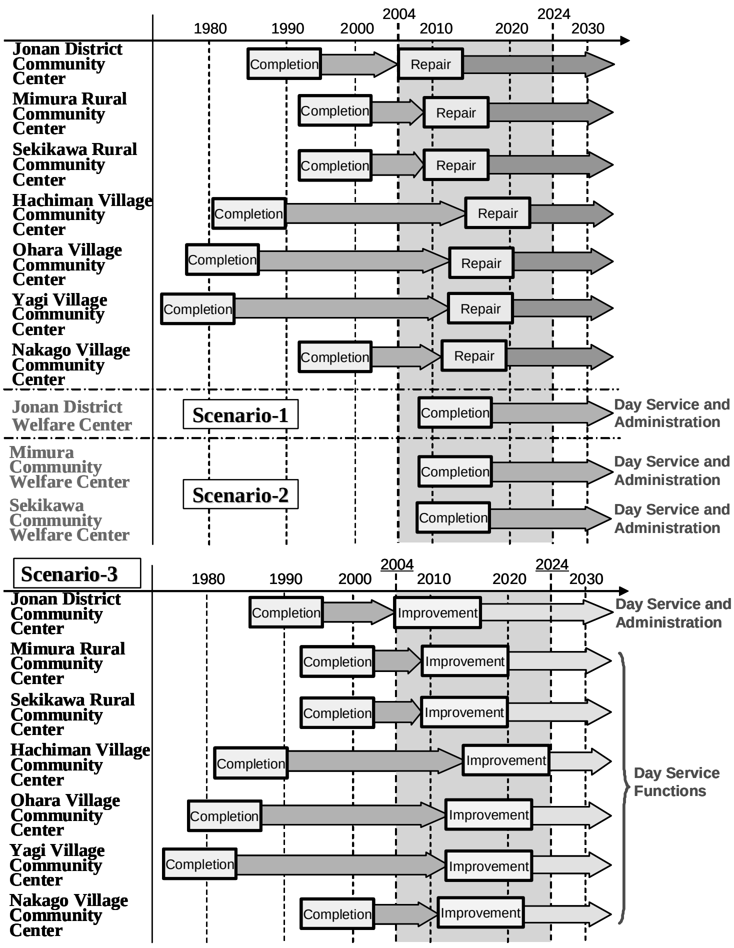

Figure 14: Maintenance & Management in Case B

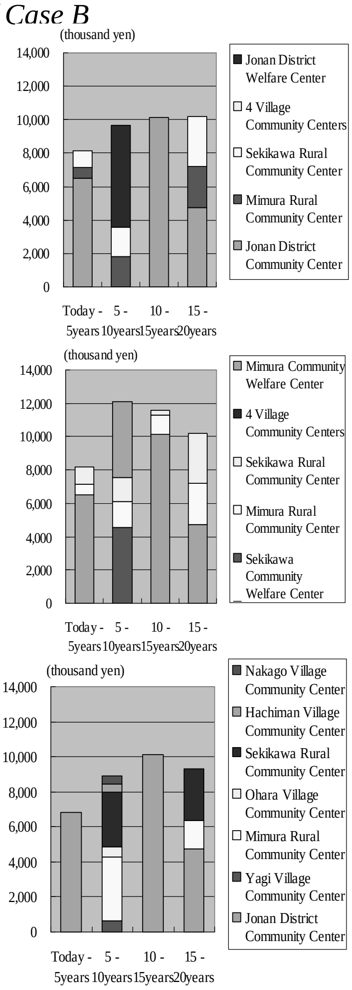

Figure 15: Expenditure of Case B

The FM Industry and Adding Value for Clients

Gerard de Valence
School of Construction, Property and Project Management
University of Technology Sydney (email: g.devalence@uts.edu.au)

Abstract

Many writers on FM stress the importance of the role FM should take in enhancing business performance. So far, the idea that FM itself is essentially strategic in nature, rather than operational, has not been widely accepted by senior management. Different writers take different approaches to this and there is no lack of ideas on how FM can be linked to business performance. This paper argues that the key issue is to help organizations increase the value gained from their use of the space that facilities provide. For the FM industry to significantly change the role it performs for clients and become a strategic rather than operational function will require a long-term approach using four approaches to value-adding for clients. This would be a major change in direction, both for the industry and the perception of FM by clients.

Keywords: Facility management, industry growth, value-add, strategic function

1. Introduction

The task of delivering 'value for money' is an important part of facility management (FM), but it is often not clear what 'value' is in the context of FM. Many writers on FM stress the importance of the business environment and suggest that there is a strategic role for FM in enhancing business performance. This would certainly add value. However, despite the importance of the workplace as a strategic management tool Price (2001) argues those involved in property and facilities, whether in research or professions, do not know how to describe themselves in terms of strategic value added. In his view "buildings operations and maintenance contracts dominate the FM market place. FM practitioners tend to focus on managing costs rather than thinking in terms of adding value" (Price 2001: 1).

While the idea that businesses use their facilities as a strategic resource is not controversial, the claim that FM itself is essentially strategic in nature, rather than operational, has not been widely accepted by senior management. FM is frequently referred to in the context of providing support to business. This divergence of views has encouraged a debate over the future development of the FM industry.

This paper first looks at the debate over the future of FM. In this debate the different directions the industry could, or should, take in its development have been identified, often reflecting different ideas held by these researchers on what FM actually is, or should be. Secondly, the paper considers the relationship between the growth of FM as an industry and the role that the increased use of outsourcing has played in that growth. There is a brief discussion on the nature of value to clients and building owners. This leads to the main contribution of the paper, identification of the four approaches available to the FM industry that can improve its ability to add value for clients. The conclusion sums up these points.

2. The Debate over Future Directions

There has been an ongoing discussion about the future development of FM and the role FM should take in enhancing business performance. While the idea that businesses use their facilities as a strategic resource is not controversial, FM is often seen in the context of providing operational support and the claim that FM itself is essentially strategic in nature has not been widely accepted by senior management.

Different writers have taken different approaches to this. Duffy and Tannis (1993) emphasise the role of workplace design and productivity. O'Mara (1998) is concerned with the drivers of corporate change and development. Alexander (1996) sees FM as enabling organisational effectiveness, and argues for FM to be 'an enabling mechanism which responds to the evolving needs of business' His belief is that the discipline should not be mistaken for a support function. Becker and Steele (1995) carry the workplace ecology argument through to its logical conclusion. Finally, McGregor and Then (1999) make the case that FM is the 'business of space' and Tay and Ooi (2001: 360) claim that "the core competence of a facilities manager is strategic level FM matters while overseeing operational matters … FM must play a bigger part in overall business development, becoming a strategic rather than operational issue".

This range of ideas is matched by the diversity of opinion on what FM is. Tay and Ooi (Table 1 below) reproduce eight definitions that vary from the comprehensive approach of Alexander (1999) or Nutt (2000) to the workplace and business focus of Becker (1990), Then (1999) and Varcoe (2000). Out of these ideas a debate about where FM is going, or should be going, has developed.

Nutt (2000) starts with the statement "the strategic objective of facility management is to provide better infrastructure and logistic support to business and public endeavours of all kinds across all sectors". Again, here is the emphasis on strategic aspects of FM that is not found in practice. Nutt identifies and discusses four basic trails or pathways to the future which are explored. These correspond to the generic types of resource that are central to the FM function: the management of financial resources, human resources, physical resources, and the management of the resources of information and knowledge.

The ideas and analysis that underpin the four trails are important and interesting. It is not clear, however, that they establish a genuinely strategic role for FM, rather than a complex operational role with some longer-term aspects. What the trails identify is the range of core areas for FM, and how developments in technology, work patterns and so on will challenge the industry to develop these core areas over the next couple of decades. In themselves, the trails will not provide the basis for a strategic role for FM, although the opportunities for making powerful contributions based on one or more of the trails are there for taking. Also, the four resource trails seem likely to be subject to radical change towards 2020, with a wide range of possible futures. While the trails share a common objective - to provide strategic and operational support to all of our endeavours - they work to different agendas, serve different interest groups, with conflicting priorities and ambitions.

Table 1. Sample of FM Definitions

Author	**Definition of FM**
Becker (1990)	FM is responsible for coordinating all efforts related to planning, designing and managing buildings and their systems, equipment and furniture to enhance the organisation's ability to compete successfully in a rapidly changing world
Nourse (1990)	FM unit is seldom aware of the overall corporate strategic planning, and does not have a bottom line emphasis
NHS Estates (1996)	The practice of coordinating the physical workplace with the people and work of an organization; integrates the principles of business administration, architecture, and the behavioural and engineering science
Alexander (1999)	The scope of the discipline covers all aspects of property, space, environmental control, health and safety, and support services
Then (1999)	The practice of FM is concerned with the delivery of enabling workplace environment – the optimum functional space that supports the business processes and human resources
Hinks and McNay (1999)	… common interpretations of the FM remit; maintenance management; space management and accommodation standards; project management for new-build and alterations; the general premises management of the building stock; and the administration of support services
Varcoe (2000)	… a focus on the management and delivery of the business 'outputs' of both these entities [the real estate and construction industry]; namely the productive use of building assets as workplaces
Nutt (2000)	The primary function of FM is resource management, at strategic and operational levels of support. Generic types of resource management central to the FM function are the management of financial resources, physical resources, human resources, and the management of resources of information and knowledge

Source: Tay and Ooi (2001: 358)

For Duffy the history of facilities management has been one of rationalisation. As the discipline developed cost cutting became the predominant objective and the chief distinguishing feature of facilities management in practice. What could have happened was the linking of design and FM, but after twenty years this link has not been established. "What has happened has been very different from what we expected. The skill of managing office space may have developed but the office environment itself remains very much as it was." (Duffy 2000: 372). He sees the challenge as being using design to achieve business goals, and this will require the reinvention and the reintegration of the entire business of design, construction and space management.

Duffy has highlighted the dilemma under discussion. A greater link with design and development of workspace would give FM the strategic role that is being sought. Design is early stage, planning intensive work and involvement here by FM practitioners would deliver strategic significance. However, once again the fact that this is not the case illustrates how difficult it will be for to achieve place in these strategically important stages.

Bon et al (1998) argue that corporate real estate management (CREM) requires an organisational structure that stimulates interaction between researchers and practitioners of CREM. They conclude that the development of management tools for CREM will require close collaboration between researchers and practitioners, with much of the research being conducted by CREM practitioners themselves. Performance measurement is one of the first steps in this direction. Therefore, the most important task is the development of management tools that can help close the feedback loop between managerial action and property performance.

A research intensive approach has much to recommend it, particularly in regard to medium-term improvement in the industry's performance. Will this also deliver strategic relevance? That probably depends on the scope, scale and focus of the research. However, practitioner led research is likely to go down the operational path the industry is already following, if for no other reason than that would be what appeals to the industry's clients.

Price (2002) argues for FM to be more focused on business language and a move from performance measured in terms of outcomes to performance considered in terms of outputs. His evolutionary perspective, also found in Price (2003), suggests that FM has yet to find its place in the marketplace for both ideas and business services. In many ways this sums up the key elements of the debate over the future development of FM rather well, given that FM is typically an outsourced function. In fact, the success of FM as an industry has been closely tied to the growth of outsourcing.

3. Outsourcing and the FM Industry

The response of many large organisations to the increase in demands for better performance, global competition or pressure on their balance sheets was to identify core activities and outsource as much of the rest as possible (Incognito 2002). Indeed, the growth of FM as an industry has been underwritten by the increasing use of outsourcing for non-core functions as business put the ideas of Hamel and Prahalad (1994) into practice. This has been crucial in establishing FM as an industry sector in its own right as organisations moved responsibility for asset management to specialists (Katsanis 2003).

However, if FM is largely responsible for managing an outsourced part of business operations (the use of physical space), how can it be included in the management tasks given to the senior executives responsible for strategic planning for these businesses? In this case, the success of FM will deny it the chance to become the strategic contributor to business performance that so many have claimed for it. Indeed, the more successful FM becomes at taking on and managing an outsourced function, the less likely it becomes that it will be included in the higher councils of management decision-making and strategy. Further, if FM is not included at this level of decision making, how will it be able to increase the value it adds for clients?

The argument for outsourcing is typically based on the perception of cost savings and improved quality. This comes through reduced capital outlay on facilities, manpower and equipment for the client while the provider is responsible for updating and maintaining equipment and technology. Other commonly recognised advantages of outsourcing include freeing up of resources, variable capacity, knowledge transfer from outside specialists, economies of scale by vendors, and it is particularly suited for specialised or risky operations (Embleton and Wright 1998). Outsourcing is seen as a means of concentrating an organisation's resources in its core competencies (Campbell

1995). May (1998) argued that many organisations spend a disproportionate amount of management time managing non-core activities and that outsourcing can increase competitive advantage.

The growth of FM as an industry has been driven by outsourcing, and the future growth of FM will also be driven by outsourcing. There are still large industry sectors where FM is done in-house, higher education is a good example. As clients become more comfortable with using contractors to supply specialist services and the FM in industry becomes more sophisticated in its marketing, customer relations and performance measurement, the potential for continued growth is clear. There is of course a countervailing tendency of clients to take some functions back in-house due to reassessment of importance of technical requirements (Luciani 2005), but the overall trend should be toward more use of outsourcing in certain client industries.

While the figures for outsourcing and views on these advantages and disadvantages would vary across countries and industries, they reinforce the argument that the scope for growth of the FM industry through outsourcing is enormous. However, the problem of strategic relevance found in the current situation thus appears in the future for FM, with the same fundamental cause: managing an outsourced function may be important, but it is not strategic. If the future growth of FM is tied to the increased use of outsourcing, as growth in the past has been, the challenge for FM to become a key part of an organisation's strategic planning will become greater. Growth in the size or the turnover of the industry will not, in itself, solve the problem.

The opportunities that design integration, workspace management, research focus or the four 'trails' identify are more like extensions to the outsourcing based growth path rather than full alternatives. Extensions because they add depth to the outsourcing based model, but do not add breadth or offer a substantially different growth path. How to deliver different forms of 'extended outsourcing', where there are more of the higher value-added services present in the outsourced package, may be the key challenge in the future of FM. But what is value in the context of buildings and structures?

4. Value to Clients and Owners

How do buildings create value for construction industry clients and building owners, and what is the role of the FM industry in maintaining or adding value to clients and owners? That clearly depends on what particular concept of value is to be applied, out of the range that are possible.

Best and de Valence (1999) suggested that, for buildings, the forms of value include: utility; use as accommodation or for income; exchange or sale value; esteem, prestige or iconic value; and a quality-cost-functionality relationship (pp. 14-17). Similarly, Spencer and Winch (2002) cover three broad sources of value: financial value, based on capital and operating costs and investment value: business processes and the people, space and productivity matrix; and the symbolic and aesthetic value of buildings. There are many other variations on these ideas (see for example Kelly, Morledge and Wilkinson 2002).

For the FM industry, the idea of value has to be strongly related to the performance of the space occupied by the client, in the client’s terms. This makes a ‘one size fits all’ definition of value difficult to find, because clients come in many shapes and sizes, with a wide range of requirements and levels of service demanded.

5. Adding Value

How can the FM industry improve its ability to add value to the way businesses approach the role, function and use of physical space? One way of responding to this challenge is to break the answer down into several parts, like a puzzle the industry has to solve. Four distinct but interrelated approaches to adding value for FM clients are identified and discussed below.

The first approach is based on the idea of business performance itself. Despite the emphasis placed on this, it is neither obvious nor constant. Both how performance is measured and how it is rated change over time. For example, the impact of Kaplan and Norton's (1996) idea of the 'balanced scoreboard' has been significant. Likewise, the growth of 'triple bottom line' reporting (financial + social + environmental results). Other measures that are widely but not universally used include R&D, innovation or revenue from new products, market share and financial ratios such as return on equity, revenue and profit growth. The implication here is that the specific indicators a FM client uses to measure performance need to be understood and targeted by the FM provider. Further, the particular measures applied to facility use and performance need to be developed for each client and made relevant to the client’s business practices and objectives.

A second approach to the problem is the changing nature of strategic planning. The detailed, prescriptive form of business planning is no longer popular, and what is considered strategic in business also changes over time. When Jack Welch became CEO at GE in 1983 one of his first actions was to close down the strategic planning department (with 200 people), and start the annual seminar series at Crotonville that became the foundation of GE's success (Welch 2001). Mintzberg (1994) discusses the history of strategic planning in business, and argues that neither business planning nor strategic analysis are any less important now than in the past. It is how these are done that creates their relevance or lack of it. The opportunity here is for the FM provider to apply the specialist expertise and experience gained from improving facility performance and to identify how value can be added for clients in the long term, through more innovative design, use and management of facilities.

A third approach to meeting the challenge concerns the development of the industry. Tay and Ooi (2001) suggest a number of areas for theoretical development in FM (see Table 2 below) and three main building blocks of FM professionalism. First, FM as a discipline must be clear on its roles in industry and in organizations. Second, for FM to be taken seriously by management it has be a contributor to profits and manage facilities to enhance performance of the firm. Thirdly, FM must develop its own specialist knowledge and toolbox in managing the workplace across six areas, with an emphasis on workplace performance and performance measurement. They conclude that FM remains reliant on management and technical knowledge from other fields. The FM industry needs to establish a core knowledge base and the techniques available for its application.

Reliance on management and technical knowledge from outside FM is not in itself a problem, especially in a time of positive externalities from knowledge, an emphasis on training and human capital, and increasing returns from the effects of network economics on industry. Perhaps the challenge has more to do with sorting the wheat from the chaff in management ideas, not getting distracted by management fads and buzzwords, and coping with information overload with so many business management books being published.

Table 2. Suggested Theoretical Developments in FM

Scope of FM	Suggested areas for theoretical developments
Location	Developing a model for locational decisions Studies on the relationships between locational choice and business performance
Type	Understanding workplace requirements for various facility users, e.g. schools, hospitals, factories, etc.
Quantity	Developing a model to forecast space requirements
Quality	Performance measures to assess the quality of workspace Developing performance standards
Allocation	Studies on emerging work patterns and their impact on space allocation
Content	Studies on the relationship between content layout and work performance

Source: Tay and Ooi (2001: 362)

Finally, the fourth approach is the type of contribution FM makes to its clients. Profit margins can be increased by either driving down the cost of products and services, or by pushing up their value and increasing the price customers' will pay. The strategic objective is to maximise the difference between value and cost, and to build value which customers perceive to be better than that offered by competitors. For most businesses changes in revenue presents both the greatest opportunity and the greatest threat, and is more significant than major costs such as staff, technology and equipment and occupancy costs. Therefore there are greater opportunities to improve organisational performance through revenue and productivity improvement rather than through cost reduction and the risk to revenue and productivity due to poor facility design and management is far greater than the expense of building or occupying space.

Lower facility costs lead to lower production costs, and to reduce occupancy costs organizations can take a range of measures, such as re-negotiating leases, teleworking and hotelling and lowering the workspace ratio (Turner and Myerson 1998). The workspace ratio varies between industries, for example the Property Council of Australia found the financial services sector averages about 15 square metres per employee and the legal sector averages 20 square metres per employee. For any organization there is some level of optimal space efficiency (Smith 1999). Another factor that is important in industries undergoing restructuring and 'creative destruction' is reducing the cost of churn (relocating employees). For firms in these industries the cost of churn can be as high as rent. Space can contribute to strategic change through aligning facilities with organisational objectives, structure, cultural values and workstyles. Finally, organizations continually seek ways to reduce capital costs of buildings, but capital expenditure is minor when compared to costs over the life of the fitout and services. The issue here is maximising the benefits of capital spent to get the best return possible.

On the value side, strategic decisions on property location, space forecasting and usage are important. However, what is crucial is how FM can contribute to developing the competitive advantage of the firm, particularly for firms or organisations attempting to enter new markets or confront global competitors. These firms are typically increasing their efforts to innovate and to develop new products or services. Also, facilities can be a source of competitive advantage if location or amenity is a barrier to entry for potential competitors

Organisations are also looking for work environments which improve productivity and efficiency, support innovation and learning, allow introduction new ways of working, increase information exchange and accommodate a diversity of management and work styles (Zelinsky 1998). The pressure to achieve higher productivity through use of teams with more effective means of communication, both electronically (through bringing different departments together) and spatially through workplaces designed to encourage increased group and shared working patterns, is one of the great opportunities for FM to add vale to clients.

6. Conclusion

Organisations spending money on the renovation or maintenance and use of a building try to get value for money, usually within a fairly clear budgetary framework. Those who authorise the expenditure will be looking at how much is spent, what return can be expected and how satisfied they will be by the outcome. The task of FM is to help users get the most benefits from their properties and facilities.

There has been an active debate over the future direction and development of the FM industry. This debate has highlighted a number of key issues for the industry, but also bought out the wide range of approaches taken by participants to both these issues and the appropriate role of FM.

This paper has argued that, if the FM industry is to significantly change the role it performs for clients and become a strategic rather than operational function, it will require a long-term approach focused on value-adding rater than cost saving. This is a major challenge, both for the industry and its clients. This paper then identified four distinct but interrelated approaches to adding value for FM clients.

The first approach involves performance measurement. By developing specific measures of performance to apply to facilities, to be targeted by the FM provider the industry can help organizations meet a range of performance criteria. These will vary between organizations and will typically be customized to take into account the location, purpose and strategic significance of the facility. Establishing for each facility this strategic significance could be the means to become relevant to and provide input to organizations' strategic planning.

The second approach is to increase this strategic relevance of the FM provider’s contribution to the client’s business practices and objectives. The opportunity here is to identify how value can be added for clients in the long term, through more innovative design, use and management of facilities.

The third part is developing FM professionalism. This involves the use of analytical tools for locational decisions, space use, work patterns and other characteristics of the modern work place. The objectives of this analytical approach are to help organizations lower occupancy costs and increase the value gained from their use of the space their facilities provides. This is the fourth and most important part of the answer. In a world of ever-increasing competitive pressure and shorter product cycles, value creation is the key to survival for many organizations. By making itself an integral part of the value creation process, FM will become a strategic function.

Until recently few organizations paid much attention to how the planning, design, and management of their buildings and associated systems, equipment and furniture affected the organization's ability to meet its business objectives. Information technology and competition, which have driven organisational changes, have placed new demands on organizations' physical resources, increasing awareness of the importance of FM. As this has happened, the role of the facility manager has grown to include more than the maintenance of the physical structure of the workspace. There is an opportunity to shift the emphasis from controlling the cost of occupying and using facilities to the contribution of the workspace and its infrastructure to the productivity of the organisation and the efficiency with which it uses its resources. This fourth approach would allow the FM industry to add significant strategic value to the operations of clients.

Therefore, the opportunity exists for the FM industry to increase its strategic relevance to clients. The idea that businesses use their facilities as a strategic resource is not controversial, but because FM is typically an outsourced function the idea of FM as strategic, rather than operational, has not been widely accepted by clients. Different writers have taken different approaches to this and there is no lack of ideas on how FM can be linked to business performance. This paper has argued that the key issue is to help organizations increase the value gained from their use of the space that facilities provide. For the FM industry to significantly change the role it performs for clients and become seen as a strategic partner, rather than as an outsourced operational function, will require a long-term approach focused on value-adding rather than cost saving.

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Change Management within FM

Alexander Redlein
IFM/TU Vienna, Austria (email: redlein@tuwien.ac.at)

Abstract

FM is always related to changes: Changes within the core processes having impact on the requirements for facilities, changes in technology and processes demand higher productivity and effectiveness. However, in contrast to the core business, methods of classical change management and process re-engineering are not yet applied in Facility Management.

This paper shows how classic methods of change management, process modelling and re-engineering can be used in the field of Facility Management. It presents a theoretical overview about the current methods and describes their advantages and disadvantages.

In the second part, the usability of these methods within FM is analysed. In about 20 case studies with companies the methods for process modelling and re-engineering were tested in practice. The results of the case studies are presented. Based on the results, adaptations and further developments of the current concepts to improve their usability within FM are pointed out and a new methodology based on classical process modelling and re-engineering methodologies is presented.

The new methodology ensures that the strategy of the company as a whole and the strategy in respect to facilities are taken into account. It also ensures, that all relevant processes are defined and the necessary changes in organisation and ICT are identified and implemented in a proper way.

This methodology has already been used in case studies and proofed its usability.

Keywords: process optimisation, process re-engineering, IT and organisation

1. Introduction

Within all industries modern companies have to change to survive in a rapidly changing world. Whereas 30 years ago an employee did the same job for his whole work-live, today's employees have to adapt to new situations and tasks quite often. Project orientation and new forms of collaboration led to more flexible forms of organisations. Today it is common to change the team and the workplace at least once a year. In some industries like telecommunication changes happen even more often. These changes also have impact on the core FM processes.

In most cases changes and optimizations within the core processes are carried out by using the methodology of business process reengineering. Business process reengineering can trigger the necessity of structural measures in order to provide the required infrastructure, can lead to changes in technology and trigger processes within FM. Therefore, process optimisation projects contain, apart from the usual activities of process optimisation, also the matching with the infrastructure. This is an iterative process, changes in the core processes lead to changed requirements for infrastructure, which offer altered framework conditions for the core processes. This can lead to changes and opportunities within the core processes. An optimum organisation for these highly dynamic and complex planning projects consists of the following teams (extended project team; see [1], p. 145):

- the team for an optimisation of the core processes, mostly lead by the organisation development;
- the team for the planning of the infrastructure (building, systems, etc.), lead by the process controller of the planning process;
- the controlling team with the task to safeguard the co-ordination of both teams.

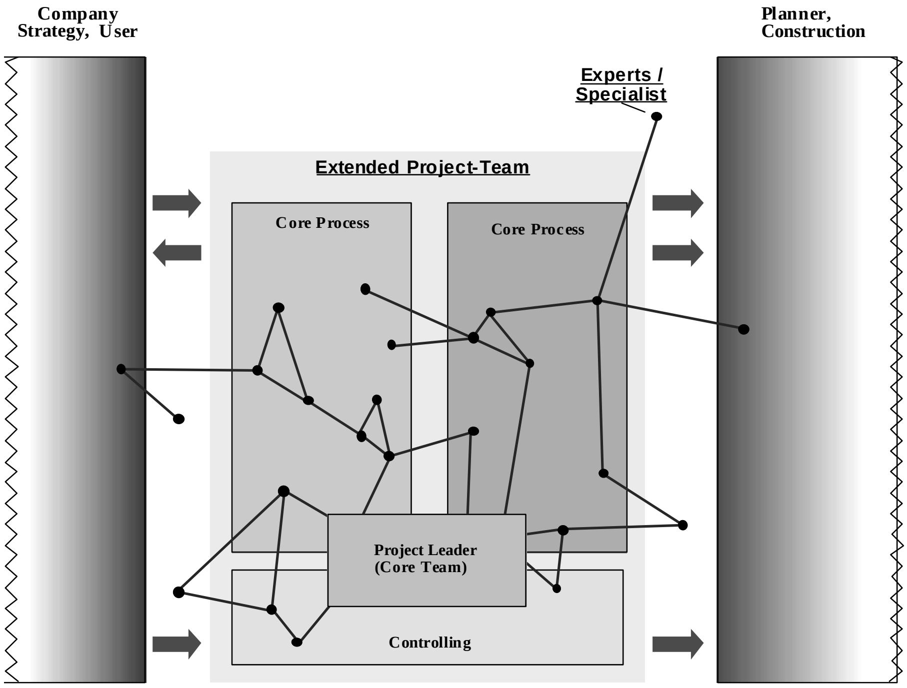

Figure 1: Organisation of highly dynamic and complex planning projects [1], p. 145

These teams are subordinated to an overall project leader, the overall process controller. He has to safeguard the comprehensive cost-benefit optimisation of the project. Today traditional planners cannot perform these tasks and are often not accepted in this role by the owners of the building, because they lack the knowledge of process optimisation. However, there is already an approach of planners towards this role. Some companies, such as Bene Consulting or DOMUS FM, already perform process analyses in order to merge the results into programming. But these planners do not perform an optimisation of the core processes or do not even trigger optimisation. Therefore, their approach lacks optimisation of core processes, but they cover the remaining activities of the process controller.

Traditional organisational consultants also cannot fulfil the tasks of a process controller in a comprehensive manner, because they lack experience of the planning of the infrastructure. A further potential process controller is the facility manager. He frequently assumes the role of the process controller for the planning of the infrastructure in case of utilisation by the proprietor. He is seldom given the task of optimisation of the core processes, although in some FM definitions also the tasks of personnel development are allocated to the facility manager. The future will show who is able to assume the comprehensive role.

Besides this question, who should carry out the tasks, there is another question, an even more interesting. It is about the methodology to be used for the optimization of the FM processes. In literature there are no guidelines. Therefore a team of researchers from the Viennese Technical University searched for methodologies employed in the core processes. The most widely spread and accepted one is business process reengineering. Therefore this methodology is analysed in detail within the next section.

2. Business process reengineering

A few years ago, most companies were organised according to Taylor. Work was splitted up in small tasks, being carried out by specialists. Between this specialists there was a lack of communication. There were even communication barriers. It was almost impossible to reach goals of time-, cost-quality and innovation leadership. Therefore, a change took place within most of the organisation.

The companies began to define their core competences. The core competences of a company are the specific abilities, which differentiate a company from others. Thus, as a basic data source to determine their core competence, they used the analysis of the needs of the customer, market analyses, analysis of the own potentials and benchmarking with the competitors in the industry.

Based on this, business process reengineering was used to “optimise” the core processes. Business process reengineering leads to a fundamental rethinking of the processes within a company. The goal of this rethinking is to gain time and cost reduction. This leads to a new conception of the work/tasks which have to be done.

Instead of Taylorism, which is characterized by the division of the work into small tasks carried out by different specialists, business process reengineering combines tasks, that belong together, to larger process steps. These lager steps have to be carried out by one person instead of many (comp. [2]). The main goal of business process reengineering is to define simple processes with few interfaces by creative reintegration and redesign of the core processes (comp. [3], p.5 and p. 49]). This also means a change of the organisation. The current horizontal organisation is changed into a vertical organisation characterized by team work.

The base line for all these changes are the needs and expectations of the customers. By changing the organisation (processes and company organisation structure) the company should be enabled to provide a better service to the customer according to his needs, and should be easily capable of adapting to changes in the customer’s requirements. In order to be able to carry out these changes the general management has to support these activities.

According to business process reengineering, the change process consists of the following parts ([3] p.42):

Renewing: In this step the needs of the customers are analysed and new business areas are defined (comp. [4], [5] p. 34ff, [6])

Relocating: In the next step changes of the location and production methodology are to be defined (comp.[7] p. 286ff, [8])

Reengineering: The next step represents the core business process reengineering, which includes the redesign of the core processes and the change of the company organisation structure (comp. [9], [10], [11])

Revitalizing: The next step is to develop the knowledge of the employees (comp. [12], [5] p. 251ff, [13], [14])

Reframing: The last step is to realize the mental change by changing the subjective behaviour (comp. [15], [16] p.116 ff)

Business process reengineering itself consists of the following steps (comp. [3] p. 50):

Communication of the necessary changes: The communication of the goals and areas of changes has to be done by the board of directors. In this step the teams and the process owners have to be defined for each process. This step should give confidence to the middle management, trade union and the employees. Change can often lead to fears about employment which leads to opposition to change.

Identification of the core processes: The core processes which are important for the success of the company have to be defined. Basis for the estimation of the importance are descriptions of the processes at a high abstraction level.

Selection of the core processes that have the highest need for change (not working properly, causing problems, not fulfilling customer needs, possibility to change processes): This step also includes the definition of more detailed goals for the selected processes regarding time, cost and quality.

Analysis to understand processes: This step is based on workshops, interviews and observations. It is quite often supported by external consultants as they might bring in new ideas.

Collect ideas for redesign and optimization: This step is carried out together with the process team and internal/external process specialists to find new ways of carrying out processes.

Development of concept: Based on the gathered knowledge and ideas a concept for the optimization of the core processes is defined. This concept includes the process steps, the organisation and the ICT support. In this step the following principles have to be taken into account:

- Relocation of decisions to working level
- Definition of tasks per organisational unit in a way to reduce interfaces
- Reduction of controls
- Combination of organisational units

Coaching of process owner: The last step is the coaching and training of the process owner and his team, so that they are capable of taking over the new tasks and responsibilities.

All these steps should follow the core principles [9]:

- Follow the natural sequence of process steps
- Definition of process variants (e.g. simple/difficult task)
- Redesign of customer contacts
- Introduction of a responsible person for all customer contacts to co-ordinate all tasks carried out for each customer
- ICT to enable new solutions

The change process based on the results of the business process reengineering can be carried out in two different ways:

Firstly by a radical change of a few core processes (American attempt comp. [9], [17], [18]) or secondly by a continuous improvement within the current structures according to Kaizen and [19] (Japanese attempt).

The American attempt leads to a lot of problems with the employees who often oppose to the changes. It also causes problems with the trade unions as they fear that the changes cause the loss of jobs. The Japanese way often cannot reach the goals as changes happen very slowly and the final target can only be reached after a long period of time.

Combining these two extremes leads to the European way of change management by business process reengineering. The European way makes changes step by step and in this way the whole company is changed and not only a few core processes. It also includes tasks to change the habits and the qualification of the employees (comp. [20]). This European way of change management is also called evolutionary change management.

3. Advantages and disadvantages of business process reengineering within FM

For process optimisation and change management in the area of core business the methodology of business process reengineering is known and accepted. Business process reengineering provides a methodology for managing the change process. It can be used for every project within every industry reaching from production processes to office automation.

Consultants and managers are well trained in this methodology. Therefore internal or external support can be found easily. In literature best practise examples can be found for several processes within different industries.

Based on this knowlegde a research group of the Viennese Technical University applied the methodology of business process reengineering within 20 case studies. The case studies were mainly carried out in companies running office buildings. The sample consisted of different industries reaching from production industry (e.g. Beiersdorf AG), banks and insurances (e.g. Dresdner Bank, Bank Austria), energy providers, public bodies (Ministry of Finance) and hospitals to outsourced facility management companies and real estate managers (e.g. LGM, SGM, ATIS international). Their FM departments wanted to improve their efficiency and effectiveness. The goal of the research projects was to optimize their processes, organisation and ICT support. One main goal was to improve the customer orientation and in this way the customer satisfaction. The second important goal was to reduce costs.

After the first case studies the following weaknesses of the methodology within FM were recognized:

1. Business process reengineering has *not been applied to FM processes* by now. Consultants and organisation managers know the methodology but not FM. They also do not know the specific problems and drawbacks in the area of FM. In literature no FM relevant best practise can be found and there are no specific guidelines.
2. Within business process reengineering normally only external customers are taken into consideration. FM also has to take care of *internal customers* as each employee of the company is a customer of the FM department.
3. A *detailed structure or guideline* how to apply the methodology within each step *is missing*. The methodology provides an overview guideline on what steps have to be carried out, but gives no advice how the steps can or should be carried out in detail. This internal guideline is especially missing within the first step "**Communication**" and the step "**Analysis to understand processes".**
4. The *start of the business process reengineering projects was difficult*. The strategy of FM and the goals of the process optimization project the strategy have to be defined before the board can communicate them. This task has to be carried out on a team basis - consisting of the facility manager and the board. A definition of the FM strategy without detailed knowledge of the companies strategy and the board will often lead to wrong decisions as company goals and strategy have a strong influence on FM. For example when the company grows or reduces FM has to include this change in its strategy.
5. The step "**Analysis to understand processes"** mainly consists of workshops and interrogation of the employees on how they currently do their work in order to define the current processes. Therefore process modelling methodologies are used. But the business process reengineering methodology gives no advices on which methodologies fit best. A second problem is that this step takes very long and team members are often not willing to carry out the next two steps "**Collect ideas for redesign and optimization"** and **"Development of concept".** Therefore in many cases the only optimization reached within a business process reengineering project is that the actual process is supported by ICT. But this cannot leverage the whole potential of optimization.

In order to overcome these disadvantages, the classical business process reengineering methodology was enlarged in two areas.

The *value analysis* was used to provide a better general structure and guideline to the projects. The value analysis has the advantage that it can be used for any project type. It provides a clear and structured guideline how to carry out projects. By adding the parts of the value analysis to the classical business process reengineering methodology the disadvantages 3 and 4 could be solved.

To overcome problem 5 the *Scheer Architecture for Information Systems (ARIS) methodology* was applied for the steps "**Analysis to understand processes",** "**Collect ideas for redesign and optimization"** and **"Development of concept"**. This methodology is used frequently for process modelling. It supports not only modelling the processes and its steps but also includes the organisations carrying out the steps and the ICT tools supporting the steps. The use of the ARIS model without applying the business process reengineering methodology would not provide the required results as the ARIS methodology is rather restricted to modelling processes and does not include areas like strategy analysis and change management.

4. Value Analysis

The value analysis is an efficient way to optimise products and immaterial objects like processes and concepts. It was developed by General Electric at the end of the 40s as a tool for cost reduction. Since 1962 it is also used in Europe, with the goal to analyse and optimise structures of functions under the aspect of value increase. Based on this idea it soon developed to a more powerful tool than a simple method for cost reduction. In this new form it could be applied for the quick and effective generation of new concepts, but also for the improvement of existing ones. (see [21] p. 371 and especially [22] 479 f.)

According to DIN 69910 and ÖNORM A 6750-6757 the value analysis consists of the following steps:

Table 1: Steps of the value analysis

Basic Steps	Intermediate Steps	Goals
Step 1 Prepare for Value Analysis	Intermediate step 1 set up goals in rough outlines	The first step is a definition of the goals. This makes it possible to check the result of the project later. The details can be added later in the project. In the case of the FM projects this step has to be carried out together with the facility manager and the board of directors.
	Intermediate step 2 plan value analysis work	The next step is the creation of a project schedule (people, tasks, time, ..). The required persons must be selected and teams must be formed. They must be informed about the personnel resources they have to spend and the work they have to deliver for the project. This step is headed by the facility manager.
Step 2 Define Situation	Intermediate step 1 gather information	As to provide a profound basis for the subsequent work, available information must be gathered and sorted out.
	Intermediate step 2 define functions	The functions are identified and specified. The level of detail depends on the goal of the analysis.
	intermediate step 3 estimate tendencies	The market tendencies have to be estimated. This makes it possible to evaluate the probability of changes.
	Intermediate step 4 identify costs	The costs of each function defined above must be calculated.
	Intermediate step 5 define situation	The definition of the whole situation can be derived from the information above. The knowledge about functions, costs and the estimation of tendencies make it possible to describe the situation in detail.

As can be seen easily, step 2 corresponds with the steps of the business process reengineering methodology. The research team decided to integrate only the first step of the value analysis into the business process reengineering methodology but to keep the steps of the value analysis in mind as a more detailed description or guideline for the steps of the business process reengineering methodology.

5. ARIS Model by Scheer

The ARIS model is a well known modelling methodology within ICT. It consist of 4 “views” which describe the following elements (comp. [23]):

Process View: This part of the model supports the description of processes. The description can be on a very abstract level using flow charts or on a very detailed level using EPK (Ereignisgesteuerte Prozess-Ketten).

Data View: This part supports the description of the required data structure. The description is mainly done by Entity Relationship Diagrams (ER-Diagrams) showing the required entities like building, floor and room and the relations between them.

Organisation View: This part describes the organisation structure. Beside the organisational units and their structure roles are defined. A role represents employees carrying out similar tasks.

Control View: This view brings together the elements of the views described above. It shows the relations between them. That means it describes the flow of process steps, describes which process step is carried out by which organisational unit (role) and defines which step is supported by which ICT tool.

The methodology can be used to model the As-Is status of the processes and the Should-Be status.

6. New methodology

In the course of the case studies it was found out that there is the danger to model the As-Is status in strong detail. This procedure takes a long time. As the team members have to carry out their “normal work” beside the project they become tired. As a result, when the As-Is analysis is finished, they are not willing to support the next steps. As a solution for this problem the research team combined the steps “**Analysis to understand processes”** and “**Collect ideas for redesign and optimization”**. This was done in an easy way. The process steps not being carried out properly or being missing at all were included in the As-Is analysis, but they were marked with a red colour. This means that the starting points for improvement were already included in the As-Is analysis. This change in methodology led to more encouragement of the team members as they could already see in the As-Is analysis were changes and optimization should take place. In some cases the Should –Be structure was already developed.

This change in methodology made it easier to carry out the next step **“Development of concept”.** In this step the Should-Be situation has to be defined. As the process steps that were missing or not properly carried out are already included and marked “red” within the process charts, the staring point for the optimization is already defined. So the time and effort to define the Should-Be situation was reduced dramatically.

The experience of the case studies regarding the disadvantages of the classical business process reengineering methodology and the enlargement of the classical methodology by the value analysis and the ARIS methodology to overcome this shortcomings, led to a new methodology consisting of the following steps:

Prepare business process reengineering project: The first step is a definition of the strategy of FM and the goals of the project based on the general strategy of the company. This makes it possible to check the result of the project at the project end. This step has to be carried out together with the facility manager and the board of directors. In this step the teams and the process owners also have to be defined.

Communication of the necessary changes: The communication of the goals and area of changes has to be done by the board of directors. This step should give confidence to the middle management, trade union and the employees. As often change leads to fears about employment which leads to opposition to change.

Identification of the core process landscape[1]: The core FM processes have to be defined. Basis for the estimation are descriptions of the processes at a high level of abstraction. This step also includes the definition of more detailed goals for each process regarding time, cost and quality.

Analysis to understand processes and collect ideas for redesign and optimization: This steps uses workshops, interviews and observations. The internal team is quite often supported by external consultants, as they can bring in new ideas.

Development of concept: Based on the gathered knowledge and ideas a concept for the optimization of the FM processes is defined. This concept includes the process steps, the organisation and the ICT support. Outcome of this concept are the required changes in organisation (new organisation structure) and ICT (e.g. tools, ICT landscape, integration of tools).

Change management for organisation: According to the requirements of the concept the organisation has to be changed.

ICT implementation: According to the requirements of the concept the new ICT landscape must be implemented and integrated.

Coaching of process owner: The last step is the coaching and training of the process owner and his team, so that they are capable of taking over the new tasks and responsibilities.

The new step “**Prepare business process reengineering project”** makes sure that the strategy of the company as a whole and the strategy in respect of facilities is taken into account. The step

[1] Selection of the core processes was skipped, as it was found out that FM process landscape consists only of seven to ten processes and all of them were important for the success of FM. So all of them had to be taken into consideration.

“**Identification of the core process landscape”** assures that all relevant processes are defined. The step “**Development of concept”** identifies the necessary changes in organisation and ICT. Together with the steps “**Change management within organisation”** and “**ICT implementation**” a proper change management and implementation is granted.

7. Conclusions

This new methodology was already used in several case studies. It could be proofed, that by enlarging the classical business process reengineering methodology by the value analysis and the ARIS methodology, the disadvantages could be overcome. The new methodology proofed its usability and efficiency in the case studies carried out.

Nevertheless, the appliance is still very time consuming. Therefore, in the next step the research team wants to define reference process models for most of the “core” FM processes. These process models can be used as reference for the modelling of the processes within the companies, which will reduce the efforts in time and cost.

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Quality Assurance in the Facility Management for Public Real Estate

Maria Rita Pinto*
DICATA, University of Naples "Federico II", Italy (pinto@unina.it)
Stefania De Medici**
ARP - Syracuse, University of Catania, Italy (s.demedici@unict.it)

Abstract

In order to reduce the burden of an efficient and effective direct management of the real estate, Public Organizations often delegate the management of their heritage to Private Organizations. A whole control of management activities and the assessment of quality represent the first request expressed by the Public purchaser.

The present paper points out methods and tools to control the management procedures of the public building heritage entrusted to Private Organizations. The work establishes parameters that affect the building's quality and the conditions in which the information examination and exchange among operators is to be carried out.

The control activity requires a continuous monitoring of management procedures, that can be performed only by an adequate informative system focused on the basis of the specific characteristics of the real estate and of the contractual agreements. The system should guarantee a continuous exchange of information between the owner and the Management Organization, in order to reach the quality control of the facilities management, and to convey the needs of the purchaser, determined by its political, social and economic strategies. Moreover, in each step of the management process, the Public Organization should have the access to specific information, as the following:

- building and plant data;
- maintenance plan and procedures of intervention;
- working progress and shifting by timing plan;
- resources in relation with the available budget.

These data should be periodically controlled by the purchaser in order to verify the quality of the management activity and give the Management Organization corrections to optimize the facility management. The continuous update and aggregation of information through the informative system and the control of each step and procedure done by the Public Organization, allow a timely action in case of disorders and not-performance of the contract.

The research purpose is to create a methodology for quality management to reduce the risk of mistakes in the steps of analysis, inspection and intervention, singling out the responsibilities of the maintenance managers and verifying the respect of procedures and activities included in the contract. The plan is focused on meaningful parameters to control the performance levels that should be guaranteed by the Management Organization, in terms of:

- reliability of the buildings' information;
- effectiveness of the diagnosis;
- ability to forecast;
- timeliness of intervention;
- optimization of the cost;
- satisfaction of the users.

Keywords: quality, facility management, public real estate, informative system, control.

1. Introduction

The singling out of strategies and procedures aimed to recover, maintain and exploit the public heritage is one of the main objectives in order to optimize the built resources. The Public Administration development policies should direct the planning of maintenance for the public real estate. The knowledge of these policies allows the optimization of investments in relation with the performance levels required. In fact, the result of an effective and efficient management of the public real estate enhances the whole area, having positive repercussion on the private heritage too [3].

Nevertheless the Public Organizations owner of big real estates often entrust private companies to manage their property. This choice is due to shortage of their staff and liquid assets, lack of competence in building maintenance, complexity of the management procedures of contracts and financing [1]. In fact, in order to optimize the public resources, today the Public Administrations rely on themselves only for their core business, such as the activities that have to satisfy the needs of citizens. Therefore, for the technical services, as for the larger part of their accessory activities, they usually entrust private companies. Nevertheless, the Public Organization should continue to control the activities performed by the Manager Organization, verifying the information reliability, their updating, the correct use of the collected data in inspections, diagnosis and intervention steps. This information allows the purchaser to control the conservation condition of its real estate and its value in time, in order to single out and assign the maintenance financial resources.

The present study's aim is to supply the Public Organizations owners of building heritage with a methodology and tools to control the management of their real estate. Today, the Public Organizations need effective tools to control the quality of the facility management, in order to verify the respect of contractual agreements, the coherence with the strategic policies planned by the purchaser, the conservation and exploitation level of the real estate.

The facility management is characterized by different activities and services, constantly performed in time, that require a managerial approach, involving different competencies. The Manager Companies should be flexible and dynamic, adjusting their organization to the specific need at the specific time.

In Italy, in the last ten years many companies involved in management of big real estates have been formed [8]. They can provide technical, legal and administrative services. Nevertheless the Public and Private Organizations that have entrusted their real estates to Private Manager Companies did not concretely benefit of their action, neither in maintenance nor in exploitation of the heritage, or in optimization of the financial resources available.

The ineffectiveness and the inefficiency of the management activities, in the case of facility management contracts, depend on many factors, mainly in building maintenance. In fact, the quality of the results is related to variables that can be found in each step of the management process, starting from the interventions programming to its carrying out.

In order to increase the management quality, the purchaser organization should perform control activities along the whole process, requiring corrective measures timely. But the Public Administrations are not ready to carry on this role yet; in fact, in the facility management contracts, they delegate not only the maintenance intervention, but the whole management activities, including the survey of the technological efficiency of the buildings, their maintenance need and planning of management actions. Meanwhile, the purchasers are not able to control the management results, both in terms of comparison of costs and benefits, and in terms of quality of granted services. The Public Organizations sometimes evaluate the tenders made for the contracts, taking into account the proposed methods and tools to control the services quality: this means that the Private Organization suggests itself how to control its own job! In other circumstances, the control consists in formal checks: delivery reports on fixed days, completeness of reports on the activities advancement, delivery of cost control reports and certificates.

The complexity of managing a big real estate is mainly due to its heterogeneity: public heritage usually includes buildings of different ages and with various uses. The age is strictly related to the buildings' features (typology, materials, construction techniques, finishing, etc.), that affect the choices of maintenance intervention. The use determines requirements that should be satisfied by the building: the minimum performance levels that must be guaranteed change in relation with the users' needs. Durability of technical elements is affected at the same time, by materials, construction techniques and use. Therefore, the frequency of check, inspections and maintenance interventions are related with buildings' features and use.

Durability is also due to the materials and intervention techniques employed in building construction and maintenance. Public real estates usually include stone or brick-wall, reinforced concrete, steel, mixed structure, etc., with different types of technical elements and plants. This variety in building typologies, requires a careful control on the analysis methods, the frequency of inspections, the choice of intervention performed by the Manager Organization, that should be adequate to each case [7].

2. The Control Activity in the Steps of Maintenance Management*

The management of public buildings requires a thoroughly organized census and analysis. The absence of these has often conduced to an insufficient knowledge of the building, to the use of ineffectual technical and financial policies.

The process of census starts with the individuation of the building. The following steps are the knowledge of building, its coding and classification, and the evaluation of the building. The lack of knowledge of the real value of public properties and their temporal deterioration does not permit the setting up of a good maintenance policy, and does not allow adequate financing of extra-maintenance and investing.

In fact, the maintenance policies are often founded on urgency, based on rapid evaluations and lack of objectiveness. The maintenance management of public buildings is often founded on innovative ways, like Global Service. Unfortunately, in Italy the step of census is frequently skipped or it depends on the Global Services' bidder [4].

The Global Service contracts usually settles that the quality of the management activities have to be controlled on the basis of minimum performance levels, that should be previously fixed. These levels should be established not only on the basis of the buildings use, the laws and the technical standards, but also on the ground of economic parameters, defined according with the purchaser's strategies and the users' needs. In fact, the programming of maintenance should be founded on a clear expression of the purchaser's aims: the lack of a briefing activity affects the effectiveness and the efficiency of maintenance.

Often the Public Organizations decide the priority of intervention on the basis of political strategies, not considering available funds and effective needs. They are unable to establish building policies compatible to all. This because there is no definition of roles among political and administrative bodies, and most political bodies do not program further ahead than their predicted term.

Another problem is the internal conflict within the Public Organization itself. There is a lack of connection among different sectors, such as management, financial services, technical services, acquisition or sale of buildings, and urban planning. This is due to a lack of skills in the management of buildings, which can be explained through the following considerations: the introduction of managerial logic requires gradual innovation and skills diffusion; the management policy is static; the management policy is often considered an exclusively political issue, that does not require a technical support; the organization does not allow relationships among its internal units.

Some Public Organizations tried to solve the problem of lack of knowledge of their buildings through an initial step of census (individuation of the building; knowledge of building; coding and classification of the building; evaluation of building). Nevertheless, many Public Organizations that undertake the Global Service, have a lack of adequate legal, administrative, physical and functional knowledge of the buildings, so that the object of the contract and the costs are often not well established. In the end, the control of the quality assurance and of the offered services is difficult for the Public Organization for this lack of knowledge.

The control activities that the purchaser should perform in maintenance management can be summarized as follows:

STEP 1 - Building knowledge

In this step the quality control should be focused on the following parameters:

- completeness of information on the building’s technical elements;
- adequacy of survey methods, evaluated on the basis of the needed detail degree, of the available financial resources, on the skill of the operators involved in the survey, on the available equipment, on the accessibility condition of the building and its parts.

The building information should be surveyed using check-lists, in order to guarantee the comparability of data and to easy up and quicken the operators’ activity.

STEP 2 - Planning of inspections

The inspection methods and frequency should be adequate to the building's construction features. For big and heterogeneous real estates, it is necessary to plan inspections on the basis of the information surveyed in each building. Durability of the materials and technical elements, building localization and use are the parameters that should be controlled to program the inspections.

In order to guarantee the quality in inspections we should control the following parameters:

- required operators' skills in inspection activities and necessary equipment;
- environmental conditions of each building (air pollution, traffic, acid rains, etc.) that influence the scheduling of inspections;
- accidental factors, that can speed up the degradation process or produce damages, requiring unforeseen inspections or interventions;
- accessibility condition of the building and its parts, that affect the completeness of information.

The prevision capability is founded on an effective and efficient inspection plan and on reliable diagnoses. The quality control in inspection activities allows the Manager Organization to optimize maintenance, reducing, in time, the controls frequency and the interventions extent.

STEP 3 - Diagnosis

The results of the diagnostic activities depend both on the accuracy and completeness of the surveyed data, and on the professional skills of the operators involved in data management. A correct diagnosis can ameliorate the maintenance, guaranteeing timely interventions and increasing building's life cycle. Often the relationships between degradation causes and degradation phenomena is not easily comprehensible. This because many causes can be related to a single degradation/damage phenomenon or the decay can be the result of a chain process.

In the diagnostic step, the quality control should be focused on the following parameters:

- reliability of the relationships between causes and degradation phenomena;
- accuracy of the analysis of degradation evolution;
- survey of the effects of damages and decay of each technical element on the whole building system.

STEP 4 - Intervention

The information system for maintenance management should describe the interventions needed to improve the technical elements' performances, showing the intervention's frequency and length, the operators, the equipment and the required materials. The information system should also show risks or troubles for the users involved in the maintenance intervention.

The quality control should be performed on the following parameters:

- congruency between the frequency of intervention and the information on materials and technical elements' durability;
- timeliness in the diffusion of diagnostic information, in order to quickly activate the intervention;
- adequacy of intervention techniques, in connection with the materials and the construction techniques of each element, and with the building restraints and available resources;
- effectiveness and efficacy of the available equipment and their compatibility with the type of intervention to be performed.

It is also necessary to control the intervention results:

- efficacy of the intervention, on the basis of the achievement of performances required;
- skills of the operators involved in maintenance interventions;
- intervention timeliness and length;
- costs, due to materials, components, manpower employed and length of intervention.

The information surveyed for maintenance management is usually recorded in electronic databases provided with a data processing system, that uses periodically updated databases [2]. The information is collected at the beginning of the contract and by periodical inspections, and all the interventions are recorded. The computerized management allows the continuous control of the activities performed by the Manager Organization, if the purchaser can access to the informative system [5-6]. Therefore, the Public Organization should include in the contract the bond for the contractor to guarantee the access to its database within the time prescribed by the quality control prescriptions.

Many Public Organizations have increased the number of services included in the contract. In the Global Services are often included the program and the carrying out of ordinary and extraordinary maintenance interventions, the management of buildings knowledge, of rents, defaults, and evictions, doorman services, cleaning service, and electricity supplying. Therefore, a quality management is necessary to control the offered services. In planning the quality, the Public Organizations can analyze and establish the way for the execution of the contract.

The application of a Quality Plan to the Global Service contract allows to avoid the selection of not qualified companies, to guarantee adequate logistics, to clarify the management method proposed by the contractor, to establish sub-contracts, to evaluate professional skills and qualification of the contractor, to understand the work methods proposed by the contractor, to review the services plan, and to analyze the quality control plan of the Manager Organization.

It is necessary to introduce in the Italian Public Organization a new professional skill, the Process Manager, in order to manage and control the whole process, and to guarantee the respect of the contract.

A high ability in planning and control of the maintenance is required to the Public Organizations. In fact, this task can not be completely delegated to the contractors, because they can not manage the social policy, the financial strategy and the budget for investments in the public estate. This estate is unsteady, because it is conditioned by obsolescence, need of maintenance interventions, requiring continuous management and control of the choices.

3. Study - Case: the School Buildings' Management in the Province of Naples**

The Province of Naples, an Italian local Public Organization, manages about 300 school buildings. With an agreement signed in 2000, the Province entrusted the ASUB company for the management of the school buildings, in order to maintain the efficiency of its property. ASUB is a limited company in which the local public authority holds the majority of share and it performs preventive and damage ordinary maintenance. The extra-ordinary interventions are usually directed by the Province's Maintenance Office.

Today the Province has an office directly involved in maintenance of school buildings, organized in four units, each one responsible of about 75 schools, and an office that manages the relationships with the ASUB (Activities Direction Office for ASUB). This because the ASUB required a single referent in the Public Organization.

The contract with ASUB included the census of the real estate, the surveying of the maintenance status and the management of maintenance interventions. The surveying was created to allow an electronic management of information, starting from a detailed knowledge of the buildings.

The census card includes information about the building, assigning it an identification code. The date of drawing up as a time reference, and the name of the surveyor are also reported. In the first section of the census card is given general information about the building:

- localization (main entrance, secondary entrance, name of the school, Council, District);
- owner data (name, address, city, telephone number, type of building: the whole building, blocks of buildings, part of a building);
- land-registry data;

- quantitative data (building area, green area, waterproof area, maximum height, number of floors, number of underground floors, number of staircases, building volume, underground volume);
- presence of cavity under the building;
- accessibility (vehicular and pedestrian accessibility, street and pedestrian access width, traffic, near by adjacent buildings).

The second section of the card reports structural information, as follows:

- vertical structures (stone or brick-wall, reinforced concrete, steel, mixed structure, etc.);
- horizontal structures (vaults, mixed floors in reinforced concrete or steel and bricks, etc.);
- roofs (sloping roof, vault roof, flat roof, etc.);
- internal staircases (reinforced concrete, steel, brick-wall, etc.);
- emergency outdoor staircases (number, structure features).

In the third section of the census card the following information about the other elements of the building is reported:

- wall panes (tufa-wall, brick-wall, cavity brick wall, prefabricated panes, etc.);
- external wall-finishing (plaster and paint, ceramic tiles, glass-sheet façade, marble or stone plates, etc.).

Plants are described in the fourth part of the card, as follows:

- lighting (presence of lighting in common areas, automatic gates, electric plant of the doorman’s lodge, earth plant, lightning-conductor plant, etc.);
- water plant (connection with the public sewage system, presence of pumping system, etc.);
- fire water plant (connection with the public system, autonomous water reservoir with motor-pump, portable fire-extinguishers, etc.);
- heating system (centralized system, type of fuel, presence of chimneys, etc.);
- other kind of plants (gas, air conditioning, intercom, video-intercom, elevators, lifts, etc.).

The card also reports all the plants certifications and the general conservation conditions of the building, with the judgement of the surveyor, on the basis of parameters described in the contract (very good, good, mediocre, poor, unusable).

The building information comes with drawings in vectorial format: plans, front views and sections fitted out with the use of each room, symbols and codes of the most part of the technical elements and the plant. These codes are reported in tables containing data on the location of each technical element (floor number and room), class of elements (floors, coatings, windows, electric plant, heating system, etc.), description of the element (ceramic tiles, washable paint, casement window in aluminum, plug, fan-coil, etc.), quantity or dimension (number, square meters, etc.) and judgement about conservation conditions or effectiveness.

The contract includes some programmed intervention, scheduled on the basis of buildings' materials and construction techniques or for the plants' features. The contract also establishes periodic inspections in the buildings in order to control the maintenance status (Figure 1).

Even if the buildings' information surveyed seems to be exhaustive, the purchaser does not control the updating. In fact, after the sample check performed by the Maintenance Office operators at the end of the census step, the systematical control on the information reliability is not performed. In fact, the information is not recorded in an informative system directly accessible both by the purchaser and the Manager Organization. Therefore, the Province can't control if the ASUB periodically updates the information.

The management contract includes an annual cost per square meter for ordinary maintenance, defined by the analysis of historical information and data by literature on maintenance costs. The total cost for each school is calculated adding 10% of the external areas to the internal surface of the building. The contract establishes that 70% of the interventions performed by ASUB are included in a fixed amount agreement and 30% are calculated on a measurement and payment base. The fixed amount is annually granted, and includes boundary and optional interventions.

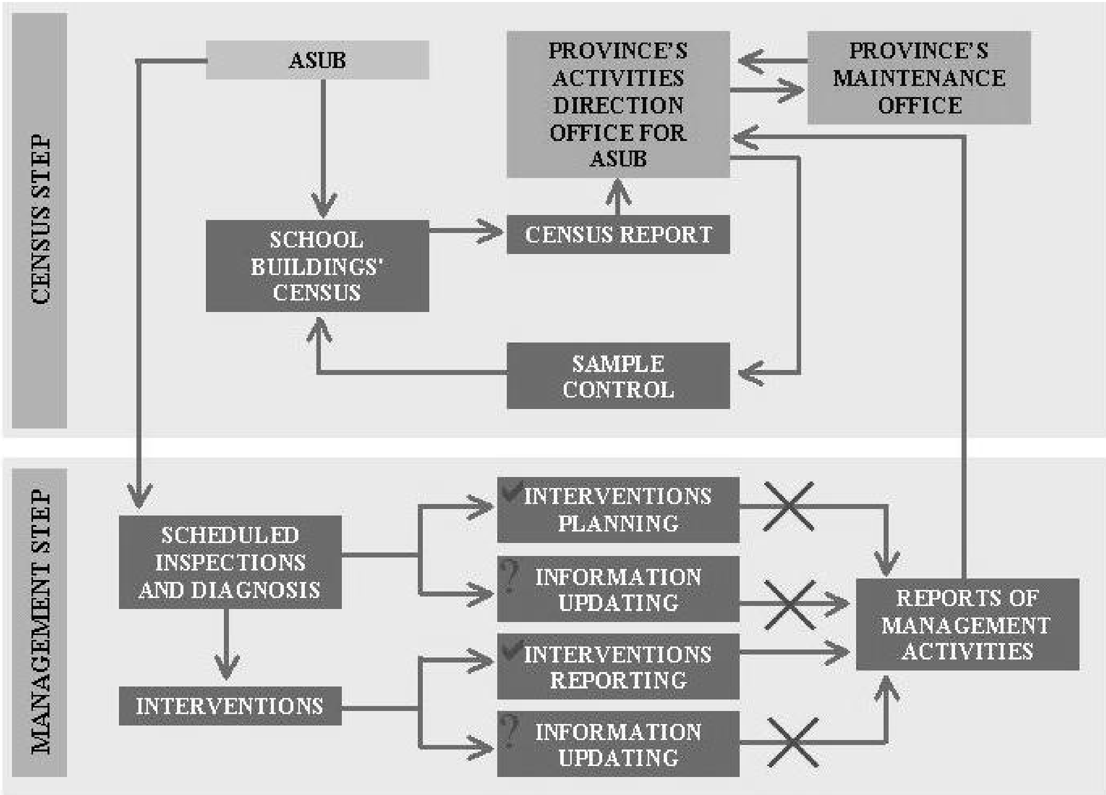

Figure 1: Information flow for the school building's knowledge in the Province of Naples

The ASUB sends to the Activities Direction Office for ASUB the reports of the intervention performed included in the fixed amount payment (Figure 2). In spite of the fact that financial penalties are established if the Manager Organization does not perform the interventions required, the control of the optional interventions is not systematically performed. The extra-ordinary maintenance and the ordinary intervention not reported in the contract are computed by measure. The accountancy reports and the intervention performed by ASUB are controlled by the Activities Direction Office for ASUB. This office can't control in situ each ordinary intervention performed. The Province's Maintenance Office also does sample controls.

The main problem of this management system is the control on the information flow: the need of intervention can be foreseen, can be surveyed in the inspection activities or can be required by the users if a damage occurs.

The users' request of intervention can be addressed both to the ASUB or to the Province's Maintenance Office. This office asks the Activities Direction Office for ASUB to report the request to ASUB, but it does not receive the information about the results of inspection or intervention.

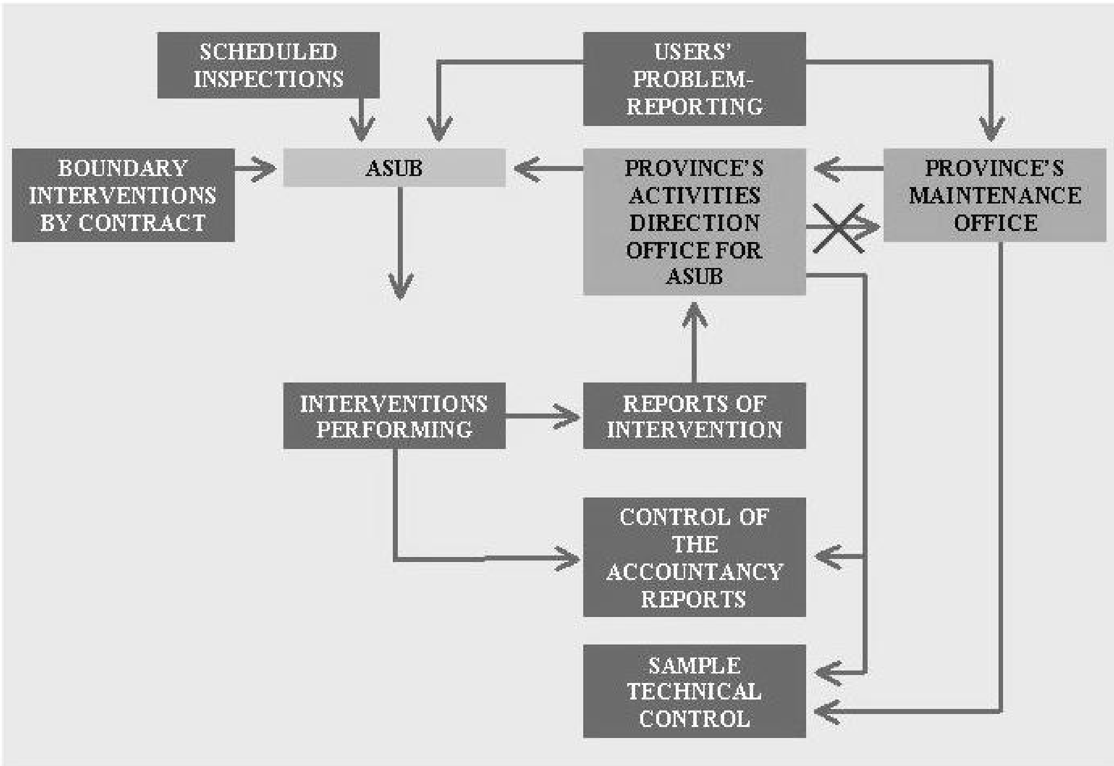

Figure 2: Information flow for the school building's ordinary maintenance in the Province of Naples: the Province's organization produces confusion in duty.

4. Conclusions

The quality control in management of real estates is a strategic activity that can guarantee the economical value conservation and the enhancement of the public building heritage. The purchaser, entrusting Private Organizations management activities, should maintain a strategic role in planning and control. It should define the maintenance policy on the basis of both the surveying of users' needs, and the available funds.

The control should be performed on specific indicators:

1. Building analysis and diagnosis:
- Buildings knowledge: adequate information about materials and construction techniques (STEP 1).
- Functionality definition of the technical element: definition of the function that each element should perform (STEP 1).

- Conservation condition evaluated on the basis of effective degradation and damages: type and intensity of the surveyed phenomena in order to guarantee a reliable control and to increase the quality of information for the maintainers (STEP 2 – 3).

2. Forecast capability:
   The systematization of the information surveyed in the periodic inspections allows the optimization of the available resources, reducing, in time, the number of inspections and the extent (and the cost) of the interventions. The forecast capability is related to an effective inspection plan and to correct diagnoses of building degradation and damages (STEP 2 – 3 – 4).

3. Timeliness in intervention:
   The definition of intervention priorities should be founded on different criteria, on the basis of the maintenance strategy adopted. In damages maintenance the purchaser should evaluate the time past between the knowledge of the damage and the execution of the intervention. In planned maintenance the respect of scheduled activities and the forecast capability (STEP 4).

4. Intervention costs:
   The purchaser can previously establish costs on the basis of the kind of interventions, to fasten the accountancy reports and to foresee the total amount. But these fixed costs should be based on materials, construction characteristics, degradation and damages surveyed, and use of the buildings (STEP 4).

5. Users’ satisfaction:
   This indicator can be evaluated on the basis of the timeliness in interventions and of their effectiveness. In the Global Service contracts, the Manager Organization usually receive the users’ requests of intervention.

Starting from the aforementioned indicators, the Public Organizations can directly control the information of the activities performed by the Private Organizations entrusted in building management. These should report to the purchaser clear, complete and measurable information. The information should be compared with the results of the controls performed in situ, in order to verify its reliability.

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Performance Measurement Applications in Facilities Management: An Investigation into the Future Directions

Dilanthi Amaratunga, Udayangani Kulatunga & David Baldry
Research Institute for the Built and Human Environment, The University of Salford, UK

Abstract

Facilities Management (FM) is very frequently described as, "an integrated approach to operating, maintaining, improving and adapting the buildings and infrastructure of an organisation in order to create an environment that strongly supports the primary objectives of that organisation". The practical and strategic relevance of FM to organisations in all sectors of the economy is now increasingly recognised. Accordingly, organisations seek to improve their competitiveness by introducing a core business philosophy and restructuring to release senior management time and improve effectiveness. Managements have begun to realise that for organisations to benefit from their enormous investment in facilities, they have to begin managing them actively and creatively with commitment and a broader vision. Formulation of techniques that are capable of assessing "facilities performance" in terms of quality, cost and effectiveness, is therefore critical for "Organisational" and "FM" advancements. Research has emphasised that there is a clear need to measure FM performance which would integrate both the business and facilities domains. Accordingly, this paper summarises a literature review of current leading-edge performance measurement and management practices within facilities management organisations and conceptual models of performance measurement and management from other industries. Accordingly, the paper identifies the directions to develop performance measurement systems in FM with specific links to measure facilities relationships with those of the core business.

Keywords: Facilities management, performance measurement, core business

1. FM and its importance in todays' business environments

Facilities management (FM) has traditionally been seen as simply the management of buildings and building services. FM is a key managerial discipline and large corporations are increasingly recognising its importance in respect of achieving organisational goals and objectives.

A variety of definitions of facilities management have arisen:

- "An intergraded approach to maintaining, improving and adapting the buildings of an organisation in order to create an environment that strongly supports the primary objectives of that organisaiton" [1];
- "The process by which an organisaiton ensures that its buildings, systems and service support core operations and processes as well as contribute to achieving its strategic objectives in changing conditions" [2];
- "The integration of multi-disciplinary activities within the built environment and the management of their impact upon people and the workplace" [3];
- "A process by which an organisaiton plans, delivers and sustains excellent support services in a quality environment to meet caning strategic business objectives at best cost" [4]

A number of basic issues may be derived from these definitions:

- FM is a function containing a series of linked activities demanding a requirement to co-ordinate all activities pertaining to the planning, design, and management of an organisation's physical resources;
- FM is responsible for co-ordinating planning processes and managing a building's continuing development and changing use patterns, as well as for maintaining the building
- The goal of FM is to contribute to organisation effectiveness by helping the organisation to allocate its physical resources in a way that allows it to flourish in competitive and dynamic markets.

but as shall be seen in due course:

- FM is not just about the maintenance and operation of buildings although so much of its activities are building-related. More accurately it is about the management of a range of services, of a variety of forms, which are necessary to support the primary activities of an organisation;
- These services are invariably people intensive which means that human resource management issues and the so-called "soft" issues are highly significant; and
- FM has no raison-d'etre or justification of its own - it only exists as a means to support the primary, goal-seeking, activities of the organisation. Nevertheless the potential impact of the efficacy of FM upon organisational success may be highly significant.

FM is intrinsically bound up with creating the conditions in which business effectiveness may be achieved. All decisions taken about FM are business decisions albeit subject to technical or organisational criteria. The business case for developing and applying the discipline of FM depends upon an understanding of the potential the approach holds for creating quality working environments to support key corporate activities. Effectively planned facilities and quality support services can generate significant business or organisational returns.

The conditions within which facilities are operated and developed, and therefore the contribution they can make to the organisation, need to be set at the most senior level in an organisation. Strategic business decisions about responses to market conditions, competitive pressures, statutory obligations, and organisational restructuring are all business decisions which will have direct facilities implications. Company policies for production, marketing, human resource management, and finance each have profound significance for the manner in which facilities management services will be required to be delivered. In this context, following section highlights strategic role of FM.

2. Strategic Role of Facilities Management

FM has three facets in organisations: sponsorship, intelligence, and service management, according to Williams and Roberts (2000) [5]. CFM (2002) [4] identifies sponsorship FM role as the "translation" role with a strategic focus:

- Get the chief executive officer and senior management involved in the process and make them are of the possible outcomes;
- Strategy involves a change management process, which will have an impact on the built environment and the human resources;
- The focus of the strategy is the community, not the building or property, or a project;
- Every individual in the company (from top management to staff) see the project as a business project, which has an impact on the business objectives

Nevertheless it is true that many organisations remain blind or indifferent to the strategic potential of FM to stimulate strategic change or competitive advantage. Instead of being seen as a strategic tool the built assets and human resources and systems remain defined as an obligation or liability, that is as unavoidable costs and charges, cost centres rather than profit centres.

FM and the business or organisational sector may be able to reach a better understanding of each others needs and potential by the co-ordination of decision-making which demands a facilities input, and which would help to bridge the gap between primary business and support activities, i.e. core and non-core. There is a powerful need for a generalised set of principles for the contribution of FM to the defining of business problems, the analysis of options, and the strategic choice of solutions. The discipline itself needs to adopt a more strategic posture about its future path, by protecting and developing the distinctiveness of its range of management activities and mix of managerial and technical skills, thereby confirming its relevance to the whole business process.

This leads to another role, which FM is playing increasingly in performance measurement (PM). The need to monitor, assess and measure FM performance to enhance workplace productivity has become critical, particularly from the strategic point of view of FM.

3. Role of performance measurement within business environments

PM is mostly identified as a system which enhances individual performance to support or achieve the organisational goals [6]. As continuous improvement in a business cannot be gained without measurement of its performance [7], measurement of performance has been given a prominent place in any organization. Kagioglou *et al.,* (2001) [8] defines, the PM as “the process of determining how successful organization or individuals have been in attaining their objectives and strategies”. Since PM systems encompasses supporting infrastructure a more wider definition has been given by Nelly (1998) [9] as the quantification of efficiency and effectiveness of past actions by means of data acquiring, collection, sorting, analysing, interpreting and disseminating. Cain (2004) [10] identifies PM as the first stage to any improvement process that benefits the end users with lower prices, and the organizations with higher profit margins whilst enhancing the quality of the product. Thus, it can be said that PM is an important aspect for any organization to evaluate its actual objectives against the predefined goals and to make sure that the organization is doing well in the competitive environment. Love and Holt (2000) [11] summarise the importance of PM as it: Ensure that customer requirements have been met (and if not, why); Enable establishment of achievable business objectives and monitors compliance thereto; Provide standards for business comparisons; Provide transparency and scoreboard for individuals to monitor their own performance; Identify quality problems and those requiring priority attention; Give and indication of the costs of poor quality; Justify the use resources; and Provide feedback for driving the improvement effort.

This section has highlighted the importance of PM in business environments. In this context, the following section identifies its role within Facilities environments.

4. Critical role of performance measurement systems within facilities environments

The importance of PM in FM organisations are been well documented in the literature. Alexander (1996) [12] identifies measurement of performance as one of “three essential issues for the effective implementation of a facilities strategy”. Due to the increased complexity of FM organisations facilities managers are accountable for the senior management regarding the FM contribution to business results and for the economic health of the organisation, the senior management at the core of the business will want to know the performance of facilities. In addition, the contributions made by the FM organisation would be assessed by the stakeholders of the organisation. Thus, facilities managers are under pressure to improve the performance in FM organisations to justify their success to the management as well as to the stakeholders. In this regard PM can play a major role in FM organisations by providing periodic information about the attainment of goals and objectives in the organisation and can guide the management towards new directions to enhance the facilities within the organisation.

Amaratunga and Baldry (2002) [13] identify the ways in which FM could contribute to the performance of an organisation such as strategy, culture, control of resources, service delivery, supply chain management and, management of change. Spedding and Holmes (1994) [14] state that FM should not only focus on reducing the running cost of the building, but also should consider the effective and cost efficient ways of space management and achievement of organisational goals. Therefore, to identify the effectiveness of the contributions of FM functions, performance has to be measured. Thus, PM systems play a critical role in this aspect.

Facilities managers are increasingly valued for their entrepreneurial skills and knowledge of the core organisation, with the ability to pre-empt and translate the organisation's need for change into facilities strategies which underpin operational objectives to yield competitive advantage. Further more, strategic appreciation and development has been viewed as the corner stones of any facility management strategy. Thus, it can be argued that PM applications within FM organisations can assist the facilities managers toward achieving the strategies in the changing business environment.

The concept of providing one working space for all the employee activities of the organisation has been changed and the concept of "activity settings" which looks at different work settings ranging from open plan, meeting spaces, quiet concentration areas, conference rooms etc. has been emerged. Thus, corporate office space planning has become an important characteristic of FM organisations and the efficient and effective management of office environment has challenged facilities managers [15]. He argues that the old adage "you can't manage what you can't measure" fit the corporate infrastructure well. Thus, PM can play an important role in FM organisations by providing quantitative and qualitative data in terms of the effective use of the building space.

The above context shows the important role played by PM in FM organisations in way of providing valuable information regarding the attainment of aims and objectives of FM organisations. In this context, following section identifies current, leading edge, PM practises within FM organisations.

5. Current performance measurement and management practices within facilities management organisations

The importance of assessing performance in FM and a general need for the assessment of FM were discussed in the above section. In recent years, a number of management tools have been found to be particularly useful in the area of FM evaluations. The provision of information decision-making is a key component of a facilities strategy, in particular literature emphasises the usefulness of facilities performance measurement techniques.

The tendency of using the PM frameworks instead of the traditional measures can be identified in the PM applications in FM. For instance, the application of Balance Scorecard [16]. Further, the development of frameworks (Service Balanced Scorecard) based on the fundamental principles of Kaplan and Norton's Balanced Scorecard can be found which appraises the performance of property organisation's against their the strategic aims [17].

Process based approach to evaluate the performance in FM organisations can be found in the current FM literature [18]. This identifies the importance of process thinking in FM organisations as it would help to align the activities of the team members towards a common goal. They argue that even though the FM has been defined in many ways, most of these definitions identify the core competencies of FM as understanding business organisation, managing people, managing premises, managing services, managing the working environment and managing resources and recognise FM as a business process. One of such approaches is the application of the SPICE (Structured process improvement for construction environments) model.

Further, a survey as reported in Amaratunga & Baldry (2002) [19] as presented in

Table *1* presents a picture of PM practices within FM organisations. This random sample may have produced a lower proportion of respondent employing the measurement techniques.

Table 1: Use of approaches/techniques for the measurement of FM performance

Approach for the measurement of FM performance	***Number using the approach***	***Proportion against the total sample***
- Business excellence model (EFQM)	3	20.00%
- Best practice Benchmarking	5	33.30%
- Total quality management	1	6.67%
- Customer satisfaction surveys	10	66.67%
- Post-occupancy evaluation	6	40.00%
- Evaluate return on funds employed	-	-
- Through observe of complains	7	46.67%
- Employee indexes	-	-
- Measurement against service level agreement	1	6.67%
- No method used	1	6.67%
- Any other method	-	-

The use of a broad range of approaches to the measurement of performance in FM was confirmed by the survey and the interviews carried out. It was further confirmed that appraisal techniques for assessing performance should become an essential part of the FM process, particularly those that provide information that can be arrayed so as to ensure management can learn about the consequences of their actions.

There is frequent comment that there are too many performance indices (especially in terms of cost) in the FM market. Therefore, a more positive and preferable stance in respect of performance measurement in FM is needed and the evaluation process should stand up to scrutiny and allow the measurement of FM performance of individual services as well as aggregating this information into indices and integrated performance measurement "universes". This should allow assessment of FM performance covering various perspectives of FM together with FM's relationship to the core organisation, although to date the key problems have been those of performance measurement techniques' availability. This leads to the exploration of similar applications within other industries from whom, FM can learn lessons forms. In this context, the following section highlights some of the most common PM approaches available within other industries.

6. A literature review of conceptual models of performance measurement and management from other industries

In order to overcome the problems associated with the traditional measures such as encouraging short-termism [20], [21]; inability to provide stakeholder perspective [22], [23]; lack of focus on the strategy [21] etc., and to facilitate the effective and efficient PM in the current business environment, various integrated and multi-dimensional PM systems have been developed.

The newly developed integrated performance frameworks have attempted to tie the performance metrics more closely with the firm's strategy and the long term vision [23]. This is due to the recognition of the importance of deriving the performance measures from organisation's strategy [24], [25], [26]. Further, it was argued that there is a need to align the financial and non- financial measures that fit within a strategic framework [27] and [28] where the non-financial measures reflect the organisational objectives while the financial measures indicate the bottom line results [29]. In addition the need of PM systems to provide a balanced overview was highlighted by many authors [30] and [31]. Accordingly, the following section discusses the common PM frameworks used in other industries.

The importance of deriving the performance measures from the strategy of the organisation has been recognised widely [24], [25], & [26] thus the newly developed integrated performance frameworks have attempted to tie the performance metrics more closely with the firm's strategy and long term vision [23].

7. Supply chain performance

Over the past two decades, manufacturing industry has changed in to a highly competitive field due to the emerge of foreign and local competitors. Due to this competitiveness many firms are adopting different strategies to secure their market share. One of such is merging with suppliers by forming long term strategic partnerships which is known as supply chain. Supply chain has been defined as ‘a system whose constituent parts include material suppliers, production facilities, distribution services, and customers linked together via the feed forward flow of materials and the feedback flow of information’ [32]. Several models have been developed [33] & [34] to measure the performance in manufacturing supply chain.

7.1 Evaluating managers’ performance

Another strategy developed in the manufacturing industry is to build up the flexibility of the firms [35] to meet the goals of the organisation in a more dynamic manner. A study has been done in this area [36] by evaluating managers’ performance through manufacturing flexibility measures.

7.2 Measuring the long term performance

Measuring the long term performance in manufacturing industry is another approach used [37]. Performance metrics such as advanced manufacturing technology usage, advanced management practices usage, globalization and cooperation capacity and the match between manufacturing capabilities and market requirements are considered to ascertain the long term performance.

7.3 Service Balance Scorecard

Traditionally the performance in Local Government Authority’s are measured using financial measures such as occupancy cost to m2, full-time employees, lease cost, lease income, capital expenditure, total revenue etc. Service Balance Scorecard (SBS) has been developed to eliminate the problems associate with the aforementioned traditional measures and a study has been done in this area [17]. The SBS provides a new method to evaluate facilities linked to a Local Government Authority’s by measuring the performance in terms of Financial perspective, Building perspective (how well the facility is used in terms of time), Services perspective (how well the facility delivers, services to the community in line with the Local Government Authority’s objectives) and Community/customer perspective.

7.4 Satisfying the customer expectations

Even though the supply chain performances are traditionally focused on operational logistic activities, the trend has moved towards satisfying the customer expectations [38]. This has driven the performance measurement towards strategic measures [39]. Research has been carried out to evaluate the supply chain performance using process capabilities, technology capabilities and organisation capabilities from operational and strategic point of view [38].

7.5 EFQM model

EFQM model is developed on the principle that “Excellent results with respect to Performance, Customers, People and Society are achieved through Leadership driving Policy and Strategy, that is delivered through People, Partnerships and Resources and Processes” [40]. The model consists of five “Enablers” namely leadership, people management, policy and strategy, resources, processes, and four “Results” called people satisfaction, customer satisfaction, impact on society and business results. The enabler criteria concerned with how the organisation undertakes key activities while the results criteria are concerned with what results are being achieved. A logic called RADAR lies at the heart of the EFQM model consists of Results, Approach, Deployment, Assessment and Review. Thus, when using the model with an organisation, the Approach, Deployment, Assessment, and Review elements of the RADAR logic should be addressed for each Enabler sub-criterion and the Results element should be addressed for each Results sub-criterion.

The model has a non-prescriptive approach and can be used to carry out excellent quality management and self-assessment of the organisation. The organisation can use the model to develop their vision and goals for the future in a tangible and measurable way, help to identify and understand the nature of the business, identify the cause and effect relationships, use as a diagnosis tool for assessing the current status of the organisation [40].

7.6 Performance Prism

Performance prism consists of five interrelated aspects: Stakeholder satisfaction; Strategy; Processes; Capabilities; and Stakeholder contribution. Similarly to the BSC, the performance prism looks at the needs of stakeholders, but in a broader way. Further, performance prism does not limit by addressing the needs of shareholders and customers as in the case of BSC, but goes beyond that and addresses the needs of employees, suppliers, intermediaries, regulators, community as they too have a substantial impact on the project performance [41].

In most of the PM frameworks, the measures are derived from the strategy, but in the performance prism it is the other way around. The strategic, process and capability aspects of the performance prism have been derived by considering the requirements that is needed for the stakeholder satisfaction which is different from the general approaches of the PM frame works. Furthermore, performance prism identifies the reciprocal relationship between the stakeholders and the organisation. Therefore, focusing on the stakeholder contribution can be identified as a unique feature of the performance prism [42].

7.6 Other mostly cited models

In addition to the above PM frameworks, SMART (Strategic Measurement and Reporting Technique) developed by Wang Laboratories [43] which includes the internal and external performance measures, Keegan et al's (1989) [44] performance metrics based on the combination of cost and non cost measures can be identified. The Macro Process Model, developed by Brown (1996) [45] is based on the concept of cause and effect relationship of the organisation which shows the links between five stages of a business process (inputs, processing systems, outputs, outcomes and goals), and the performance measures.

The PM models used by other industries were reviewed in the above section. It can be identified that every model has its own set of advantages and disadvantages and the suitability of a model to a particular scenario is governed by these advantages and disadvantages.

8. Directions to develop performance measurement systems with specific links to measure facilities relationships with those of the core business

As discussed in section 4, PM plays a critical role by providing concrete evidence about the successful attainment of organisational goals and objectives in FM organisations. A criticism levelled at FM researchers is that they do not use the concepts of PM in as rigorous a manner as, for example, business performance theorists. Furthermore, they make no use of more general discussions of performance measures, e.g. the usefulness of constructing a PM framework for FM, and add PM into models of FM processes in the same way that they add project management techniques. The study of PM in a FM setting has therefore been somewhat superficial. However, it was identified in from the section 5 the positive motive of PM applications in the FM organisations.

The commitment from the people factor involved in FM organisations has a major role to play. For instance, evaluation of the efficiency and effectiveness of the existing building in terms of user satisfaction, identifying new improvements to buildings etc. are major roles of facilities managers. Therefore, similar to industries like construction, "people factor" can be considered as one of the important assets of FM organisations as improvements and challenges in the FM organisations can be met through the work force. The importance of human resource performance evaluation systems to organisations in general [46] & [47] has been highlighted by many human resource researchers. Further the need of aligning the human resource management applications of the firm with other management activities, creating a positive relationship between the organisational performance and the human resource practices focused on employee commitment are being well accepted in the studies done in other disciplines [48]. Therefore, such directions can be taken by FM organisations by measuring the performance of its workforce.

Quality of designs has been identified as an important dimension of buildings [25], [49], & [50]. However, due to the emphasis made by various authors [51[& [52], a new culture has been embarked in the UK construction industry towards measuring the performance [53] and more emphasis has been focused on the performance of the physical process [54] neglecting PM during the design stage. Lack of attention towards the PM during the design stage of buildings may forego the efficient and effective use of space within the building. Thus, measuring the performance during the design stage of FM organisations can be taken as a new direction.

The industries like manufacturing has identified the importance of creating long term strategic partnerships with both upstream and down stream partners such as suppliers, customers, and logistics service providers and the need of integrating and managing the multiple processes within and beyond the boundaries of individual organisations in the supply chain [55]. The research done in other industries revealed that the PM in supply chain facilitates the inter-understanding and integration between the supply chain members and the results indicates the effects of strategies and potential opportunities [56]. Furthermore, aligning the performance measures with the corporate strategy of the organisation have been well experienced by the PM studies in supply chain management in other disciplines as it would make sure that the supply chain processes are delivering the value to the customers and acting as a core competency of the organisation [39]. Further, PM of the whole supply chain and all of its entities has been identified as a strategic issue by many industries [57].

9. Conclusions

Appropriate measurement procedures can provide major benefits. When applying current measurement principles applicable to FM environments, several problems have to be faced: it is difficult to isolate FM's contribution to organisational performance from the other business activities because it is always the intertwined efforts that eventually result in outcomes in the market place; the problem of matching specific FM inputs and intermediate outputs with final outputs; a third major measurement problem is the time lag between FM efforts and their payoffs within an organisational setting; besides problems with the selection of performance metrics, there is also the problem of determining the right norms to compare with; and another issue, which is already mentioned in the previous section, is the acceptance of performance measurement in FM.

Therefore, it is argued in this research paper that performance measurement techniques available in general management literature haven't been fully transformed into FM literature, emphasising the research need in performance measurement in FM. The process should include links to the core business at a corporate level.

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Structured Process Improvements in Facilities Management Organisations: Best Practice Case Studies in the Retail Sector

Dilanthi Amaratunga* (r.d.g.amaratunga@salford.ac.uk) ,
Richard Haigh* (r.p.haigh@saslford.ac.uk) ,
David Baldry* (d.baldry@salford.ac.uk)
*Research Institute for the Built and Human Environment, The University of Salford, UK

Abstract

Facilities management is a key managerial discipline and large corporations are increasingly recognising its importance in respect of achieving organisational goals and objectives. Enterprises are able to improve their performance by the more effective use of resources, the matching of appropriate support systems to business activities, and the application of assertive management by those best qualified and equipped to carry it out. However, FM organisations lack clear guidelines to direct their improvement efforts and to benchmark their performance against other organisations. The SPICE FM (Structured Process improvement in construction environments – facilities management) maturity framework was developed as a response to this requirement. SPICE FM draws a distinction between FM organisations that have ‘mature’ or well-established processes, and those where the processes are ‘immature’. This paper briefly describes the characteristics of the SPICE FM Framework, followed by a review of the key findings from the case study undertaken.

Keywords: facilities management, SPICE, process capability assessment, performance

1. Process Thinking in FM

A process has several essential features, which Ould (1995) [1] lists as follows:

- A process involves activity. People or equipment do things.
- A process also generally involves more than one person or piece of equipment. A process is therefore about groups, and concerns collaborative activity.
- A process has a goal. It is intended to achieve something and to produce results.

A process determines the way we act and react. The activities and tasks we perform to achieve a certain goals form the “process” for achieving that goal. A disciplined process will result in ordered and consistent patterns of behaviour, whether by individuals or by groups of people. The process defines how we act or react, or it defines the activities needed to fulfil a certain task. We have a process for ‘going to work’, a process for ‘defining service standards’, and so on.

In this context, most FM organisations focus on the services they provide. In such a business culture, people are naturally inclined to emphasise issues that are tangible, visible or measurable. Many organisations are likely to resist process improvement activities that do not contribute to short-term tangible results. Consequently, FM managers often view process related work as low priority. In contrast, process-focused organisations consider tangible results in service delivery to be just one aspect of the business picture. For such organisations, how the service is delivered is equally important. The objective is that process thinking should be accepted and used consistently. The process is seen as a disciplined way of conducting business. In contrast to functional definitions, a process perspective in FM focuses on the tasks and activities that take place internally in the FM organisation. The emphasis is on how the work is done, rather than the functional responsibilities.

In this context, SPICE FM is primarily concerned with management FM processes. The underlying philosophy is that if management processes are well performed, they will have an impact on the performance of core processes. SPICE FM does not prescribe how organisations should perform core processes. Instead, it focuses on creating a management infrastructure that allows members of staff to perform core processes successfully.

2. SPICE frame work

The SPICE FM process maturity model promotes continuous process improvement based on many small, evolutionary steps. It provides a system for initiating and implementing continuous improvement. The model divides these evolutionary steps into five maturity levels, which lay the foundations for continuous process improvement. The maturity levels form a scale for measuring the capability of an FM provider's management processes. Each level of maturity is defined by a set of key processes. When an organisation is successfully applying each key process, it can stabilise an important part of the service delivery process and achieve the next level of maturity. The five levels also provide guidelines on how to prioritise efforts at process improvement. Figure 1 illustrates the five stages of the SPICE FM framework. For each level, the model specifies a number of ‘key processes’. By following the steps in the model, an organisation can achieve effective and continuous improvement based on evolutionary steps. An organisation can only be at one level of the model at any one time. If an organisation is at level 1, but implements some of the key processes of level 3 or 4, it is still considered a level 1 organisation. This is because each level lays successive foundations for the next. An organisation has little to gain by addressing issues at a higher level if all the key processes at the current level have not been implemented. To date, the research has focused on defining the characteristics of Levels 1 and 2 of the model.

2.1 Stepwise improvements in organisational maturity

The process maturity model lays foundations for continuous process improvement, by establishing controls on service delivery *management processes* before focusing on technical issues. Starting with ad-hoc processes, the evolutionary 5-stage model guides FM organisations towards developing their process capability. In the SPICE FM framework, organisations at level 1 have little process focus. Organisations at level 2 have achieved high capability in managing service delivery. Level 3 focuses on knowledge management and sharing best practice across the organisation. In levels 4 and 5, the model introduces statistical controls and measurement. Level 1 of SPICE FM is the entry to the framework and has no key processes. Organisations at level 1 focus on achieving the seven key processes at level 2. This lays the foundation for the key processes at the next level. Each key process is defined by a set of critical practices that indicate if the process has been implemented in a way that is effective, repeatable and lasting.

Table 1 lists the key processes at level 2 and their "enablers". The SPICE FM approach is not prescriptive in terms of how activities are performed. Instead, the model focuses on the broader issue of process management. Effective process management encourages and supports innovative approaches to solving day-to-day business problems, rather than constraining organisations to a particular way of working.

Figure 1: The SPICE FM process maturity model

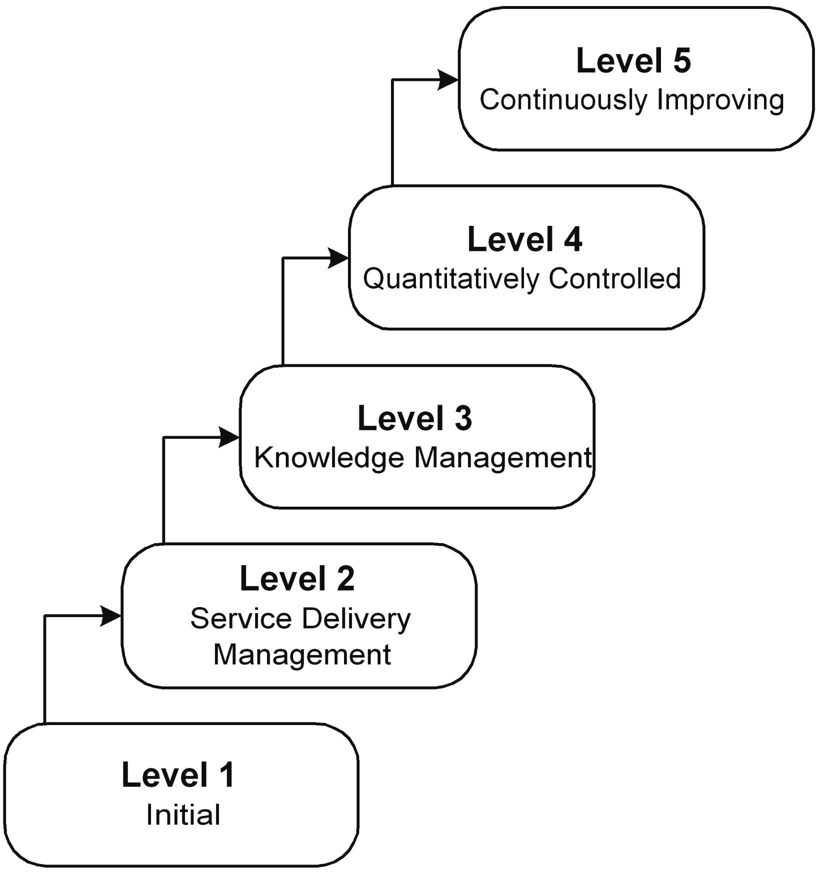


Table 1: Level 2 key processes and their enablers

Level	Key Process Areas	Generic Process Enablers
2 - Service Delivery Management	Service Requirement Mgt. Service Planning Service Performance Monitoring Supplier and Contractor Mgt. Health and Safety Management Risk Management Service Co-ordination	Commitment Ability Activities Evaluation Verification

2.2 Level 1 – Initial

Level 1 is the basic entry level to the model, and has no key processes. An FM provider at this level has little focus on process, and service performance is poor. Good practices are local, and are not repeated or 'institutionalised' across the organisation. The ineffective capture and co-ordination of service requirements tends to undermine good practices. Organisations make commitments that staff or the supply chain cannot meet, which results in crises. During a crisis, facilities managers typically abandon planned procedures; instead, individuals do whatever activities it takes to get the job done, with little regard for the effects on other people. Time, cost, quality and customer satisfaction may all suffer. Level 1 organisations must implement all of the level 2 key processes in order to progress, or 'mature', to the second level of the model.

2.3 Level 2 – Service Delivery Management

At this level, service performance can be predicted to a certain degree. A level 2 organisation has established policies and procedures for managing and delivering customer requirements. Service performance standards are established, and service delivery is co-ordinated to minimise disruption to the core business. As the service is being delivered, continuous monitoring ensures that performance standards are met. At level 2, FM providers have effective processes to directly meet the requirements of the core business. An effective process is one that is practised, enforced, trained, documented, evaluated and able to improve. To date, most of the efforts of the SPICE FM project have concentrated on defining and raising confidence at level 2 of the model. The research has identified seven key processes at level 2 which are described below.

- **Service requirement management -** Effective management of customer requirements identifies the needs of the organisation and its users. The service delivery team identifies how many tiers of customers it has and how their requirements differ. The team has a clear sense of priority in term of its customers and the service mixes it offers. Service level agreements and performance standards are developed and continuously reviewed to remain consistent with customer requirements. They are also communicated to all staff involved in service delivery.

- **Service planning** - Service planning establishes realistic schedules of work based on customer requirements. Estimates (e.g., resources, maintenance schedules, budgets, purchasing) are prepared for all work to be performed (e.g., scheduled and reactive maintenance).
- **Service performance monitoring** - Service performance monitoring ensures that services are delivered in a manner that is consistent with the service level agreements and performance standards established with the customer. Feedback is gathered (e.g., from customers and staff) to monitor customer satisfaction levels. Performance measures (e.g., waiting times, error rates, processing times) are reviewed on a regular basis, with the involvement of staff, and corrective action is taken when service delivery deviates significantly from service plans.
- **Supplier and contractor management** - This key process starts with the selection of suitable suppliers and contractors. Service level agreements and performance standards are established and their performance is continuously reviewed.
- **Health and safety management** - Health and Safety Management ensures that services are delivered in compliance with, or exceed, all mandatory health and safety legislation. Health and safety risks are identified, assessed, and action taken to eliminate or minimise the likelihood of any incidents.
- **Risk management** - Risk management involves identifying and evaluating risks so that action can be taken, either to reduce the likelihood of an event occurring or to limit the consequences should that event occur. Risks are identified in all areas of the business (e.g., to the environment, supply breakdown, property, financial performance). Employees are actively involved in identifying risks and taking steps to prevent risks becoming a reality.
- **Service co-ordination** - Service co-ordination draws on the experience of other service teams, suppliers and customers to meet customer requirements effectively. Co-ordination between these three groups ensures that disruption to the core business is minimised. Representatives with responsibility for co-ordination are appointed, and co-ordination methods are agreed.

2.4 Level 3 – Knowledge Management

A level 3 organisation builds on the achievements of level 2. At this level, the organisation has the capability to capture and share knowledge across the organisation. So far, the SPICE FM research has had less focus on level 3, which is anticipated to be the subject of future research.

2.5 Level 4 – Quantitatively improved & Level 5 - Continuously improving

So far, the SPICE FM research has had little focus on level 4 and 5. At Level 4, the organisation will have a programme that measures productivity and quality for important process activities related to service delivery. This programme forms an objective basis for measuring the process, customer satisfaction, and harmony across the supply chain. Organisations gain control of service delivery by narrowing variations in process performance, so that they fall within acceptable boundaries. Meaningful variations can be distinguished from random variations. The expectation at level 5 is that the entire supply chain is focused on continuous process improvement. Level 5 organisations can identify weaknesses and strengthen processes before any problems emerge, and can do so in a collaborative manner. Data on the effectiveness of the process is used to perform cost benefit analysis on any new technologies and on proposed changes to processes. This increased level of understanding allows organisations to consider large-scale changes to their processes. Innovations that exploit best practice are identified and adopted throughout the organisation.

3. Process Enablers

Anecdotal evidence from the research suggests that if managers are asked: "Do you implement level 2 key processes?" they are likely to respond "yes". On the other hand, current studies indicate otherwise. So how can managers ensure that they are performing the key processes adequately? The SPICE FM research has identified five process enablers, which are either activities or modes of thinking. These enablers are pre-conditions for implementing the process. They are based on principles established in CMM® [2] and SPICE [3] that were developed for the software engineering and construction sectors respectively. Process enablers focus on the results that *can be expected* from a key process. This is a forward-looking approach, which indicates an organisation has process capability *before* a process takes place. Process enablers detail the features a key process must have before it can yield successful results. Ensuring that all the process enablers are in place improves the performance and predictability of key processes. Process enablers apply across all the key processes.

- **Commitment** - This involves an organisation taking action to ensure that the process is established and is lasting. Typically, this means establishing policies that are shared by the whole organisation. Some processes need sponsors or leaders in the organisation. Commitment ensures that leadership positions are created and filled, and that the relevant organisational policy statements exist.
- **Ability** - This describes the conditions that must exist before a process can be implemented competently. It normally means having adequate resources, an appropriate organisational structure, and training in place.
- **Verification** - A verification procedure checks that activities are performed in compliance with the agreed process. Adopting such verification checks as a process enabler emphasises the need for independent quality assurance. The focus is on *external* verification of processes.
- **Evaluation** - This involves internal process evaluation and reviews to help control and improve processes. During the early stages of maturity, this will mean efforts by the team to improve existing processes. The focus here is on the project team's *internal* improvements.
- **Activities** - This describes the activities, roles and procedures necessary to implement processes. They typically involve establishing plans and procedures, performing the work, tracking it, and taking corrective

4. Core, support and management processes

Business processes can be divided into three broad types: (i) core processes; (ii) support processes; (iii) management processes. Core processes concentrate on satisfying customers. They directly add value to the product in a way that clients understand. These processes respond to the needs of customers and generate customer satisfaction. Support processes concentrate on satisfying ‘customers’ within the organisation. They might add value to the business indirectly, by supporting a core business process, or directly, by providing a suitable environment. Management processes are concerned with managing the core and support processes. SPICE FM is primarily concerned with management processes. The underlying philosophy is that if management processes are well performed, they will have an impact on the performance of core processes. SPICE FM does not prescribe how organisations should perform core processes. Instead, it focuses on creating a management infrastructure that allows members of staff to perform core processes successfully.

5. SPICE Applications in the Retail Sector

The SPICE FM framework described above was tested in a series of case studies with FM providers to ensure that its outputs are appropriate to the FM sector and of value in the real world. Members of the research team worked closely with FM providers and clients to test the SPICE FM framework in a variety of real-world scenarios. In this context, this section of the paper documents the findings of one such study, undertaken at the Property Services Department within a leading retail group in the UK.

The primary objective of the case study was to establish whether the concepts behind the SPICE FM framework are applicable and relevant to a FM provider in the private sector.

5.1 Study methodology

A series of meetings with the management team at the Property Services department gained the necessary commitment to proceed with the study. This paper does not disclose the precise source of process capability findings. This ensures that members of staff can speak openly about their perceptions of the organisation. The confidentiality of assessment data was made clear to all members of staff that participated in the study.

As already mentioned, this study aimed to assess the capability of the management processes that support the implementation of the Department’s business strategy. Below is a list of the key assessment activities undertaken:

- **Departmental management interviews** - The objective of the interviews was to understand: What management views as the critical issues facing the department; What process capability management believes the department has; How policies and procedures are defined; How communication flows through the organisation; and How process improvement fits into the department’s vision.

- **Employee interviews** - A representative cross-section of employees were chosen to participate in semi-structured interviews, ensuring an unbiased view of the organisation.
- **Document review** - The research team reviewed items of documentation that employees referred to in interviews. This was to establish whether such documents actually exist, what form they take and their availability to staff.

A detailed description of the SPICE FM process maturity model is already given. The key processes considered within this study were the SPICE FM Level 2 key processes: - Service requirement management; Service planning; Service performance monitoring; Supplier and contractor management; Risk management (including health and safety); and Service co-ordination. These key processes were assessed against the process enablers, as already described in section 3 above. SPICE FM process maturity model identifies five process enablers, which are types of thinking or activities that are pre-conditions for implementing the process. Process enablers focus on the results that can be expected from a key process. This is a forward-looking approach, which indicates an organisation has process capability before a process takes place.

6. Case Study findings

This section refers specifically to the results and outcomes from using the SPICE FM model within the Property Service department. An important objective of the case study has been to understand how the criteria identified in the SPICE FM process model relate to the department. Using the results of the assessment undertaken during the study, this section highlights some of the areas in which the department satisfies or fails to satisfy the key criteria of the key processes and their enablers.

6.1 Service requirement management

Effective management of service requirements identifies the needs of the organisation and its users. The service delivery team identifies how many tiers of customers it has and how their requirements differ. The team has a clear sense of priority in term of its customers and the service mixes it offers. Service level agreements and performance standards are developed and continuously reviewed to remain consistent with customer requirements. They are also communicated to all staff involved in service delivery. The process meets the needs of both responsive and preventative maintenance requirements

The integrated helpdesk is used by the department to record requests from individual stores. Specialist support is available to the operators to respond to more complex queries. The Property Management System establishes schedule of compliance (asset registers, PPM plans and performance criteria). The asset register names appropriate specialist contractors – including primary and secondary options where appropriate. A combination of on-the-job training and procedures are used to train operators. The supervisor is in the process of expanding this into a more comprehensive training schedule. The move towards an integrated helpdesk has improved resource efficiency and ensures effective backup is in place for busy periods. Out of hours provision has also been addressed.

6.2 Service planning

Service planning establishes realistic schedules of work based on customer requirements. Estimates (e.g., resources, maintenance schedules, budgets, purchasing) are prepared for all work to be performed (e.g., scheduled and reactive maintenance). The department has well established systems in place to plan service provision in line with service level agreements. Service level agreements establish clear expenditure guidelines and budgets for individual chains and allow the department to service chains in line with their specific requirements (e.g., the balance between proactive and reactive maintenance). The department has distinct prioritisation levels for jobs that form the basis for establishing target times. The escalation procedure for prioritisation appears well established and understood by staff. tment has distinct prioritisation levels for jobs that form the basis for establishing target times. Costs for maintenance activities are clearly defined based on a schedule of rates for each contractor (including call out rate / hourly rate). Clear guidelines for approval to proceed are in place based on automatic approval mechanisms. Managers have recognised that efficiency savings can be made through a more intensive planning process. This indicates evaluation of the process is taking place.

6.3 Service performance monitoring

Service performance monitoring ensures that services are delivered in a manner that is consistent with the service level agreements and performance standards established with the customer. Feedback is gathered (e.g., from customers and staff) to monitor customer satisfaction levels. Performance measures (e.g., waiting times, error rates, processing times) are reviewed on a regular basis, with the involvement of staff, and corrective action is taken when service delivery deviates significantly from service plans.

Significant efforts have been made to introduce key performance indicators. The department has a wide range of systems in place by which to monitor its performance. Examples include: Financial reports; Weekly reports; Call statistics; Complaints / complements log; Job Checking report; Quality audits; Work record sheet auditing; Invoice auditing; and Year on year profiles. However, there is little evidence that the new reports and key performance indicators are being linked to the needs of the core business. For example, the department appears keen to demonstrate the importance of the FM function to the core business, emphasising the cost of maintenance and the need for proactive maintenance. However indicators are not being developed to address these issues. Although some feedback is gathered at a branch level, it is sporadic and probably inadequate to provide an accurate reflection of customer satisfaction. Tools such as post project reviews and more comprehensive questionnaires were suggested by staff to address this. Despite the similarity between the chains served by the department there appears to be little or no internal benchmarking. Such systems could be used to demonstrate the effectiveness of a chain's property management strategy relative to others in the group.

It is clear that the department has spent significant resources identifying and implementing improvements to its monitoring and reporting structure and these appear to be largely successful. However two areas were identified by this assessment for improvement: more extensive monitoring of individual maintenance tasks (at a branch level) is required to ensure quality standards are being met. Additional resources may be required to address this issue satisfactorily; and although key performance indicators have been fundamental to the changes in reporting, their relationship to the core business appear unclear.

6.4 Supplier management

This key process involves the selection of suitable suppliers and contractors. Service level agreements and performance standards are established and their performance is continuously reviewed.

Due to the nature of the departments operations (i.e., subcontracting of work to external supplies), there are significant overlaps with comments in other key processes. The retail group operates a strict buying policy that is well communicated and understood by staff. The department has a clear objective to streamline the current supplier base in an attempt to improve services and gain ownership. Related to this is also a desire to move towards total FM - supply, install and maintain. This objective is understood by staff within the department. Service level agreements are in place with the supplier base creating performance standards and establishing levels of cover within different contracts. However monitoring of suppliers is simplistic (e.g., random checks, clerk of works, named and shamed, periodic review meetings) and is felt by staff to be ineffective. There is little data available to establish whether performance standards are being achieved. The department has expressed a desire to introduce more objective incentive targets in the future that will make the service level agreements more comprehensive. The department has recognised that the performance of suppliers reflects on its own image within the Group and is taking steps to address these weaknesses. At the time of assessment, there was evidence of significant shortcomings in the systems for selecting and monitoring the department’s supplier base. However it is clear that the department has recognised these problems and is in the process of identifying and implementing steps to resolve them

6.5 Risk Management

Risk management involves identifying and evaluating risks so that action can be taken, either to reduce the likelihood of an event occurring or to limit the consequences should that event occur. Risks are identified in all areas of the business (e.g., health and safety, environmental, supply breakdown, property, financial performance). Members of staff are actively involved in identifying risks and taking steps to prevent risks becoming a reality.

At the retail department, formal risk management is limited to health and safety issues. An external consultant is responsible for the majority of health and safety issues. Consequently it was not feasible to examine the process in detail during the case study. However, the department has a clear reporting structure and systems in place for recording and monitoring health and safety issues. The procedures developed to manage unplanned events suggest some awareness of broader risk management issues within the department.

It lacks a clear directive from senior management to manage broader risk issues. The majority of staff are unfamiliar with the concept of risk management and are therefore not in a position to play an active role in the management of the Group's risk – in particular, an awareness of how their job might impact the core business. Consequently the department's employees are unaware of risk management and have received no specific training. Some escalation procedures are in place to manage the unplanned event. Employees feel that the Group is committed to managing health and safety and in particular, recognise its importance to the core business. The department employs an external health and safety consultant "Safety Works" to investigate health and safety problems. The consultant issues questionnaires and carries out audits to ensure method statements, risk assessments, policies and training are in place. There is a well defined accident reporting structure in place. However the role of the health and safety manager within the department is poorly defined, lacking clear scope and objectives. The significance of the department's operations to the core business suggests that this is an important issue to address in the future.

6.6 Service co-ordination

Service co-ordination draws on the experience of other service teams, suppliers and customers to meet customer requirements effectively. Co-ordination between these three groups ensures that disruption to the core business is minimised. Representatives with responsibility for co-ordination are appointed, and co-ordination methods are agreed.

The restructuring of the department to offer a cross chain service has improved integration and communication internally. The relationship between the department and individual stores is remote due to the work being performed by external suppliers. The department has little insight into the effectiveness of the suppliers' co-ordination with individual stores due to the poor monitoring of individual jobs. The 'Vision' process is actively bringing together different sections of the department to improve service delivery. By addressing operational management and reporting issues collectively, this should aid process integration. However, the membership of the Vision group remains small. Some of the department's systems have not been effectively integrated to reduce duplication.

It is clear that integration and co-ordination have improved in recent months as a result of the significant changes taking place within the department. The main weakness concerns the relationship between the department and the customer, due to the poor supplier monitoring and communications currently being utilised. This issue should at least in part be addressed by changes to supplier management monitoring process.

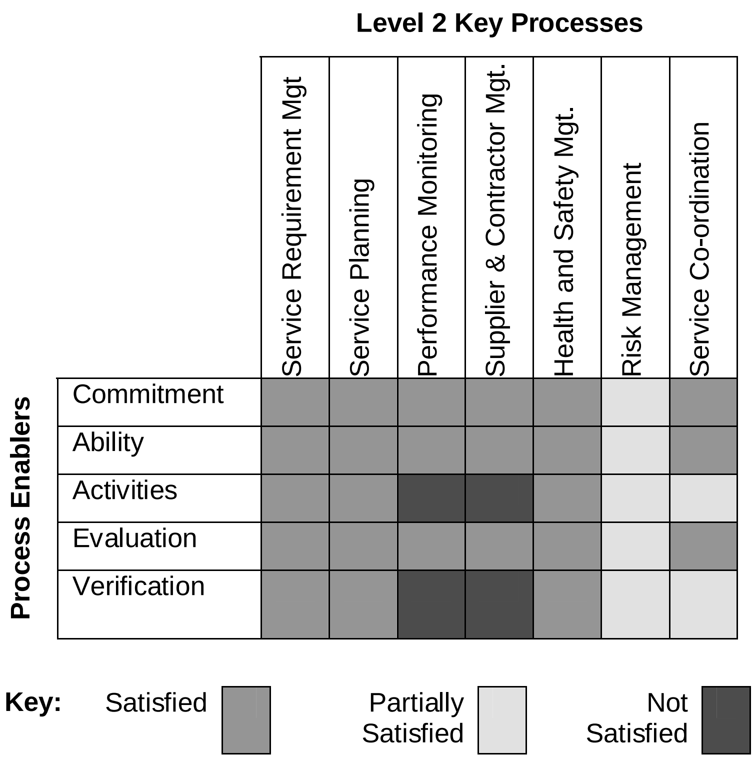
6.7 Process Evaluation and Verification

Evaluation involves basic internal process evaluation and reviews. These internal evaluations are used to help control and improve processes. During the early stages of maturity, this translates into efforts by the team to improve existing processes. The focus here is on the project team's internal improvement efforts. A verification procedure checks that activities are performed in compliance with the agreed process. Adopting verification as a process enabler in turn emphasises the need for independent verification by management and quality assurance. The focus is on external verification of processes.

The department is progressing with a significant change programme, supported by a dedicated resource to identify and drive improvements. A comprehensive "joint action plan" is in place to continually evaluate its operations, identify improvement areas and establish actions based on those requirements. Each action is assigned to specific staff and has clear target implementation dates. The "joint action plan" has a relatively small membership base, making it difficult for some employees to have an input into the process. The quality of communication to those employees has been variable. Consequently, everyone is aware that changes are taking place but the effect of those changes is sometimes not apparent. The value added to the core business through the change programme is not clear. The reporting systems being established within the department provide a checkpoint to ensure that the correct process is being followed. Some formal auditing of suppliers takes place, particularly in relation to health and safety issues. Procedures within the department tend to be informal rather than documented. To ensure that new reporting systems and processes are understood and adopted by staff, it may be necessary to formalise them, including the identification of clear responsibilities and duties. It is clear from the assessment that the department has established a suitable infrastructure to continuously review and improve its key management processes. Verification is also being addressed by this action, through the introduction of a new reporting structure.

7. Summary of process capability assessment

Figure 2: The department's process capability matrix



During the period of the SPICE FM study, the department was part way through a significant change programme aimed at improving the department's processes and reporting systems.

The change programme complicates the findings due to the inevitable collection of contradictory evidence – a before and after scenario. The SPICE FM assessment emphasises the importance of establishing the necessary infrastructure to support and improve processes over time and it is clear from the assessment that the department has allocated significant resources and introduced new systems that address this issue directly. Although the department still has some weaknesses to address, the necessary infrastructure is being put in place to identify and correct these issues in the future. Indeed, because of this infrastructure, many of the weaknesses raised in this report may already have been identified by senior management. Figure 2 is an attempt to summarise the department's process capability against the SPICE FM model. The matrix highlights the mature nature of its processes following the change programme. The main concern surrounding the change programme is the lack of clear strategic direction. Consequently, despite the efforts and likely performance gains the benefits to the core business are likely to remain unclear.

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Encouraging Facilities Managers to Conduct Post Occupancy Evaluations

Nina Ryd,
Facilities Management Consultants Inc., Sweden (email:nina.ryd@fmkonsulterna.com)

Abstract

A range of methods for building evaluation exist. In post occupancy evaluation (POE) methods the focus is on user satisfaction. It is a formal evaluation of buildings made by its occupants after it has been completed, to identify areas that do not meet users' requirements. However these kinds of evaluations are seldom done in Sweden. This paper reports preliminary findings from an ongoing research and development project intended to implement the latest thinking and experience on POE into facilities management practice. The overall aim is to provide the Swedish market knowledge of how to make POE better, faster, cheaper and implemented in practice. Barriers to POEs are scrutinized, as well as suggestions of how these barriers might be overcome. An interview and questionnaire based method is applied. One basic assumption is that results from POEs is essential as input in the construction briefing process, as feedback for productive feed forward. Data generated during an evaluation is suggested to be used in the briefing process for a new building. The results provide insight contributing to the facilities manager's understanding of the potential benefits that an organisation can gain through the use of building evaluations.

Keywords: evaluation, tools, facilities management, briefing/programming*, corporate real estate, end users.

**The British concept construction and design briefing is used as a synonym to the American concept architectural programming throughout this paper.*

1. The Encouraging POE Project

1.1 Overview

This paper report preliminary findings of an ongoing research and development (R&D) project that aims to put into practice the latest thinking and experiences on Post Occupancy Evaluation (POE) and Building Performance Evaluation (BPE) at the strategic and operational levels for, facilities manager, clients, and building occupants. The project is founded by FORMAS, the

Swedish Research Council for Environment, Agricultural Sciences and Spatial Planning, during the period of October 2004 until June 2006.

The overall aim is to bring together knowledge and experience from practice and research, to provide knowledge of how to improve Swedish POE, make them quicker, and cheaper, and to develop compatible, robust methodologies for use throughout the life cycle of buildings, usable for facilities manager among others.

1.2 Industrial Relevance

This R&D project bring together contributors from the industry, real-estate companies, and the real estate division of one county council, one municipality as well as from universities [1], where new ideas about building evaluation can more easily be developed, reach industry's expectations and, methodically discussed.

The practical value of the project is expected as following:

- to consider barriers to post occupancy evaluation across a range of industry representatives
- put forward suggestions as to how these barriers might be overcome
- use the results from a POE as input in the construction briefing process
- In doing so it:
- encouraging the facilities managers improved use of feedback
- presents a way of measure building performance goals adjusted to a Swedish context
- presents barriers to POE as perceived by clients, facilities manager, designers, contractual bodies and POE activists and describes the perceived benefits of POE
- makes suggestion as to a way forward that might overcome the perceived barriers, including alternative means of dispute resolution - encouraging post occupancy evaluation
- outlines POE services offered for facilities manager as an aid for them to identify the purpose of an evaluation before selecting a suitable method.

In terms of the interaction between clients and users it is often suggested that the greatest improvement would come through the provision of systemised feedback and in instituting post-occupancy evaluation. It is unrealistic to expect buildings to operate perfectly at handover, some degree of post handover tuning are essential. In response to Rethinking Construction [2], The British RIBA Practice Services proposed a move towards making POE a standard service. This project will survey the Swedish conditions for such an approach and the conditions for the facilities managers taking a more offensive part in the evaluations process.

2. Post- Occupancy Evaluation and Value Management

Post-occupancy evaluation (POE) is the process of evaluating buildings in a systematic and rigorous manner after they have been built and occupied for some time - a definition of post-occupancy evaluation offered by Preiser et al. [3]; [4]. The evolution of POE begins with unique case studies in the late 1960s and continues to system wide and cross-sectional evaluations in the 1970s and 1980s. These assessments focused mainly on the performance of buildings. Now days' building performance evaluation (BPE) and universal design evaluation (UDE) stress a more holistic, process-oriented approach to evaluation. Prieser [4] emphasize that this will lead to that not only facilities, but also the forces that shape them (political, economic, social, etc.), are taken into account.

In the future, Prieser [4] expect more process-oriented evaluations to occur, especially in large government and private sector organizations. Ideally, the information gained through POEs is captured in lessons-learned programs and used in the briefing, planning, and design processes for new facilities to build on successes and avoid repeating mistakes. Consequently, POE is not the end phase of a building project; rather, it is an integral part of the entire building delivery process. It is also part of a process in which a POE expert draws on available knowledge, techniques, and instruments in order to predict a building's likely performance over a period of time. In this sense, a process is understood as a bounded group of interrelated work activities providing output of a greater value than the inputs by means of one or more evaluations.

The concept evaluation include value, thus, occupant evaluations must state explicitly whose values are referred to in a given case. An evaluation must also state whose values are used as the context within which performance will be tested. This research and development project focuses on the values behind the goals and objectives of those who wish their buildings to be evaluated, in addition to those who carry out the evaluation. Value, in its relevant sense, describes benefits to the client and can be quantified in business terms; for example, value describes the improvements patients experience during treatment, or the value an employer or an employee receives from creating a better working environment. Kelly et al. [5] define value from the client's point of view as a relationship between cost, time, and quality where quality includes esteem, exchange, and use. Furthermore, Kelly et al. [5] defines a value system as the representation, at a fixed point in time, of a discrete range of variables against which all decisions affecting the core business or a project can be audited. The variables are determined by time, cost, and quality. Value Management (VM) is a planned, multidisciplinary group decision-making process that supports the improvement of the value of a project, process, or product in a manner consistent with the business goals of the stakeholders and customers [6]. While this often leads to cost savings, more importantly it provides the best outcome for a project by considering a variety of evaluation criteria. These assessment criteria are most useful in POE:s and help clients, facilities managers and other stakeholders identify a desirable building project

The understanding and fulfilment of requirements is also closely related to the concept of quality, which is a measure of the extent to which requirements and expectations are satisfied in relation to their own set of values [7].However, this research project focus on the construction client as one major stakeholder for such an evaluation and the Facility Manager as the adviser in quality evaluation matters.

2.1 Experience from Existing POE Methods

From current research and practice [4]; [5] certain types, or levels of effort of POEs can be identified. For example: -indicative, investigative, and diagnostic as well as its different phases – planning, conducting, and applying. These can also be divided in two main categories – user based evaluations or expert based evaluations. The facilities manager role is to be familiar with the different types of POE:s and recommend whether more or less expert-oriented methods is needed. Hence, qualified evaluators usually carry out the process and users contribute at the request of the evaluators. The facilities manager is thus assumed take responsibility of the planning, preparation, selection of interests groups, as well as review of the evaluation.

Within the limitations of this paper, it is not possible to completely describe the different POE types. However, this paper would not be comprehensive without concise accounts of these types.

Indicative POEs give a hint of the most important strength or success as well as weaknesses or failures of a building overall performance. Data collection is made fast and easily available. Indicative POE:s usually consist of selected interviews with well-informed staff members, as well as a subsequent walk-through evaluation of the facility. The typical outcome is understanding of issues in building performance and recommendations presented in a short report.

Investigative POEs go into more depth, often as a second stage after that a problem has been identified during an indicative POE. This level of evaluation relays of a more sophisticated data collection such as for example comparison with reference buildings as one way to identify the reason to problems. Evaluation criteria can also be found in the functional briefs, or have to be assembled from guidelines, performance standards, or available literature on the specific building type. The result from an investigative POE is presented in a report and gives a more thorough understanding of the foundation and matters in building performance together with plans for action.

Diagnostic POEs contains of a multi–method strategy, counting questionnaires, surveys, observations and physical measurements by the intention to compare physical environmental measures with subjective occupant measures. The outcome is usually long-term oriented as the results after several months of assessment generate new knowledge about the performance of the specific building as more general aspects of the whole category of that particular building type.

For each level of POE there are tree phases - planning, conducting, and report of findings. In this R & D project the facilities manager is suggested to take the responsibility for the planning phase and preparations of the POE project. One assumption is that the facilities manager should be able to identify the purpose of the evaluation and after that select an appropriate level of conducting the POE. This assignment includes investigation and feasibility, resource planning, and in case of need even research planning together with qualified evaluators. The facilities manager is thereby responsible for that the constraints for the POE project are well-known by the participants. The facilities manager is also responsible for the schedule, costs, and skills needed. When the evaluation is completed the facilities manager should report the findings in a proper way to staff members as well as to the facilities department as an outlook for future action.

3. POE for Construction Clients and Facilities Manager

In much of the recent debate on the construction industry, construction clients are pointed to as the major steering force for directing the construction processes and results [8];[9]; [10]; [11]. The construction client is also responsible for ensuring that wishes and preferences of the end user are met and that all laws and regulations are complied with. A construction client is a person or organisation that contracts the construction of an object (a building, road, bridge, facility) [12] either for their own use or someone else's. The construction client may be the real estate owner or the one who orders the proposed construction. Sometimes, but not always, the client is also the user of the building. Regardless, the construction client often represents many different interests in terms of required services, functions, designs and interpretation aspects. This is a function that represents the owner's interests, perhaps even representatives of the client, the end-user, the operations that will use the facilities and different groups and organisations that in one way or another are influenced by the proposed planning, production, operation, and/or demolition process.

The basis for being able to satisfy the needs of the client, however, is a good understanding of the client's situation, which demands effective means of working within the construction and management processes [13]. Large client organisations who procure new buildings on a regular basis, the maximum value only can be achieved if it is used in conjunction with an ongoing commitment to post-occupancy evaluation. Construction briefing and POE:s is seen to provide the means of ensuring that an individual building design satisfies an organisation's strategic property needs. However, it is also necessary to recognise that an organisation's strategic property needs will continually be in a state of change. As the Facility Manager have the responsibility to strategic planning, aligned to business needs and demonstrating contribution to archiving explicit business needs this acquire effective change management in combinations with evaluations skills. Consequently, economic and functional under-performance can only be avoided by regular performance evaluations of existing facilities in accordance with changing requirements [14].

4. Systematic Feedback to Improve the Briefing Process

The less well exploited opportunities for improving performance, reducing costs and abortive design time lie in the rationalisation of the client's briefing and evaluation process. The major focus has been on improving the construction design and delivery with much less concern for achieving gains by rationalising the client briefing and evaluation. The improvement of the client briefing and evaluation process by systematising the gathering and application of feedback from completed projects to improve the construction industry productivity, building performance and user satisfaction.

This R & D project will encouraging the improved use of feedback particularly for clients with continuous building programmes that will facilitate the prescription of tried and tested solutions yet allow and encourage value-adding innovation in a controlled manner.

5. Preliminary Findings – Feasibility Study

In order to understand the problems and barriers to POE:s one initial feasibility study were carried out. This investigation includes literature studies and a workshop with the industrial partners. The findings from literature studies regarding the use of post occupancy evaluations and the tools utilise will be combined in order to provide a deeper understanding of the mechanisms that are fundamental for minimising the barriers of innovative post occupancy evaluations. The workshop provided some preliminary findings that are to be compared with the outcome from future following interviews, a comprehensive questionnaire and deeper analysis of the literature study.

Preliminary results indicate that:

- There is a call for for checking that the desired objectives are met. The industrial partners' claims that thorough requirements are not met in the final product too often. However, the partners neither conduct nor have appropriate verification methods for assessing the desired performance of given building properties.
- The partners wish to ensure that the desired performance targets will be fulfilled. And if this is not possible, they want to know this beforehand. There is a call for early and continuous verification to take place in the design process and not only as a post occupancy evaluation.
- Expectations, goals, and objectives for the evaluation program are to be stressed. The focus of the evaluation /POE information-gathering process has to be more expressed towards respondents.
- There is a wish for feeding back the results of a POE to building practice, enable or constraining the performance approach and its benefits. Information gathered through evaluations/POEs should be tied into feedback loops for planning, briefing, and capital asset management.

- The partners seek for arguments, criteria and driving factors for establishing whether an evaluation should be conducted or not - with the intentions to empower the facilities manager.
- The facilities manager has an important role in being familiar with different types of POE:s and recommend whether more or less expert-oriented methods is needed. The facilities manager is also assumed to take control of the planning, preparation, selection of interests groups, as well as review of the evaluation.

The next steps in the process are as follows:

1. Start-up (October 2004 – mars 2005): A feasibility study in the form of studying the participating partners POE tools, perspective and other background material. Planning of the following empirical study, and the formulation of questions for the interviews and questionnaires. Contact with key persons within selected construction client organisations.

2. Data collection and theoretical analysis: Data collection, retrospectively by a detailed evaluation of a selection of the industrial partners recently completed new- build and refurbishment projects. The carrying out of the first series of interviews based on the selection strategy from the feasibility study. Preliminary analysis. Interim presentation in the form of POE-seminars. The formulation of questions for follow-up questionnaires.

3. Continued data collection and theoretical analysis: Follow-up interviews and implementation of questionnaire study. Continued processing and analysis of the case-study data gathered in. Workshop techniques with the industrial partners and members of specialist occupier-focused organisations with various backgrounds such as health, education, academic institutions, housing, and others.

4. Analysis of data and final report (June 2006): The final report, a national implemental POE tool and efforts to spread the findings of the project. Opportunities for improvement developed through workshops into a generic briefing and evaluation framework appropriate for organisations with continuous building programmes.

6. Conclusions

In the framework of this R&D project the participants have stated that the assignment for the future work is to:

- focus on tools and techniques for management of requirements throughout the entire construction and design development process by making available internationally based briefing and evaluation support methodologies, tools and concepts through research, management, execution and dissemination.

That is the goal we are pursuing for and it goes beyond merely establishing a set of evaluations tools. As presented earlier in this paper there are already progresses in parts of the briefing process but big gaps still exist in the evaluation process to really enable the mission statement to be realised.

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A Simple Reliability Analysis of Essential Services in a Building

Timothy Michael Lewis
Department of Civil and Environmental Engineering, The University of the West Indies,
St Augustine, Trinidad & Tobago, W.I. (Email: tmlewis@eng.uwi.tt)

Abstract

In a hot tropical climate it is important to have building services functioning in such a way as to provide a suitable level of functionality and comfort for the normal use of that structure. A fairly modern university building in which high levels of sustained concentration are expected to be maintained needs certain basic standards of service, such as those of lighting, ambient temperature and availability of water for drinking, washing and waste disposal. A study was undertaken of a particular building of this description that has suffered from fairly regular interruptions in service ever since it was completed. A study was undertaken to record the interruptions to services to the building during the year 1999, and a simple reliability analysis suggests that the level of service was below what should be considered acceptable.

Keywords: essential services, electricity, air-conditioning, water, probability.

1. Introduction

When a building is being designed and constructed one of the key parameters that must be taken into account is the functionality and comfort for the normal use of that structure. The building's performance when in use can be affected by its design, its construction, its maintenance and by factors that are external to the building. The ideal is to provide a building that is comfortable, efficient, safe, healthy and durable. The recent focus on 'sick buildings' in various parts of the world has also brought home the economic impact of malfunctioning building systems in terms of the human costs incurred. The huge increases in energy costs have also alerted building designers and users to the importance of energy in the life-cycle costs of buildings, and increasing general awareness of the issues related to global warming and sustainability have also served to change the focus of building system design.

In a tropical climate, as exists in Trinidad & Tobago, design practices nowadays take into account most of these factors, however, the University of the West Indies has a significant legacy of buildings completed more than a decade ago in which the design parameters were less far sighted. There are also differences between building designed and constructed in the optimism of boom periods, and those constructed during the pessimism of a slump. In the former case, for example, less attention was paid to sustainability and life cycle cost issues than in the latter. This has had far reaching implications for the long-term facility management of these buildings.

Little systematic research has been done into the performance of the buildings within the University Campus so a start has been made into the recording of the breakdown of the systems in place in order to establish the sacle of the problem, and then to diagnose, explain and attemp to provide solvutions to the failings identified.

2. The Building Systems

In a tropical climate the design of buildings for comfort must address, particularly, the flow of heat from outside, as well as disposal of the heat build up from occupants and appliances inside the building. In old-fashioned structures the design encouraged cross ventilation using the tendency for heat to rise as well as the natural wind patterns to keep the internal spaces cool. Very modern buildings use photo-voltaics and solar energy and limited air conditioning to assist nature. However, buildings designed and constructed during the boom years of the late 1970s and early 1980s in Trinidad & Tobago, made no such concessions. Although the standards and regulations regarding what are considered essential building services have not changed significantly, the approach adopted by most architects has. The result has been that a number of the buildings of that period have proved to be problematic in operation, and have had to be retrofitted with systems designed to improve their performance. This is not to say that the buildings were badly designed for the time when they were designed. They were well designed given the knowledge and objectives of the period, however, things have changed since the building was completed. [1]

As an example, the building in question was designed as a solid, box-shaped, mass-concrete structure, in which the separate rooms and offices needed to be air-conditioned. The system chosen was a water-cooled system, with fan-based blowers in each room. It was also designed on the premise that it was cheaper to leave the lights on inside the building permanently than to install switches and allow occupants to turn lights on and off. The reduced wear and tear on bulbs and the saved expense of installing wiring and switches was felt to more than offset the cost of electricity being wasted in empty rooms. In addition there was the benefit of the aesthetic cleanliness of walls without wires and switches. As time has passed, the logic behind these choices has become suspect.

The key services to this structure are those that make it usable in the most basic sense. Because of the building's configuration and structure, it experiences significant heat gain during the day and because the building is designed to be closed up (i.e. the doors have return springs to close a door after it has been opened) it has very little natural ventilation. As a result air conditioning is essential – all the more so in rooms like lecture theatres where relatively large numbers of people gather for extended period, and computer laboratories where the equipment generates significant heat. Because the air conditioning is water based, it is necessary to have water to feed the system, and electricity to activate the blowers. In a building in which staff and students need to be able to read and write documents of various kinds it is obviously necessary to have adequate lighting, which again requires electricity. Similarly in a large public building where people will be spending a major part of the day it is necessary to have water available for drinking, washing and the flushing of toilets. The lack of water for air conditioning also signals a lack of water for fire fighting, and this threatens security as well as comfort levels. Thus, if any one of these three services (air conditioning, electricity and water supply) is unavailable the building becomes very un-user-friendly.

3. System Reliability

Reliability is a broad term that focuses on the ability of a product to perform its intended function. Mathematically speaking, assuming that an item is performing its intended function at time equals zero, reliability can be defined as the probability that an item will continue to perform its intended function without failure for a specified period of time under stated conditions. [2]

Engineers undertake reliability analysis in order to measure and predict the reliability of mechanical or electrical components and systems. Measurement is based around the occurrence of failures, and analysis depends largely on statistical probabilities. The probability of the survival times for components and systems can be used to help predict their life expectancies. The more complex the set of components and their interdependencies that maintain a system in effective operation, the less reliable that system becomes. When that system is one on which our comfort and convenience depend then it is unfortunate when it breaks down; when it is one in which failure can be life-threatening then it is critical.

A simple measure of reliability can be obtained in terms of the proportion of the actual recorded observations relative to the total instances on which an observation could be made. This can be represented in one of two ways, as shown in equations (1) and (2):

$$\text{Reliability} = \sigma_{\text{(actual measure)}}/\sigma_{\text{(total possible observations}} \qquad (1)$$

$$\text{Reliability} = \sigma^2_{\text{(actual measure)}} / \sigma^2_{\text{(total possible observations)}} \qquad (2)$$

In the case of equation (1) the reliability is measured as a simple ratio of the number of occasions when a service is not available to the total number of occasions when it could be available[1], and

[1] What we are doing here is to use a raw count of occasions when a service has been unavailable in order to determine its frequency – and hence the relaibility of the system. In the example of the air conditioning there were 105 days on which the service was out of action out of a total of 250 possible days, so the

where a system involves a number of independent processes working together, identified as σ_1, σ_2, σ_3 for example, the value of the reliability index is derived as the multiple of the separate ratios, hence:

$$\text{Reliability} = (\sigma_1/\sigma)(\sigma_2/\sigma)(\sigma_3/\sigma) \qquad (3)$$

In the case of equation (2) the total system reliability is given by the sum of the individual measures, and because we are not dealing with variances here, the use of standard deviations is not really appropriate. However, the strength of the relationship between two states is sometimes expressed by squaring a measure of their interaction (the correlation coefficient) and multiplying by 100[2], it may be acceptable to measure the overall reliability of a system by squaring the reliability index for each parameter affecting the system and adding these values. The reason why squaring the index may be appropriate is a result of the way in which correlation is defined, hence

$$\text{Reliability} = (\sigma_1/\sigma)^2 + (\sigma_2/\sigma)^2 + (\sigma_3/\sigma)^2 \qquad (4)$$

There are much more complex models of reliability available based on such measures as the mean time between failures (MTBF) for example, however, given the coarseness of the data acquired for this study, the equations here are more than adequate. The reliability values obtained from these two simple models are compared to see what difference in reliability is indicated.

4. The study

The building used in this brief study was the civil engineering building, known as Block 2 at The University of the West Indies, St. Augustine, Trinidad & Tobago for the year 1999. The basic methodology was to keep a daily record in a desk diary of the occasions on which any or all of the specified services were non-functional. Because of the coarseness of the raw data, the lack of explanation for the events causing loss of service and the preliminary nature of the study, no detailed statistical analysis has been undertaken. All that has been done is to calculate the values of two alternative 'reliability indices' that can indicate the overall system reliability - where:

$P(x)$ = Probability of an event x

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measure of reliability is that on 42% of working days, there was no a/c. This approach is used because of the familiarity of the concept of a percent frequency.

[2] The resulting statistic is known as variance explained (or R^2)

A = Air-conditioning malfunction

E = Electricity outage[3]

W = Disruption in water supply

$P(x) \approx$ [(Number of days failure occurred)/(Total number of working days 250)]

$P(A) = 0.42$

$P(E) = 0.04$

$P(W) = 0.27$

Assuming that P(A), P(E) and P(W) are independent processes, the probability that on any given day the three essential services are concurrently **working** is – using equation (3):

$= (1 - 0.42)(1 - 0.04)(1 - 0.27) = 0.58 \times 0.96 \times 0.73 \approx 0.40$

and the probability that on any given day the three essential services are not concurrently working is – using equation (4):

$= (0.42)^2 + (0.04)^2 + (0.27)^2 = .176 + .0016 + .073 \approx 0.25$

Giving a probability that the three essential services are concurrently working on any particular day as around 75%. Instinctively this 'feels' like a more reliable value for the probability of the all the systems working, given the practical experience of the day-to-day serviceability of the building. The value of 40% for the building availability is very low, and although it was a particularly bad year, it seems unlikely in retrospect that it was so bad. It must also be noted that there were breakdowns of various systems that lasted for extended periods, such as several weeks without air conditioning. So the values do not represent discrete occurrences of breakdowns of particular days, but rather an overview of the effect of breakdowns on the system.

It must be said that the 'better' value for the probability of all systems working, of 75%, is not very good, as the failure of any one of these systems is sufficient by itself to make the building virtually uninhabitable. The problems that are responsible for this poor level of reliability are almost entirely extrinsic. The supplies of water and electricity which govern the functioning of the building support systems are public utilities outside the building and the campus, over which nobody within the University has control. However, the choice of a water cooled air conditioning

[3] This does not include voltage surges or short term, transient outages.

system built in an extra mode of failure for this critical system – it fails when there is no current and it fails when there is no water. In addition the choice of a central air conditioning system means that when it is down, none of the building is properly usable. The central system is also running all the time, cooling the building even when it is empty. Although it would have been a larger capital expenditure at the outset, much more flexibility and economy in operation would have been achieved by designing individually controlled air conditioning systems with thermostatic controls that automatically cut off when the temperature reaches its design level.

5. Conclusions

Obviously it is desirable to have a building that is used for University staff and lectures available almost 100% of the time. Thus it is necessary to improve the reliability index of the building's availability from its current value of around 75% up to around 100% by improving the systems that cause it to be unavailable. There are various techniques available to help identify problems and solutions including Fault Tree analysis and Failure Mode and Effects Analysis. These techniques can highlight the effects of failures in elements of the design in order to help find ways to reduce the probability of a loss of service occurring.

An economic cost-benefit analysis can help to identify which amongst the technically feasible solutions are economically feasible as well. Given the change in the economic parameters that exist nowadays compared with those that existed when the building was designed and constructed, it is almost certain that the support systems are not optimized for today's market. Given also the failure of those systems to provide a sufficiently reliable building in terms of its availability, then there is a clear need for a review of its critical design characteristics. The two key elements are electricity and water, and if the supply provided by the public utilities is inadequate, then the building systems need to be designed to take this into account. Depending on the cost functions, this may mean either building storage for sufficient water and installing stand by generating capabilities or redesigning the systems to operate differently.

It also seems likely that the economic efficiency of the system is now poor given that there is a lot of waste of energy through air conditioning and lighting that is not turned off when rooms are not occupied. Although this does not show up in the analysis carried out for this study, it is an observation that is hard to avoid.

6. Acknowledgement

I should like to express my gratitude to my colleague Dr Gyan Shrivastava[4] who kept the detailed records of the availability of services in this building, on which this commentary was based

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[4] Senior Lecturer, Department of Civil and Environmental Engineering, The University of the West Indies, St Augustine, Trinidad & Tobago, W.I. (Email gyans@eng.uwi.tt)

Demonstrating the Added Business Value - Appraisal of Tools and Methods

Riikka Huovala
DEGW. Workplace strategies (rhuovala@dewg.com)
Keith Alexander
University of Salford. Department of Construction and Property Management
(K.Alexander@salford.ac.uk)

*This paper reports findings from Masters of Philosophy thesis completed whilst working in Centre for Facilities Management, School of Construction and Property Management, Salford University. Subsequent to this work, the author is currently working in DEGW, London.

Abstract

This paper is concerned with the appraisal of current workplace performance measurement tools and methods, and identifying flawed understanding within them to distinguish how they could be further developed to enable better demonstration of added business value through workplaces. Thus this paper presents an exploratory framework (rather than a review of previous work) for those facilities/workplace managers as well as academics and consultants who are keen to develop business oriented workplace performance measurement tools.

Practice-initiated problems have been used as a basis for this research, representing a timely, real world, enquiry. The aim of the research was to reflect on and critically appraise the current tools and methods documented in literature and used in practice - 14 varying tools were identified and examined. The setting of logical and comprehensive criteria for the critical appraisal became a fundamental challenge -better understanding of different approaches to workplace performance measurement was needed. This was achieved through a parallel review of the Centre for Facilities Management's case study database and through a literature review. Further interviews were also carried out with the FM practitioners to confirm the findings and to better understand their practice of workplace performance measurement.

Gap analysis of the identified methods and tools, and the proposed criteria was undertaken. It was recognised that these tools and methods place little emphasis on supporting the continuous change within organisations and that an understanding of people activities, such as communication and team interaction, was under developed. Paper concludes with recommendations for further development for workplace performance measurement tools and methods.

Keywords: workplace performance, tools/methods, Facilities Management, usability

1. INTRODUCTION

The competitive market has pressured companies to produce more, to a better quality, in less time with fewer resources, hence the drive to increase business productivity and cut costs. At the same time the nature of work is becoming less tangible and the employees are increasingly considered as the most valuable resource of an organisation. One consequence of this is that the relationship between an organisation's measured resources and its market success has become tenuous[1]. This leaves organisations in a situation where core competencies, such as the ability of employees and teams cannot be tangibly measured and listed on balance sheets. Nevertheless, the traditional approach to increase productivity has been to reduce costs and especially costs not directly involved in creating tangible value are usually the first ones to be scrutinized [2]. In the field of facilities management this has meant that the need to demonstrate the contribution made to improve productivity has intensified. Nutt et al.[3], for example, suggests that two of the key questions for the future of FM includes how to create, quantify and demonstrate linkages between FM and business, and how to assess and measure the contribution of FM to improving business productivity. One fundamental attempt to illustrate this contribution has been directed toward high performance workplaces – and the demonstration of the business value through workplaces. This has meant that facilities managers and other related disciplines have to go beyond the traditional methods of controlling costs and maximising the value of the built assets by utilising space, by placing more emphasis on the impact workplaces can have on the performance of the people.

Similarly, in addition to the general discussion in the field, the practitioner-led Facilities Management Forum (facilitated by Centre for Facilities Management and led-by senior managers of large UK/global organisations[i]) initiated, in 2002, a research enquiry to gain more knowledge about workplace performance measurement and associated tools to provide a framework for the demonstration of the business value. The Forum group agreed that [4]:

1. *The FM practice suffers from an over-emphasis on cost reduction, which limits the ability to demonstrate potential workplace improvements due to the insufficient evidence of the value these would add to the business.*
2. *They also suggested that 'one reason for this is a lack of workplace performance measurement knowledge' as the measurement of workplace outputs has until recently been largely non-existent*
3. *Those measurements being developed focus on the efficiency in Facilities Management processes (such as cost against cleaning process), rather than the development of effectiveness measures (such as contribution of clean buildings to the reduction of sickness and absenteeism), which would create a link between Facilities Management input and output and would be seen as a contribution of FM to the core business.*

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[i] The CFM forums facilitate the open exchange of facilities management best practice and provide structures for a non-competitive environment to debate common issues, concerns and market trends. The CFM forums work on an action research basis (as defined in Alexander *et al* 2003) and therefore the main principle in the collaboration is to narrow down the research interests through the activities and interests of the participating organisations. Forums operate in two ways. In the first instance, there are workshops, which encompass discussion and debate about topical FM issues, with guest speakers from within and outside the industry driving forward the discussion themes in a bid for breakthrough solutions. In the second instance, forums generate long-term research projects.

4. *Further it was identified that there is a lack of qualitative measures. It was suggested that metrics that fail to measure quantitative and qualitative performance outcomes may depict an inaccurate picture of what really happens in the organisation.*

From these issues the practical enquiry (as used in the forum) was formed: ***How to demonstrate the business value of improved workplace performance?*** This enquiry motivated the authors to carry out further investigation, with more theoretical rigour, to run parallel and subsequently to the implementation of a workplace performance framework developed for this forum activity. It was believed that a more thorough understanding than was possible to be gained within the business timescales was needed and therefore the practical enquiry was lifted from the forum for the purposes of theoretical reflection.

Subsequent interviews with the practitioners within the six case study organisations further validated the forum enquiry. The following statements were recorded when senior managers were asked about their concerns associated with workplace performance measurement :

- *'The facilities management calls for a means of collecting 'soft' data to support better management decisions.'What should Central Services do in order to reflect the corporate value in physical workplaces?*
- *'What would the appropriate tools for measuring the performance of FM be that go beyond the focus on 'cost per' and are valued by the business?'*
- *'How can we implement flexible workplace concepts to meet business needs in terms of trust (related to staff absence), communication between managers and employees and team working to support off-site working?'*
- *'How to improve the employee's working environment to enhance performance?'*
- *'How to measure office effectiveness and to demonstrate that certain layouts have increased input?'*
- *'How frequently workplace performance should be measured?'*

In this context, these practical enquiries were expanded upon to define research questions and the scope. The following questions were created:

1. *What requirements can be identified in literature and in practice for the measurement of workplace performance to enable the demonstration of the value of the workplace to business?*
2. *What tools and methods that aim to demonstrate value are currently documented in literature and used in practice and what do they actually measure?*
3. *How do these tools meet the set theoretical and practical requirements identified?*

The paper first describes a research process, emphasising a practice-led research approach. In turn, this is followed by three sections, each providing identified answers to the three research questions presented above.

2. RESEARCH PROCESS / METHODOLOGY

2.1 Practice-led research

Instead of following the conventional approach of identifying research problems through an extensive literature review and aiming to find answers to these (theoretical) problems through investigations within practice, this research emphasises the importance of defining the research topics through understanding the practical enquiries in the field (of FM). Thus, the participation of practitioners is fundamental to the usefulness of the research undertaken, as they contribute to the research process and the monitoring of the relevancy of research to practice. The importance of involving practitioners in the defining of a problem has been emphasised [5,6,7,8]. Lawler [5] states that: '*clearly the researcher ought to offer expertise about theory, past research, and methodology, but needs to rely on the members of the organisation to provide expertise about the practise. For this to happen, the practitioner has to be involved in the study at a more than superficial level and, indeed, has to influence both the kind of topic studied and methods used*. It has also been recognised that the thorough knowledge of prior research is very important, it is very rare for good research ideas to be derived directly from literature [6].

2.2 Research process

The practice-led research process and methods used are presented in the Figure 1. The research questions (as presented above) were narrowed down through a content analysis of the problem defining process of a FM practitioner-led research forum and through an initial literature review. As the setting of logical and comprehensive criteria for the critical appraisal became a fundamental challenge - a better understanding of different approaches to workplace performance measurement was needed. This was achieved through a parallel review of the Centre for Facilities Management's case study database and through a literature review. Further interviews were also carried out with the FM practitioners of the research forum, but also with other case study organisations (to gain a broader view) to confirm the findings and to better understand their practice of workplace performance measurement (six case studies).

As a result, exploratory criteria were developed and further examined. Parallel to the case study investigations, eight workplace performance measurement tools/methods were identified within literature. A gap analysis was carried out to define how the tools used in practice and identified in literature met the created criteria for workplace performance evaluation, providing suggestions for the further development of measurement tools.

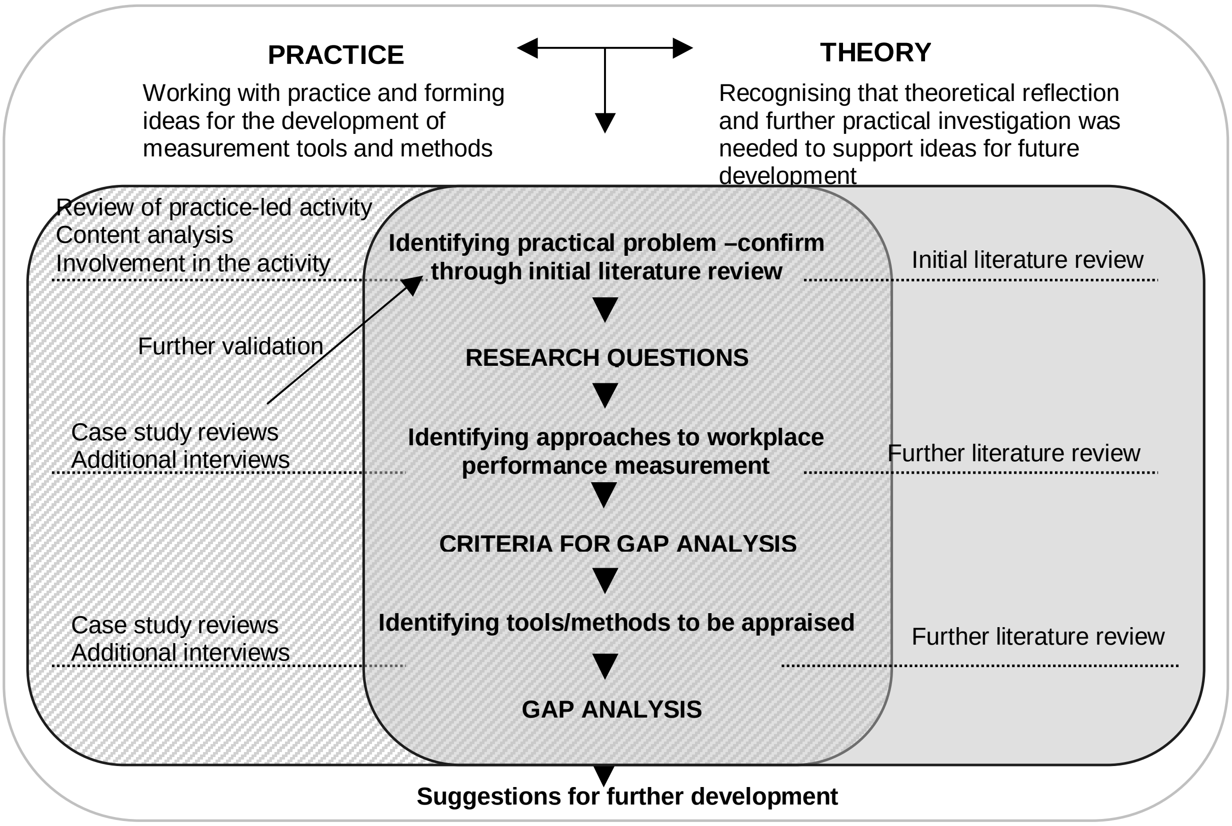

Figure 1: Parallel research process of practical and theoretical reflections

3. WORKPLACE PERFORMANCE MEASUREMENT

Research Question 1*: What approaches/ requirements can be identified in literature and in practice for the measurement of workplace performance to enable the demonstration of the value of the workplace to business?*

As the authors' aim was to define what is meant by workplace performance and what elements it consists of (to better understand what should be measured) different definitions, and practical examples were initially examined. It was recognized, as the nature of practical enquiry demonstrated, that amongst practitioners there was a clear lack of definitions for workplace performance. Instead, it became more relevant to understand what was driving measurement in the case study organisations. The following drivers for practice approaches were provided:

- Need to develop other means of collecting 'soft' data to **support better management decisions**.
- The results need to be transferable into reasonable indicators to **feedforward** to probability cash flow

- **Identifying spatial needs -** focus on collecting information concerning work functions- what facilities are used and when.
- Collecting information on the **current situation -** to understand where the company is now and **what should be improved**
- Providing a further benefit of data collection as to **illustrate change** (improvements) over time.
- **Identifying the major issues** relating to the ways of working
- External benchmarking comparisons are seen as a useful **reassurance** that the service is competitive/effective compared with other market benchmarks.

These identified, practical, purposes for measurement reflect on literature. Nani et al [9] see performance measurement as a means of monitoring and maintaining organisational control to ensure that strategies that lead to the achievement of overall goals and objectives are pursued. The purpose of performance measurement is also to clarify *organisational success* and to *inform and guide change* (continuous, improvemental and emergent change and discontinuous change) [10]. It is also proposed that applying disciplines of performance measurement helps to *determine the crucial success factors* for the overall organisation as well as for the delivery of the specific function or operation concerned [11]. Performance measurement is used for purposes of *problem finding and solving*, and it therefore supports efficient decision-making. It also helps to *identify the success of improvements*, determine whether the *customers' requirements are met* and where *improvements* are needed. Further, measurement helps in the understanding of *processes* (in terms of confirming what is known or revealing new) and to *ensure decisions are based on fact* [12,13].

However, even though the drivers were clear, it was recognized that in literature there are numerous different approaches to defining workplace performance, also the terminology was perceived to be inconsistent. Examples of the used terms are: building performance, office productivity, workplace functionality, office environment and facility performance. Therefore, an initial attempt to define the criteria for the evaluation transpired to be complex, and instead, the overall understanding of the approaches was to be achieved through experimenting, at a more general level, different dimensions of measurement. As a result, four different approaches were identified. The distinct division between these approaches was the point of focus on either improving a product or a process. Similarly it was recognised that there was a division between measuring to gain benefit for construction industry and measuring to gain benefit for business itself. These approaches are demonstrated in Figure 2.

Approach 1: Construction Product

It was identified that one approach to workplace evaluation was to evaluate a building. In these cases literature often refers to a building's capability to meet the mandates and health and safety regulations. An approach of this kind is perceived to focus on the physical (tangible) elements that are valued from a quantitative perspective rather than a qualitative one. Also, the efficiency of different elements of the building (products) is assessed rather than the effects of them (on business process). Findings from these kind of approaches are often fed back to the construction industry to reflect on the failures within the building [14].

Approach 2: Construction process

Similarly, the construction industry benefits from evaluating the physical product, and failures within, by reflecting the results on the construction process and how the briefing or management of the process, for example, could be improved.

Approach 3: Product for Business

The focus in this approach is perceived to be on the workplace environment and people (occupiers') perceptions are considered as an integral part of the evaluation. However, people are only considered from a physical well-being point of view and better performance is to be achieved through a well functioning building (air-condition, ventilation, operable windows etc.). Similarly, a well-functioning building is a target when evaluating functionality. Nevertheless, not only the relationship between the physical environment and the individual is considered, but also the fitness (of workplace) for purpose from an organisational point of view is reflected on. Functionality is achieved if the original brief has been met or the objectives of the accommodation plan have been attained [15]. In this instance, also qualitative (subjective) issues are considered (fit for purpose, flexibility etc.).

Approach 4: Business Process

Originating from the product design/software industry, it is proposed that more focus should be placed on people activity. Furthermore, emphasis should also be placed on social and cognitive aspects rather than considering people only from a physical/ mechanical point of view - 'repertoire of action and potential to break down' [16]. Characters of measurement associated with this approach should focus on the users: ease of use, usefulness, user-friendly etc. Usability in the product and software industries is widely accepted as a critical element for a product to be successful.

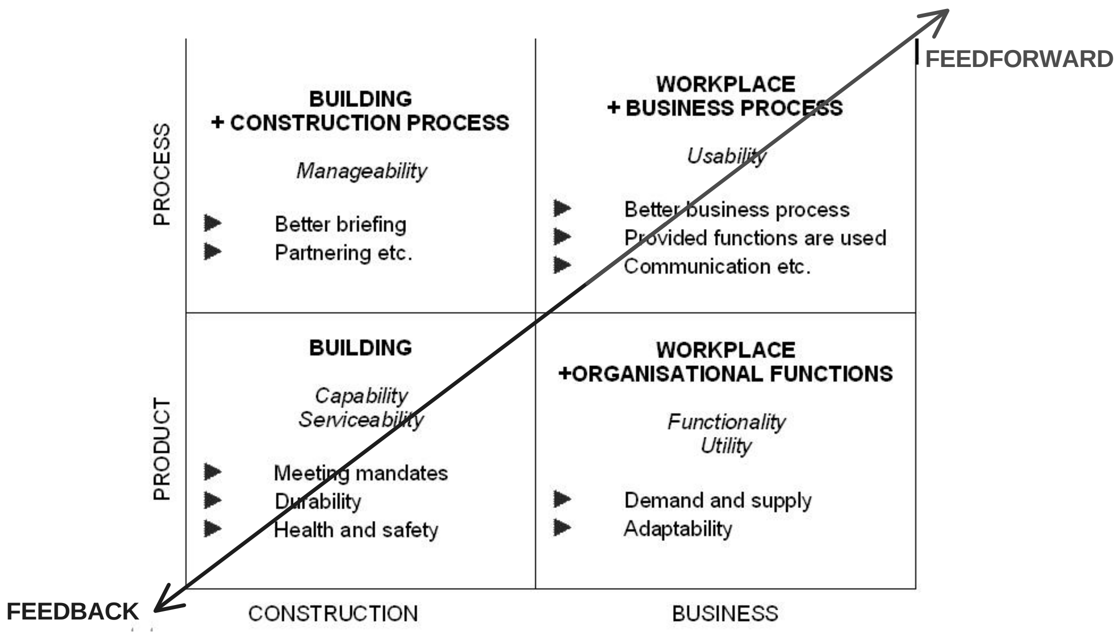

Figure 2: Approaches to workplace performance measurement

Feedback- Feedforward

It is also proposed that there is a fifth dimension to the approaches presented above: By evaluating the usefulness (of provided functionality) as in the approach 4, the knowledge gained is specific to that organisation and thus the nature of the feedback is to feed it forward to the development of processes and strategies within that organisation. Conversely, the assessment of the building from the physical point of view (approach 1) tends to provide feedback that is most useful for the construction industry. Thus, more focus should be placed on identifying how the business could benefit from evaluating the different elements of a workplace. Whereas assessing functionality aims at improving the physical product (workplace), usability aims at improving the business processes through better understanding them and through evaluating how the provided functions are actually used. It is proposed that the latter approach (Business process / usability) is seen to benefit the organisation the most as the results of workplace performance measurement can be fed forward to the future management of the workplace.

4. WORKPLACE PERFORMANCE MEASUREMENT TOOLS

Research Question 2*: What tools and methods that aim to demonstrate value are currently documented in literature and used in practice and what do they actually measure?*

To provide a context to the gap analysis, an overview of different approaches to workplace performance measurement within the six case study organisations and eight identified measurement tools/methods[ii] documented in literature is to be provided. The tools and methods used in the case study companies are first discussed. An overall comparison of the identified approaches is discussed in the next section.

4.1 Tools/methods in practice

All of the case study organisations had some means of monitoring workplace performance - most commonly: meetings with business units, monitoring of occupancy costs and utilisation of space studies. Occupant surveys and similarly Post Occupancy Evaluations (POE) type of surveys had usually been undertaken only once. Table 1 summarises six approaches that were considered as tools/methods.

[ii] The term 'tool' in this study is referred as to a research/data collection tool/method rather than, what could be perceived as, a verified measurement tool. The selected *tools* for the appraisal include various research tools/methods under development, but also more verified tools (mainly used in consultancy) are taken under examination. Common to these is a questionnaire-based approach to evaluation.

Table 1: Summary of the approaches to measurement in practice (case studies)

Method/tools	**Approach**
Time utilisation studies	Focus is on meeting the business needs to reduce costs (A, E, F).
Satisfaction survey	Focus on getting feedback on physical elements of the building and the service delivery (F)
Workplace performance survey	Focus on defining what aspects within the (physical) workplace and support services hinder task completion. (A,B,C)
POE	Focus on reviewing whether mechanical systems work in the new building. (A)
	Aim to identify satisfaction with environmental conditions and physical elements of space – whether workplace meets the expectations. (B,C)
	Aiming to understand how the space support business aims and objectives and functional requirements (F)
Communication network analysis	Focus on identifying who communicates with who – how is knowledge distributed and what impact space layouts and workplace improvements have had on communication (F)
Walk-through	Aim to identify what improvements in the management of workplace could be made and if physical changes needed. (D)
	Checking the quality of service delivery. (E, C)

4.2 Tools/methods documented in literature

Eight tools and methods were identified from literature (Table 2). A characteristic common to all of these was the development of performance of workplaces. All of these tools and methods include an occupant questionnaire (mainly targeted at staff, but in some cases at senior management only) and some of them also include specialist observations and measurements of the building and the environmental conditions within. However, the focus is not specifically on a process or method of data collection used, nor placed on the specific questions asked, but in the basic principles of the surveys. This is to better understand what these tools are aiming to measure and whether they meet the criteria identified in literature and in practice (which they were not necessarily developed to meet), and to identify what has already been done and tested and what areas need to be concentrated on in the future development of measurement tools and processes.

Table 2 – Tools under investigation

Tool	Approach
1. Workplace utility survey [17]	To assess usefulness, through defining the difference between the expectations and perceptions of the building's users.
2. User based building performance appraisal survey [13]	Provision of office accommodation design/ quality characteristics (supply) measured against specific property requirements (demand)
3. Hierarchical analysis model (HAM) [18]	To recognize the confrontation between the supply and demand of a set of building attributes, by identifying what kind of activity or organization does the building intend to suit (supply), and what kind of resources, installation or localization must be considered to suit a certain activity or organization (demand).
4. Office Environment Survey – Building Use Studies [19]	To identify positive and negative relationships between indoor environmental factors and human productivity.
5. Building-in-Use Assessment [20]	To determine patterns on comfort and discomfort throughout the building based on users' experiences and perceptions (functional comfort) and to relate this to physical environmental elements (such as floor layout differences, type of workstations etc)
6. Office productivity survey [21]	Matching facilities and building services to the specific business needs of the different departments within the building, through defining downtime factors, satisfaction and self-assessment of productivity. Defining the elements of the physical environment and how they can enhance or hinder performance.
7. The Serviceability Tools & Methods (ST&M)[22]	To specify the performance requirements for facilities, and to measure how well a design proposal, or an existing facility meets those requirements.
8. Workplace innovation Survey [23]	To enable analysis of the impact new workplace environments have on the performance (productivity, quality, flexibility and innovation) of organisations accommodated in these concepts, and to gain insight in the effects of technical, economical, social and organisational developments on the workplace.

5. GAP ANALYSIS

Research question 3*: How do these tools meet the set theoretical and practical requirements identified?*

The gap analysis is formed by evaluating the introduced tools (used in practice and documented in literature) against the proposed criteria (Figure 2). Thus, the provided matrix is updated to illustrate the current and proposed approach to workplace performance measurement through placing the introduced approaches onto this matrix according to the following aspects:

- To what extent have the organisational requirements been considered? Have they been considered from the point of view of space provision (functionality) or from the point of view of the actual support the space provides for business processes (usability)?

- Is the focus on improving the physical elements of the building (capability and functionality), on the process of constructing/ managing the building (manageability), or on improving the business processes (usability)?
- Is the main aim to collect information to feed back to the construction industry on their processes or products, or to feed forward to the business to enable the development of processes and strategies within their workplace provision?

As a result of this exercise, the demonstration of the gap between the current approaches and the proposed approach was enabled, as illustrated in figure 3 (blue circles illustrate the studied approaches and red the proposed target).

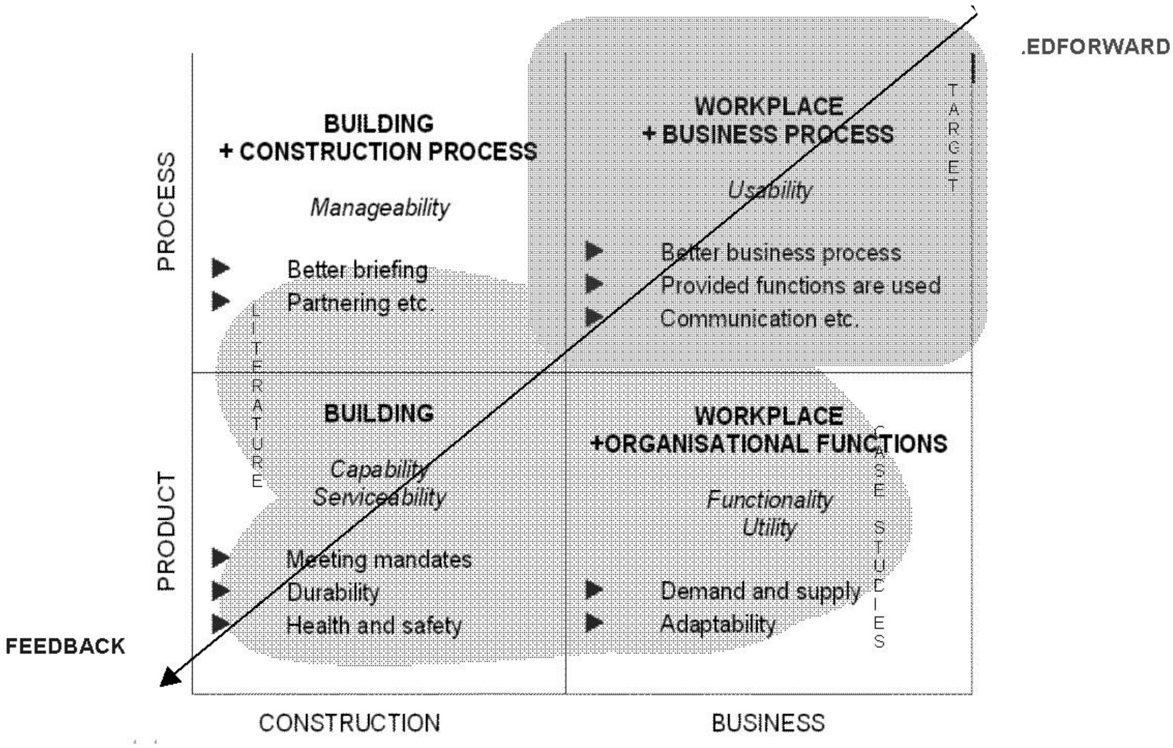

Figure 3: Gap between proposed and identified approaches

Thus it is proposed that there are no appropriate tools and methods identified for demonstrating the business value through workplaces. The following key reasons to justify this emerged:

1) Approaches focus mainly on providing feedback on the qualities of the workplace 'product' for the construction industry, thus little emphasis is placed on collecting information to support the continuous change within organisations (feedforward).
2) Focus is mainly on improving the physical workplace rather than the efficiency of the business processes – measuring the product rather than measuring the *effects* of the product.
3) An understanding of people activities, such as communication and team interaction that support business processes was underdeveloped.
4) The focus was mainly on defining the performance of a physical workplace, rather than the effects this has on the people activities.

6. Conclusions

As it has been emphasised, the workplace performance measurement should, instead of viewing workplaces purely from a functionality point of view (assuming that if the space supports the business functions it is useful), the usefulness of the workplace in use, during the activities, should be evaluated. Usefulness, learnability and ease of use were some of the qualities to be promoted. The aim should be to evaluate the effect of the workplace on the activities. By evaluating the usefulness of functionality, the knowledge gained is specific to that organisation and thus the nature of the feedback is to feed it forward to the development of processes and strategies within that organisation.

It is believed that the selection of tools that were documented in literature is fairly representative within the different UK approaches, but further investigation (prior to this thesis) is needed to confirm this i.e. an up-to-the-minute review of literature and other available material needs to be carried out. The scope could also be extended to an international level to identify whether different approaches have been taken elsewhere, for example, during the course of the study the authors have become aware of US based research that has established links between workplace design and job performance, job satisfaction and communication [24].

Less focus was placed on defining the processes of measurement as to who participates, when they are undertaken, how exactly they are carried out (reliability and thoroughness) and also 'by whom' and 'for whom' they are carried out. The impact of these elements needs to be further investigated.

The timing of the assessments and the replication of these, for example, are important areas of investigation, this, in turn, places importance on both the planning and design processes and on the on-going management processes. This enables the aims businesses set for new workplace settings to be reviewed and whether they have assessed the success of the outcome; but also whether there are/have been assessments of on-going (changing) business aims and any integration of these into the workplace settings.

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Delivery of Council and Community Facilities: Implementing a Stakeholder Process Model

Chris Heywood
Faculty of Architecture, Building and Planning, The University of Melbourne, Australia
(e-mail: c.heywood@pgrad.unimelb.edu.au)
Jim Smith
Faculty of Architecture, Building and Planning, The University of Melbourne, Australia
(e-mail: smithjj@unimelb.edu.au)

Abstract

In this Melbourne local government area the proposed library-community centre was the largest construction project ever attempted by the Council (A$8 million). This project incorporated innovative briefing methods through the use of a performance brief, which was developed and agreed with a range of stakeholders. This work focuses on the interactions, activities and processes following the initial development of the performance brief.

The study examines the processes used by the Council managers as a provider and developer (client) of the facility on behalf of its rate paying public. Recording and analysis of the processes captured the organisational learning that occurred during delivery of the project. The learning outcome is a model for future practice to guide this Council and other similar community based projects.

Research data gathering has included review workshops, interviews with project team members, attendance at consultations with community facility user groups, analysis of Council project documents and other Council documents. Analysis has been by means of a qualitative methodology analysing the textual materials with coding and time-event mapping techniques to identify key events and themes.

The project has provided sound lessons in strategic connectivity with organisational and Council strategies, the inclusion of a range of stakeholder interactions and consultations of real benefit to the value of the project, the use of innovative performance briefing methods and identifying the characteristics of an informed and engaged client. The study synthesises the key aspects of the project into a normative community based project model that represents the lessons learnt in the delivery of this library- community centre.

Keywords: design management, community interaction, project processes.

1. Introduction

The importance of including stakeholders in project processes is being increasingly recognized as important in delivering satisfactory project outcomes (Gray, et al, 1994; Kamara and Anumba, 2001). This is despite Walker's (2002) observation about 'unreliability' in stakeholder assessments across project lives. It is possible that part of this unreliability arises from not adequately engaging with and binding stakeholders into project processes from early stages.

This paper builds on earlier work by one of the authors into processes at project inception (Smith 2002) by examining the implementation of a stakeholder approach throughout pre-construction processes. The project examined is an *Urban Village* Library-Community Centre and originated from an external review by one of the authors of the processes designed and implemented by Council in delivering this important project. The Library-Community Centre is the largest construction project undertaken by this municipality (a middle suburban local government in Melbourne) with construction expected to be completed in mid-2005.

This paper is divided into three major parts as follows:

1. an identification of the most significant processes used in delivering the project including strategic connectivity;
2. an examination of the role of clients in construction projects and how the municipality has acted as a client in this project. This includes consideration of the interactions (including, but not exclusively, consultation) involved in delivery of the project; and
3. the 'Glen Eira Model' of project delivery processes is presented as a model process consolidating the lessons from this project as a guide for future local government facility projects.

2. Data collection and analysis

A variety of data collection methods have been used in the course of these reviews. These include:

- Review Workshop with Council stakeholders in March 2004;
- Interviews with project team members;
- Attendance at consultations with community facility user groups;
- Analysis of Council's project documents;
- Analysis of other Council documents such as Council meeting minutes, and municipal newsletters; and
- Analysis of local newspaper articles.

These data collection methods are in addition to those used by project team members during the project. Analysis has been by means of a qualitative methodology analysing the textual materials using coding techniques to identify key events and themes. Green (1996) describes this methodology as a Naturalistic Enquiry and notes it is overlooked in, yet is of importance to, research in the management of the built environment (in Green's case – construction management, but equally applicable here).

3. Processes to date

The four key processes identified in this review are:

1. **Strategic development** consisting of five strategies – two organisational and three municipal[1].
   a. Organisational – Service delivery (primarily Library, elderly citizens, and child care) and a Corporate Real Estate (CRE) strategy that matches the property portfolio better with organisational strategic aims; and
   b. Municipal:
      i. Local business development through support of threatened sub-regional strip shopping centres (Urban Villages strategy); and
      ii. Strategic Land-use planning (Urban Villages Strategy).
      iii. Community development through renewal of several community support assets.

   The development of the Council's Urban Villages Strategy was conducted in parallel to the development of its Library Strategy.

2. Council stakeholder **Strategic Needs Analysis Workshops** (Smith and Jackson 2000, Smith et al. 2004) in May and August 2000 has had several consequences:
   a. Strategic alignment between facility objectives and Council strategy;
   b. Council stakeholder 'buy-in'; and
   c. The generation of a *Performance Brief* used, in conjunction with an *Indicative Functional Brief*[2] to guide the project and in selection of the project consultant team.

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[1] Municipality is taken as the administrative area and its population, whereas the Organisation is the Council with its governing, administrative, managerial and service delivery functions.

[2] Performance-based briefs are thought to encourage innovative solutions to meet client needs and objectives and are framed as statements of required performance against project outcomes. Performance-based briefs may not contain, for building projects, definitive statements of functions and their requisite areas that are to be included in the building. Such definitiveness is more the domain of Functional Briefs. The use of an indicative functional brief established latitude that required negotiation within the stipulated performance parameters.

The client representatives commend the approach for its ability to negotiate the removal of sectional and political interests and any preoccupation with project minutiae by concentrating on the big 'picture

3. **Project's consultant team selection and appointment** consisting of consultant team Registration of Interest (ROI), short-listing and interview, and inspection of nominated architectural projects prior to final selection. The capacity to conduct community consultations was a key selection criterion.
4. **Consultation** has been a feature of this Library-Community Centre project with several consultative processes, both in the project itself and in the preceding Urban Villages Strategy which provided the siting rationale. Consultation is discussed further, below, in Interaction Processes.

4. Linking to strategy & strategic outcomes

Strategic planning and connection to organisational and municipal strategies are important features of this process. Of particular relevance are the Urban Village strategy and the planning amendments that followed these early stage developments. Community Consultative Committees for each of the Urban Villages made up of Councillors and community representatives were used during preparation of the Urban Villages strategy, commencing in 1997 (City of Glen Eira 1999) up until the adoption of the Urban Village Structure Plan in July 1999. Subsequently, amendments were made to the municipal Planning Scheme to incorporate the Urban Villages concept into the Planning Scheme requiring further consultation required by State Government legislation. The Library-Community Centre project specific consultations starting in late 2001 benefited from the previous consultation processes as they followed soon after these Planning activities in a roughly contiguous process spanning 4 to 5 years.

Assessments to date show that the proposed Library-Community Centre plan meets the five Council strategies identified earlier. It is both a supporter of community support policy (*a heart of the village*) and as a driver of change (catalysing behaviour change) and land use commensurate with the Urban Village concept. There are indications of anticipated positive behaviour change by municipal residents that is expected from and intended to be gained from the project.

5. Role of Council as a client

It is not unusual for construction projects to have several sub-clients each with an interest in the project outcomes (Walker 2002, p87-89). These sub-clients may, variously, have formal decision-making and governance roles, or roles as nominated client project representative, or champion, or as users. In this project, as for all local government projects, there are five sub-client groups, or clusters of groups (also called stakeholders). However, it should be noted that where an external funding authority exists, such as state or federal (central) governments, a sixth group would be added to the list.

1. Council (as Councillors). The group with formal legislative authority as decision-makers and holders of governance responsibility.

2. Council (as Council officers). The cluster of groups with a role as client representatives responsible for the project's day-to-day management and administration. This cluster includes a nominated project representative (Manager Corporate Assets in this project) as well as Council officers from stakeholder groups within Council. Such groups with a service delivery interest in the completed facility are the recipients of 'Internality effects' from the facility, being the effect the facility has on their operations[3].
3. Facility users from the community (as part of the municipality). Members of this cluster are also recipients of 'Internality effects' from the facility as a direct consequence of their use of the facility.
4. Neighbours (as part of the municipality). This group are the recipients of 'Externality effects' that are the impacts that flow outwards from a facility as a consequence of siting in a particular location.
5. Municipality (as a whole). Frequently styled as 'community', municipality is the preferred terminology as community is a contended term (Gibson and Cameron 2001)[4]. Also the recipient of 'Externality effects,' which are more diffuse in impact when considered at this level of generality.

The project's Council officer managers have been aware of these client groups and have incorporated interactions with them in the course of the project, particularly levels 2, 3 and 4 above.

6. An informed client

One of the key features of this project's delivery is how the Council has acted as an *informed* client in the project delivery process. In this project, Council, as client, has been highly motivated through awareness of the project's importance to Council and the municipality[5]. In addition to being informed about Council's client role, discussed above, the Council officers demonstrated informedness about:

- Their individual service;
- The combined overall Library-Community Centre facility;
- The synergies derived from the combination of services onto a single site;
- The Urban Design and Urban Planning context; and
- Site constraints and opportunities.

[3] Facilities, for the purpose of this discussion, are a conflation of the physical entity (building) and service delivery from that physical entity (Building + service) as defined by Brackertz & Pontikis (2000) + site + context, be that physical context (neighbourhood), and political, social and psychological contexts.

[4] There are two main categories of community. Firstly, there is a 'community of place' that assumes a consensual harmonious view where differences are ignored through an emphasis on common territorial or spatial interests (Saunders (1979); Martin (1998); and Lowndes et al. (2001)). The second is a 'community of interest' where a common stake creates a specific grouping (Martin (1998); Lowndes, et al. (2001)) .

[5] The metaphor 'Jewel in the Crown' was invoked more than once.

Being informed may derive from being an *experienced constructor* ((Walker 2002) citing (Masterman and Gameson 1994)). Local government, while experienced in construction, builds each type of facility infrequently which erodes assumed experience levels. To increase that experience level requires research and other informing processes during the project processes.

Research and informing is infrequently or poorly done by clients, drawing instead on their stock of 'lived' experience of the built environment (and in particular – facilities in this instance). This is risky as that the experience may be flawed being based on exposure to poor facilities (which may be the reason for them being replaced), or on facility and building types unlike those that constitute the project. In this project research at service delivery level occurred through review of work practices, consultant advisors on occupational health and safety, and inspection of exemplars.

The exposure key client groups – Council officers and Councillors – to exemplar projects, both positive and negative has had important consequences in attaining levels of informedness. The exemplars have been at the levels of the constituent facilities, such as Library, Child care, Community centre, and urban development projects where Council properties were key constituents in contributing to and leveraging urban development projects providing Council's desired outcomes. The latter investigations occurred at an early stage with Councillors and Council executives (decision-makers and influencers of decisions) participating. Exemplars were also used in interactions with facility users as part of an educative, expectation adjusting process.

A subtle, but important, part of this examination of exemplars is not using them as a model that may be copied directly to the project, but through suggestions that the new Library-Community Centre 'May be like this,' or 'This is similar to an outcome that this project may produce,' or enquiring 'How does this work?' The exemplars acted an 'inspiration' – in a mind opening sense, as there were positive and negative ones.

The use of exemplars in this way has, at least, two effects. Firstly, it focuses on outcomes from facility delivery processes rather than purely the physical product or environment. Outcomes may be service delivery, social, community support and development, urban development or similar. Secondly, it evokes affective type evaluations[6] which at the most global level are of the form 'We/I like/do not like ….' Or, 'We wouldn't want that.' Comments of this ilk certainly emerged from the data relating to exemplars.

Overall, this 'informedness' has contributed to an exemplary process that may act as a model for future project processes. This process is summarized later in the paper.

[6] Affect is a general class of psychological processes (Affect, Cognition and Behaviour) that include feelings, emotions, moods and similar aspect of beliefs, values and attitudes (Amedeo, D. (1993)).

7. Interaction processes

The Urban Village Library-Community Centre project can be characterised by the high level of consultation that has occurred in the project's Planning and Design phases. Review of the literature during the course of this research revealed a range of possible ways of engaging with project stakeholder and community groups.

The term 'Interactions' was preferred to 'Consultations' as the authors consider interactions in management consist of more than consultation, including a range of possible management activities used in achieving project ends which may include meetings, data gathering and decision-making interactions. Unfortunately, limitations of space prevent a detailed discussion of the types of interactions, but (Heywood et al. 2002) propose a typology of interaction practices in a local government context.

The municipality's CEO noted at a Community Forum in May 2001 that this Council used at least 15 consultation (interactions) methods in its activities. Some of these are legislated in Planning or Best Value requirements, and some are not applicable to project delivery. For example, elections, and the focus groups and telephone survey interviews operate only in a more general sense as part of setting and confirming organisational priorities and agendas through research.

8. Types of interactions

It was important to have appropriate interactions occurring at times of maximum advantage to the project's delivery. The project benefited from its links with the Urban Villages strategy and their Urban Planning interactions. Within the project there have been several timely types of interactions, including:

- The use of Strategic Needs Analysis Workshop leading to the preparation and agreement of the content of a *Performance Brief*;
- Research by Council officers into the constituent facilities (use of exemplars), and review of current work practices, and the like (as noted above).
- Data gathering and brief building interviews (individual and group) by the project consultant team at the commencement of the Design phase. This provided necessary, specific information from the project's sub-client groups;
- Project Control Group meetings continuously (approximately fortnightly) throughout the Design phase made up of design team members and Council stakeholders;
- First Community Review and Input Consultation with responses from the round of interviews evident;
- Subsequent rounds of Community Review and Input Consultation at the end of stages and precluding subsequent stages;

- Linking with Public Relations releases by Council at the commencement of project stages;
- Important, in terms of project governance, are approval interactions at stage ends both with Councillors and PCG; and
- While it is still to occur, a review approximately 6 months following occupation would be another possible interaction.

The content of consultations was important. Initially the design team relied on ‘Asking’ and ‘Listening’ type interactions in the data gathering and brief building; that is listening without having explicit, concrete requirements already set[7]. Consultations of this form were a requirement of the project’s performance briefing approach as definitive functional statements were not provided initially but which required negotiation achieved in this project through:

- The early use of design drawings to respond to the briefing information provided; and
- The Project Control Group (PCG) meetings noted above.

In this process data gathering was not on the basis of ‘Tell us how much space you need,’[8] but rather on the basis of, ‘Tell us what you do in your spaces.’ The dimensions of existing spaces were ascertained from facilities’ existing conditions drawings. This approach had several benefits for the project as it utilised:

- The workplace activity and service delivery knowledge from Council officers;
- The activity basis knowledge of users; and
- Architect’s integrative capacity and expertise in spatial matters in ‘design’.

Several benefits flowed from this approach. Firstly, it avoided the premature fixing of space demands acting as a ‘circuit-breaker’ between existing space occupied and that to be provided in the new facility. Secondly, in capturing the activity knowledge of facility users and service providers the spatial consequences of those could be ascertained by experts in building spatial matters (architects and the like). And, thirdly, this listening data gathering process utilised the integrative capacity of architects in ‘design’ to translate the received information into design solutions that responded to the *Performance Brief*, information received in consultation[9].

Evidence of this ‘listening’ approach was apparent in the presentations by the design team to the Community Review and Input Consultations. It was noted that they always referred to the points that the particular group had mentioned as important to them in previous interactions. Major benefits of this approach have been stakeholder buy-in (a psychological commitment and ownership of the project) from the earliest phases of the project and the achievement of high

[7] It should be noted that Council officers had conceptualised where the project might go as a result of the Strategic Needs Analysis and performance briefing, without necessarily pre-empting input from consultees and project consultants.

[8] This approach is often used to construct functional briefs.

[9] Which were considerable, being an elongated rectangular site located between and interfacing with both a residential area and a sub-regional strip shopping centre.

satisfaction levels now noted as being expressed by community groups and have been so from the earliest parts of the Design phase.

9. Project reviews

Project reviews have consisted of Schematic and Design Development reports from the design team for sign-off by the Council before proceeding to further project stages. Formal review meetings were not conducted to assess achievement of the Briefs (Performance and Indicative Functional)[10]. Rather, continuous review through the Project Control Group meetings and the Schematic and Design Development reports sign-off achieved much the same effect.

At the completion of Schematics Stage and before Design Development commenced a series of one-on-one internal review meetings between the Manager Corporate Assets and Council client groups assessed design and brief status.

Finally, the Review Workshop that examined processes used in delivery of the project to encapsulated the organisational learning to date and acted as a transmission of project history and learning following staff turnover during the project.

10. Project overview

10.1 Satisfaction with project processes

A high degree of satisfaction has been expressed with the project and project delivery processes to date. ‘Happiness’ and ‘pleased’ are frequently reported responses from individuals and groups participating in project interactions.

The satisfaction of project participants is based more on the fact that they were consulted, rather than what they saw as important was being included in the project; and seen as important by the project team; certainly in the emphasis given to these important items in reporting back to project participants.

10.2 Criticisms with the project processes

Given the satisfactions noted above and the positive reporting of project processes in this paper, it would be anticipated that there were few criticisms to date. This is the case. Criticisms coalesce around two points. The most minor of these is some of the arrangements for

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[10] Note that the term, *achievement* is preferable to *compliance*, which does not fit the concepts of performance in the performance briefing approach used in this project.

consultations could have been better. The more important point that received more criticism was related to project delays.

From the elderly citizens came a telling and poignant critique of the project delays. Having contributed to making the project processes successful, thus far, there were speculations whether they would live long enough to have their efforts rewarded in seeing the new Library-Community Centre open.

Project delays could be attributed to three causes. Firstly, ‘political’ reasons which would be linked, in the main, to matching organisational funding requirements. Secondly, the compulsory acquisition of adjoining properties, which took time to resolve. Thirdly, that all of the project’s Urban Planning requirements were not made clear enough early in the project enabling all the project requirements to be dealt with in a single planning application process. It should be noted that this criticism is one that is frequently made by many sponsors of development projects in both private and public sectors.

11. The ‘Glen Eira Model’

To date, the project delivery process for the Urban Village Library-Community Centre has been exemplary through the strategic connectivity achieved, the inclusion of a range of interactions of real benefit to the project, the use of innovative performance briefing methods, and an informed, engaged client across the levels of sub-client. These characteristics have all contributed to the derivation of positive project outcomes.

Given the success thus far, it is possible to condense out key aspects of the project delivery into a normative community based model – ‘The Glen Eira Model.’ The Model is a representation of the lessons learnt in the delivery of this Library-Community Centre, and as a model process may be used to guide other local government facility projects. The important first part of the process the strategic management component of the model is summarised in Figure 1, below. However, in its entirety the model and process contains three connected streams as follows with the significant features noted:

Stream 1 – Strategic

- Strategic connectivity;
- Service delivery strategies with requirements for a built environment;
- *Strategic Needs Analysis* Workshop and creation of a *Performance Brief;*
- All possible Council stakeholders invited and present, and
- Output – Performance brief and indicative functional brief.

Stream 2 – Informing

- Informing via exemplars;

- Types of questions asked of exemplars, and
- Building knowledge as a basis for detailed briefing.

Stream 3 – Design management

- Use of performance brief;
- Consultant selection that was responsive and with a consultative track-record;
- Project Control Group with all possible Council stakeholders participating;
- Brief building through:
    - interviews with all possible stakeholders, and
    - Community groups' interviews
- Consideration and inclusion of recipients of 'Externality' and 'Internality' effects from the new facility in project processes;
- Early use of drawings, particularly 3-dimensional ones in consultation;
- Use of tactical Public Relations;
- Iterative/feedback reviews/consultations with stakeholder Community groups, and
- Review to confirm achievement of Performance Brief objectives.

12. Conclusion

The project delivery processes for this Urban Village Library-Community Centre has been an exemplary implementation of a stakeholder approach to project delivery. Lessons that may be taken from this study include:

- High levels of strategic connectivity showing relevance to and of Council stakeholder strategies;
- Client (as project delivery manager) awareness and engagement with client sub-groups identified (stakeholders);
- Development of client informedness through research and access to exemplars by client sub-groups;
- Deep and contiguous[11] interactions with stakeholders throughout project processes;
- Content of interactions is important, particularly the form of questions asked; and
- Development of a normative model encapsulating organizational learning from this project.

[11] Contiguity is suggested as a form of connecting content from one interaction to the next.

13. Acknowledgements

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Appendix

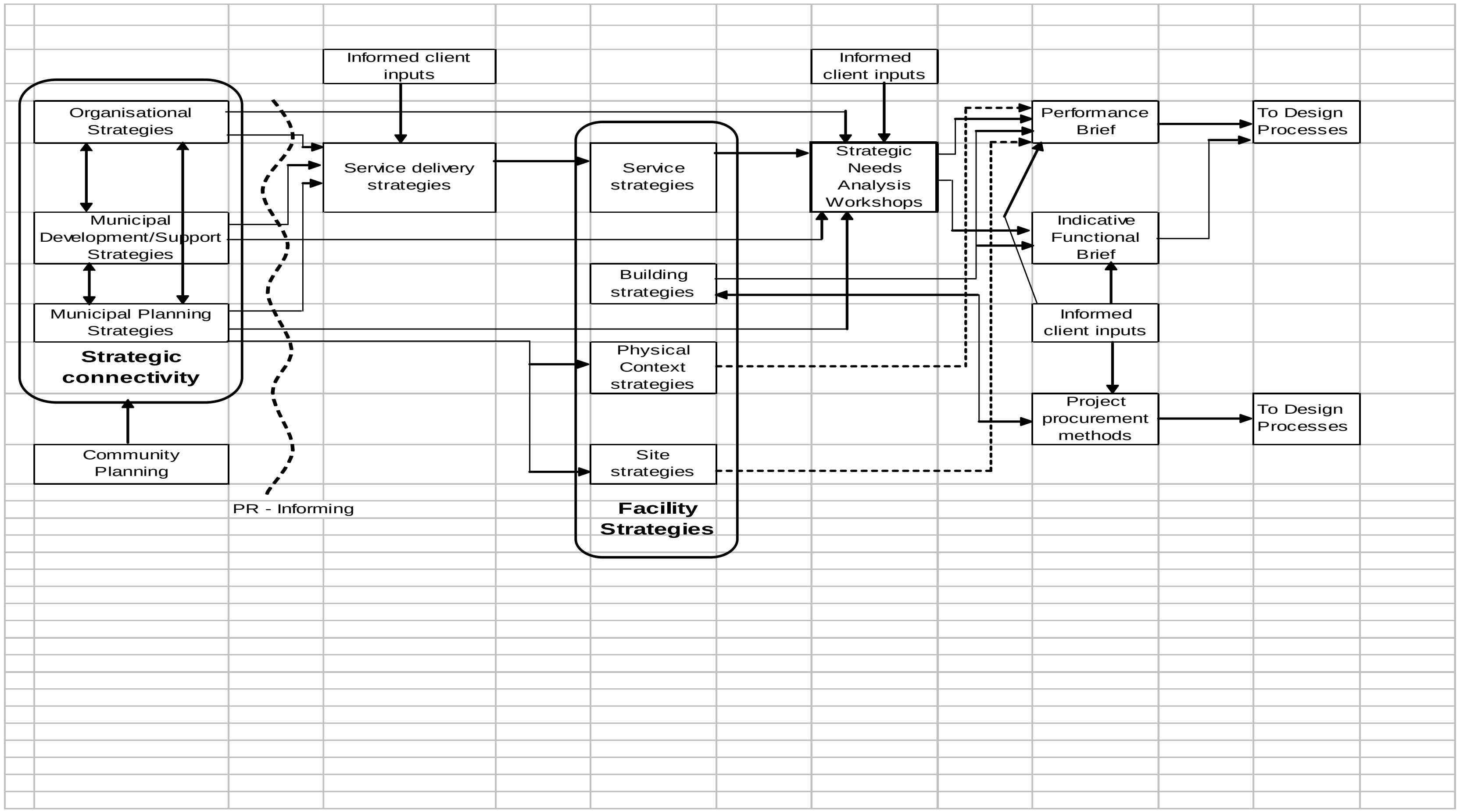

Figure 1 Strategy Stream

Section II

Emerging new FM aspects

The strategic impact of managing risk with high performance, high cost shopping centres

Prof. John D. Gilleard
The Hong Kong Polytechnic University (email: John.Gilleard@polyu.edu.hk)

Abstract

This research paper compares and contrasts the risk management approach adopted by a major public sector operator of shopping centres in Hong Kong with those managed by the private sector. By adopting a structured survey, the paper establishes 'risk items' identified by the public sector organization; the response by the organization to these risk items; and a comparison with their response to that of the private sector. Survey results indicate that managing risk in shopping centres is complex, where relatively small disorders can create a significant impact on a centres' successful operation. The survey also revealed that the public sector operator's risk assessment awareness was weak, generally focusing on emergency guidelines for previously known, identified risk items. In addition, public sector response to risk was determined to be overly bureaucratic, with a potential for crises to degenerate to a disaster. This may be contrasted with the private sectors whereby risk is, by and large, proactively managed through active avoidance measures, risk reduction and risk transfer. The paper concludes by recommending a facility management response to managing risk for public sector shopping centres.

Keywords: Risk management, shopping centres, comparative survey, public / private sector

1. Introduction

"*When the going gets tough, the tough go shopping*", Anon.

Hong Kong is home to seven million inhabitants, and the city's tourism board expects the tally for tourist arrivals in 2004 to exceed 21.4 million, a record for Hong Kong. The city prides itself as a "*shopper's paradise*", a theme trumpeted loudly by the Hong Kong Tourist Authority. Sceptics may wonder at the veracity of this notion, yet few would deny that shopping in Hong Kong is a serious business. Locals and visitors alike have a wide choice of shopping venues, from the hustle and bustle of Causeway Bay on Hong Kong Island, with its cluster of Japanese department stores, dense street side markets stalls and more recent up market exclusive designer label shopping emporiums. Kowloon-side also offers a similar range of traditional shopping experiences among the environs of Nathan Road, Temple Street and Canton Road. During the last twenty years Hong Kong has also added the ubiquitous shopping centre, from the prosaic out of town "*local*" shopping arcade with its Chinese wet market, government offices and retail outlets to amazingly glitzy malls that provide both entertainment thrills as well as retail therapy. On Sundays and festive holidays these venues often arrange promotional activities to attract visitors, and it is not uncommon for the serious shopper to have to weave around these watching crowds in order to continue their hunt for bargains, exclusivity or the merely fashionable. Under these circumstances, shoppers are probably more mindful of the risk to their wallet than their physical security, assuming that risk, in whatever form, is being managed "*behind the scene*" by trained property managers whose skills and knowledge are sufficient to deal with all eventualities. This naïve assumption is perhaps understandable, for few untoward occurrences have (publicly at least) taken place among Hong Kong's shopping centres during the last few years. Nevertheless, the public has a right to demand at the very least that those who manage facilities are aware of potential risks, and have contingency plans to ameliorate crisis or disasters from occurring.

1.1 Risk Management

Risk management is the process of measuring, or assessing risk and then developing strategies to manage the risk. Ideally, risks with the greatest loss and the greatest probability of a risk occurring are dealt with first, and risks with a lower probability of occurrence and potential lower loss are dealt with later. Unfortunately balancing the likelihood of an event occurring against its potential loss is extremely difficult, and property managers charged with maintaining shopping centres frequently face difficulties that extend beyond their built fabric. For example, shopping centres, similar to other buildings that accommodate public space, typically bring together relatively large numbers of people (shoppers) whose knowledge of the facilities is low. These shoppers may be first time, or infrequent visitors whose general awareness of the centre construction, layout, safety features or safety personnel is generally weak. Shopping centre design attempts to mitigate potential hazards by imposing restrictive building codes and regulations, particularly those related to fire safety. Even so, without effective property management, architectural good practice can be frustrated by uncaring or ignorant behaviour, [1].

The UK's MI5 Security Services [2] has recently published a guide for protecting assets. Although focused on terrorism, the guide offers a general review of managing risk. The guide adopts an integrative approach, highlighting four main issues, i.e. 1) identify the threats; 2) establish what you want to protect and your vulnerabilities; 3) identify measures to reduce risk (security improvements / plans; and 4) review security measures and rehearse / review security plans. The singularity of the guide highlights the times that we live in, albeit to date the threat is more in the imagination than the execution. However, being prepared for eventualities is the hallmark of good risk management and the guide offers excellent advice. For example, is there anything about a shopping centre, staff or its activities that would attract (in this case) terrorist attack? It also questions whether the centre's location would mean that it may suffer collateral damage from an attack on a high risk neighbour. (Given Hong Kong's proclivity for mixed use commercial development, blending shopping malls and high rise office space with hotel and serviced apartment accommodation, this latter scenario is more likely.) The guide's advice on what to protect is instructive with its focus on people (staff, customers, visitors and contractors);

physical assets (building fabric and contents); information (electronic and non-electronic data); and processes (supply chains and critical procedures). People take top priority when assessing the consequence of risk, with other assets depending on the nature of the business. In the current context, shopping centre managers normally have well rehearsed contingency plans in case of fire and crime. In addition, the guide reminds shopping centre HAs that they should also have procedures for assessing the reliability and integrity of those they employ. This is an increasingly difficult and controversial issue, particularly in Hong Kong where contracting out of safety and security personnel is common. The MI5 Security Advice also highlights this point "*There is little point in investing in costly security measures if they can be easily undermined by a disaffected inside, or by a recruitment process that permits people wanting to cause harm to infiltrate the organization.*" Continuing, the guide continues by emphasizing the need to conduct regular reviews and rehearsals to ensure that security and safety plans remain accurate and workable, and take into account any temporary or permanent changes to both the physical assets (the shopping centre) of procedures (information and communication system, health and safety issues). The guide also emphasizes the role of vigilance among shop tenants, shoppers, visitors and contractors when confronting untoward events.

1.2 Risk preparedness

The Genesis for the study was a freak accident that occurred at one of Hong Kong's suburban shopping centres. A nine year boy fell through an unsecured glass balustrade resulting in serious head injuries. Fortunately he made a full recovery. An investigation instigated by the centre HA concluded that the original building contractor was liable for the accident. (The shopping centre was relatively new.) As a result the HA suspended the contractor's new project tendering rights for a period of six month. The decision initially closed the case. However, public misgivings lingered over the accident. For example, public opinion questioned why the HA had not monitored the construction work more diligently, or why at handover a thorough check of the centre had not found the problem. Knowing that the centre's day-to-day property management had been contracted out, they also questioned why this company had failed to undertake periodic inspections of the balustrade? These questions go well beyond simply knowing the technical cause for failure: they fundamentally question the existing design – construct – commission – operate paradigm. Knowing that each phase of the project is directed by competent professionals, the public's misgivings are understandable. Simply put "*who is responsible for checking as built systems and determining risk?*" "*Is risk awareness in shopping centres inadequate?*" "*Are current property management systems sufficiently flexible to deal with risk?*"

To answer these questions, a small scale research study was undertaken, [3]. The study adopted a three pronged approach. First, a literature review was undertaken. Second, a series of semi-structured interviews were conducted with shopping centre HA representatives and personnel. Interviewees represented both the public and private sector, including in-house and contracted out personnel. Interviewees represented mid-level managerial grades tasked with either overseeing property management contracts, or with direct day-to-day management issues. All shopping centres formed a part of Hong Kong's largest public sector housing authority's portfolio. Interviews were divided into two parts. The first part requested information pertaining to the interviewee’s organizational, management structure and their general awareness of risk within shopping centres. The second part reviewed their knowledge of the organization’s business continuity planning and management. During each interview supplementary questions explored the existing procurement, operation and maintenance systems, and inquired of the difficulties (if any) of implementing these systems. Thirdly, an observational record was conducted over a one year period. The last provided sufficient insight to verify that risk “*hazard, chance of bad consequences, loss etc, or exposure to mischance*”, OED, rarely occurred without some foreknowledge. Unfortunately the observational evidence indicated that these warnings were frequently overlooked or went unnoticed due to ignorance, negligence or sloth. The study also indicated that preparedness for risk appeared to be variable, with some centre managers uncertain whether problems had been caused by natural force, human error, deliberate damage or progressive deterioration.

1.4 Interactive complexity and tight coupling

Two identified factors or properties determine whether a potential danger is more “risky”, i.e. ‘interactive complexity’ or ‘tight coupling’ [4]. Interactive complexity describes the potential for unforeseen interactions to occur where complexities and interdependence of relevant factors are unpredictable. For example, the failure of a computerized building services system that causes the breakdown of other systems may eventually paralyze most other systems. Tight coupling describes rapid and uncontrolled propagation of undesired events due to failure. The process happens very fast and cannot be turned off until the failed parts are isolated. Complexity and coupling may also be interrelated. For example, locating building systems in too small a space with complicated access may lead to missed routine maintenance. In consequence, this may lead to possible difficulties in isolating failed components thus resulting in a potentially more widespread catastrophe. High system complexity also demands greater technical awareness among operation, maintenance and management personnel. Where these conditions apply, system buffers and redundancies, deliberately designed into the system, act as a safety feature. However, without an intrinsic understanding of system safety and reliability issues, catastrophic failure can easily occur.

2. Risk and diversity in shopping centre design

The Hong Kong Housing Authority (HA) owns 650,000 public rental flats, housing approximately two million people (about one-third of Hong Kong's population). To bring convenience to and cater for the daily needs of public housing tenants, the HA also builds shopping facilities in the vicinity of our estates.These centres provide retail, recreation and leisure, health and social functions, etc. The HA categorizes shopping centres into four distinct groups, i.e. District Centres, Greenfield Centres, Large Neighbourhood Centres and Small Neighbourhood Centres.

District Centres are characterized by their strategic location, typically adjacent to mass transport railway stations serving a comparatively large catchment's area. The level of retail provision is usually high, catering for both local and outsiders. District Centres typically support a population of 150,000. Major tenants include department stores, supermarkets, Chinese and western restaurants as well cinemas. Building service provision is high, with full HVAC, escalators and lifts. Greenfield Centres are 'first generation' shopping centres located in New Towns. These centres typically enjoy good business during the early years due to the absence of competition. However, as the New Town matures, the population increases and private sector development is encouraged Greenfield Centres face increasing competition. Consequently these centres are normally upgraded to a level similar to District Centres. Large Neighbourhood Centres are typically located within public housing complexes away from private sector housing. Typically, they serve a community of 25,000 to 50,000. Their primary market is nearby public housing tenants, although well managed centres have the potential to attract outside customers. Major tenants are usually at least one Chinese restaurant, supermarket, and fast food café. Neighbourhood Centres are limited to no more than three floors, with escalators providing vertical movement between floors. Usually these centres are located close to main roads and bus terminals. Small Neighbourhood Centres are small commercial centres serving communities with a population of 25,000 or less. Typically, these centres are single storey located on the ground floor of a multi-storey housing complex. Retail provision is limited to a supermarket, small wet market and a convenience store. Usage level is normally low due to keen competition in the vicinity and because there is little prospect of attracting outside patronage.

During the 1990s the management of these shopping centres changed from in-house to one where the majority were outsourced, or contracted out. Two separate schemes were adopted, i.e. Single Operator (SO) and Private Management Agents (PMA). The SO scheme aims to enhance shopping centre management standards by developing a close partnership with the HA and the SO. Under negotiated lease terms the SO operates, manages and maintains the whole centre for periods of six to nine years. The SO is allowed to sub-lease separate units in the centre to third parties, or licensees. In agreement with the HA, the SO is also permitted to make minor alterations and decorate the centre. The primary aim of the SO scheme was to harness private sector expertise in the management of the shopping centres, e.g. shop layout, trade mix and promotional activities, etc. At a secondary level, the scheme also had the advantage of redeploying shopping centre estate staff. Disengagement by the HA from day-to-day management also provided an opportunity for top management to deal with strategic issues, whilst withdrawing from tactical, day-to-day concerns. Under the SO scheme the HA performs the role of intelligent-client, concerned with establishing, reviewing and monitoring the SO contractor's performance and securing compliance of the contracts terms and agreements. However, once the SO scheme had been operating for a number of years a number of weaknesses appeared. For example, in some instances, the HA was unable to ensure that the SO delivered the best quality of services to the public. By forfeiting the right to select sub-leasers, the HA was also unable to influence or protect essential yet low margin retail outlets or public service facilities. Experience also indicated that at the conclusion of the lease major renovations to the shopping centre were unavoidable.

The Private Management Agent (PMA) scheme introduced in the late 1990s attempted to address some of the problems of the SO, particularly those concerning tenant mix. PMA contracts are normally for a two year period, with the right for an additional two year renewal. The PMA contractor is paid a fixed fee for services provided, and reimbursed for all costs incurred in connection with the operation and management of the centre, e.g. electricity, water, consumables. The duties of the PMA contractor are defined as: to collect revenue and other payments to the HA; to follow up delinquent payments; to enforce tenants' contractual obligations; to be responsible for all minor repair and maintenance of the building fabric and building services systems; to provide daily cleaning and security; to prevent illegal hawking; and lastly to plan, organize and coordinate promotional activities. On the other hand, the HA retained the right to handle all leasing matters and tenant selection; set rent levels and tenancy agreements; deal with tenancy renewals; act as final arbitrator between the PMA contractor and tenants; and monitor and assess PMA contractor performance.

The PMA scheme has been judged to be a success, with the majority of the HA's shopping centres now managed in this way. Nevertheless, during the research a number of HA representatives expressed concern at the relatively high turnover rate of PMA staff, with its attendant need to train and offer guidance to new PMA employees. They were also voiced disquiet about the unwillingness of some PMA contractors to deal with the public. For example, one representative stated that some PMA contractors were slow to respond to requests for repairs and maintenance, and that they lacked initiative with respect to environmental issues. He considered that, in this case, the PMA contractor lacked experience in handling the agent / tenant / customer interface. This is perhaps not unsurprising since pre-registration criteria for potential PMA contractors tends to emphasize property management skills, financial integrity and legal knowledge rather than customer services' skills. Further, observations indicated that PMA staff tended to rely heavily on the HA representative to handle sensitive public relations issues. Concern was also expressed that the PMA scheme created problems in communication and coordination between the HA representative and PMA staff. This may be a reflection of the potentially adversarial relationship between the HA representative and PMA contractor whereby performance standards are strictly enforced through legal interpretation of the contract specifications. This was also true for SO contracts, although one interviewee stated that poor performance of a PMA contractor might result in a warning letter; whereas a SO contractor may incur a financial penalty or possibly termination of contract.

Interviewees were also asked to identify risk elements related to their potential threat, expressed in terms of emergency, interruption, severity and frequency, tables 1 and 2.

Table 1: The relationship between emergency and interruption related to shopping centre risk, or threats.

Threats	Emergency			Interruption		
	Low	Medium	High	Low	Medium	High
Natural hazards		X			X	
Man-made errors		X		X		
Progress deterioration	X			X		
Deliberate damage	X				X	
BS system breakdown		X				X
Fire			X			X
Personal injury			X		X	
Renovation / improvement	X					X
Criminal activities			X		X	
Uncommon disaster			X			X

Table 2: The relationship between severity and frequency related to shopping centre risk, or threats.

Threats	Severity			Frequency		
	Low	Medium	High	Rare	Seldom	Often
Natural hazards		X			X	
Man-made errors	X					X
Progress deterioration		X				X
Deliberate damage		X			X	
BS system breakdown		X				X
Fire			X	X		
Personal injury		X				X
Renovation / improvement	X			X		
Criminal activities		X			X	
Uncommon disaster			X	X		

As the tables illustrate some risks are deemed to be more important than others, either due to their propensity to occur or severity of problems manifest from occurring. Interrelated but not assessed is the impact on business continuity in the event of a serious breakdown. Nevertheless, the two tables help to prioritize commitment and remind the centre managers of the most critical and important issues in operating the shopping centre, i.e. health & safety of the public, tenants and staff; maintenance of building services systems; and maintainability of business.

When asked to reflect on the most common emergency to occur within the shopping centres, the interviewees identified three issues, i.e. personal injury - slipping or falling; power outage; and flooding. Response to an emergency usually related to the availability of on-site resources, the experience of front line staff and written guidelines. However, SO / PMA staff criticized these guidelines, identifying a general lack of experience from those charged with drafting them. They also commented that these guidelines did not always clearly identify responsibilities. The respondents were asked to comment on their knowledge of risk planning. Most knew that emergency and safety plans existed but few could identify who within the organization constituted the emergency team or what backup or recovery systems existed. They were also unaware if a public relations strategy formed a part of emergency planning.

3. Conclusions

The study indicated that risk awareness was not linked to the management structure of the shopping centre, nor was it substantially impacted by whether the centre's management was in-house or contracted out. Nevertheless, a lack of contractual clarity in defining risk responsibility does seem to have had an impact. Additionally, because of the HA reliance on contracting out, with its attendant loss of control of on-site staffing, training, and quality control, securing the right contracting-out partner was considered to be essential. Unfortunately, guidance on the selection of SO or PMA organizations tended to emphasize cost targets, not quality, timeliness and good practice. Ultimately this approach may be said to be counter productive. Poorly trained, low waged and unmotivated personnel have limited capabilities for dealing with a crisis. What is needed are staff who can recognize an unfolding situation, instinctively knows how to react and well able to communicate the threat or risk to authority. If a security guard has to evacuate a shopping centre they need to have an understanding of how to do it, or at the very least they have the initiative / authority to make it happen.

The study also indicated that although senior management were cognizant of documented risk exposure, they were less certain on how to deal with unconventional problems. For example, during the interviews good practice relating to shoplifting and vandalism was discussed. However, no mention of the possibility for acts of terrorism was raised. In the context of Hong Kong this may be understandable since outside terrorist threats would appear to be minimal. However, shopping malls are increasingly raised as possible targets in both the US and Europe, [5]. Recent troubles in the Philippines, Indonesia and Thailand belittle Hong Kong's absence of concern. If such sentiments seem too alarmist it is only necessary to go back to Hong Kong circa 2003 to find evidence where, initially at least, risk preparedness was woefully lacking. From March to August 2003 Hong Kong was on high alert for the SARS virus, a virus that eventually killed 299 and infected almost 1800. The virus also had a severe impact on Hong Kong's economy. However, in the early days little was understood about the virus in terms of transmission. Consequently, shopping centres, intended to be friendly locations, were treated by customers as potential hazards. Restaurants, cinemas and many public venues were deserted and universities and schools closed. Shopping centre owners were alarmed at the prospect that their property would be associated with the SARS virus. Eventually, they went to enormous lengths to ensure that the risk of infection and contagion was minimized. However, in the beginning few had contingency plans to deal with the SARS crisis at the beginning. Gradually, operators introduced extensive SARS preventative measure, e.g. disinfecting common areas, lifts and entrances on an hourly basis; air-conditioning filter replacement rates increased; outdoor air intake increased as well when feasible natural ventilation was adopted. In an attempt to gain the approval of their tenants and their tenant's customers one Hong Kong private developer acted very quickly by issuing instructions to their centre management staff and security guards "*to be* *extra vigilant and actively monitor tenant activities….report any unusual occurrences to the Property Manager for them to confirm a potential change in the level of risk…..vacation of premises, changes to cleaning schedule of premises, request for additional ventilation or air filter cleaning, extensive wearing of face masks, and attendance of medical/ambulance personnel to the premises or rumours of an incidence of infection*." By raising the company's level of risk awareness the firm was assuring both employees and tenants that '*expecting the unexpected*' was good risk management. They recognized that they needed to "*identify potential impacts that threaten an organization and provides a framework for building resilience with the capability of an effective response that safeguards the interest of its key stakeholders, reputation, and brand and value creating activities,* [6]. Under these circumstances effective public relations was seen to be as important as technical know how. The obvious lessons to be learnt from SARS is "expect the unexpected" and develop a comprehensive business continuity plan sufficient to include an effective emergency response, a workable contingency arrangement and a feasible recovery plan.

Postscript: Since the study was completed the HA has initiated a major scheme to bundle all shopping centres and car parks in a Real Estate Investment Trust, or REIT. The Link REIT is composed of the HA portfolio of 2.85 million sq. ft. of retail space and 59,000 commercial parking spots. The initial public offering is valued at almost US$2.7 billion, making it the largest REIT offering in history. It was expected to debut on Hong Kong's Hang Seng exchange December 2004 but due to legal issues the launch has now been delayed. However, the Hong Kong Government is confident that the Link REIT will eventually go ahead.

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Parking Storage Planning and Facility Installation in Buildings

Jin-Fang Shr
Associate Professor – Department of Construction Engineering, Chung Hua University, Taiwan
(shrj@chu.edu.tw)

Abstract

Increasing the prosperous economy and national income, a convenient lifestyle needs more automobiles. According to the Government of Taipei statistics, the metropolis owns 62,536 chargeable parking spaces and 670,999 vehicles registered in Taipei, indicating that approximately 11 cars share a single parking space. This fact means that existing parking spaces are not enough to accommodate the number of automobiles. Upon integration into the international free economy and entry into the WTO, a suggestion is to reduce import duty on automobiles. This way leads to a rapid surge in the purchasing of automobiles and an increase in parking space demands. Meanwhile, in Taiwan's previous development plans, no parking spaces were set-aside in the downtown area of Taipei. The ideal areas in downtown feature high costs, are difficult to acquire and the amount of traditional ramp or flat parking spaces are not effectively adequate. In view of that, large-scale construction corporations have cooperated with Japanese experienced parking facility manufacturers to solve the problem and create new business opportunities. The latest automatic mechanical parking storage facilities provide much needed parking space and make the multi-sectional parking facility attached to main buildings a standard. This results in new opportunities for the construction industry.

Keywords: Parking storage, park, facility, car

1. Introduction

Current macroeconomic distress has resulted in a downturn for the entire building industry and the price of real estate also dropped significantly. Therefore, hard-won parking spaces are more popular and prominent. The series of products launched by construction corporations, combined with parking space storage, provide households who originally possessed cars with parking spaces, as well as additional income for office buildings. This fact obviously proves that there would be more common scenario in the future real estate market. Nevertheless, this breakthrough would bring about quite different and new circumstances to the space of the architecture itself, and also construction cost and environment. This study intends to provide useful information, for attracting potential purchasers and new ideas will be presented for investors.

2. Literature Review of Parking Storage Facility

The “Advanced Storage” fully automatic parking system, also called the “Large-Scale Plane Reciprocating System” in the Norm of Type Determination by Japan’s Ministry of the Economy, mainly consists of tower and underground storage systems in Taiwan. The basic movements are as Figure 1.

Advance and Be Warehoused onto Wagon

↓

Shut Down Passage Gate

↓

Universal Stage Rotates for 90° (The wagon stage turns 90°)

↓

Elevator moves up to designated parking lot warehousing

↓

Traverser moves the wagon stage warehoused into the parking lot

↓

The elevator rises/descends to the parking lot

↓

The traverser moves the wagon stage to be sent to the elevator

↓

Universal Stage Rotates 90° (The wagon stage turns 90°)

↓

The elevator descends to passage level.

↓

Open Passage Gate

↓

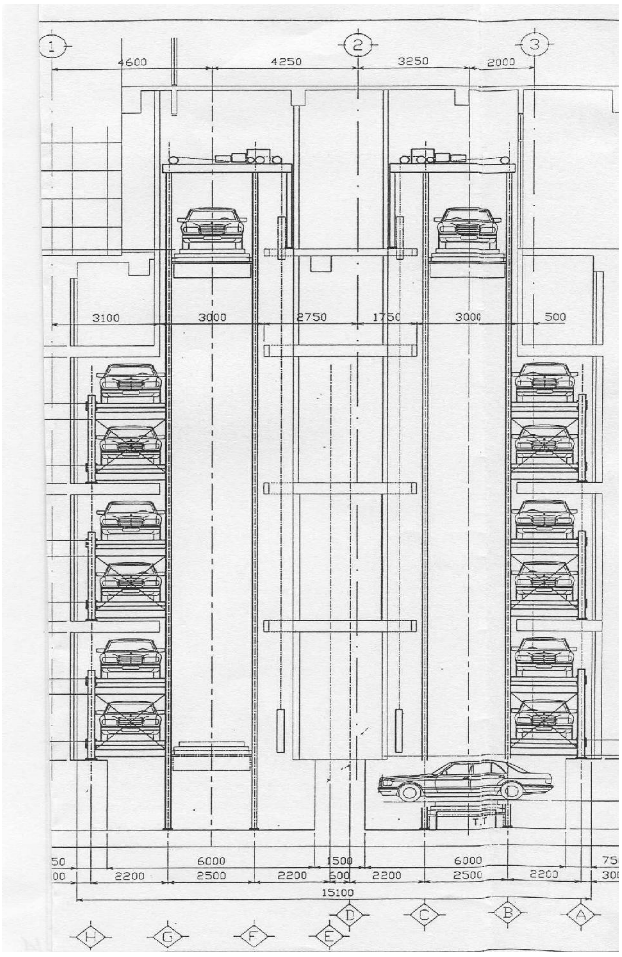
Advance for Sending the Car Out

Figure 1: *Basic Movements of the Parking Process*

The components of fully-automatic parking storage system are mainly introduced as follows:

l Parking Area for Garage Entry/Exit (Figure 2)
l High-Speed Elevator (Figure 3)
l Multi-Layer, Synchronized-Operation, High-Speed Jack Plane
l Multi-Layer, Multi-Row, Parking Lot (Figure 4)
l Active Automobile-Safety Monitoring Network
l Operating Control Information Transmission Network
l Electronic Vehicle Passage Management & Subscription (Figure 5)

Wen-Ting, Liao, 2000 Jan.



Block Diagram of the Parking Storage System Structure

Figure 2 : Parking Area for Into/Out of Garage

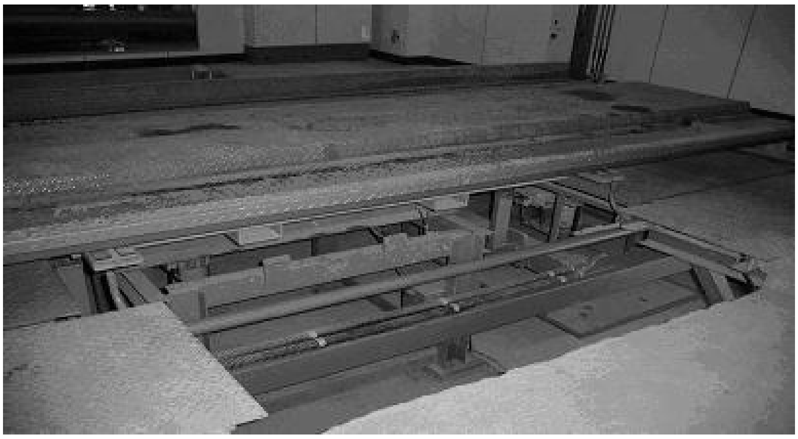


Figure 3: High-Speed Elevator

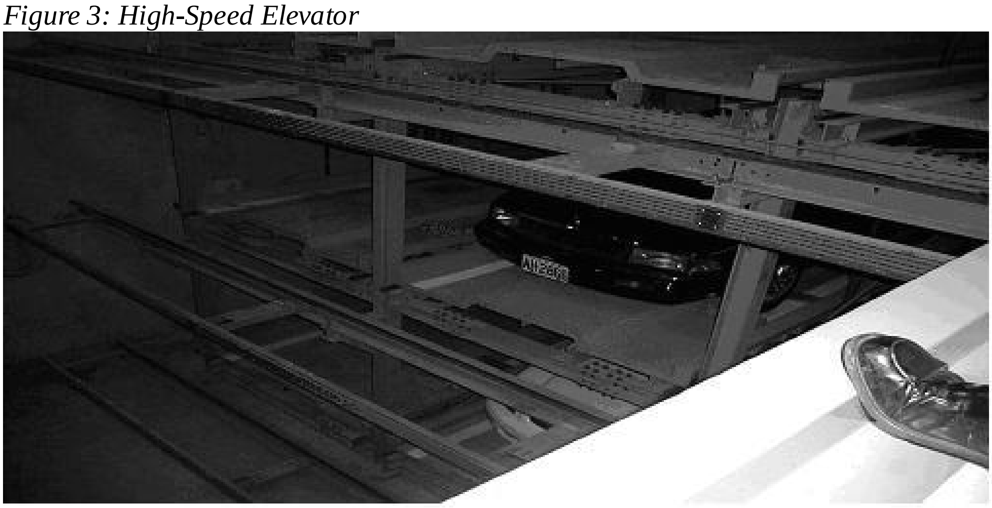


Figure 4: Multilayer Multi-Row Parking Lot

Figure 5: Electronic Vehicle Passage Control

Due to different design organizations providing a variety of design philosophies, market partitioning and technological integration methods, this study organizes those fairly common and relatively competitive parking storage systems in the market, generally introduced here:

1). Crawler-Type System: Vertically elevated, multiple groups of crawlers or universal rollers, traverse traveling driven by motor in order to conduct transport.

2). Wagon Stage Plate-Type System a): Vertically elevated, traverse steel tracks, wheeled secondary frame, operated by mainframe power (see Figure 6).

Wagon Stage Plate-Type System b): Vertically elevated, the traverse motion is initiated by the traverse's radial arm, which clamps to the groove attached under the wagon stage plate, leading it to laterally move the secondary frame (see Figure 7).

3). Comb-Type Frame System: Both vertically and laterally moved by the mainframe, the comb-type wagon stage plate makes the need for exchanging secondary frames unnecessary. Its design principle indicates that while the automobile is accessed, no empty sweep template should be reset, concerning the operation between every parking lot and a jackplane lot, whose process reduces a car's passing time (see Figure 8).

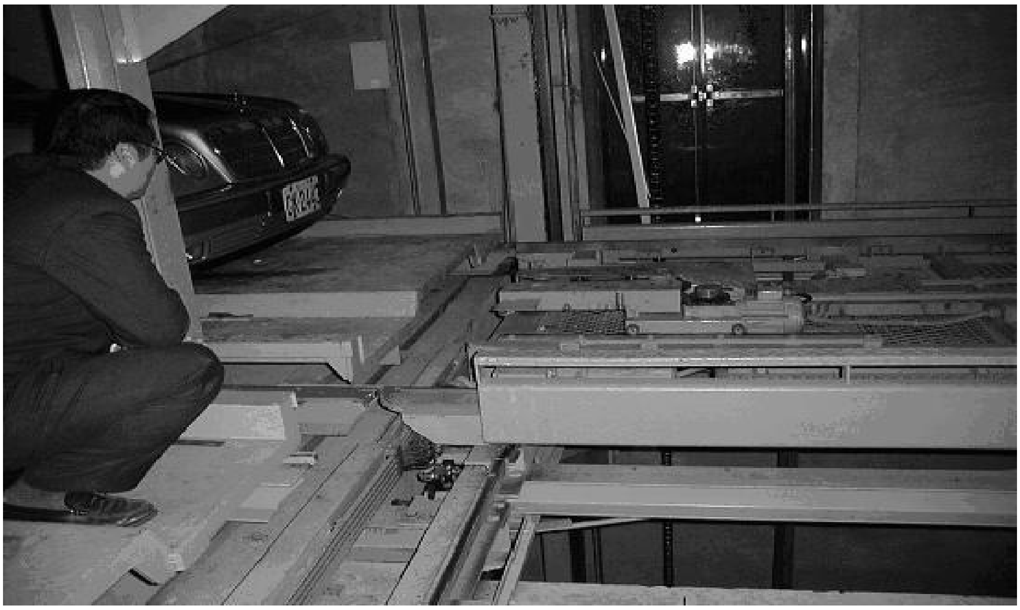


Figure 6: Wagon Stage Plate System 1


Figure 7: Wagon Stage Plate System 2

Figure 8:. Comb-Type Frame System 3

3. Analysis of Investment Appraisal

3.1 Background

In view of the increasingly deteriorating issue of car parking, accompanied with the traffic turbulence caused by illegal curb parking and the high cost of traffic jams, the government faces the situation that if those problems are not properly resolved, economic development will certainly be retarded. Besides passively restraining the decrease in the amount of cars, the policies of great importance adopted by the government are to proactively compile the budget according to the "Program of Ameliorating Parking Issues" and further accelerate the amendment and implementation of laws and regulations concerned. For example, regarding the parking storage affiliated inside architectures, available laws or regulations in Taipei cover the Essential Encouraged Aspects on Public Parking Spaces Extended Inside Architectures, which stipulates that the structures allow additional established parking spaces that should be incorporated into the floor area as calculated in the floor area ratio. The calculating process should be conducted according to the formula shown as follows (the added parking spaces do not need to be taken into consideration during the calculation process; however, the uncalculated area per building should not exceed 40 square meters.).

FA **FA** **FA**

FA Total floor area concerning the allowed essential floor area ratio as calculated.

FA Referred floor area calculated on the basis of the designated floor area ratio in the Urban

Planning Law and related laws and regulations.

FA Floor area calculated by the floor area ratio of the allowed additional established parking space, which should be less than 1/5 of the reference floor area and be incorporated into legal parking spaces as calculated.

3.2 Location Factors

The location factors that should first be taken into consideration in investing in parking areas are, including land application, compilation of city planning, average automobile occupancy ratio as concerned, existing regional number of parking spaces, time spent searching for a parking space, and the punishment possibility of broken-through parking, etc. For land that cannot be customized, the selection of investment bidding is fairly difficult to control. Thus, case analysis is demanded to be conducted for each bidding process. The average “parking supply and demand statistics” sufficiently known are used to determine the market value of the region concerned for investment.

3.3 Relation between Cost & Price

Cost factor analysis mainly includes land price, construction cost, operation cost, and maintenance cost, etc. The case of an office building in Hangchounan Road, which was launched by Fubon Land Development in the 1990s, is an example described below:

The base’s total area accounts for approximately 148 plateaus, with the cost at approximately 1,500,000 Taiwan Dollars (TD). According to the planning design, the structure has been equipped with 54 parking spaces in its internal parking storage, with an individual cost of approximately 250,000 TD The case has installed 54 parking spaces on 20 plateaus. The relation between price and land cost is shown in Table 1 as follows:

It is assumed that the parking space’s market quotation is acceptable for consumers, and higher than the pre-set rate of return. Therefore, the case is very profitable if the land cost is determined to be 1,500,000 Taiwan Dollars per plateau.

Table 1 :. Relation between the Cost & the Land Cost of Parking Storage Unit: 10,000 Taiwan Dollars

Program No.	Land Cost (TW)	Total Parking Space Cost (TW)	Individual Parking Space Cost (TW)	Estimated Rate of Return (%)	Price (TW)
1	3,000	1,350	80.5	25%	100.6
2	3,000	1,350	80.5	30%	104.6
3	3,000	1,350	80.5	40%	112.7

According to the case, it is obvious that the final price of the parking space depends on land cost. In other words, if the land cost is fairly high, the price of the parking space will not be correspondingly increased due to a restrained market quotation, cause of limited construction cost adjustment. Therefore, the tender investment would probably fail and eventually be terminated.

4. Condition Analysis of Architectures

4.1 Foundation Conditions

The foundation's ground shape and area are main factors in determining the appropriate type of off-road parking area. According to the Parking Area Layout Manual, it stipulates that mechanical parking lots may be installed if the foundation's width is less than 35m or the area does not exceed 1,500 square meters; cause by the limitation of the restrain of landform that self-automatic parking lots could not be established . Therefore, the optimum parking area can eventually be determined when the foundation area is between 1,500 and 4,000 square meters, by measurement accounting to adopted local conditions, evaluations, and comparisons of various parties (Ta-Yu, Lin, the Institute of Traffic and Transportation). Current data according to partitioning and estimated designs are provided at the website on capacity calculation of architectural design (www.iarchi.net), various references could then be further calculated as required by the designing process.

4.2 Roadside Traffic Factors

Under the volume specifications on architectural design and construction of the Building Technology Instructions, the automobile entranceways of such structures should not be placed on roads or locations as follows:

1) Road junctions, chamfering lines, initial points of a corner, zebra crossings, traversing of a bridge, and 5 meters within a subway entrance.

2) Roadway with a slope greater than 8:1.

3) Less than ten meters away from a bus station or railway level crossing.

4) Twenty meters within the passage ways of kindergartens, public schools, schools for the deaf, mute and/or blind, reform schools for the disabled, parks, etc.

5) Other roads or localities deemed as harmful for public transportation as determined by competent departments in the construction industry or transportation.

Open space should also be additionally prepared for an automobile's passage on the basis of calculation from one point of the automobile's passage center line, 2 meters behind a building line to the area over 60 degrees left and right of the vertical lines of the center line. The land covered should be regarded as an open space without holding the line of sight. A waiting area with a width and depth both over 6m should also be prepared due to the construction of parking areas. Otherwise, flow rate for this area's road system will fluctuate. Analysis for primary roads, secondary roads and regional roads (laneways) in the concerned area must be carried out, regarding issues such as road width, number of lanes, partitioning type, one-way or two-way lane, roadside parking control, vehicle flow rate statistics on intersection peak hours both in the morning and evening, and mean vehicle delay time, etc

4.3 Matching Requirements of Structure

1) Structural Section –The most suitable beam column construction must be calculated to match the entire system during establishment of the parking storage facility, which has a much higher requirement on the arrangement of parking lots and parking areas, the spacing layout and column positioning, the opening position of floor slabs with reinforcement, as well as the static loading on floor construction. The structural drawings should be reviewed in advance to avoid after-the-fact revision that may pose a danger to the construction's structural strength.

2) Electric & Fire Control Sections – Generator capacity, short-circuit tripping design and installation of maintenance lighting should all be taken into account, and the fire control section equipped with double-purpose equipment. This equipment should be both fully-automatic and manual, and meet the concerned fire code specifications. High-end industrial computers serve as a control center for smooth, rapid and secure operation of the parking facility under whatever operating mode, fully-automatic, semi-automatic or manual.

3) Management System –Improper operation should be prevented from occurring which could cause malfunctioning when the parking facility is in operation, and periodical maintenance is also of great importance. It is absolutely forbidden to have the equipment repaired by non-professional manufacturers. In addition, pre-service training should also be provided for operators concerning non-sophisticated trouble-shooting and emergency response. The service life of parking facilities can be prolonged while the safety of the entire structure is fully guaranteed.

4.4 Evaluation of Environmental Issues

Multipurpose projects should be advanced according to the concerned area's development. Such issues are required to be taken into consideration in combining parking storage together with buildings including: feasibility, the compatibility with it's surrounding environment, the impact on nearby traffic flow and the safety of residents in the region, the prevention of noise and air pollution, etc, should be included in the evaluation of the environmental impact for discussions in an item by item manner.

Regarding air pollution, outdoor air pollution control measures should be prepared well according to specifications in the "Air Quality Standard of Taiwan" (as shown in Table 2). Meanwhile, ventilation systems should also be mounted to ensure air quality according to the "Volume of Equipment of the Building Technical Instructions", stipulating that "In the parking area with a floor area over 500 square meters, mechanical ventilation should be provided for with the ventilation volume of over 35m3/hr per square meter for each floor."

Table 2: Air Quality Standard & Pollution Control Countermeasures in Taiwan

<table>
<tr><th>Standard</th><th colspan="2">Aerosol Particle (um/n m)</th><th>Sulfur Oxides (ppm)</th><th>Nitrogen Oxides (ppm)</th><th>CO (ppm)</th></tr>
<tr><td rowspan="2">Air Quality</td><td>Limited value excluding the particle with a diameter over 10um
Monthly average: 210
Yearly average: 160</td><td>Limited value including the particle with a diameter over 10um
Monthly average: 260
Yearly average: 170</td><td rowspan="2">Hour value=0.3
Daily mean of hour values=0.1
Yearly mean of hourly values=0.05</td><td rowspan="2">Daily mean of hourly values=0.05
The number of days exceeding the limited value in a whole year should account for no more than 10% of the total.</td><td rowspan="2">Mean of 8 hours of hourly values=20ppm
Daily mean of hourly values=10ppm
Hourly value at whatever location/time= 40ppm</td></tr>
<tr><td colspan="2">The monthly average value should exceed the limited value for at most twice in a whole year.</td></tr>
<tr><td>Countermeasures</td><td colspan="5">To match traffic impact evaluation results, the parking area's passageway should be arranged on the road section with comparatively high traffic service quality. This is in order to avoid a high-volume discharge of pollution, which is generated by low-speed operation or traffic jams.</td></tr>
</table>

Controlling the situation of countermeasures on noises vary with different noise sources Due to the semi-enclosed space of indoor parking lots, and regarding the propagation of sound, the sound wave travels parallel to the work direction of vehicles spreading outdoors, while other sounds are also reflected and transmitted between the indoor walls. The types and countermeasures of noise sources are shown in Table 3.

5. Conclusion & Prospect

Parking storage facilities are an ideal instrument in the solution to a metropolis' severely insufficient parking spaces. However, a wide range of aspects should be taken into consideration when determining the establishment of parking storage in buildings. These include: processes related to such fields as government laws, regulations and policies, the mentality and financial operation of owners, architects' planning and design and the strength calculation of structural engineers, the construction accuracy of related manufacturers and their technical exchanges with overseas counterparts, agent companies' marketing philosophy, customers' acceptance, and the response of neighboring residents, etc. After all those aspects are well arranged and integrated, the feasibility study can be finally determined in establishing parking storage and successfully combining the structure within the parking facility. Therefore, an old adage states that "good creation yet unfeasible" can be avoided.

Table 3: Noise Sources & Corresponding Preventions

Noise Sources	Causes	Methods
Vehicle Noise	**Power system and running noise generated by the friction or vibration during contact with external surroundings.**	**Vehicle noise is not completely generated by the establishment of parking space, and laws and regulations concerned stipulate that the automobile speed in lanes around the parking space should be kept under 15km/hr. Furthermore, it has also been determined that the speed of entering the parking space should be no more than 10km/h which would yield no noise level disturbance to surrounding residents. With regard to ramps, floorboards and sidewalls made of special materials should be implemented to absorb the noise generated by accelerating or decelerating vehicles.**
Mechanical Noise	**Operation of mechanical component parts.**	**Washers should be installed on the interfaces between the mechanical equipment and major structures. This process is required to conform to the "Maximum Limited Noise Level of Noise Control Standard".**
Ventilation Noise	**Start-up or operation.**	**Acoustic treatment could be utilized concerning the ventilation noise, such as a single wall, jacketed wall, sandwich wall, damping materials, etc.**

(Chen Yung-Yu, 2000 / 01)

Once the vehicles on the road have been halved, roadsides are not crowded with automobiles and all issues concerning car parking in a city are completely resolved. The road is actually the most original and creative artist in metropolitan life (Hsiehku International, webpage from www.dodohome.com.tw). The smooth, rapid, secure, timesaving and convenient parking lot is now coming into being!

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Maintenance of university premises - principles, tools and experiences in practice

Martti Hekkanen
VTT – Technical Research Centre of Finland (email: martti.hekkanen@vtt.fi)

Abstract

The importance of renewal and repair older ecucational buildings is rapidly growing. Changes in use and at same the time the aging of HVAC-systems and building stocks causes need to plans repairs beforehand. The fair divide of costs is more and more important because of lack of funds. The positive side of lack of resources is that to day both the owner and the user have to think very carefully which rooms are really important. In the paper two simple pc-tools are presented. Both can be used when making long time maintenance plans and diving the costs of renovation by transparent and fair way.

Keywords: maintenance, maintenance costs, university premises, quality

1. Background and purpose of the lecture

In the real estate business the owner manages and maintains facilities for which the user, in the role of the client, defines functionality goals. In many cases the requirements set for facilities during the construction phase change. Alongside a long-term technical maintenance and repair plan, it is necessary to compile a facility development program based on the needs of the client, in other words, a functional maintenance and repair plan.

Program integration is a technically and administratively demanding process that requires customer service management, integration of a technical repair plan, efficient quality assurance during the repair process and careful documentation after implementation. To deal costs by transparent and right way betveen the owner and the user - that is in many cases the most hardest phase.

The currentness of the problem is rapidly growing. Educational, office and commercial buildings in Finland will enter their technical renovation phase in 2010 - 2020. The need to make functional changes grows as clients use facilities more efficiently. So far, no rules of the game or theories for implementing the process have been compiled.

In this presentation I'll show you some examples of simple pc-tools by which we can use to shed light on problems that arise when integrating technical and functional maintenance programs.

2. Planning of renovation

2.1 The Basis

Maintenance keeps the technical properties of a building in operating condition that corresponds to the original level. Programming of maintenance refers to a process in either the construction phase or the maintenance phase whose goal is to implement maintenance on the basis of a real estate strategy approved by both the owner and the client. A real estate strategy describes the goals which the owner and user set for the functional use of a facility. If the owner and user do not have a common real estate strategy, it is necessary when programming repairs to simultaneously examine a technical maintenance plan compiled by the owner and a functional maintenance plan compiled by the user. In such a case the plans are integrated by either speeding up or delaying technical maintenance according to the dictates of functional changes. Figure 1 presents common goals for which a real estate strategy is compiled. The importance of the goals varies, depending on the functional use of the building.

Safety in use
No disturbances in use
Support to the customer's business idea
Possibility to focus earmarked funds for planned renovation works
Possibility to measure services right and by that way find smooth stress of resources
Possibility to combine owner's and use's maintenance processes

Figure 1:. General goals for optimized maintenance and repair

The programming process consists of four phases. It includes parallel development tasks. The programming process is presented in figure 2. In phase 1 the process is assigned objectives based on the real estate strategy, and tools for cooperating are created for the owner's and user's organizations responsible for maintenance process. Repair and renewal plans are compiled in phases 2 and 3. The owner's repair plan is technical and focuses on maintenance of external structures and the building's basic technical systems. The user's renewal plan includes improvements caused by functional changes to the facility and repairs to the distribution systems of the building's technology. The limits of responsibility for maintenance are agreed on in phase 1. Phase 4 is critical from the standpoint of the success of the process. The user's customers are informed of the progress of the repairs and, for example, achievement of the goals set for the indoor climate. The measures are documented on the basis of rules of the game agreed on in phase 1.

Quality assurance covers both the technical quality of the measures and the functional quality of the process. Necessary development measures are implemented and the process is made into a routine.

In phase 4 repair costs have to be dealed between the owner and the user. Usually the owner is responsible all the planned repair costs. The functional aging cause needs for new rooms and better technical systems.

Part of these costs belongs to the user. The common way is that the the owner pays the renovation and the costs are to be included to the rent.

Co- operation process of renewal and repair work between the owner and the user (the client)
Repair and renewal plan for technical aging made by the owner
Repair and renewal plan for functional needs made by the user
Combinition of technical and functional repair and renewal plan

Figure 2. Phases of the maintenances process between the owner and the user

2.2 Implement the co-operation between user's and owner's maintenance organizations

In the 1st phase of the process the user's and owner's representatives agree on the principles to be applied in making more efficient use of the facility. These principles are:

- distribution of responsibility for maintenance between the owner and the user
- principles to be followed during implementation of repairs
- entry of changes made during repairs into the real estate information system and documentation of repairs
- planning meeting agendas and schedules

Development of cooperation is the key question of the process. The significance of this activity increases as buildings age and the need for repairs become concrete. Development of co-operation in new buildings can take place more freely.

2.3 Compiling a technical repair plan

A preliminary repair plan should be made already when the building is taken into use. The objective of a theoretical repair plan is to assess the proper level of costs during the life cycle. The assessment is based on suggested repair and renewal phases and investment costs. The assessment makes it possible to calculate a reservation for maintenance, which indicates what portion of the rent income from the facility needs to be set aside for future maintenance. Because tax legislation does not allow advance transfer of reserves for maintenance, the significance of the calculated reservation for maintenance is to indicate to the owner and user the magnitude of the costs. The theoretical assessment does not need to be very detailed, it is only used to determine the target level.

A repair plan that covers the entire life cycle or a life phase includes an estimate of costs and the timing of measures that will be implemented. The need for repair is grouped as follows:

The renovation phases can be selected in 5-year periods, for example. The economic life is usually considered to be 25 - 100 years. It is recommended to make the plan for 50 years The calculated interest rate can be freely selected (see figure 3). In planning life cycle-long maintenance, assessment of alternatives should take into consideration both the costs of the investment phase and future energy and maintenance costs.

The estimation is made by LCC. It gives us oppurtunity to see, what is the relation between investment costs and repair and renewal costs. This method is very usable in new constrcution models (so called Life Cycle Models). Anyway it must be remembered that the plan consists only repairs and renewal based on technical aging. Most cases changes in rooms are much bigger need for renovation in real life.

REPAIR PLAN 2000 - 2049		Economical life time	50	Building volume, rm^3	109734
Educational Building 1		Internal rate of interest	4	Building area, brm^2	27000
Rakennustyyppi			0,0466	Room area, htm^2	25304

RO	Kuvaus	yks	Amount yks	Investment cost [€/yks]	Repair costs KUST [€/yks]	Life cycle for renewal jakso [v]	Life cycle for repair [v]	Present value of repairs NA [€/brm^2]	Present value of renewal NA [€/brm^2]	Annual costs of repair vuosikust [€/brm^2,a]	Annual costs of renewal vuosikust [€/brm^2,a]	Annual costs of investments vuosikust [€/brm^2,a]	LCC [€/brm^2,a]
A1	Surface structures of site area	brm^2	27000	15	3	50	25	1,13	0,00	0,05	0,00	0,70	0,75
A2	Outside equipment	brm^2	27000	2	0,5	50	25	0,19	0,00	0,01	0,00	0,09	0,10
A3	French drains and piping	brm^2	27000	8,5	3	50	25	1,13	0,00	0,05	0,00	0,40	0,45
A4	Other earth and ground work	brm^2	27000	6	2	50	10	3,30	0,00	0,15	0,00	0,28	0,43
B1	Surface structures of outer walls	brm^2	27000	240	24	50	25	9,00	0,00	0,42	0,00	11,17	11,59
B2	Balconies	brm^2	27000	1	0,5	50	25	0,19	0,00	0,01	0,00	0,05	0,06
B3	Roof	brm^2	27000	9,5	5	25	10	8,24	7,06	0,38	0,33	0,44	1,15
B4	Windows	brm^2	27000	24	12	50	25	4,50	0,00	0,21	0,00	1,12	1,33
B5	Outer doors	brm^2	27000	6	3	50	25	4,95	0,00	0,23	0,00	0,28	0,51
C1	Internal doors	brm^2	27000	12	3	25	10	4,95	8,92	0,23	0,42	0,56	1,20
C2	Surfaces of rooms	brm^2	27000	76	25	25	10	41,21	56,48	1,92	2,63	3,54	8,09
C3	Fittings, equipments and installations	brm^2	27000	50	17	25	10	6,38	37,16	0,30	1,73	2,33	4,35
D1	Heating system	brm^2	27000	17	8,5	50	25	3,19	0,00	0,15	0,00	0,79	0,94
D2	Plumping and sewage system	brm^2	27000	28	14	50	25	5,25	0,00	0,24	0,00	1,30	1,55
D3	Ventilation system	brm^2	27000	58	29	50	25	10,88	0,00	0,51	0,00	2,70	3,21
D4	Electicity system	brm^2	27000	80	40	50	25	15,00	0,00	0,70	0,00	3,72	4,42
D5	Lifts	brm^2	27000	30	15	50	25	5,63	0,00	0,26	0,00	1,40	1,66
D6	Other HVAC-works	brm^2	27000	2	1	50	25	0,00	0,00	0,00	0,00	0,09	0,09
										(b)			
	Yhteensä, euroa									5,82	5,10	30,96	41,88

Figure 3: The magnitude of repair costs is determined with the help of a maintenance plan compiled in the investment phase. It is recommended that the repair plan is based on life cycle costs, not only investment costs.

The accumulation of repair costs during use is usually not linear. The need for maintenance in the initial phase is minor and the need increases as the building ages. Nevertheless, in order to plan maintenance, an estimate of maintenance costs is needed. An educational building is used as an example, where the economic life is considered to be 50 years and the calculated interest rate is 3 %. Figure 4 present accumulated maintenance costs during the life cycle.

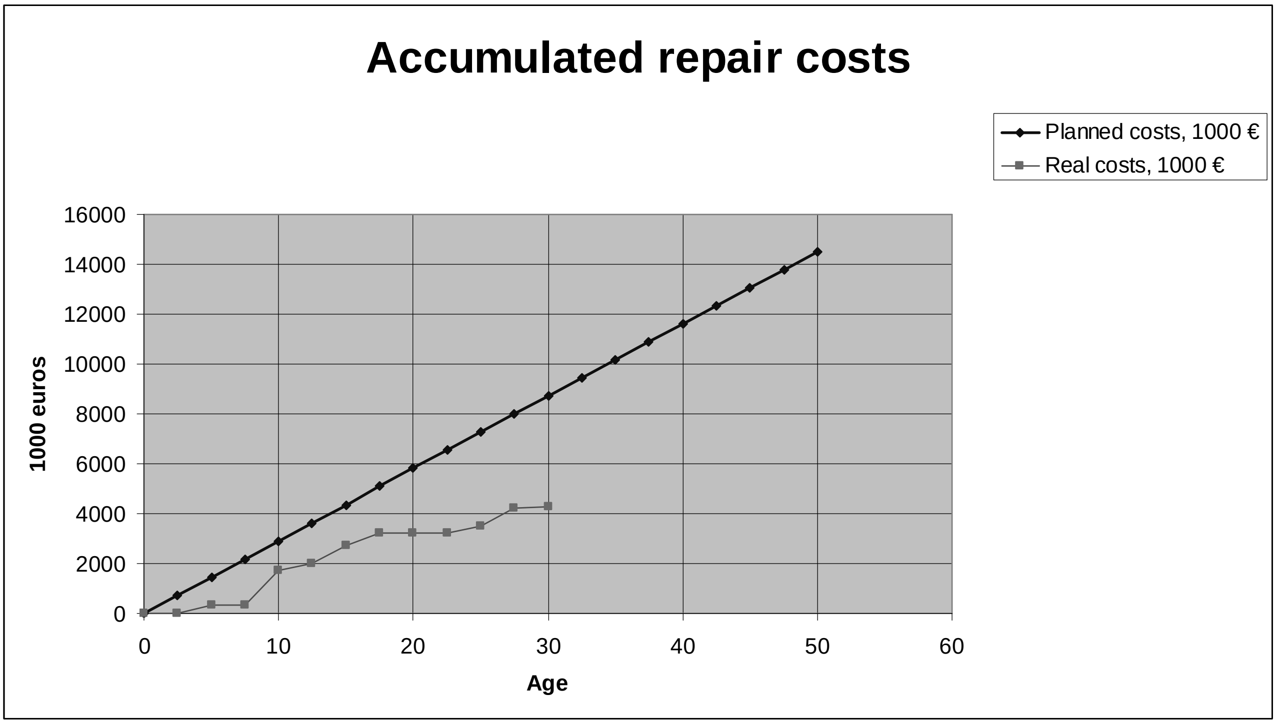

Figure 4: Timing of maintenance costs during the life cycle when accumulated maintenance costs are assumed to be linear. The white arrow indicates the difference between actual and theoretical repair costs during the life cycle.

In practice, it is not possible or even expedient to adhere completely to the theoretical repair model. There is considerable variation between the maintenance phases of different buildings, and other repairs resulting from changing needs in functionality are also always done in conjunction with maintenance.

In actuality, the need for repairs is based on periodic condition assessments and supplementary condition studies. A general operating model for condition assessments has been developed in Finland for both residential buildings and commercial and service buildings. Guidelines also exist for the most important condition studies.

A repair plan is always separately compiled for building components for which the owner is responsible (structures, building's technical systems) and for facilities where responsibility for maintenance can be divided between the owner and the user.

2.4 Compiling a functional repair plan

The owner's task in the maintenance process is to maintain such features of the building which ensure that the user's activities are safe, healthy and as profitable as possible. The user's needs change over time. Changes in functions may require

- new construction to provide additional facilities
- changing the facilities to better serve activities (dividing or combining rooms)
- improving the properties of facilities by technical means (structural improvements or technical improvements)

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1.2	Hanke 2			600	250	1.2																		
1.3	Hanke 3			300	200	S		13	1.3															
1.4	Hanke 4			600	260	S			1.4															
1.5	Hanke 5			600	800			S		1.5														
1.6	Hanke 6			600	200						S				1.6	R		600	150	RR				
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Figure 5: The user compiles a general schedule for functional improvement projects, which is integrated with the owner's technical maintenance plan.

Small user organizations usually do not have resources for programming functional changes. The problem with large users is the considerable number of customers, in which case programming needs to combine many different wishes.

Figure 5 presents a good example of a maintenance plan compiled by a user, where projects are timed over the planned period. The length of the planned period is usually 5 years.

2.5 Integration of the technical and functional plans

In order to be able to integrate technical maintenance, which is the responsibility of the owner, and functional improvements, which are the responsibility of the user, the user's maintenance plan needs to be joined to the technical maintenance plan. Part of the cost effects belong to the maintenance responsibility of the owner, and part are the responsibility of the user. In practice, the owner usually has the repairs done, and changes which are clearly caused by functional needs have an effect on the rent of the facility.

In integrating it is important to determine how the responsibility for repairs is to be divided between the user and the owner. The distribution can rarely be made only on the basis of the technical age of the building components, since it is possible that varied amounts of repairs have been made to the building components during their usable life. Furthermore, functional changes are made in the facility which result in changes to its properties. Figure 6 presents a model for dividing costs.

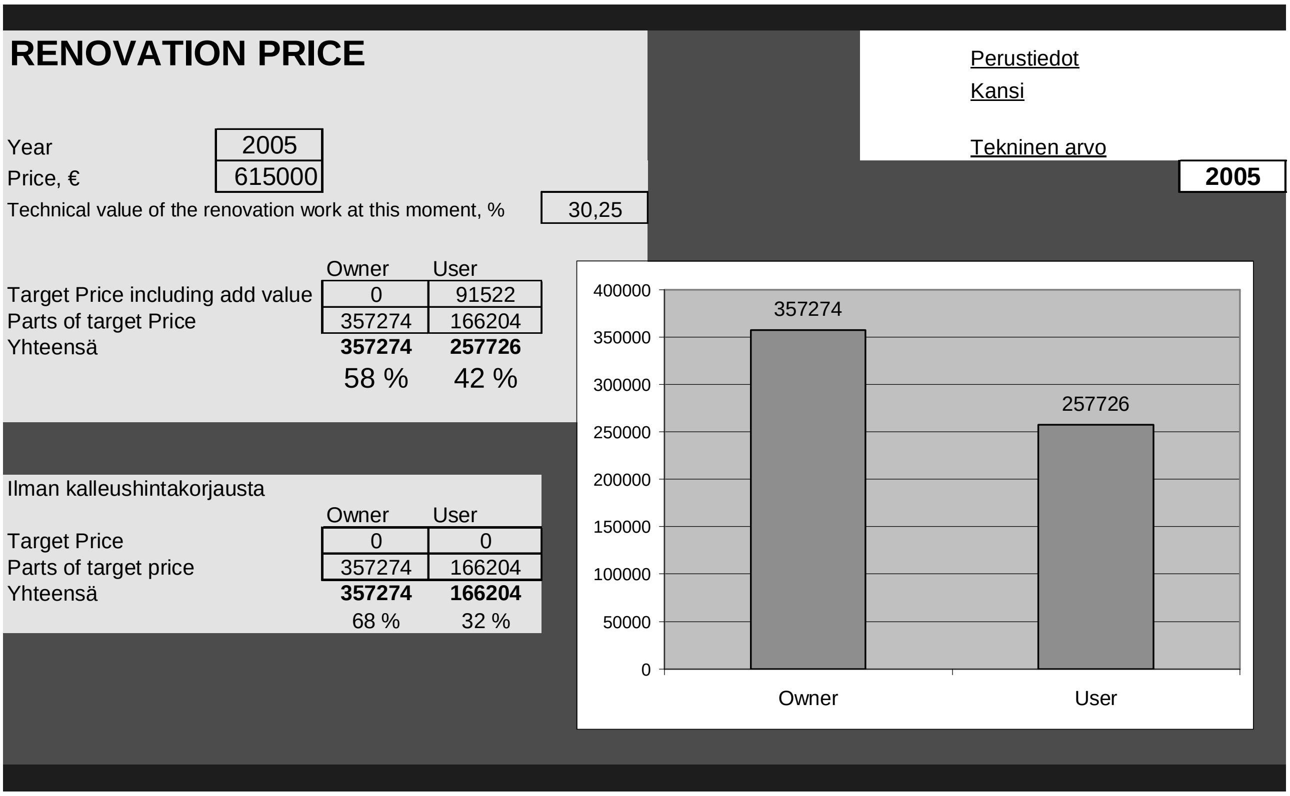

Figure 6: Cost distribution model for dividing the cost of facility repairs, where the change in technical value is based on progressive depreciation.

3. Conclusions

Organizations that are responsible for users' and owners' real estate management in Finland are generally professionally very competent. There is an abundance of technical tools for facility management. It has usually been possible to agree on the main principles used to reflect the costs of maintenance and modifications in facility rent.

The need for functional development of facilities in university buildings, in particular, will be very significant in Finland in the near future. Universities in Finland mostly operate in facilities owned by Senaatti-kiinteistöt. Senaatti-kiinteistöt is a professional real estate owner whose main objective is to function as a service organization and as far as universities are concerned, to be a responsible partner that develops its facilities. The development of the products presented in this presentation has been commissioned by Senaatti-kiinteistöt.

Enhancing partnership is a continuous process. At the strategic level, partnership can be developed, for example, as follows:

1. Compile a vision of operation in 2015, for example, together with the user
2. Compile an estimate of the facilities needed to implement the vision
3. Compile economic planning calculations of the effects of the costs of the target state on the user's operating costs and prioritize the vision's focal areas of development

4 Compile a plan of how technical repairs can be made to support implementation of the vision in the best way possible

5. Develop the owner's customer relations management, create real benefits based on a regular customer relationship.

At last - buildings are only resources. The money we need for maintenance and operations is also a resource. We have to remind that universities are places where the seeds of better global future are seeded. That is why it is highly recommended that co-operation process between owner and client consists of any high barriers. My own experiences after having involved as a small part of the process tor three years are, that people in both sides are so educated that provisions for managed co-operarion really exist.

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Relating Housing Maintenance and Professionalism of Owners

Roode Liias,
TUT – Tallinn University of Technology (email: r.liias@anet.ee)

Abstract

Reports about poor condition of dwelling stock discuss about lack of proper maintenance and about poor repair of the dwellings in shared ownership. These reports do not always touch the role of the (co-)owners in the whole process, rather the papers are concentrating on the affordability issues – the vast majority of the households still cannot meet their housing costs.

Current paper is based on the results of research done for the Nordic Council of Ministers funded project 'Developing professionalism for housing maintenance management in the Baltic States'. Housing maintenance related professional associations of the three Baltic States have been the major partners to this project.

The following issues are to be discussed in the paper:

- role of condominiums (home-owners associations) and the relevant non-governmental institutions when improving the housing environment
- professional services and raising public awareness about housing maintenance
- lack of reliable data about housing conditions

Contemporary facilities management (incl. housing management and maintenance) requires wider introducing of the principles of informed owner in the property market, requiring significant degree of operational knowledge and experience. Housing maintenance has become a customer-oriented service industry where the service providers are organised and running their schemes for professional certification. Especially in the transition economies the key-counterparts – the owners of the dwelling units – are often lacking any informational support and possibilities to co-ordinate their activities.

Keywords: facilities management, maintenance; housing stock; owner-occupation; intelligent owner

1. Role of maintenance when preserving property

Until very recently, designers of buildings and advisors for the property owners have focused their main attention on capital costs, paying little heed to the interest to forecast maintenance and other running costs. Yet over the life span of a building, expenditures for maintenance and proper repair may be at least 2 or more times of the initial costs. [1] Moreover, though manufacturers advertise about availability of maintenance-free materials, the costs for maintenance are growing on most of the buildings.

'Maintenance' as term has been missing from the professional terminology not only in the East and Central European (ECE) countries, but this term has not always been very clearly defined in the western countries. [2] Rather often maintenance is used in direct connection with repair and refurbishment activities; accordingly these activities and the related to these costs are sometimes handled as one causing major confusion in the field. [3]

Any structural part of a building or a utility-system requires relevant maintenance to be planned and carried out there to assure they provide the necessary service for the users and the environment remains safe and sound. Correspondingly, not only the originally installed and currently ageing structures of buildings (built either during the soviet period or even much earlier), but even the newly built, or refurbished, or restructured, or reinstalled finishing and structures, though especially the engineering service systems would require planned care taking. Even the very different construction projects developed today rather often do not foresee any activities for regular maintenance during the period of use.

Buildings – their structures and the engineering services – that are not maintained as required will cease to fulfil their intended functions. Regular maintenance that has been carried out just-in-time for preventing and doing away with the defects while they are still minor is generally considered as the most cost-effective strategy for providing well functioning buildings. Planned maintenance can normally prolong the useful life-time of the structures and systems almost indefinitely as replacement will be required less often; accordingly operating costs will be reduced for the owners and users, but also less resources will be used and wasted for the society in general. Moderate financial inputs into maintenance enable operators to extend the life-span of an existing building until a replacement will be required.

Buildings are developed to satisfy different human needs – we may talk about buildings that are developed for different business but also living purposes. ‘Facilities management is the provision of the physical infrastructure necessary to best support the achievement of an organisation’s primary objectives. It is a managerial service related to the continuous provision of space for working and living.’ [4] This is one of the oldest and the most traditional definition for facilities management (FM) provided in academic literature. Thus, all the activities related to servicing the buildings and the users located there may be covered by the umbrella term FM. And it is of major importance to understand that these are not only the walls and structures (created by the construction professionals) that are required by the different users of the buildings – the users require quality-services to be provided during the period of use.

In fact, any company, and a public office, and a household are organisations requiring adequate space for their major activities – either for business, or for public administration, or for living. This-why for a FM professional there should be no major difference what is the purpose of the organisation he is servicing – facilities manager has to understand the specific interest of the end-user-organisation and based on this information as input to build up a network of in-home or outsourced service-contracts from different most adequate providers. Maintenance services are amongst these services that are to be provided for the buildings anyhow to satisfy the requirements of the users.

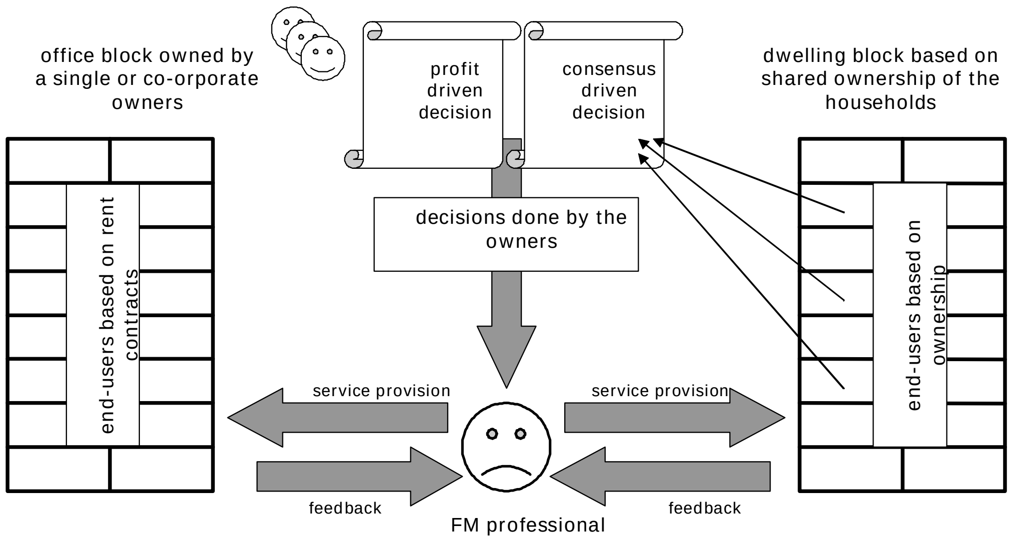
Maintenance services provided by a relevant contractor do not automatically create a good environment for the users – maintenance helps only to develop required conditions for suitable and adequate using of the premises. Though, poorly provided maintenance always leads the users of the premises to question the facilities manager about the reasons for not adequate quality of services delivered for them. Poor quality of maintenance is usually a result of lack of consciousness and knowledge among one or more of the parties acting in the FM market.

2. Relating housing sector and facilities management

Dwellings are valuable assets which are normally built up using substantial investments over a long period of time, but these assets are not always managed and maintained with the care that they actually deserve. The experience of the author of the paper gives the evidence that in many countries in East Europe building maintenance is insufficient or in fact non-existent. [5,6] The resulting deterioration reduces the ability of dwellings to perform the intended functions designed for these buildings. For example, a heating system requires similar maintenance technology to be implemented either in a block of offices or in a block of flats – only the output performance level may differ as to timing of the inside temperature requirements may differ.

Though for the maintenance service providers there is no technological difference when arranging and providing services for the user organisations in different buildings, there is still considerable difference for the facilities manager especially when business and housing premises are concerned. (Figure)

A block of offices is owned either by a single owner or by a corporate owner; most of the small business organisations are relatively short-term tenants in these office-blocks using one or a couple of office units there. The owners of these blocks are interested in having tenants using the premises and facilities. Tailored for the user's needs and in adequate repair premises are prepared for them; afterwards regular and reliable cleaning service – but not only – plays an important role to assure satisfaction of the tenants as the clients. Quite often in 2-3 years most of the user-organisations restructure their company-structure, sometimes this restructuring may be rather considerable. The facilities manager has to refurbish and rebuild the premises, though technically these premises may be excellent and they may still meet the common aesthetic requirements. The user organisation may even move out of these excellently maintained premises in any moment not dependant on the quality of services provided for him; removing elsewhere may be related to better functionality or better location of the new premises that will fully meet the current needs of the organisation. In any case the facilities manager in charge for the premises has to start looking for the next tenant organising total refurbishing even if there have been no any crucial damages



caused to the vacant premises.

Figure: Role of FM professional when managing different properties

In a block of flats in the case of condominium type shared ownership organisational behaviour is different. Considering the experience of the Baltic countries due to massive privatisation of flats in large-scale housing in average there are about 50 up to 100 co-owners in a block there. In this case though the ownership-rights for the block are shared, each household has still the right to say a word and participate in deciding about the repair-level of the block. In the case where the owner-occupation ratio absolutely prevails – in Estonia and Lithuania the total ratios of owner-occupation is more than 95 per cents – getting consensus is extremely difficult; when making decisions each household will rank their household-interests as the priority ones. As currently there is still not much variety and possibilities for the households to move into different blocks being more adequate and affordable for them, accordingly the structure of the residents in the blocks remains stable and each of these co-owners will give the highest priority to private and household's interests.

The major difference when maintaining these two blocks is based on the motivation of the decision-makers. In the office-block the owners are profit-led when making decisions and quite often they use the facilities manager as the adviser to get financially the most feasible solution. On the contrary, most of the flat-owners have limited budgets for their households though they are also looking for 'best value for money' they are aiming to the same target through cost-reduction. On the general meetings of the owners rather often there appears the clear conflict in the interests of the owners and the facilities manager – the latter is obliged to carry out professional service which is inevitable related to certain costs, on the other side his activity is limited with costs which rather often are not adequate for the target.

Facilities manager is the mediator, not the decision maker, who has to turn the owners' decisions into practice through providing relevant maintenance services. In different blocks decisions may be differently targeted, though the technical specification of the service is quite the same; in any case the facilities manager cannot initiate providing any services that are against the will of the owners.

Rather often it is stated in the papers and reports that massive home-ownership in large-scale housing stock is not affordable! [7] As the quality of these blocks from 60es – 80es is poor and no refurbishing has been done there for about two generations, correspondingly to make these blocks habitable to meet the current technical requirements will require too much sources by the households to be invested. Though most of this housing stock in the ECE countries is currently privately owned and the flat owners (or homeowners) are responsible for all the costs related to these blocks, still there remains rather heavy burden on the society as well. Too many of these households – though being the owners of the properties – still require different housing allowances and the neighbourhood renewal projects require also considerable investments to be done by the authorities.

The numerous surveys give clear evidence that the households and the homeowners' associations (HOA) quite often reduce their housing costs through avoiding preventive maintenance. Only emergency maintenance is considered to be inevitable, but in long-run this is always relatively more expensive as ordering the works for preventive and routine maintenance.

The attitude to solve the affordability related problems through avoiding maintenance gives only short-term 'profit' or 'benefit' for the home-owners – affordability level of the sitting households is improving, the next generation has to pay the 'not-paid' bills. Doing away with regular maintenance reduces the level of sustainable living-conditions both for the households located in the block, but also for the society in general. Dwellings that lack normal maintenance will burden the next generations with much higher costs related to housing stock; if by this time it will be still feasible to make any investments to improve these facilities. In any case the initial target to create the housing stock of adequate quality will remain unreachable; avoiding maintenance will reduce the general level of sustainability in the society and in housing sector. This is the decision-maker's 'trap' in there.

Decision makers in housing often do not pay much attention to management aspects of the building. This may be because they are not fully aware of the financial implications caused by poor care to the buildings they have been appointed to manage. This is still a rather typical approach to the problems in the housing sector – there is an institutional 'somebody' who is the decision-maker and everything depends on his awareness and competence. Poor maintenance usually results from lack of awareness amongst these decision makers and the residents of the buildings; therefore the buildings are not managed professionally and maintenance in particular is not given high enough priority – resulting in unnecessarily high operating costs and low building standards. Improvements in the management of such large building stocks can save reasonable amounts of money.

High prices for houses and fees for housing services, also for maintenance works, are much discussed in media; also the problem of continuous disrepair is understood by most of the households. As the property owners they are legally responsible for funding all the works to keep up their properties meeting certain standards; but money required for maintenance works comes directly from the budget of the households accommodated in the block, households are interested in influencing the decisions done in the way that the expenditures from the budget of their household would be minimal – low costs are ultimate priority! In fact, this is fully clear and understandable from the human point of view. This why, all the scheduled activities of preventive nature – if not inevitably required when the decision has to be done – are post pond. Shortage of funds by the owner-occupier households is the reason for poor maintenance, but also lack of awareness about the consequences when scheduled preventive works are not executed.

The basic human need for shelter is defined as the housing problem in terms of quantity and quality: is there enough housing to go round, and is it of satisfactory standard? But often the physically decent or even excellent standard cannot guarantee satisfaction for the tenants when the facilities in question are poorly managed, or the expenditures for keeping these up are not affordable for the person responsible for cost-covering.

Successful management of dwellings is almost completely based on skills and efficiency of facilities management services provided, therefore requiring skills and knowledge not only about the financial and technical-engineering aspects, but also social-managerial aspects are of crucial importance.

3. Intelligent owner – key-actor in the market

Professional and quality FM services are always connected with relevant expenditures; any property owner will require these services to be provided. Therefore, based on the basic principles of FM [8] only the largest property-owning organisations can benefit from the strategic approach to FM. The whole housing sector – though it consists of a large number of estates of reasonable size – during the privatisation has been split into rather small and independent management units (home-owners' associations – HOA-s). Professionally reasonable FM advice can be provided for the whole estate, but these recommendations may be of no great value for particular block and for a HOA as they may be in lack of relevant finance; but even if the money would be there, not always there is common understanding in this block about using these sums.

During transitional changes the general trend in the housing sector has been from a parochial and highly regulated and centrally managed market to one, which is increasingly deregulated and split into small and rather unprofessional units where conflicts and different viewpoints and interests govern. Even if professional FM-consultancy is provided for the HOA to improve the current condition in the blocks, the final decision lays anyhow after the owners who will vote democratically keeping in mind private priorities. The majority of owners are not professionally skilled as for construction, maintenance and facilities management services.

The role of an informed owner in the property [9] but also in the housing market requires a significant degree of operational knowledge and experience to:

- understand and clearly specify the service requirements and targets that are most suitable for the property they own;
- arrange the relations amongst the co-owners when managing property;
- understand and develop service delivery strategies and to manage the implementation of outsourcing strategically most important services;
- agree when monitoring the standards used when describing quality levels of services and benchmarking performance;
- manage different contractors for cleaning, maintenance and repair works and monitor their performance level;
- understand relevant financial, technical and managerial reports provided for them;
- be ready for negotiations with contractors or users of the spaces and for decision-making agreeing changes to service requirements;
- develop his/her own owner’s skills through awareness raising, but especially through regular training.

Based on the criteria listed above, educating the property owners (especially owners in the housing sector), it is vital for managers and operators to enable them to fulfil their roles and perform their full professional potential in the market.

Administering of owners obligations may be viewed as a three-fold list of activities to be covered. An owner has to consider any activity listed how it can be carried out in practice to meet his or her interests in the best possible way:

long-term decisions

- introducing a maintenance manual for the property – the building and its structures – and assuring reasonable performance of it
- compiling a relevant economic plan (business-plan) to run the property following the requirements described in the manual
- planning schedules for maintenance works for the forthcoming years

- preparing and signing long-term contracts for preserving the property and getting necessary utilities services
- assuring the availability of professional supervision to guarantee that all owners interests are reasonably followed
- deciding about developing different projects to refurbish and renovate the building to improve its quality and meet the changing needs of households

operative decisions to

- assure that routine and regular monitoring of the situation and condition-assessment is be carried out on the property
- supervise over different contractors/workers performing scheduled maintenance works
- plan and order all necessary security measures, incl. negotiating reasonable insurance
- assure that professional teams are available to treat emergency situations
- take decisions about organising tenders; incl. setting up a list of criteria for selecting the best bid
- prepare and sign contracts for maintenance with suitable contractors

administrative decisions

- taking reasonable decisions about employing staff and assuring that the owner can properly fulfil an employer's role
- forwarding relevant authority to any person who can represent owners in negotiations or dispute settlements
- related to administering financial and technical documentation about the property
- assuring the availability of all necessary reports and taking decisions based on analytical data about the results of maintenance

4. Some conclusions and findings

Contemporary property management (incl. housing management and maintenance) requires introducing the principles of the informed owner in the property market, requiring significant degree of operational knowledge and experience. Housing maintenance is a customer-oriented service industry. The service providers are organised to professional associations and running their professional competence and certification schemes. The key-counterparts – the owners – are quite often lacking any informational support and co-ordination in their activities.

The following questions are still to be highlighted for further studies and debates:

- who should have the major incentives in the society and/or in the business sector for organising and training the residential property-owners in the society?
- what is the role of the state and/or the municipalities when organising these awareness raising schemes who have been the institutions standing behind the massive privatisation?
- what is the public attitude and the general understanding of ethical behaviour in the market – is it considered fair behaviour when the service providers themselves start training the owners as their potential clients?

The result of the study done within the project however has been targeted is to rise as many questions as possible, though currently it was even impossible to supply the data that was requested. One finding that came through very strongly is that many individuals and institutions involved in the study have not robust performance about management and maintenance systems in place.

Difficulties have been experienced concerning the use and meaning of terminology. It cannot be the aim to come up quickly with fully harmonised maintenance related terminology. Currently maintenance is rather widely used not only by the professionals, but mostly by the politicians and in the legislative documents as an umbrella-term and though several publications and presentations done during the last couple of years it will require much time to become accepted in the society.

Most of the estates visited during the project are in poor physical state due to the neglect of essential repairs and maintenance for many years. In many large-scale housing estates especially the residents have become dissatisfied with the management of their estates; the residents – mainly the owner-occupiers of the privatised flats on these estates – complain of lack of commitment by the authority staff which is said to result in repairs and cleaning not being performed and in general neglect of the estate and its surroundings. Thus, the authorities have treated the privatised housing as property owned by them – the actual owners are fully distanced from the possibility to make decisions.

Collaborative activities are needed amongst leading practitioners, education and research sectors to ensure that the processes in housing maintenance are fully understood by the decision-makers, knowledge and experience are shared by the counterparts and that professional and ethical standards are established to provide the benchmarks for resident interests based effective practice.

Engineers and other technical staff employed for managing maintenance of housing estates are too often by training background mainly oriented towards new construction; maintenance is always perceived as direct extension of the original construction process that should and could be carried out by professional building staff. Therefore several housing maintenance organisations are often subsidiaries for construction companies with good technical competence and equipment, but far away from the estates and targeted to doing works on the sites rather than providing residents targeted services. Maintenance has to deal with the existing buildings and with the needs of the households living there; accordingly many routine maintenance activities absolutely do not require technical skills rather human understanding. Therefore, in addition to educating the owners also professionally skilled maintenance managers are required.

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A New Paradigm for Construction Demand and Delivery: Developing a “Living Building” Concept

Hennes de Ridder
Centre for Process Innovation in Building and Construction, Delft University of Technology, Faculty of Civil Engineering, Delft, The Netherlands (h.a.j.deridder@citg.tudelft.nl)
Ruben Vrijhoef
Centre for Process Innovation in Building and Construction, Delft University of Technology; TNO Built Environment and Geosciences, Delft, The Netherlands (ruben.vrijhoef@tno.nl)

Abstract

Managing construction projects and life cycles of built objects including their dynamics, and the inevitable changing circumstances and environmental context has proven to be difficult. However, procurement and supply strategies in construction are often based on a static approach: fixing briefs and contracts at the beginning of construction projects, when many issues are obviously still unknown or unresolved, many parties are not yet involved in the process, and change orders through the project and the life cycle are not yet known. This paradox calls for a shift from static to dynamic control of projects and life cycles, towards a “living building” paradigm of construction. This means introduction of new models, methods and contracts enabling to cope with the dynamics of construction projects and life cycles, and assuring that value is delivered and maintained adequately under changing circumstances.

In this paper a concept is presented to develop a “living building” paradigm for construction. The concept addresses two basic problems that currently exist in design and construction processes, leading to many conflicts between demand and supply. The inefficiency and ineffectiveness between demand and supply is caused perception of demands and solutions, combined with process statics and fragmentation in time. The development of the concept is based on a dynamic and interrelated approach to the demand and the delivery of built services. The concept implies new principles for procurement and supply strategies, process management and alliances between stakeholders involved in construction projects. The next step in the development of the concept is the extension of the new paradigm through the entire life cycle. This includes the formation of stakeholder alliances for the life cycle aimed at the maintenance of the long-term functionality and serviceability of built objects. Ultimately, this must lead to a shift of the construction industry as a whole from a project delivery industry towards a built service sector.

Keywords: construction projects, life cycle value, dynamic control, price development, process statics.

1. Introduction

In construction, demand and supply of value can be a complex undertaking, particularly for large construction projects involving many parties and long lead-times. The main problem identified is the intrinsically dynamic character of the process, and the changing and often diverging perceptions of parties of the outcome of the process, versus the static approach to the control of the process, because of formal arrangements between parties. What is needed for the effective control of construction is an aggregate and comprehensive model to be able to dynamically and effectively control and adapt demand (clients' value) and supply (delivery) in an integrated manner through the entire process, and idealistically through the whole life cycle of built facilities. Such a "big picture" model or "master plan" method has not been common in construction, but is essential to be able to control the complexity of building.

The concept presented in this paper represents an abstract, "sociological", or even "philosophical" view on building and built services. The concept is called the "living building" concept to indicate the dynamic approach to built services, the construction project, and the life cycle. In the concept presented the basic economic parameters value, price and costs are defined and interlinked on a high abstraction level representing the performance of the built service. The basic premise is the dynamic character of the connection between value and costs, price and performance, and therefore should be controlled dynamically; so no prescription of output against a fixed price, but rather defining a dynamic connection between performance and price. The concept is representing a further development of the concept of dynamic control, which has been introduced by the authors in previous papers [1] [2] [3]. The concept is based on the essential notion that the world is changing. Second construction is a social activity: Construction implies complex product development in a changing context, involving many parties, delivering products with value to society, pulling high levels of resources from the economy. Construction projects often take long time, and the life cycles of built services are long. During the construction process, the level of information and knowledge grow, by both the client and the supplier. Demand and supply influence one another. So requirements of buildings change constantly. Demand must be adaptable and supply must grow along. Procurement and supply strategies as well as project and life cycle management arrangements must be able to cope with these dynamic mechanisms. This calls for a reconceptualisation of the demand, delivery and life cycle management of built services.

2. The "living building" concept in construction

2.1 The problem of perception

The basic reason and rationale of a "living building" concept in construction is based on two underlying problems in construction: perception and process statics. These problems start with the demand and the fact that the first demand is basically always incorrect or incomplete, while it is impossible to demand before knowing what is available and possible, nor is supplying without knowing on a basic level what is wanted. So demand and supply are intrinsically connected, and this should be reflected in the process towards delivery of built services. However in current construction practice, this is often not the case. Demand and supply are relatively disconnected. Consequences are extra work and creation of extra value after establishing what had to be delivered after all, or work or value delivered in vain when finding out what not had to be delivered. This is basically the result of the tension between value and costs, i.e. the interest of clients' value versus suppliers' profits.

2.2 Construction process statics

The ideas and expectations of a successful project are often subjective, implicit and contradictory. For whatever reason there is always a need for change during process, so there is a need for a dynamic approach. This is particularly true in construction, where there are often no formal rules, no strict hierarchy, no fixed product, variable projects, many parties involved, unsynchronised involvement, absence of one party who has complete overview and authority. Traditionally, the "natural response" in construction is to try and fix and isolate various aspects as much as possible, including fixing the price and the design early in the process, which leads to quasi-certainty, process statics and disproportional additional transaction costs. Due to the fragmented and delegated control, and long demand and supply chains, changes come often too late to be able to effectively and systematically deal with. Change orders take lots of effort to follow up, and are often compensated through extensive rework or claims [4] [5].

2.3 Need for a dynamic approach to construction

The problems of perception and process statics and the paradox between static control and dynamics of construction life cycles call for a dynamic interrelated and long term approach to the demand and supply of built facilities aimed at systematic and adaptive maximisation of the total life cycle benefit (total value minus total costs) of built services. Value and costs are time dependent, thus the dynamic process must be aimed at the continued maximum benefit. When the total value could be interconnected qualitatively and quantitatively to the total costs of a built service, and parties would agree on the algorithm between value and costs, then the collective of demanding and supplying parties can aim the process at achieving the highest possible benefit to the mutual advantage of both demanding and supplying parties.

The contract will then not prescribe an absolute performance output against a fixed price but rather define an agreed-upon performance-price balance, i.e. value-costs balance. Within a "performance related partnering" arrangement the process can then be dynamically controlled, i.e. clients can alter their initial demand and calculate the impact on the initial price, and vice versa supplying parties are enabled to come up with new solutions that may reduce costs, or deliver additional performance output increasing client value. The initial price will grow within this dynamic process in a controlled way to a final price that may be higher or lower than the initial price for the initially planned performance. Instead of enforcing the initial planned performance against a fixed price calculated in the first phase of the process, the price is based on the actually delivered performance at the end of the process. The final price goes up to the maximum of the initially set maximum guaranteed price, not exceeding the planned budget of the client. The range between initial price and maximum budget can be considered as the client's "control budget" for dealing with problems of perception and additional value delivered through the process. Because of the transparency of the process, on the supply side, contractors and other parties are enabled to reserve budget too for extra investments to reduce costs or increase value. This approach can be defined for the project scope only, but can be extended to the whole life and the facility management of built facilities, and be implemented to a variety of contract formats from build-only contracts to more inclusive "DBFMOT" kinds of contracts.

3. Principles of the "living building" concept

3.1 Procurement strategy principles

The client's budget needs to include a buffer for dynamic control by the client. The supplier (e.g. contractor) sets an initial price for a basic solution to meet the client's initial wishes. The buffer between the budget and the price is used for unforeseen changes and change orders; changing demands, requirements, regulations, standards, technology, finance etc. The following procurement process is based on a continued process of "price development": it starts with an initial price for initial design, through a final price for actually measured additional output at the moment of delivery, and next constant measurement of delivery of life cycle value (figure 1). This process can be capped, e.g. by means of a guaranteed maximum price [6]. Thus the lowest price is must not necessarily be the client's main selection criterion and driver. Rather it is necessary to realise that costs have to be related to the value delivered in a constant manner, and value for money has to identified, to assure that clients get the best possible life cycle value from suppliers (contractors etc.) [7]. However, in current practice, criteria for selection and bid evaluation of contractors are often still aimed at mere project delivery capabilities. For the "living building" concept, a wider range of criteria is needed to evaluate suppliers' capabilities against the needs of clients and other stakeholders [8]. Thus the procurement system must be linked to the client's priorities. The priorities and the procurement system are influencing the team selection, and thus the project outcome and performance level [9]. The use of "sound" selection criteria and application of a "best value based contractor selection framework" are essential to achieve the desired project outcome and "best value" [10].

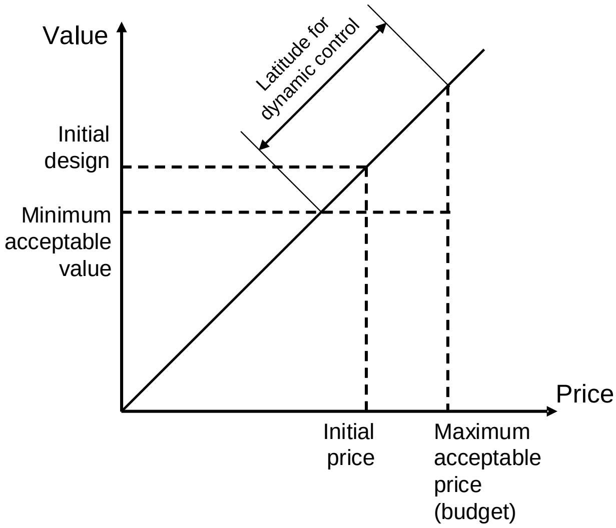

Figure 1: Principle of dynamic control

The ultimate goal is to find the best solution for clients and other stakeholders, as well as the contractor and suppliers, i.e. best value for the client at minimal costs for the supplier. This maximises the benefit; value minus costs. Client and supplier share the benefit by finding a right price in the middle. The goal specificity is influenced by value specificity and the client's requirements. Higher levels of value specificity and observing life cycle value rather than project delivery improve the final project outcome and the starting point for the rest of the life cycle of the built service [11]. In order to specify all stakeholders' values and project priorities, value engineering must be a structural component of the procurement process. Analogously to the procurement process, the value engineering must be performance based, not price based. This implies measuring and rewarding performance delivery, minimizing adversarial relationships and collaborative decision making leading to "best client value" [12]. Besides "value optimization" value engineering must be aimed at target costing, in order to increase and maximise the gap between value and costs, i.e. maximising the total benefit for client and supplier [13]. This kind of "value for money" approach has the largest potential in the early stages of the project, i.e. the briefing phase, when strategic decisions are made, together with application of integrated life cycle contract types [14] [15]. During the value engineering both client and supplier must be committed to invest and use extra budget to develop the design collaboratively based on life cycle incentives within an alliance or partnering arrangement [16].

Negotiation and collaboration have been advocated rather than competition and relying on market mechanisms to achieve best value for money. However, it has also been argued that competitive procurement methods achieve better value for money than negotiated procurement methods [17]. Clients tend towards competitive tendering to get value for money. Contractors tend towards negotiation and longer term contacts to strive for delivering value for money for a longer in the life cycle [18]. Strategic procurement methods, like framework contracts, have been observed to be more effective in particular sectors of construction, where longer term contracts offer specific benefits [19]. Reengineering procurement methods towards more from adversarial relationships to more co-operative and partnering relationships, need to be combined with fully integrated and coordinated design, integrated supply chain management, and efficient managerial control of the whole design and construction process, leading to benefits to all parties [20].

3.2 Supply strategy principles

Current supply strategies in construction are in most cases restricted to project delivery only. Future supply strategies must be extended beyond project delivery, including facility management, maintenance and refurbishment, to assure the functionality and serviceability of the built service. This implies "continuous value delivery" or "life cycle value delivery", instead of project delivery. This approach requires dynamic control capabilities of the whole life cycle by suppliers of built services. The industry needs to broaden its approach to value delivery, and apply the concept of value delivery proactively vis-à-vis construction clients [21]. In general, the "living building" concept requires that the industry moves from a delivery system within a price based environment towards higher level of "performance based competition" [22].

Industry partners must adopt the use of integral value management through the supply chain to facilitate collaborative working and increased inter-organisational collaboration for resolving current industry inadequacies regarding design, construction and facility management [23]. Integration of the team to the client's value system is essential to capture client value from the beginning of the project and informing further decision making during the project, and continued value delivery through the value chain [24]. Therefore, contractors and other suppliers in construction must develop and improve their pricing strategies, their costing capabilities and their financial risk management [25].

3.3 Integrated process principles

The "living building" concept must result in the integration of the design, construction and facility management of built services. Based on the awareness that perception and increasing knowledge will influence and affect demand as well as possible solutions during the process, clients and suppliers team up to develop and deliver the built service, based on a common understanding of the demanded value, performance, and how to define value, costs and price dynamically. Both clients and suppliers are no single entities, but often complex configurations of stakeholders, with different value assumptions, interests, investments, particularly in large construction projects, sometimes within a complex political social, economic context. This calls for extended stakeholder identification and involvement to define best value (demand) and deliver best value (supply) [26].

Operation costs of a built service over the life cycle are a multiple of the initial construction costs. Decisions in the briefing stage and the design process influence life cycle costs [27]. To improve the delivery of client best value the contactor gains more control over design and construction, in order to be able to assure the continued value delivery thought the life cycle. Therefore life cycle costs data and evaluation techniques must be linked to design development tools [28]. Then process control can be based on dynamic performance information and continuous output measurement, aimed at total costs minimisation and life cycle value maximisation [29]. For the cost evaluation of choices made through the life cycle, a comprehensive framework for decision-making is needed; ‘a continuum which links the life cycle cost across different stages of the life cycle’ [30].

4. The “living building” future of construction

4.1 From performance specification to output measurement

The “living building” concept advocates the shift from performance specification to output measurement. In current practice, clients often define the performance in the brief at the start of the project and use change orders to alter their demand during the process, even still in the construction phase. Change orders are often regarded as a phenomenon occurring outside the briefing rather than integrated part of the briefing process. Previous authors have proposed the application of “dynamic brief development”; a process to develop the brief allowing change orders until the brief and the price is fixed after a certain period of time during the first phase of the project [4]. The “living building” concept implies a dynamic approach to the brief that goes beyond this in two respects: the brief is kept dynamic until the project is delivered allowing changes from both clients and contractors/suppliers aimed at further improvement of the value and cost level; the price forming process is kept open based on the dynamic brief. The price is established eventually at the end of the project based on output measurement according to formulas that have been agreed upon by client and suppliers.

4.2 From static to dynamic process control

In the “living building” concept, the dynamic briefing approach is extended from the early briefing stage of a project through the design and construction process. This implies that the entire process is managed by dynamic control. To enable integrated dynamic control of the entire process and the supply chain, the interfaces in the design and the team are conceptualised by means of a systems approach that allows to design and evaluate the design holistically, and to monitor and take collective action after things change. In this way, the dynamic briefing process is extended throughout the entire project process. The project brief is the dynamic basis for continually developing and adapting in an integrated manner design and further technical development and realisation of the built service. This requires a control mechanism for development and feedback that incorporates all aspects of the value delivery process and connects all actions by participants to project priorities, and supports information sharing and informed decision-making [5].

4.3 From a project towards a life cycle perspective

The ultimate step of the "living building" concept is the extension of the dynamic approach after project delivery, through the entire life cycle. Clients and users, and contractors and suppliers continue their involvement in maintaining the functionality and serviceability of the built service. The team is involved through a long term contract to take action based on new demands and insights from clients and users, and make alterations and changes to the built service based on new knowledge that improve the usability or cost levels. The performance of the built service is evaluated continually, and decisions to take action are made through the continued measurement of value and cost levels. This implies life cycle alliances to assure the continued involvement of parties and stakeholders during the life cycle. This is particularly complex while after project delivery, alterations and changes to the built service imply reconstruction and refurbishments, which are part of the use and facility management of the service, involving users and facility managers and other parties that have not been involved in the project before. In addition, changes of users and owners through the life cycle make this even more complex.

4.4 Dynamic control for different types of contract

In a certain way, dynamic control is applied in current practice: Suppliers ask a price for the construction of the project as specified by the client. In order to cope with unforeseen events and the associated consequences, additional work due to perception is measured as additional quantities of materials related to the initial design. When multiplied by unit prices these quantities are the basis for supplier's financial compensation for additional work. This simple measuring system can not used for integrated contracts such as DBMOT, BOT, DBFMOT, as quantities can not be measured due to the absence of a fully specified design of the building. For these types of contracts, the changed value should be measured in another way. For DBM kinds of contracts the changed value due to perception can be measured in performance of the building expressed in measurable aspects such as form (e.g. aesthetics), function (e.g. capacities), technical quality (e.g. energy consumption). For DBMOT kinds of contracts, the changed value due to perception can be measured at a high level by the net present value of the life cycle value. With a fixed relation between the measured value and the price to be paid, dynamic control leads to large benefit for the client and large profit for the supplier. The price development for the three different contract types is shown in figure 2.

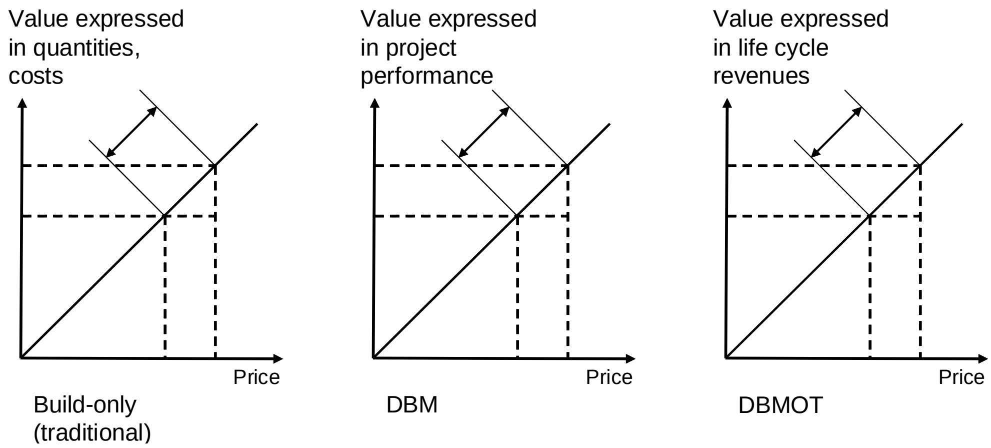

Figure 2: Price development for different contract types

5. Discussion and conclusion

The "living building" concept represents a new and comprehensive approach to demand and delivery of built services, based on a dynamic approach to the construction process and the life cycle. It solves problems of perception and process statics. It offers great potential advantages to demanding parties (clients, users etc.) as well as supplying parties (contractor, suppliers etc.). Particularly the continued dynamic approach, performance measurement and involvement of parties through the life cycle imply a great endeavour for clients as well as suppliers.

6. Further research and developments in practice

Further research and current developments in practice in the Netherlands have been aimed at at the development of the "living building" concept and life cycle contracts, particularly for road infrastructure. Few contracts have already been implemented by the Ministry of Transport, Public Works and Water Management for some roads. These contracts include the maintenance and facility management for a long period of time. The performance is predefined as much as possible, leaving open how the contractor/facility manager takes care of this operationally and technically, but only predefining cost levels and minimum performance specifications. The contractual and operational arrangements of adaptations that may have to be done to the roads in time, and proper corresponding financial arrangements still pose quite some difficulty. Delft University of Technology and TNO Built Environment and Geosciences have been doing and planning research projects aimed at these issues, as part of the national research and innovation programme for the Dutch construction industry PSIB. The research is aimed at the further development of contracts and procurement methods that include effective arrangements for adaptations of built facilities (i.e. roads) during the life cycle as a result of changing circumstances, demands and knowledge, including the definition of corresponding contractual financial mechanisms based on dynamic value-cost calculations and life cycle performance measurements. Results of these research projects will follow in subsequent papers.

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e-Construction – finally taking off?

Jakob Munk Nielsen
Manager, Rambøll Management (email: Jamn@r-m.com)

Abstract

Various pilot projects on the use of advanced ICTs in the construction sector has demonstrated that stimulating digital integration is a key measure to improve quality and increase the productivity in the construction sector. Especially applications aiming at collaborative working are seen as promising, i.e. software to facilitate cooperation between designers, suppliers, engineers, software developers etc. [4, 5, 6]

Traditionally, the construction sector has been a slow mover in the field of ICT [1] [8], but a number of drivers challenge this conservatism, including increased competition in the internal market, increasingly complex project management and industrialisation. Thus, it could be expected that construction companies adopts a more pro-active approach in this field.

This symposium presents the 2005-results of the largest survey in Europe on the use of ICT in the construction sector. This presentation will explore:

- Recent developments of the use of ICT in the construction sector
- The impact of e-business on the European construction sector
- Comparison of the development with other sectors
- Implications of e-business on construction companies, including SMEs

Keywords: e-Construction, E-business, E-procurement, e-Collaboration, e-Invoicing, Productivity, Integrated IT-solutions

1. The e-Business W@tch

1.1 Overview

As part of the so-called EU Commission initiative e-Business W@tch, Construction has been selected as one of ten sectors to be analysed. The presentation on the symposium will be based on the analysis of the Construction sector conducted within this framework.

Brief presentation of the e-Business W@tch

The eEurope 2002 Action plan provided the basis for targeted actions to stimulate the use of the Internet for accelerating e-commerce, acknowledging that "electronic commerce is already developing dynamically in inter-business trading [...]" and that "it is important for SMEs not to be left behind in this process [...]." The eEurope 2005 Action Plan, endorsed by the Seville European Council in June 2002, confirmed and built further upon these objectives with Action 3.1.2. "A dynamic e-business environment", which defined the goal "to promote take-up of e-business with the aim of increasing the competitiveness of European enterprises and raising productivity and growth through investment in information and communication technologies, human resources (notably e-skills) and new business models".

It is against this background that the European Commission, Enterprise Directorate General, launched the e-Business W@tch in late 2001, with the objective to provide sectoral analysis based on sound empirical research, including annual enterprise surveys in all countries of the enlarged European Union. Special emphasis is placed on the implications for SMEs. [1]

Since its launching, the e-Business W@tch has published e-Business Sector Studies on 17 sectors of the European economy, synthesis reports about the status of electronic business in the European Union, statistical pocketbooks and further resources (newsletters, presentations, special issue reports). These are all available on this website: http://www.ebusiness-watch.org/

1.2 Introduction

The European construction sector includes more than 2 million enterprises of which the majority are small companies with fewer than 20 employees [2]. The construction sector is the biggest industrial employer in the European Union, with a GPD contribution on approximately 10%, an overall employment rate of 7% of European workforce and 28% of the industrial employment [3].

The European construction sector is characterised by a few large design and engineering companies and a large number of small sub-contractors. The role of the large construction companies are changing from pure contracting towards a greater focus on project management. Moreover, they increasingly outsource work to small companies and concentrate to a greater extent on running the projects.

Various pilot projects on the use of advanced ICTs in the construction sector has demonstrated that stimulating digital integration is a key measure to improve quality and increase the productivity in the sector. Especially applications aiming at collaborative working are seen as promising, i.e. software to facilitate cooperation between designers, suppliers, engineers, software developers etc. [4] [5] [6]

The symposium explore to what extent ICT is used today in the sector, where the development is heading and if potentially promising technologies are adopted in the sector. Some of the key issues related to the use of ICT in the sector are:

- Productivity: ICT aimed at controlling projects with marginal profit are important. To what extent are ICT used for project planning, budgeting, controlling of projects etc.? Will ICT increase productivity in the construction sector similarly to other industrial sectors?
- Integration: Integrated IT-solutions, which supports project management and tunes companies to an increasingly competitive market, is an important issue in the sector. Which problems related to IT-interfaces and standards are facing construction companies when integrating working processes horizontally and vertically?
- Cooperation: Production processes are changing internally due to new mobile/wireless solutions and externally due to collaborative software. Which new forms of internal and external organisation are emerging as a result of new ICTs? Are new technologies likely to catalyse a restructuring of the sector?
- European market: Systems for e-procurement and e-invoicing are evaluated and implemented in larger construction companies at the moment. Does e-business stimulate the cross-border consolidation of the sector? Does it promote the establishment of a single European market for construction services?

1.3 Findings

The construction sector today is characterised by a large degree of fragmentation in IT usage. [2] [8]

- A multitude in standards, technical specifications, labels, and certification marks as well as diversity in local, regional and national legislation and regulations.
- A low adoption and integration of relevant ITC in most business processes – especially with SMEs that are often characterized by communication and knowledge sharing based on personal contact or telephone.
- High sensitivity to changes of economical conditions in market and society.
- Companies are typically either organized around projects and project flows or suppliers to project managed companies.

The following trends also set the stage for further uptake of ICTs in the sector:

- Increasing pressure for consolidation
- Industrialisation based on new concepts, e.g. pre-fabricated houses
- Outsourcing and specialization

- Internationalisation including new market opportunities and increased competition from foreign players

E-business activity

The attitudes towards ICT in the sector have traditionally been of a conservative nature. Apprehensions towards ICT investments are still strong and most companies are re-active rather than pro-active in the usage of ICT as a tool for competitiveness. [2] [4] [5]

Four topics can be recognised as important drivers for the development of electronic business in the Construction sector. These are productivity, integration, collaboration and the European market:

Productivity in the building and construction industry has yet to show the same level of productivity improvements as other industries including production. This has to do with the line of work and the type of production involved in construction processes but it also has to do with a slow ICT uptake in a sector dominated by small and medium sized players. Large enterprises in the industry as well as new sector entrants have adopted ICT based production improvements, but there is still un-used potential for ICT uptake in the area of productivity, e.g. with production planning systems, ERP-systems with financials, MRP system, Inventory management systems, CRM-systems, SCM-systems and Mobile solutions.

Integration is an important driver for developing ICT in the Construction sector. Many companies have a low degree of integration of both internal and external business processes as most companies in the Construction sector organise work around unique construction projects leading to fragmented business processes supported by “home made” ICT systems that do not integrate across the basic ICT landscape of the company.

SMEs in the sector are especially behind on system integration – also compared to other sectors. However, new sector specific solutions for smaller companies are being developed and ICT vendors take a growing interest in the market.

Collaborative systems are important as the construction industry is characterized by bringing together many different organizations dependant on coordination and cooperation to complete a shared goal. Effective systems to distribute and share information are a critical precondition in order to raise productivity and manage resources and costs, and potential benefits and savings enabled by improving interoperability and implementation via digital solutions are extensive. But implementation of collaborative systems is hampered by a number of barriers ranging from form lack of shared standards for information exchange to technical limitations, social and cultural issues.

ICT as a means of creating a European market in the building and construction industry is limited by the location bound nature of construction. However, e-procurement (e-tendering and e-ordering) as well as e-collaboration (e-communication and e-SCM) can contribute to the creation of a European market by making the market more transparent and by facilitating communication and coordination across borders.

In the future new solutions and increased uptake can be expected in five areas:

- Platforms for collaboration between the many partners in consortia, mainly by project webs where drawings etc. are shared. This development will be facilitated by increased standardisation of information on building projects.
- Integrated ERP solutions will be developed further focusing on the main business processes of project management, risk management and resource management. As standard industry solutions become available at lower prices, more SMEs will begin to adopt such solutions.
- The large project driven firms (consortia leaders) will adopt e-procurement as a means of reducing costs
- The increased industrialisation driven by new concepts and increased internationalisation will be supported by e-SCM (systems for supply chain management)
- As reduced margins drive business models to focus on services, industry ERP-solutions will include management of services, e.g. facility management. Other construction companies will expand into project development (e.g. developing plots of land into housing and selling or letting the buildings instead of just building them) and look for IT-solutions that support this.

1.4 Methodology

As in the previous years, the e-Business W@tch 2004-2005 use internal as well as external sources to collect not only data and indicators but also background information about the sectors covered. The different types of sources and the information they deliver constitute the main input for the sector reports. These sources are complementary to each other. The nature of information to be extracted can be qualitative or quantitative. Qualitative information (e.g. from case studies, or as provided by industry associations) will mainly serve as context and have an explanatory function, while quantitative data gathered through primary research (mainly via the e-Business Survey 2005) will deliver the e-business indicators and the sector statistics for reports. [1]

- Desk research (secondary sources) will be used to identify business examples, background information about trends and e-business developments in the sectors, and as pointers to potential case studies which can be followed up.
- Primary research will be used in form of the e-Business Survey 2005 and for collecting new case studies on e-business.
- In addition, the e-Business W@tch will continue to use industry statistics obtained from the Eurostat New Cronos database. However, data from this secondary source will be

processed and refined as necessary in order to close gaps (for specific countries or years) as good as possible.

The e-Business Survey 2005 is a cornerstone to this initiative, as it is a key instrument to collect e-business data on sectoral level which are not otherwise available in this structure and coverage. The survey also represents an important cost position in the project. As in 2002 and 2003, the survey is carried out as a CATI survey and cover all 10 of the sectors selected. The survey provide aggregated data for the European Union as a whole.

<u>The e-business indicators (questionnaire)</u>

The questionnaires used in the e-Business Survey 2005 is based on a conceptual framework for the measurement of ICT adoption proposed by the OECD, namely to at "readiness, activity and impact".

"Readiness" translated into ICT infrastructure diffusion and the development of accompanying skills. "Activity" was defined as e-business processes between enterprises and their customers, suppliers and cooperation partners, as well as internal business processes that are conducted electronically. "Impact", which is still the most difficult area to be translated into survey questions that can be directly asked to interviewees, was dealt with by asking companies about the perceived consequences of their e-business activities. In addition, in 2003/04 the relationships between innovation activities of firms and the level of their e-business activity was investigated, which presents a more complex and sophisticated approach to look at possible implications and "impacts" of e-business.

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Forgiving Technology in Automated Office Buildings

M. Himanen,
VTT Building and Transport, Helsinki University of Technology (mervi.himanen@vtt.fi)
J. Brissman,
TAC AB (jan.brissman@tac.com)
S. Lundberg,
TAC AB (stina.lundberg@tac.com)
R. Vastamäki,
Helsinki University of Technology (raino.vastamaki@adage.fi)

Abstract

A smart control device with an additional tool box which includes educational and information kits, called forgiving technology, has been developed in the EU funded project EBOB (2002-2004). It is meant for personal computers of the office workers enabling sustainable office working environments based on user behaviour. Careful design of the new prototypes for smart control devices has been accomplished with usability studies in different working environments in Sweden and in the Netherlands.

Promising results of the effect of the forgiving technology on the end-user behaviour are expected, which can result in ever more sustainable office buildings in the future. The possible changes in the office workers behaviour, which improve energy-efficiency are discussed in the paper. They concern both new office buildings and renovation projects.

Keywords: Office buildings, building automation, forgiving technology, end user control, energy saving, motivation tool

1. Background

This paper is drawing much from the EU Fifth Framework project EBOB, Energy Efficient Behaviour In Office Buildings (NNE5-2001-0263). The key focus of the EBOB project (www.ebob-pro.com) is on the combination of the human and social perspective with advanced modern control and ICT (Information and Communication Technologies) solutions. This is done in order to make energy efficient behaviour natural, easy and intuitively understandable for the end-users, and at the same time to achieve the most energy efficient solutions while improving standards on indoor comfort in refurbished and new office buildings. The results gained due to this combining approach of human perspective and available new technology are called 'forgiving technology'.

The EBOB project creates new technical and socio-economic solutions to make energy efficient behaviour natural, easy and intuitively understandable for the end-users in refurbished and new offices. This will be achieved by starting from human perspective and use available and new technology (including ICT, smart control, user interfacing).

All energy use in a building interacts with each other in different ways. The focusing points in motivating the use of energy efficient solutions can be: information, user behaviour (end-user satisfaction, personal motivation), productivity, health aspects, indoor climate and tools (control systems and user interface). In this paper the building automation tools to be used to make the office space better regulated by the end-user and the end-user better informed of the influences of their acts are discussed. The more new knowledge is available the more productivity, health and indoor air aspects are talking for the need of flexible, adaptable and well regulated workplace and workspace. Furthermore, workers want to feel comfortable when working. The joy of work is gained out of empowerment, which forgiving technology allowing personal control is about. They are the basis for developing and using forgiving technology, but discussed in more detail in other context. First, this new way of controlling is introduced.

1.2 Definitions

Building automation is related to the phenomena of automated and intelligent buildings, which sometimes are mixed. There is no universal definition of intelligent buildings. However, certain consensus of the intelligent building concepts exists and efforts for agreement of the definition are available (cf. e.g. [4] and [18]). The latest of them is available of the automated buildings (Technology Roadmap for Intelligent Buildings, 2002). Also the ranking lists for the automated buildings are under development by the efforts of the CABA (Continental Automated Buildings Association, www.caba.org).

To differentiate intelligent buildings from other building concepts the forms of building intelligence[1] have been studied ([10], pp. 284-342). The forms of Building Intelligence (BI) are

[1] *Building-connectivity* (speaking and speech recognition including music and linguistics; user-connectivity and control: either personal or automatic or defined by the organisation in concern); *Building self-recognition* (building knows the state it is in; a kind of consciousness); *Spatiality* (a more conscious understanding of the spatial expression of the architecture, structures, interior design); *Building kinaesthetic* (a sense of change, active structures, moveable structures, furniture and equipment, adjustable technology or building services), and *Building logic* (embedded sensors to monitor the occupants' daily activities, combinativity).

derived from the forms of human intelligence[2] [11]. Automated or integrated buildings are intelligent buildings, where logic is the key attribute of the design, and the human ability of mathematical and logic intelligence is the motor for the solutions. Building automation is the leading application for this form of building intelligence. The other forms of building intelligence assist in making the building logic work for the benefit of the building occupants and occupant companies. Such assisting factors of intelligent buildings are (1) inter-connectivity by user interface (cf. also [12]), (2) building recognition which means that the building is aware of the status of building services and occupant activities, (3) spatiality which is related to the right locations of the building automation control units, and (4) the existence of active structures which make the building control come true.

Sustainability covers both the ecological issues and the human welfare. That is why the EBOB project and the development of forgiving technology have much to do with the Green building concept, which is also lacking a universal definition. Green buildings are according to the U.S. Green Building Council (USGBC), buildings that are environmentally responsible, profitable, and healthy places to live and work in (http://www.usgbc.org/). Furthermore, there is the concept of Healthy buildings, which is the continuation of the research of Sick buildings. The Sick building syndrome has been a concept to study phenomena of indoor air quality which affect people in a negative way causing syndromes such as back or head ache, irritation in throat or nose, difficulties with vision, etc. In healthy buildings indoor air is supportive to human health condition, abilities and activities.

1.2 State-of-the-art of Office Building Control

The need for energy renovation is urgent in such older office buildings where not only the envelope and the structures need repair, but also the control of HVAC systems is lacking. The change of the end-user behaviour can be an alternative strategy for reaching energy savings and still avoid high renovation costs. In the new office buildings that have been built by following the latest knowledge of the energy efficient and sustainable building technology and with the latest control technology, the correct energy efficient end-user behaviour is the only way of letting the technology prove its efficiency.

The end-user behaviour can be changed even without technology by informing and motivating. The automated control technology saves trouble caused by manual operations. However, still

[2] Seven forms of human intelligence by Gardner (1983 in [8], pp. 120–123, 1991 in [8], pp. 345–352, 1993 in [21], pp. 107–110, 1993 in [7], p. 28) are: Logical-mathematical, musical, linguistic, interpersonal, intrapersonal, visual-spatial and bodily-kinaesthetic.

personal involvement might be needed for special occasions or for personal needs differing from the standard norms of indoor climate.

1.3 Need of Personal Control

It is common knowledge among facilities managers that the possibility to influence one's work environment is one of the most important factors of the workspace design. A second one is the feeling that problems are taken care of, in one manner or another like change, repair, etc.

According to "What Office Tenants Want, the 1999 BUMA/ULI Office Tenant Survey Report" only 56 percent of all respondents are located in buildings with any of the intelligent features listed in the survey[3]. The questionnaire was sent to approximately 20,000 office tenants throughout the USA and Canada. Slightly more than 1,800 responses were received, primarily from principals or owners, executives, office managers, or department managers of the responding companies. Intelligent building features are much more prevalent in owner-occupied buildings ([24], p. 50).

In tenants' rating of the importance of intelligent building features to their business, but not currently available in their building no single intelligent building feature stands out, but six features are consistently among tenants' top three: high-tech and energy-efficient HVAC system, wiring for Internet access, wiring for high speed networks, LAN and WAN connectivity, fibre-optics capability, conduits for power/data/voice cabling ([24], p. 42). Automatic on/off sensor in the lighting system was not among the top six. The priority of the features changes when the tenants were asked to indicate whether they would be willing to pay additional rent to have those features: computer-related features, high-tech and energy-efficient HVAC system, security systems, telecommunications capability, and redundant power source ([24], p. 44).

The relatively high ranking of HVAC systems in this corroborates the importance tenants place on having a comfortable temperature in their office and having control over the office temperature ([24], p. 43).

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[3] Fiber-optics capability, built-in wiring for Internet access, wiring for high speed networks, LAN and WAN connectivity, satellite accessibility, ISDN, redundant power source, conduits for power/data/voice cabling, high-tech and energy-efficient HVAC system, automatic on/off sensor in the lighting system, smart elevators that group passengers by floor designation, automatic sensor installed in faucets/toilets, compurized or interactive building directory

- According the IBs Survey, carried out in Finland in the Helsinki metropolitan area in twelve office buildings, the possibilities to control room temperature and lighting were not particularly good. They were evaluated with no high rates; room temperature with mean rate 6.2 (n[4]=455) and lighting with mean rate 6.7 (n=455) ([10], pp. 242-243). The index was from 4 to 10, which was the best. In general the building and office automation was rated with 7.9 (n=286) in the intelligent buildings and with 7.5 (n=182) in the other high quality office buildings used as reference buildings to the intelligent ones ([10], p. 208). The respondents' evaluation was based on the effect of the building feature to the working efficiency. In this Finnish survey, there was found a statistically significant difference in the quality of technology between intelligent and other types of office buildings in whole, when all rates were summarised. However, this correlation was not found on controlling possibilities. The control was not better in the IBs than in other office buildings, although in some cases good personal control possibilities of indoor air had been in focus in the design of IBs.

The IBs Survey proved the work environmental control possibilities important, while those who had the chance to participate in design of their work environment evaluated the quality of it better than whose who could not, or had difficulties in influencing the design ([10], pp. 264-267). Besides, the majority of the respondents (60.4 per cent) could not even participate in the design.

Wyon (1999) states that no improvements in sustainability will occur unless users are provided with insight, information and influence. Insight includes an understanding of the context in which the behaviour and its consequences occur. Information includes feedback on current conditions such as room temperature and energy use. Influence includes providing means of affecting the relevant variables such as a user friendly, intuitively understandable user interface enabling users control of indoor climate parameters on the office room level.

The office workers and the facility management have to be involved for effective use of technology. Commitment and encouragement of the office workers and facilities managers to promote sustainability, and prevention of misbehaviour in use of technology are seen among other benefits yielded from technology as a new potential for even better energy efficiency in commercial buildings. It is not even enough to provide motivation in the form of rewards or sanctions. Occupants must also be empowered to adapt modified behaviour.

[4] number of respondents

2. Forgiving technology

Practice shows that many technical solutions for energy saving exist and are installed in many office buildings, but the real energy saving effects are not there. Reasons for these deviations can be found from: wrong combinations of building and installation technology; misinterpretation of operational staff; misunderstanding and energy inefficient behaviour of the office occupants [5]. The overall aim in the EBOB project is to save energy by:

- Integration of and interaction between behaviour aspects of office workers and energy saving technologies
- Prevent wrong combinations of building and installation technology
- Prevent misinterpretation of operational staff
- Prevent misunderstanding of office users
- Prevent energy inefficient behaviour of office users
- Produce (energy saving) systems, that seduce people to participate in energy saving behaviour
- To guide the design process towards energy saving solutions that considers human behaviour.
- Design guidelines.

2.1 Need of End-user Involvement

The work done in the EBOB project has resulted in the conclusion that a major factor explaining the bad energy saving results in office buildings is that users are misunderstanding how the HVAC systems work, e.g. not seeing the relationship between lowering temperature and raised energy use during Summer conditions and on the other hand the relationship between high indoor temperatures and raised energy use in Winter. Information of the effect of personal behaviour on the energy use of the building where the end-user is working is expected to result in less energy use.

Also, office workers are not always aware of the correct use of the control equipment, which causes energy losses. A user-friendly technology with informative control alternatives – the forgiving technology created by the EBOB project - could solve this problem (Figure 1).

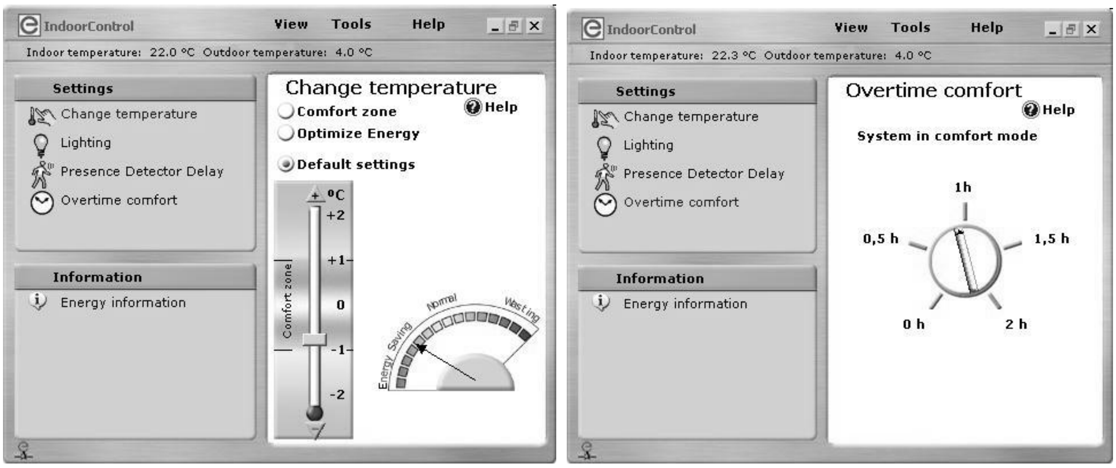

Figure 1: The control unit for forgiving technology. (TAC)

2.2 Technology

To allow the lowest energy consumption it is necessary that the building permits energy saving. A good starting point for energy optimisation of a building is that the building in itself is designed in an energy efficient manner.

In the modern office indoor environment the control of the room temperature, lighting and office automation equipment affect the energy consumption the most. In the EBOB project the work has been concentrated on the temperature and lighting regulation, and their co-operation. The temperature control involves heating and cooling and the lighting control includes the control of Venetian blinds. The system is generic and adaptable for other solutions in the future. The office automation as well as lighting is becoming energy-efficient. The energy losses from them or the use of free energy out of them will be reduced in the future.

Workers are a source of free energy. The occupancy of the office spaces varies during the working day. Working culture and the line of business influence the occupancy too. Occupancy has been discovered to be rather low for example in Northern American and English working cultures and higher for example in Finland. In England the occupancy can be as low as 45 % ([25] in [17], pp. 25) and in USA 33 % ([9] in [17], pp. 25). The occupancy of executives and executive assistants is 30 % and that of secretaries 60 % according to the British workplace consultants of DEWG [6]. However, Brill and Weidemann report higher occupancies in USA; managers 78 %, professionals 82 %, engineers and technical 80% and administrative 86 % (2001). According to the IBs Survey the occupancy of the Helsinki metropolitan offices is 87 % (62 % of the working time is spent at personal workspaces and 25 % in other spaces in the building) ([10], pp. 213, 228-231), and the occupancy of 67 % was found by Nissinen in Finland (2003, pp. 66). On the other hand, in the Netherlands the occupancies have been discovered to be low; 60 % of the office workers are in the office, and 35 % present at their personal workspaces [20]. The presence detection is the tool to take the occupancy into account also in the EBOB project in addition to the end-user motivation to prevent energy losses to reduce unnecessary heating and lighting of empty spaces.

The indoor air quality is out of the scope of EBOB project, although the standard of it might have influence on the need of energy for ventilation. However, the regulation of the heating and air-condition systems done for keeping up the comfortable indoor air temperature affect also the indoor air quality; odours, particles, etc.

A set of EBOB rules for installations have been defined including the temperature control set points, heating and cooling operation times, etc. They are based on the data of the most effective heating and cooling periods of office buildings around the clock, use of heat recovery, new theories of the use of outdoor air temperature for dimensioning, etc.

The building manager chooses the buildings' temperature set point value. This set point can vary during the seasons and should be easy to change. It can also vary how much flexibility the building manager want to give to the users in the aspect of how many degrees of centigrades they should be able to change the temperature. The set-up of the steps a user should be able to change has to be done as well.

The EBOB solutions may include equipment with specified functionality and performance. It is important that these requirements are made clear so that the right type of equipment is actually purchased by the subcontractors, and not replaced by lower functionality or lower performance products. E.g. the contractors should be educated in these questions after signing the contract.

2.3 User Motivation

Influencing the behaviour of the actors can be done by; a) investment in energy efficient equipment (e.g. insulation, energy efficient equipment), b) more efficient management (e.g. thermostat setback when the office-worker leaves her/his room) and c) curtailment of needs or comfort. The multidisciplinary approach to workspace design and energy-efficiency is needed, because only rarely one idea alone is strong enough to solve several problems at the same time. Also the humble ideas of not knowing all – or even the possibility of not ever being able to cope with all phenomena of energy efficient workspace design – might be useful in design, in particular in the era of demand driven knowledge workplace design. For successful implementation of forgiving technology a supportive energy-efficiency of the building environment in the terms of the life-cycle of the building is needed.

Control is about possibilities and limitations [22]. The limitations of control can be classified in two main categories: external limitations and internal limitations. When actors experience that they have external limitations they can believe for example that they cannot regulate the energy consumption of their room. External limitations are:

- The action is under the control (or responsibility) of other actors
- Economical limitations
- Limitations of social or work-related roles
- Time limitations
- There is no (realistic, good) alternative
- Lack of tools available
- Lack of information available.

When actors experience that they have internal limitations, they believe that their behaviour is not under their free will but under the control of an internal force. They are:

- Psychological aspects (personality, addiction, habit, lack of motivation)
- Cognitive aspects (lack of knowledge, biased mental models, lack of skill, has not thought about the issue before).

Motivation is based on the human tendency to use intelligence for the benefit of oneself and for satisfaction of one's needs, which can be described by the Maslow's Hierarchy of Needs according to his latest work [13]. A good environmental design cannot forget details that can clinch on the success or the fiasco of any solution, and an energy efficient forgiving technology respects the human needs, either separately each of them or in relevant combinations. There are a few interesting phenomena influencing the R&D work of products, which can be derived from the hierarchy of needs [12]:

- The human desire to easiness allows the automated functions.
- Variety of lifestyles makes the possibility to switch on manual mode necessary.
- Because of the need to know, occupants want to know what the automation is responsible for and what happens when a certain sound is heard or other activities take place.
- Such a human need as self-actualisation in the modern times goes hand in hand with the growing individualism influencing the design and research and technical development.
- Everybody wants to be good. A desired product provides the client with such an added value, which makes it possible.

To involve the service technicians, they need to be engaged in the creation of a new system. The main part of the life-cycle of a system is during the services and maintenance, after an installation is made. Often developers forget this and adapt the system to be easy to install but not to maintain. We can see the system as a combination of different modules and each module needs to be administrated and maintained.

By choosing this method of working we will get continuous feedback also from the service technicians on how the functions work and if they are easy to maintain or change. Good input can be given by them since they are used to work with different user interfaces and can pick the best pieces from each.

Commissioning of the installation system when the building is first used is a very important factor that can influence the energy use and comfort. It is important that the service technicians receive sufficient and correct information and training. The user interface should therefore be intuitive to minimise training.

Still, the knowledge of the state-of-the-art of building is valuable for those in charge of the energy costs and the comfort level of end users is valuable information for the human resources departments of the occupants companies, and the future design of the control systems. The possibility to transfer that information further to those in need is a mean of improving motivation among FM personnel.

The motivation of the building owners and providers emerge from such company goals as [14]:

- the matter of interest in developing the relatively traditional building sector with acceptance and understanding of knowledge and means how to embed new and radical technology
- to polish the image of the companies working in the fields of building automation and building parts and products with a sustainable or energy-efficient technology
- the understanding of the business of buildings as a form of advantages input to the core process of a the occupant companies
- the interest in gathering end-user feedback (cf. e.g. [16]), and the consideration of the satisfaction of the user needs as the best business opportunity, because the problems of the client are solved
- correct information of the cost competitiveness of intelligent energy-efficient products without over estimating the R&D costs, etc.

2.4 User Interface

The control unit of the forgiving technology of the EBOB project has been designed using expertise in psychology, usability, industrial design and functionality (Figure 1). It resembles the manual control panels for heating and ventilation, but it is run on the screen of a personal computer. In addition to the user friendliness of the control activities the forgiving technology is developed to give information to office workers to make them more aware of sustainability and motivated to behave energy-efficiently. Given information are of three kinds:

- General tips and knowledge
- Specific characteristics for this building
- Real-time feedback in the user interface.

Such factors that are related to the thermal comfort as clothing, so called climatisation[5] during longer warmer or colder periods or due to seasons will be taken into account with the information which will be given to the occupants via the user interface, as well as by education, energy saving campaigns and the EBOB toolbox.

Information and knowledge is only of real value in the process of decision making if it is Just in Time and Tailored to the demands of the end user. Most information systems fail because of the end user gets too much or irrelevant information. This means that the user has to be clear what his interest really is and for which purpose he or she needs information. In the EBOB InfoDoc, this will be solved by a users profile to be filled in before the request of information. Information about the person, interest, professional role, building phase and the organisation and the building will be required.

Such motivators can be mentioned [22] as:

- Comparisons with other's energy usage
- To see one's status compared to the average usage is useful
- To see one's status compared to one's earlier usage
- To display the usage in a graphical or in another easy-to-understand format,
- To display the energy usage in comparable terms which are easy to understand i.e. number of trees that can be saved by the energy savings etc.

Information and notes about energy usage should be short, practical but not too obvious. There also should be a link to further background information (e.g. scientific validity information). The energy related information should be shown already on the page where the users set the temperature so that it is up to the user to decide if he wants to perform the action or not (and not after doing it).

[5] with climatisation is meant the process while human body adapts to warmer or colder climatic condition either when moving to a warmer or colder climate or during spring and autumn

The system has to be able to give each type of user the appropriate information and steering option based on situation, role and authorisation. E.g., the office user will only see a certain portion of the information relevant to them in the “Information System” while the technician will be able to go deeper into the information, even read the manuals for the hardware etc.

3. implementation

The forgiving technology has been tested in a lab-environment at TNO in Delft in the Netherlands and in an office building of Kärnfastigheter in Helsingborg in Sweden. The rooms with and without forgiving technology are tested and compared (Figure 2). The evaluation of the tests has given feedback to the development of the prototypes of the forgiving technology.

The test results are also input to the activities of a simulation model and calculations which predict the success of the new technology under development. The calculation instrument of the energy consumption in one office building includes all kinds of influences such as sun, outdoor climate, design of the building, installations etc. The user of the instrument can define packages of all kinds of energy reduction measures.

Figure 2: The test room installations. For the end-users’ convenience the control of the heating fan coils and the lighting and their different combinations are in focus in the design and testing of forgiving technology.

The classification of the problems implemented [23]:

- Catastrophic: Can lead to a situation where the user has to suspend the use of the product. The problem is catastrophic when it prevents the user from completing his task, causes distortion of information or when it is related to a crucial function. Has to be eliminated.

- Severe: Significantly disrupts the efficient use of the product or slows it down remarkably. Prevents the learning of its functions. Should be corrected.
- Major: Moderately disturbs the efficient use of the product or prevents the efficient use of a limited part of the product. Recommended to be corrected.
- Minor: Disturbs the efficient or fluent use of the product to some extent, generally however within a quite restricted situation. Worth correcting if it is not too difficult.
- Cosmetic: Doesn't directly affect the use of the product, but it might affect the user's experience about the reliability and convenience of the product.
- Technical Problem: A feature of the prototype or a programming- or functional error discovered during the usability assessment, which affects the usability of the product. Is likely to have to be corrected before the implementation of the product.
- User Expectation: User's wish for something generally to be added, but isn't really a usability problem.

In an ideal situation, the occupant's role in controlling energy use and indoor climate is overridden by the system in all aspects except for those in which they need to have the control. It is ideal because it would optimise the comfort and energy use, and at the same time the users do not have to worry about issues they do not want to be concerned with. Expert knowledge gives as an example of this the occupants disability to perceive or not wish to influence normal changes on humidity or air quality parameters as carbon dioxide levels.

However, there are some parameters or installation aspects that cannot be completely automated, parameters that the users want and need to control at least in some aspects [23]. These are:

- Indoor temperature (in a range of a few degrees),
- Lighting (can be partly automated),
- Being able to keep doors and (and in some cases) windows open and
- Shutting down the computer (can be automated in some cases).

In conclusion, these above mentioned situations are the most important cases where the incorrect uses are relevant [23]:

Misuse of temperature controls; four main reasons why the temperature is not always good enough:

- The temperature controllers are too difficult to use and understand.
- The natural feedback (the actual change in temperature) is delayed.
- People have wrong mental models about good indoor temperatures.

- The space is shared (e.g. open office space or a meeting room)
- Incorrect use of lighting, doors and windows, and the personal computer.

The common wrong mental models about the indoor temperatures and air quality are typically the following [23]:

- Most of the people seem to think that a good indoor temperature is always the same independently of other conditions (e.g. season).
- Some occupants think that comfortable indoor temperature is higher in the Winter than during the Summer (which is completely opposite of the reality).
- Many people think that a good temperature is always somewhere between 19-21 degrees of Celsius, which is often uncomfortably cool during the Summer times.
- The users want to change the temperature, or maintain it constant, it may be difficult if they have a door or a window opened.
- The outdoor air quality is also some times worse than the filtered indoor air, which is not always understood by many occupants.

The problem of shared spaces is inherently very tough issue to solve, because all individual preferences and differences cannot be matched. However, the problem is bigger, if there are temperature controllers available. This can produce constantly changing temperatures, if different occupants are often trying to change the temperature according to their own preferences. This kind of situation is uncomfortable for all occupants. It is probably recommendable that in shared spaces the temperature is automated according to the average preferences. In that case at least the majority of the occupants are not complaining. The rest of the occupants might be educated to control their thermal comfort by clothing.

Similar arguments can be found from lighting control as well as myths about computers and energy consumption 1[23]:

- One typical myth is that putting the light off and on too often consumes more energy than it saves.
- It is quite misleading to believe that shutting down the computer shortens the life span of the hard disks in general or shortens the life of the common hard disks.

The potential of computer energy saving settings depends on the computers and on the software used. The existing potentials are not often used because of a lack of time, knowledge or interest.

4. DISCUSSION

It is only recently that smart control technology for better indoor air quality took place, and now it is there for both better indoor air quality and better energy efficiency in buildings. In addition many papers claim that well being and productivity are related to indoor comfort and individual controllability if only without any exact measurements of the effect of them over productivity ([1], Farshchi and Fisher in [3], p. 60, [10], p. 264-268.).

The IBs Survey shows that the office workers (in 1994) wanted to have a building manager to help with facilities management rather than building automation systems (Table 1.).This is challenging for the R&D and testing of forgiving technology. Is current building automation technology able to please the customer needs in the office work environment?

The EBOB forgiving technology is an interactive system with several optional control possibilities, which are very different from fully automated systems dominating the end-user. Unknown in this phase of work when the last year of the three year project is left, is if the interaction between the end-user and the control technology can be used in the indoor air and lighting control satisfactory enough in the end-user point of view.

Table 1:. Man or machine the IBs Survey by VTT in 1994 [15].

Percentages of the respondents, n=514 (office workers)	**Favouring manual operation**	**Favouring automated operation**	**Both**
Text editing by secretary or text editing programs	27	71	2
Copying by a service or from personal computer	37	61	2
Information transfer in meetings or by phone, by emails and via video-conferencing	37	54	9
Image handling by draftsman or image handling programs	37	57	6
Information service by informaticians or from databases	42	51	7
Secretary answers the phone or use of answering machine	70	28	2
Education by personally attending seminars or by interactive multimedia	84	11	6
Building management by building managers or by building automation	**92**	5	3

5. Conclusions

For the time being the conclusions regarding the development and testing of the forgiving technology is based on the first version of the prototype. New software is now running in the test sites and the user feedback from the second prototype of forgiving technology is expected in summer 2004 for more evidence and indications. So far the results are very promising and the belief of the project participants is that the empowerment of the end-users with forgiving technology as developed in the project gives substantial benefits both in terms of savings of energy and more motivated and productive users.

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Evaluation of proposals for PPP-projects from the perspective of the rational consumer

Wisa Majamaa,
YIT Construction Ltd
Helsinki, Finland (email: wisa.majamaa@yit.fi)

Abstract

This article analyses the evaluation process of public–private-partnership (PPP) projects from the perspective of a group of rational consumers. This is done by analysing a specific case study and examining how the evaluation process acts and how it affects the criteria, when public private provision is changed from the purchaser/provider model to the community service model so that the focus of the service is on the end-users instead of the relationship between purchaser and provider. The result of this article is the framework of the evaluation criteria of proposals for PPP projects, based on the advantage of the end-user. The proposed framework offers both the public sector in its role of purchaser and the private sector in the role of provider a new perspective for developing PPP-projects that are more valuable and innovative for both parties.

Keywords: Public Private Partnership, PPP, BOT, evaluation process, evaluation criteria, rational consumers, end-users, value for money.

1 Introduction

Viewing public services from the perspective of the end-user has received too little attention. One tool for improving this situation is the public private partnership (PPP). Traditionally, analysing the development and research work related to the mutual efforts of the private and the public sectors to provide public private service has been based on the purchaser/provider model. The purchaser/provider model is particularly evident in the building and real estate industry and research related to this field. In the purchaser/provider model, the end-users, independent consumer groups and associations have been acting in the role of "watchdog", to protect the public's interests [1]. Nowadays customer-orientation is widely considered to be the key to improving the quality and efficiency for ensuring and modernising the provision of welfare services. This means shifting away from the producer and administration-orientated thinking and from the purchaser/provider model towards a process of public services that is customer-orientated in their provision and organization. [2]

The aim of this article is examine how the method of evaluation works when the procedure for public private provision is changed from the purchaser/provider model to the community service model, and the focus of the service is the end-users instead of the relationship between purchaser and provider. The goal is to answer the question; what are the elements of the evaluation criteria to be considered when the PPP-model service production is assessed from the perspective of the end-user?

This article is based on a theoretical framework that reflects the end-user perspective of public services, i.e. the community of individual consumers in PPP projects. An evaluation process in action is considered with a case study of a PPP-project, where the focus of analysis is on tendering documents and evaluation criteria.

Chapters 2 and 3 are elaborated on the basis of the author's previous studies presented in, e.g., the Finnish article "Julkis-yksityinen yhteistyö rationaalisen kuluttajayhteisön näkökulmasta" [3].

2 Consumer community as a customer and end-user

The objective of a public-private-partnership is a cooperative arrangement between the public and private sectors to mutually produce services to a third party – the end-user. The public sector is responsible, amongst other obligations, for providing statutory services to the nationals of the state [4]. As the government in Finland is responsible for the entire public policy of the state, local and regional authorities (municipalities) have traditionally been considered to be in the best position to ensure that the statutory-service objectives were met at the local and regional levels of government [5]. Whether the participation of the public sector in service provision is based on law or voluntary action, the provision of services is dictated by current obligations, and benefits of the society constitute the market of public services for members of the society. Within this market, the consumer is expected to act as in the private market, where the consumer aims to fulfil his needs through consuming.

In the past, public service provision has been closely linked to decommodification [6], in other words, equal service provision for all members of the community [7]. This has led to a situation in which the consumer community was considered as a homogeneous (X=Y=Z) group of end-users whose needs have been viewed as consistent. Today's post-modern thinking, however, promotes individualism which recognizes the diverging needs of individual members of the community. As Bauman says, the changing needs and lifestyles of individual consumers affect the formation of one's identity, which is strengthened through consuming [8]. In accordance with this thinking, the community of end-users is actually a far looser heterogeneous (X≠Y≠Z) group of consumers with different needs. The purpose of the public sector is not to directly monitor psychological changes in consumers or to predict their future needs, but to meet the existing demand. It is, however, in the interests of the consumer community if the public sector takes advantage of service provision models which can, with optimal flexibility, adjust service provision to reflect the changing demand.

The following figure illustrates public private service provision in a process based on the purchaser/provider and the community service model.

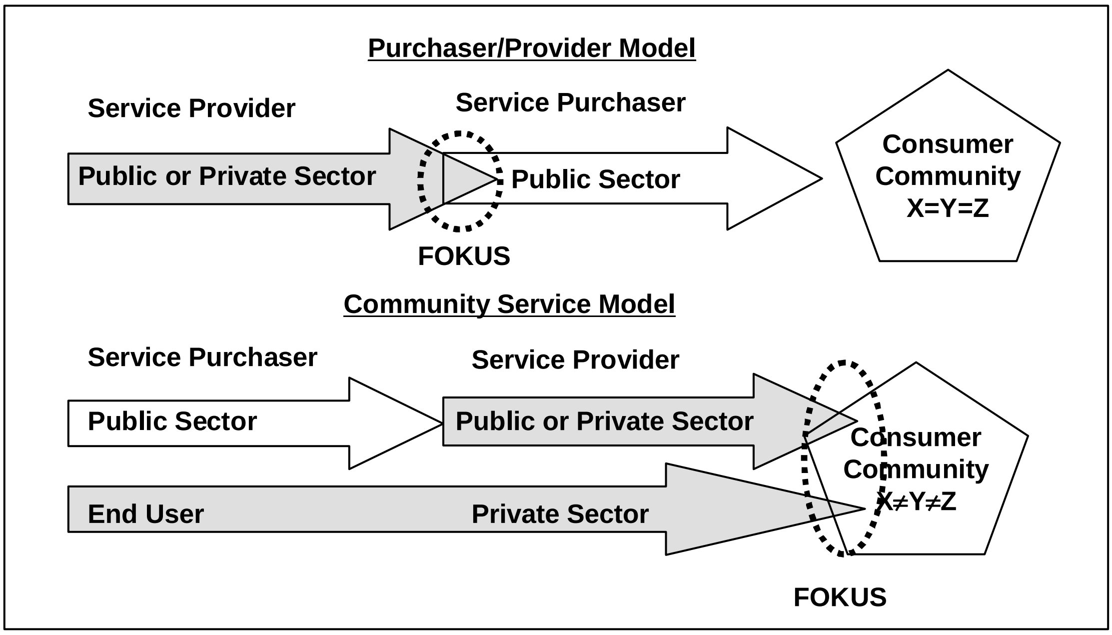

Figure 1: The community as the customer in a Public Private Partnership.

The focus of the purchaser/provider approach, previously used with relation to the PPPs, is on the interface between the provider and the purchaser. Less attention is given to the end-users, who are seen as a homogeneous community of consumers. In the purchaser/provider model, the provider can be a public sector unit or a private body. The purchaser is a public sector unit, representing the end-users. No actual customer relationship is formed between the service provider and the end-user, as the end-user cannot influence the content or scope of the service.

Service provision that utilizes the community service model is carried out through a private or a public unit or through the cooperation of the two. The purchaser of the services is the public sector or a member of the community, the end-user directly. When the purchaser is the end-user and the provider the private sector, the public sector has no role in the process. The customer, and thus the end-user of the services, is always a member of the consumer community, a resident of the local or regional authority or a national of the state. The focus of service provision is on the interface between the heterogeneous group of end-users and the service provider, where the customer relationship is also formed. In service provision models that are based on the community service approach, the possibilities of reacting to changes in the needs of consumers are better than they are in the purchaser/provider model, thanks to the direct customer relationship. Creating a true customer relationship is also an important step in shifting from the earlier provider and administration-orientated approach or the purchaser/provider model towards customer-orientated service provision.

3 Framework for Public Private Service Provision

The theoretical framework for service provision from the perspective of the consumer community is based on a process of the aforementioned community being the customer and the principle of maximising the benefit for the rational consumer community [9]. In considering the community as the customer, the focus of service provision was illustrated in terms of a public private service provision based both on the purchaser/provider model and the community service model. What is essential here is the creation of the customer relationship between the service provider and the end-user of the services, the rational consumer community, that becomes possible only within the community service model.

In addition to the basic presumptions included in the theory of consumer choice, this article presumes that a rational consumer monitors the use of tax revenue collected from the consumer. Therefore he expects efficiency and a high level of quality in the provision of services that are maintained through tax revenue. This presumption is also included in the *Value for Money* principle, which has a central role in promoting the development of public service provision through public-private-partnerships. In addition, a rational consumer is expected to prefer a wider selection of services and therefore to maximise the type and number of different alternatives available and to value the opportunity to make individual choices. The consumer's ability to make individual choices and his capability to compare and choose are also included in the basic presumptions of the theory of consumer choice [10,11,12].

In this article, the assessment of public private service provision from the perspective of a group of rational consumers is founded on the following three presumptions on the basis of which a rational consumer maximises his benefits:

1. **The Value for Money principle** both in an individual's personal decisions and his behaviour as a part of the community as well as his expectation that the representative leadership of the community also adheres to the principle.
2. **Appreciation for diversity in selection** and the resultant ability to make choices between different alternatives.
3. **Independent choices** and expectation of having the possibility to make free choices based on personal preferences.

The following figure illustrates the process of assessing public private service provision, which is based on the above presumptions and which is conducted from the perspective of the rational consumer community. It also highlights the theoretical framework that can be produced from the assessment.

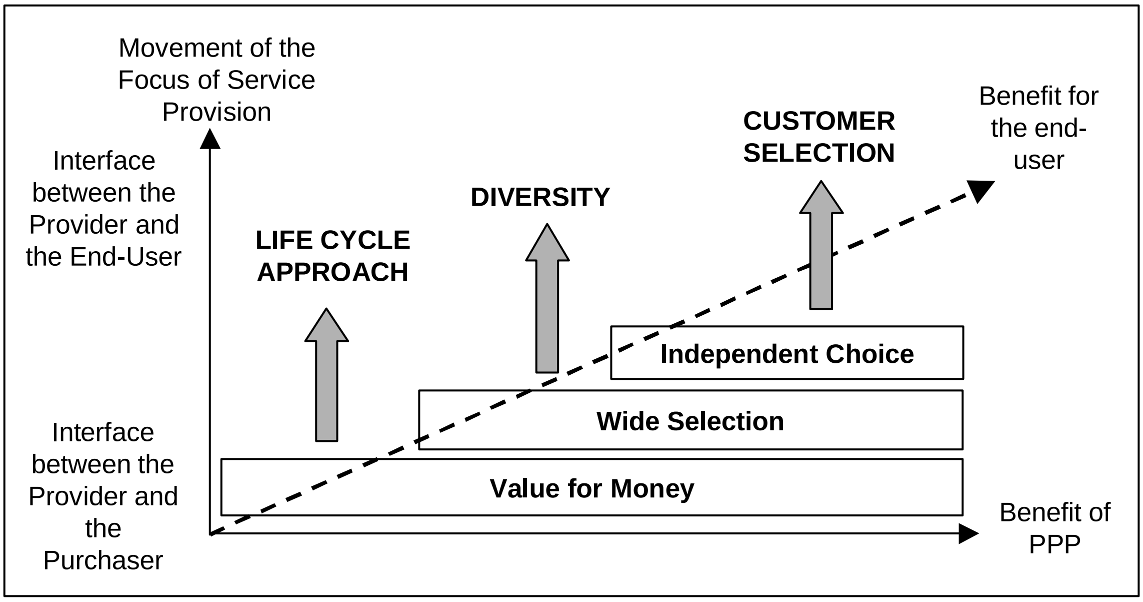

Figure 2: Benefit of public private service provision from the perspective of the rational consumer community.

The examination of public private service provision has been conducted in terms of the focus of service provision and maximisation of benefits. The vertical axis illustrates the movement of the focus of service provision from the interface between the provider and the purchaser to the interface between the provider and the rational consumer community as per the community service model. The horizontal axis illustrates the benefits of PPP in general. The dotted arrow illustrates the increase in the benefit to the end-user from public private service provision that is based on the preferences of the rational consumer community. From the perspective of the rational consumer community, the *Value for Money* principle is fulfilled through the life cycle approach. In addition, the diversity pre-requisite fulfils the wide-selection preference for the rational consumer community. Furthermore the maximisation of benefit is achieved through customer selection and, as a result, the possibility for independent choice is also fulfilled.

Examination of public private service provision from the perspective of the rational consumer community covers the structure of service provision and the scope and content of that provision. PPP, which is part of the life cycle approach, mainly concerns the investment and maintenance services that are connected to the structures of service provision and that involve its operational environment, for example. In terms of diversity, the examination focuses on the structure of service provision as well as its scope. This means an operational environment providing multiple purposes within the available resources as well as optimally diverse and versatile service provision. In terms of customer selection, the examination also involves the content of the service provision and the ability of the rational consumer to make independent choices between available forms of services. It is important to observe that from the perspective of the rational consumer community, it is irrelevant whether the service is provided by the public or the private sector or how the distribution of work is allocated between the two in relation to public private service provision. The relevant issues are the fulfilment of the life cycle approach, diversity and customer selection in public private service provision.

4 The case-study of a PPP-model for a High school and Leisure centre project

4.1 The Overview of the case

The first and only PPP-project in Finland that includes both construction and wide service supply at substance and support services is the Kaivomestari High school and Leisure centre in Espoo. The project was between BOT (build-own-transfer) and a leasing model. The private partner was responsible for the planning, construction and providing the service, exclusive of the educational element. The real estate has been funded through a leasing contract. The partners of the project company, Arandur Ltd., were NCC (the construction partner), YIT (the maintenance partner) and Sodexho (the service partner).

4.2 Evaluation criteria and evaluation process of the case

The evaluation process was based on procurement negotiations and began with a public notification on 2.6.2000 [13]. The information bulletin and pre-qualification requirements were announced in a public meeting on 15.6.2000. After the pre-qualification procedure, the call for bids for the PPP project and 25 year-concession agreement was sent in October 2000 to the three candidates (project groups lead by the construction companies YIT, Skanska and NCC). Detailed standards for technical requirements and services were articulated in the call for bids. The evaluation criteria also reflected the focus on technical and economical points [14]. The bids were then evaluated against the public comparator. The preliminary evaluation between the bids and the public comparator was conducted only from the economical perspective. As all the tendered PPP solutions were feasible against the public comparator, all three candidates were invited for negotiations in the spring of 2001. The second round of negotiations was set up only with the YIT and NCC, at which stage the candidates made their bids public. Based on the technical and economical points, the NCC group won the contract, and the school was ready to start operations in the autumn of 2003.

As this was the first PPP project of its kind, it was feasible to use a negotiating procurement procedure. In addition, all the candidates were asked to take part in a research program of possible PPP solutions in Finland which could lead this project. As was outlined in the call for bids announcement, the project also served to collect data and experience from the PPP model as an alternative to the traditional method of offering public services [15].

4.3 Case-study analyse

4.3.1 Evaluation criteria

As the article is based on a theoretical framework that reflects the end-user perspective of public services and the aim is examine the requirements of a new evaluation criterion, existing criteria should also be reviewed. This is done with a case-study, where the main criterion is the benefit to be gained with the public private service provision, as analysed from the perspective of the end user. The requirements given in the pre-qualification material and in the tendering and selection documents have been divided into three categories: Life cycle approach, Diversity and Customer selection. In each evaluation stage the given criteria are considered in greater detail.

Table 1: Evaluation of proposals from the perspective of the end-user. Criteria and weighting are based on tendering and selection documents [16,17].

CRITERIA CATEGORY	**EVALUATION STAGE**		
	Pre-qualification	**Tendering documents**	**Weighting in Selection**
Life cycle approach			
Economical factors and risk management and risk sharing	Economical requirements for tenders	Value for money principle and risk sharing mechanism from the provider's perspective	30%
Quality and technical factors related to design and construction	Technical requirements for tender	Functionality, architecture, technical usability, materials etc. from the providers perspective	40%
Quality of required services	Organisational requirements for tenders	Detailed services for the school and sport authorities from provider's perspective	10%
Project control and certainty of service performance	Organisational requirements for tenders	Detailed services during construction phase and during service –delivery time from the perspective of provider	10%
Risk sharing and economical points in concession agreement	–	Legal factors in approved concession agreement from the perspective of provider	10%
Diversity	–	Extra services identified and included in value for money principle. Economical view from the perspective of provider.	–
Customer selection	–	Private cash flow from extra services included in value for money principle. Economical view from the perspective of provider.	–

4.4 Results

4.4.1 Evaluation criteria

In the pre-qualification process the municipality of Espoo stipulated the technical and economical requirements for the tenders. At that time, the main interest was to estimate the potentiality of interested tenders on the basis of technical, economical and organisational factors. Only technical and economical requirements were made public, no evaluation criteria were given. The purpose of the pre-qualification phase was to short-list at least three, and no more than four, candidates for the ordinary tendering process.

The weighting of the evaluation criteria in selection indicated that the focus was on technical and financial points. The municipality of Espoo, as provider, tried to secure the service on behalf of its educational and sports authorities. The call for bids did not pre-exclude innovative solutions which would include some services and private cash flow. The main interest was in public services and the evaluation criteria were set up on this basis. The breakdown of the required services was specified in great detail, and the call for bids did not encourage tenders to innovate, develop extra services or to extend the service supply to end-users.

Evaluation was made from the public provider’s perspective. There were no factors at all which would have necessitated a direct link between the purchaser and the end-user. All the criteria were founded on managing the interface between the purchaser and the provider. The end-users of the public services, eg., students and users of the leisure centre, were considered as a homogenous consumer group. The innovative services and diversity of the project were evaluated only on the basis of the life cycle approach and against the V*alue for money* principle.

4.4.2 Public comparator

The public sector comparative is a financial model for service delivery through the utilization of the public sector only. It provides a benchmark for evaluating the PPP alternatives [18]. In the case-study, the public comparator could not offer an all-encompassing alternative and the municipality of Espoo has difficulties in collecting the data for the comparator because all the information was not available from their own system. If the public comparator is not a noteworthy alternative, the comparison should made only for the purpose of assessing the costs of the PPP model solution against the traditional delivery of public service.

4.4.3 Evaluation group

The evaluation group was identified in the call for bids and all its eight members represented the municipality of Espoo, with representation from each of the various technical, financial, educational and legal departments [19]. The end-users had no direct representation. When the evaluation group is based only on representatives from the public sector, there is a risk that the group focuses only on the interface between purchaser and provider, and no one oversees the advantage of the end-users.

5 The evaluation of proposals from the perspective of the end-user

5.1 Framework of evaluation

Previously, the focus has been on the technical and economical values and the risk-sharing element between the purchaser and provider [20]. *Value for money* has been a primary objective in maintaining public interest and projects have been evaluated according to the cost-efficiency point of view [21,22]. These criteria have applied in PPP projects, for instance, in an evaluation method based on decision analyse, where the vital part is the regulation of evaluation: must criteria, want criteria and evaluation matrix & analysis [23,24]. As we note from the case study, the advantage of the end-user has been secondary and is evident only through the services supplied by the municipality.

When we consider that composition of the consumer group is heterogeneous, it is not important to try to make universal and unambiguous evaluation criteria for all types of PPP projects. The evaluation criteria must reflect - and be made specifically suited to - the nature of the project. It is essential that all the agreed criteria be observed from the perspective of the end-user; this can be ascertained by recognizing the advantage of the end-user as a main criterion.

Table 2: Framework of customer based evaluation criteria for PPP project and its benefits for public sector and end-user.

CRITERIA CATEGORY	BENEFITS	
	FOR PUBLIC SECTOR	FOR END USER
Criteria of Life cycle approach in substance and support services and investments and maintenances linked to them	Value for money Risk sharing and risk management	Value for money
Criteria of Diversity in substance and support services and in services directly to end-user	Increase in substance services through combining their provision or/and expanding the support services	Diversity of services
Criteria of Customer selection in substance and support service	Innovations and continuous development Confidence from security to surpass the minimum standards Value for money through private cash flow and lower yields	Possibility to make independent choices

During the first criteria, Life cycle approach, end-users expect that the PPP-model construction project or service production be evaluated as *Value for money* based in its whole life cycle. Because the end-user, through taxation, is directly or indirectly the only sponsor for public services, the *Value for money* concept is relevant for them. The *Value for money* concept has also been the primary advantage of PPP projects. The life cycle approach and *Value for money* assessment comprise two key elements [25]:

1. Monetary comparison – comparison of the cost of the proposals, expressed in term of discounted cash flows over the life of the PPP contract
2. Non-monetary comparison – comparison of all the factors that are difficult to quantify in monetary terms, but their value to government and the wider public is significant. Examples include speed of project delivery, quality of service, and security of supply.

Evaluation of bidders based only on quantitative criteria (monetary comparison) is irrelevant for large, complex projects. On the other hand, a selection process that focuses solely on qualitative (non monetary comparison) criteria may lead to subjective appreciation. It is also important that the procedure is governed by transparency of criteria. The evaluation should be based upon a combination of relevant realistic quantitative and qualitative criteria conducted through a process that is transparent and fair to all parties, including the public comparator. [26]

Diversity of services by increasing substance services through combining their provision or/and expanding the support services is the second criteria. The main idea for PPP should be how to offer more and better services for the end-user. The third criteria, customer selection, forces the purchaser to develop the concept in an open, market-based environment. From the perspective of an end-user, customer selection is the opportunity to make independent choices by selecting the desired substance service freely amongst the selection of various service providers. The end-user can make its own choice between the public, public-private and private services. This stage anticipates that there is a wide selection of service providers, and real markets can develop. In some fields where public services have been in a dominant or monopolic position, it takes time to dismantle the production structure. Free competition speeds up the innovations and depresses the price of services. Strengthening entrepreneurship and improving its conditions in these fields is closely connected to the desired development of new service structures [27]. In Finland this has been done, for example, in telecommunications and the results have been encouraging.

If the criteria in Life cycle approach category are satisfied, this can made at less cost to the public system. Diversity and customer selection can also create new innovations and services to the end-users. In an optimum case public services can become a catalyst for building new and better services to the end-users. Another noteworthy point is the possible cash flow from private use of public facilities and the rise in the utilization rate of real estate facilities. Private cash flows help to reach the financial goals of projects and to insure the quality of the service to the public provider. This also supports the first criteria by increasing the interest of investors to ask lower yields from a multipurpose property when the residual value and rental value are higher. It is also almost impossible to create a concession agreement for 25 years without gaps in service quality. If a significant part of the purchaser’s income is derived from the private sector under free competition, the facilities and service must be competitive price- and quality-wise all the time. Market-based service production needs innovations, continuous development and the confidence due to security for surpassing the established minimum standards for public service.

5.2 Public comparator

If we consider the typical tendering process in PPP projects, there are two evaluation steps. The first step occurs when the PPP-bids are evaluated against each other, and the second step is the assessment of the PPP-model bid against the public comparator. Normally this second step is conducted between the preferred PPP tender and the traditional public sector procurement at the end of the tendering process. [28]

In considering the evaluation method from the perspective of the end-user, we need to examine how the evaluation works in this new situation. When public private provision is changed from the purchaser/provider model to the community service model and the focus of the service is on the end-users instead of the relationship between provider and purchaser, we find that it is not relevant to isolate the traditional public comparator from other competitors. Traditionally the main aims of the PPPs were to explore for innovative solutions and to search for cost efficiency. From the perspective of a group of rational consumers, more aims than just the value of money are involved, such as diversity and customer selection [29]. It is not self-evident that this kind of development can only be achieved by the private sector. Public sector can also be innovative; it should strive for development and attempt to make the best proposal. From the end-users' viewpoint, it is fundamental that the public comparator be treated in a manner similar to the private comparators.

5.3 Evaluation group

In evaluation no criteria are important without the know-how on how to use them. The problem from end-users perspective is how to give 'voice' to the opinion of the consumer communities in the evaluation process. This can be done by using criteria which accommodates the consumer community, for instance, using an independent party to audit these criteria would ensure adequate representation. In its capacity as the service purchaser and decision maker, the public sector needs to give consideration to a fair representation within the evaluation group, so that it reflects the end-users as well as secures the transparency of the assessment through an open evaluation process. The process varies within projects and it depends on the public purchaser, government or municipality concerned on how consumer opinion can be taken into account. One solution is via representative democracy and another is via independent consumers or consumers groups.

6 Conclusions

This article confirms the need for an end-user perspective in the evaluation process of PPP projects. The traditional purchaser/provider service model and its attendant evaluation criteria do not acknowledge the requirements of the end-users. Concentrating only on Life cycle approach and the interface between the purchaser and provider, the case analysed indicates the lack of recognition for end-user opinion in evaluation process and criteria. In the case-study analyse, it was also noted that the main purpose of the project was to seek for a new PPP-model solution where the municipality as a provider offers a traditional service portfolio to the inhabitants of the municipality via private purchaser. The tendering process did not prepare tenders to develop innovative and customer-orientated PPP solutions.

The review of a PPP-project must be done in the interface between purchaser and consumer community where the focus is in the community service model. From the perspective of the rational consumer group, the relevant elements behind the evaluation criteria are based on life cycle approach, diversity and customer selection. Using the advantage of the end-user as a primary goal, we can create suitable framework for the evaluation criteria of PPP-projects. In criteria-setting the focus should be on questions such as how the criterion creates value for money, diversity, or makes the customer selection possible for the end user.

The used two-step evaluation process where bids are first compared among themselves and then against the public comparator is not a fair and relevant method for the end-user. In the case-study project, this was improved, as all the bids were compared to the public comparator. The problem at issue was the fact that the public comparator was not a comparable bid and the comparison was done only on an economical basis. In customer selection, the end user evaluates the service provision only on the basis of the contents of the service provision. From the perspective of the end-user, the crucial element is therefore not the service provider but rather the contents of the service concept and the relationship between its cost and quality. It is not specifically stated that the public sector cannot also assume an innovative role to develop and make the best proposal itself. If the public sector cannot offer the required service, this will become openly apparent when the public comparator in the evaluation process is given the same treatment as the private competitors.

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Designing buildings for a crime prevention strategy

R. M. Barboni,
Teacher of Criminology at 'C.Bo' University of Urbino, Italy
R. Montagna,
Professor of Building Technology at Polytechnical University of Marche, Ancona, Italy

Abstract

The problem of reducing the rate of crimes in towns is therefore an emergency in a great number of countries. Criminologists debate of reducing the rate of violation in towns trough a different design of buildings and of their aggregation. This also involves a change in users' behaviour in order to reach a site control according to the theory of the "community policing".

To reach this goal a cooperation between architetcts and criminologists is strenghtly recommended. One of the trends is of reducing the rate of crime in towns through a different design of buildings and of their aggregation.

This paper aims to define how to modify traditional building components and to identify which is the level of "crime performance" to assign to different types of components and to various design solutions. A standard of "crime safety" is to be defined for each building and a scale of values is also to be defined according with the recently issued European standards "prevention of crime by urban planning and building design"

Keywords: Criminology, town design, CPTED (Crime Prevention Through Environmental Design)

1. Introduction

From the oldest times, the first purpose of urbanization is getting an higher level of living standards for the urban society. Using design to foster security has its origins in the early history of the development of communities.

Early Sumerian codes (4,000 BC.) identified the importance of respect for property rights, while the Codes of Hammurabi (2,000 BC.) introduced the responsibilities of builders to their clients. Eighth century Chinese practitioners of Feng-Shui promoted the design of harmony in space from the size of the smallest rooms to the planning of cities. Native American cliff dwellers at the same time were developing hierarchies of family and community identity and protection through the design of living space, building impregnable living areas on the face of cliffs accessible only by ladders.

European cities with historical defensive walls are a further and well known example of the historical consciousness of the problem.

Now-days, the rate of violence in towns is a relevant item of criminology in most of the industrialized countries. The problem of reducing the rate of crimes in towns is therefore an emergency in a great number of countries.

The concept of "Crime Prevention Through Environmental Design" (CPTED) has emerged world-wide as one of the most promising and currently effective approaches to reducing the opportunity for crime. Good results have been achieved in most environmental settings ranging from small stores to entire residential communities. Much is known about the relationships and causal links between street design, traffic control and behavior management. How space is designed and used directly affects profit, productivity and quality of life. CPTED concepts can be applied to an individual building as well as to an entire neighborhood.

CPTED is based on the theory that the proper design and effective use of the built environment can lead to a reduction in the fear and incidence of crime and an improvement in the quality of life.

This paper aims to define how to modify traditional building components and to identify which is the level of “crime performance” to assign to different types of components and to various design solutions. A standard of “crime safety” is to be defined for each building and a scale of values is also to be defined according with the recently issued European standards “prevention of crime by urban planning and building design”

2. Criminological tasks

One of the trends is of reducing the rate of crime in towns through a different design of buildings and of their aggregation. To reach this goal a cooperation between architetcts and criminologists is strenghtly recommended.

In the last thirty years criminologists debate of reducing the rate of violation in towns trough a different design of buildings and of their aggregation. Many criminologists believe that people who commit crimes often do so out of rational motives: that is, they want something and they consider the best/easiest way of getting it, but they will not take action unless the benefits outweigh the risks.

Under this cost/benefit model, if you make it harder or riskier for a person to commit a crime, you will reduce the amount of crime that occurs, opportunities for crime and, hopefully, crime itself.

A professional burglar, for example, will weigh the risks costs and benefits of breaking into two different houses. If one has locks and is easily visible from the street, while the other has concealing shrubbery and no defences, a widow left open, the burglar will naturally choose is likely to choose the second house. A non-professional burglar may only decide to break into a house if he or she notices an ‘easy mark’. Changing the environment so that it is harder or riskier for someone to commit a crime is known as situational crime prevention. This term also includes removing the rewards for crime in order to reduce the benefit side of the cost/benefit formula.

‘Situational crime prevention is directed at highly specific types of crime that involve the management, design or manipulation of the immediate environment in as systematic and permanent a way as possible so as to increase the effort and risks of crime and reduce the rewards as perceived by a wide range of offenders.’1

Some types of crime respond well to situational measures, such as graffiti, vandalism, assault, break and enter, theft, trespassing, motor vehicle theft, and computer-based fraud, etc.

Other types of crime, which are not motivated by greed but by other emotions such as hatred, fear or anger, etc., are not strongly affected by situational control’s measures: domestic violence is a good example, as is serial rape, child abuse, elder abuse, and terrorism.

This program is not only a technical item, but it involves, and needs, to be effective, a change in users’ behaviour in order to reach a site control according to the theory of the “community policing”.

Most of people live the urban criminality emergency in an emotional way, automatically increasing the use of mechanical defence devices (such as armour-plated doors, unbreakable glasses, alarm systems etc) and accepting restrictions in their life style and in the social behaviour (less social events in the night, no use of high value wares such as jewellery, watches, nice cars etc).

[1] Clarke, Ronald V., ed., ‘Situational Crime Prevention: Successful Case Studies’ sub-committee add full reference please, p. 4.

Moreover the "fear of crime" leads to prepare self defence organizations, similar to a private police organization, that may degenerate and cause acts of intolerance or violence toward people suspected as criminal groups (such as immigrants, drug addicts, prostitutes etc..), this causing further crime acts and making hardier the already difficult cohabitation of these social and ethnic groups.

In historical times everybody was conscious of his role for the care of his house and external areas; this involved not only jobs for maintenance and ornament, but also a real engagement for a strict surveillance on the areas. The result was a signal, for ill-intentioned persons, of a site well cared, guarded, thus hardly accessible.

In the last decennia the reduced level of social relations of people living in the same neighbourhood or even in the same buildings had the consequence of less of connection with the territory. The same consequence follows from the stereotyped buildings and town design and organisation.

The actual resident behaviour is to exclude from his own care the common parts of buildings and town and to refuge himself inside his private areas.

Neglected areas thus become "no-man's lands" whose maintenance and care is committed to external agencies.

Criminologist suggest to modify this type of behaviour by means of information to the residents leading to a social consciouness: the final result aimed is to reach a site control according to the theory of the “community policing”.2

Of course the better strategies involve some differences when employed for existing or new quarters. The common method is that an everyday control must be carried out by the residents who must be encouraged to find out again this important role in the social organization.

The goal is to take again under residents' care the common areas by means of reducing the extension of each of them. It is thus necessary to increase their number and to personalize them for a reduced number of users in order to increase the attachment of each of them to that particular area.

Suggested solutions are to relocate gathering areas to locations that provide natural surveillance and access control, as opposed to locations away from the view of would-be offenders. For

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2 R. M. Barboni “Perspectives of crime prevention involved by building design” IAHS world congress, Lubiana, 2001

example, all play areas should be located within the central common area of the building with as many units as possible able to glance or actively watch children at play.

Further suggestion is to place activities in locations where the natural surveillance of these activities will increase the perception of safety for legitimate users and risk for offenders. For example, well-used common areas (safe) may overlook a parking area (unsafe) to provide additional security for the parking area.

And again, placing activities in locations to overcome vulnerability of these activities with natural surveillance and access control of the safe area. For instance, common toilet facilities and laundry rooms should not be located in a remote corner of the site or at the end of a long nameless hallway. Locate these facilities (unsafe) adjacent to the entry or location where there is normally high foot traffic (safe). It is also advised to redesign or revamp existing spaces to increase the perception, or reality, of natural surveillance.

A result of this method is to create half-private areas where people can recognize each other and easily detect incoming persons. In the meantime a potential criminal should be discouraged by the possibility of being identified.

The “community policing” also involves the idea of greater transparency in buildings (Newmann 1972, Stollard 1991).; it means that staircases, entrance doors, common areas must be transparent, the purpose is to allow a person entering into a building to know in advance what and who he shall meet inside the building.

Transparency must, of course, coexist with high level antintrusion properties of building components (windows, doors, glasses, etc) and this involves a better knowledge of technical solutions and a new specialization of architects.

Outside areas, and especially the entrance area should be under visual control from the apartments; better if from living rooms and/or kitchens. Surveillance facility must be provided also for external areas such as parking areas, gardens, play grounds etc... The idea is to portion greater spaces into smaller easily controlled areas and clearly mark transitional zones that indicate movement from public to semiprivate to private space. For example, the sidewalk represents public space and the main path into a residential development is semiprivate, and a path that branches to an individual unit(s) becomes semiprivate and the interior of the unit becomes private space.

Three relevant case studies are described at Lawlink Crime Prevention Division of New South Wales Government, Australia (www.lawlink.nsw.gov.au)

Case study: Delta City

A quiet suburban community was being disrupted by high levels of malicious damage and house burglaries. Enforcement-style Police operations were unsuccessful. An analysis was performed of the pattern of crimes: they surrounded an old walkway, which joined a baseball field to a shopping centre. The walkway went between backyards and had poor natural surveillance with relatively easy access to private property

The walkway was closed, while pedestrian traffic was diverted to the streets. The problems stopped immediately.

Case study: Park Safety, Calgary, Canada

A park in Calgary was the site of a number of assaults and sexual attacks. The trees of the heavily wooded park had top-to-bottom foliage which reduced opportunities for natural surveillance from nearby streets. The trees were removed and replaced with high canopy trees with low level shrubbery. This not only significantly increased natural surveillance of the park from nearby streets, but also enhanced its attractiveness so that use of the park increased considerably. The number of assaults and sexual attacks decreased significantly. The cost of the project was kept to a minimum through service organisations and community groups working with the local authority to carry out the work

Case study: Kirkholt Housing Estate

A housing estate in the UK, Kirkholt had a very high rate of burglary (one in four dwellings in 1985). The local authority, Police and the residents of the estate co-operated in setting up a program to reduce burglary rates. Information was gathered from victims, neighbours and known burglars. The chance of a second burglary was four times as high as the first burglary (note that Australian statistics support this pattern).

Dwellings which had been broken into were given security upgrades by the town’s Housing Department and some changes to utility connections were made (for example, removing coin-fed electricity systems). A watchful ‘cocoon’ of near neighbours was asked to keep an eye on the house – this program was highly publicised. The program went on to set up a school-based crime prevention program, groups for offenders from the area to address their problems, a cheap saving and loan scheme for the estate residents, experienced probation officers and an increase in resources to the local court.

Results: The program was intended to prevent re victimisation of burglary targets. It succeeded in this and in reducing burglary rates by 75% for the whole estate. There was no evidence of displacement

From a statistical point of view, it can be difficult to evaluate a multi-pronged strategy in that it may be difficult to isolate the effects of individual strategies on reducing crime. This is the case of CPTED programs where it is common to operate at different and integrated levels.

While individual strategies may have specific performance indicators, the group of strategies which are aimed at a particular crime problem should share a major indicator or Key Result Area – that of decreasing the incidence and/or effects of that particular crime.

Any agencies which contribute to these strategies, therefore, should agree to the overall indicator as a measure of success for their programs

3. Buildings typology related to crime prevention

In addition to a development of the site control, buildings with specialized characters are requested to increase the protection level.

The problem is to identify which parts of the building play a relevant role in crime prevention and to give to each part an evaluation of its level of efficiency, facing the proposed item.

A first step is to find out which is the type of crime that can be related to a specific building component, a second step is to classify the right solutions and the wrong solutions. This is a long work that requires an exam of all the types of components and of their way of realization and leads to large archives; an example is given in fig. 2 referred to the balconies.

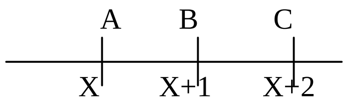
The tabulation leads to a first level of classification: the nominal scale that is based on the direct comparison of the possible solution to an assigned problem; the scale values are yes or not, this makes possible to affirm if a solution is correct or not, but does not affirm which is the value among correct (or incorrect) solutions. At this point we can say nothing between solution 4b and 2b.

A second level of classification is the ordinal scale that is based on three level comparison:3

$$\begin{array}{c} A > B \\ A = B \\ A < B \end{array} \qquad (1)$$

the (1) allows to create a sequence; so we can introduce a criterium to compare different solutions that can be better or worse than others and to find out a continuous scale where to ordinate the solutions

[3] L. Predabissi, A. Trotta, S. Soresi, "Appunti di teorie e tecniche dei test", Erip edit. Milano, 1996



(2)

and to attribute to each one a numeric value that is the measure of the difference of their efficiency. At the moment we cannot point a zero for this scale, but this is a minor problem, because we are only interested to the difference of values.

The problem is how to evaluate the efficiency of a specific solution for an assigned type of criminal attack.

	3	3	4	5
Level of potential risk ↑	2	2	3	4
	1	1	2	3
		1	2	3

Level of potential significance →

Figure B.1 – Matrix used to determine the level of protection required

Figure 1: Matrix used to determine the level of protection required.

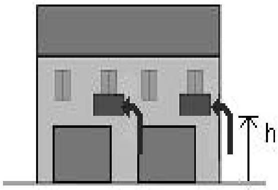
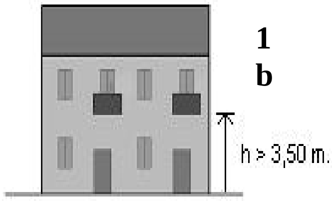
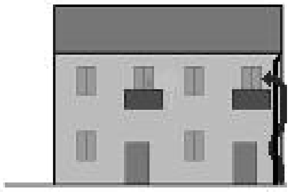
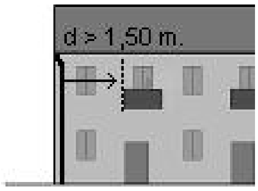
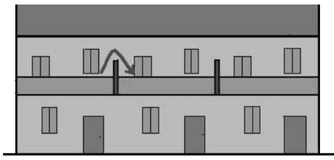
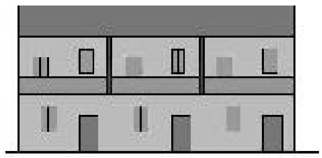
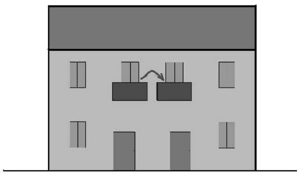
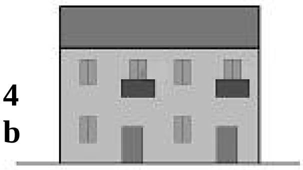
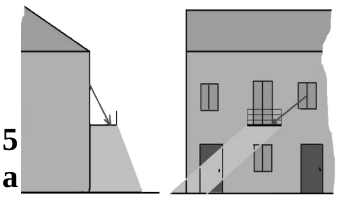
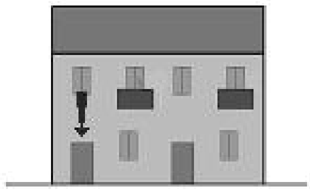
Building Component	Type of risk	*Wrong solution*	**Right solution**
BALCONY	At a lower level the criminal enters with the help of an accomplice or any support	**1 a** 	**1 b** 
	The criminal enters the balcony with the help of the waterspout	**2 a** 	**2 b** 
	The criminal enters from the gallery	**3 a** 	**3 b** 
	The criminal enters from the adiacent balcony	**4 a** 	**4 b** 
	The balcony prevents to look at the entrance door	**5 a** 	**5 b** 

Figure 2: Example of an archive of solutions referred to a building component (balconies)

The recent european code CEN TS 14383-3 adopts the shown correlation between the risk and the protection required. The correlation is built on the basis of a model with three steps level of risk and of significance, but models with greater number of steps are allowed, and sometimes useful.

A further step of resarch is a typological analysis of buildings in order to define which component must be related to a stated level of risk. This analysis is of course depending on the type of building, its position in the town, the dimension of the town, the relation with other buildings and so on, here following an example is shown for new buildings in a middle town (80-150.000 inhabitants)

Residential housing	Group 1.1	Villas (isolated building)
	“	Serial houses
	Group 1.2	Block of flats
Commercial buildings	Group 2.1	Shops in town centre
	“	Shops in commercial centres
	Group 2.2	Larger commercial centres
	Group 2.3	Private offices
	Group 2.4	Hotels, restaurants, pubs etc.
Public buildings	Group 3.1	Hospitals
	Group 3.2	Schools
	Group 3.3	Sports centres
	Group 3.4	Theaters & cinemas
	Group 3.5	Stations, airports etc
	Group 3.6	Public & government offices

Group 1.1	1. ground floor	**a** Entrance door
		b Rooms windows
		c Bath-room & service windows
		d French windows
	Upper floors	**e** Rooms windows
		f Bath-room & service windows
		g French windows

Group 1.2	1. ground floor	**a** Entrance door
		b Rooms windows
		c Bath-room & service windows
		d French windows
	Upper floors	**e** Rooms windows
		f Bath-room & service windows
		g French windows

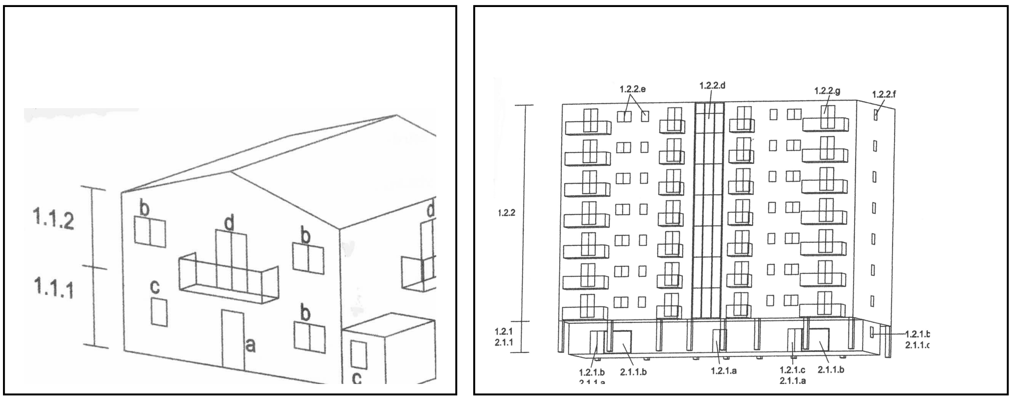


Figure 3: Typological analysis in order to assign risk and protection values to each window of a fixed building; from a research of Polytecnical University of Marche, Ancona Italy

In the example the risk level was assigned following the EU code prEN14383 which has 5 levels :

very low - low - medium - high - very high

the problem was to assign a numeric value to different components paying a role as in crime protection and to chose an algorithm that could lead to a synthetic value to be reported into the above shown risk scale

The building components that play a role come from various aspects such as the type of the area, the typology of the street, the level of the floor, and so on. As a general purpose the algorithm will be of the kind:

$$\textit{global risk level} \quad \mathbf{RL = (\Sigma\, Ri)\, \gamma\, \delta}$$

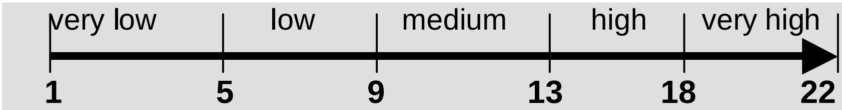
where Ri is the risk level under a specific point of view (level of floor f.i.), γ and δ are coefficients that take on count the "weight" of that point of view. The following example will make the process clear.

Tab A		
Area in the town	Suburbs	5 pt
	Semi-peripheral	3 pt
	Central	1 pt
Typology of street	One way	5 pt
	Double way secondary street	3 pt
	Double way main street	1 pt
Level of floor	Lower floor (1-2)	5 pt
	Intermediate (2 –to 6)	3 pt
	Higher (over 6)	1 pt

Figure 4 Tab A shows values of risk related to different components; tab B shows correcting coefficients related to the situation of the building.

Tab B	γ		δ
village	0,7	Well lighted area	0,5
Middle town	1	Commonly lighted	1
city	1,2	Poorly lighted area	1,3

Both tab A and B may be built up with a greater number of levels and with different values for the single items, anyway the above algorithm is valid and will show a numeric value that leads to the scale of risks provided from CEN codes. The final operation is to compare the scale of numeric values to the five steps of the CEN prEN14383; in the case of the above example this is as follows



in the case of a window at the 4th floor of a block of flats in a middle town , in a well lighted main street

$$(\Sigma\ Ri)\ \gamma\ \delta = 4{,}9$$

that means a risk level **very low**;

a window of the same building and level, but facing a one way poorly lighted street, will get

$$(\Sigma\ Ri)\ \gamma\ \delta = 10{,}8$$

that means a risk level **medium**

Once the risk level defined, the protection level required to the specific building component follows as a natural consequence (at a low risk follows low protection, at a very high risk follows a very high protection) and requirements to the component follow as well:

4. Perspectives of research

The research we are developing aims to analyse, inside a specific town, which may the correlation between crime and town design and, for an assigned building which is the level of efficiency of the building components and the adopted architectural solutions.

A first step is defining a typological organisation of the existing buildings in order to evaluate the role, and the "weight", of the typical architectural solutions.

This data organisation leads to an archive whose access is possible by building typologies (single houses, dwellings, commercial etc.) or by building components (entrances, garages, stairs

SAFETY REFERRED TO BUILDING TYPOLOGIES : **APARTMENT BUILDINGS**					
TYPE OF LAYOUT	TYPE OF FACADE	TYPE OF FLOOR	PARKING AREAS	GREEN AREAS	LIGHTING

STAIRS & LIFTS	***GARAGES***	***ESTERNAL STAIRS***	***PEDESTRIAN WAYS***
GATES	***TECHNICAL INST.***	***ENTRANCES***	**OUTSIDE FENCING**

Entrances must not create dark areas or offer the possibility to hide a criminal person.

There is a large variety of solutions in building practice: at street level, at higher level, covered by arcades, pilotis, etc.
This card shows the type and number of entrances for apartment buildings.

§ ***Linear building with single entrance***

pro: with a single entrance the criminal must cross it twice coming in and out increasing the probability of being noticed

con: with a single entrance the number of people crossing it becomes greater and the fact can induce a lower level of attention for visitors

* ***Linear building with several entrances***

pro: the increase of number of entrances helps the sense of property of each of them for the reduced number of inhabitants served thus increasing the level of surveillance

con: criminal persons have a larger choise to enter the building and of coming out from a different entrance.

FOTO A
Single entrance apartment building
Zona Palombare (AN)

FOTO B
Several entrances apartment building
Zona Grazie (AN)

INDEX	**VILLAS**	**SERIAL HOUSES**

Figure. 5 example of an archive of the expert system developed to analyse the influence of building components related to crime prevention

and lifts, balconies, arcades etc.) or by type of crime (burglary, violence etc.) and so on. A clever use of “links” (Fig 5) let us analyse the problem at the change of the selected item (type of aggregation, type of facade, type and level of lightning, type of pedestrian ways etc).

In this way we could build up an “expert system” where, by means of informatics, it is easy to find out the influence of the single variables.

This “expert system” needs, of course, the identification of the basic archives for each building component, in order of being sure to consider the whole range of possible solutions; an example of archive is shown in fig. 6 referred to windows in external walls

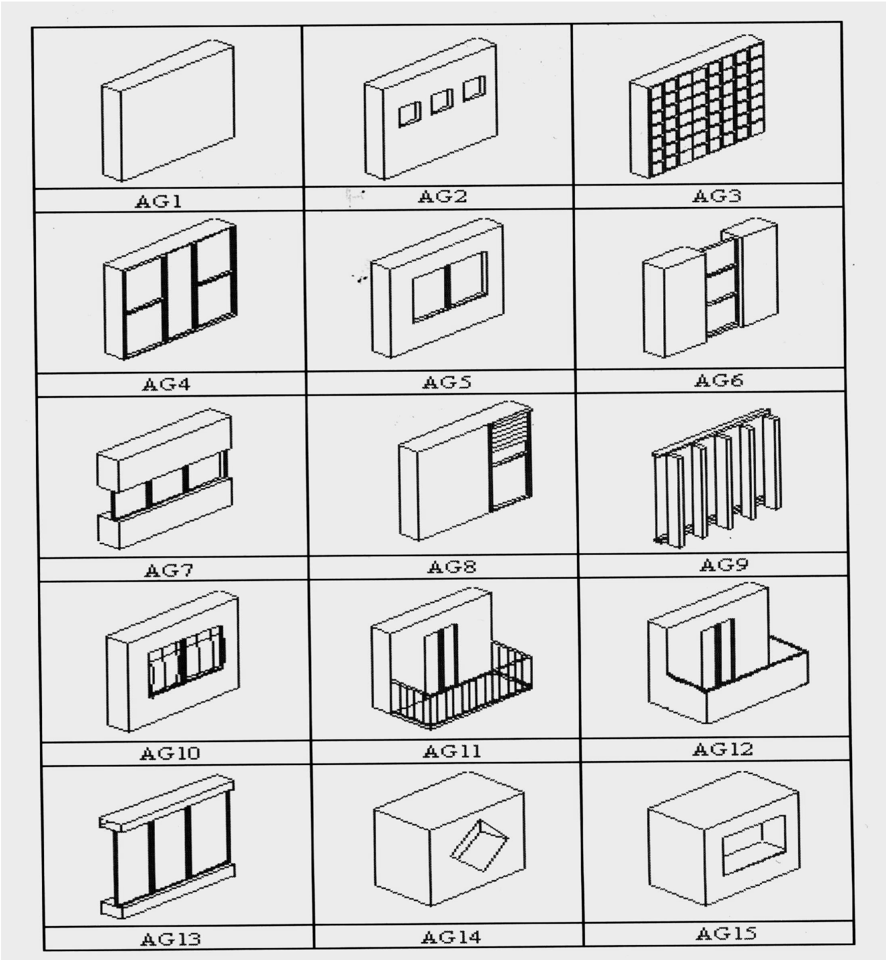


Figure 6: Shows an example of archive of typologies referred to windows in external walls, similar archives are built up for each component in order to evaluate the aptitude of the single solution to prevent crime.

5. Conclusions

It is well known to criminologists that people who commit crimes often do so on the basis of rational motives: that is, they want something and they consider the best/easiest way of getting it, but they will not take action unless the benefits outweigh the risks.

Under this cost/benefit model, if you make it harder or riskier for a person to commit a crime, you will reduce the amount of crime that occurs, opportunities for crime and, hopefully, crime itself.

A professional burglar, for example, will weigh the risks costs and benefits of breaking into two different houses. If one has locks and is easily visible from the street, while the other has concealing shrubbery and no defences, a widow left open, the burglar will naturally choose is likely to choose the second house..

Changing the environment so that it is harder or riskier for someone to commit a crime is known as situational crime prevention. This term also includes removing the rewards for crime in order to reduce the benefit side of the cost/benefit formula.

Not all types of crime are sensitive to situational measures (fraud, for instance, isn’t), but the most common crimes such as vandalism, assault, break and enter, theft, trespassing, graffiti , etc. are sensitive.

The research shows how architectural design has a relevant role in situational crime prevention and that a correct design may outcome an effective crime prevention device in town design.

The basic idea of increasing residents' watch as a crime prevention method, can be realised in a plenty of different ways depending both on the ability of the architetcts, and on the level of risk for the area, but as a first step a perfect knowledge of the correlations between building components and of their weight in crime prevention is of basic importance.

The following step is assigning to each component (or architectural solution) a numeric value related to its efficiency in preventing crimes (or a specific crime). The said value can be modified (increased) in two different ways: by changing the design, or by adopting an higher level of protection for relevant parts of the component.

For instance, the use of breaking-safe glasses instead of common thermal glasses can improve housebreaking resistance without modifying the aesthetics of the building; the same level of improvement can be obtained by means of the use of metallic gratings or railings, but with a change in the exterior aspect of the building. To the architect, or to the owner, the choose, but finally based on a well know (numerically identified) level of efficiency.

Of course improvement in crime prevention is based on strict cooperation among architects, criminologists, and public institutions, but also on the evolution of the cultural an social background of residents, and, last but not least, on the budget.

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Perceptions of Personal Safety in relation to the Physical Environment of University Campuses

Joanna Waters,
The University of Glamorgan, Pontypridd, UK (email: jwaters1@glam.ac.uk)
Richard Neale,
The University of Glamorgan, Pontypridd, UK (email rhneale@glam.ac.uk)
Kevin Mears,
The University of Glamorgan, Pontypridd, UK (email kjmears@glam.ac.uk)

Abstract

This paper discusses research at the University of Glamorgan which focuses upon personal safety on the university campus, its immediate environments and access routes. The issue of personal safety is significant because of the design and layout of many university campuses and facilities. Campuses are often large open spaces and lack systematic access control, which may lead to a higher propensity for campus users to experience victimisation and fear. In addition, previous research has shown that university students are more at risk of being victimised than the general population. The primary objectives of the research were to identify areas of the campus that posed possible threat and vulnerability to campus users and to identify solutions in the form of design and management modifications that were based on users' perceptions of their personal safety. This user-led approach produced a number of cost-effective and achievable recommendations for modifications so that all users could feel safer, as well as a generic, evidence-based model for comparable universities to emulate. The initial research determined the most common routes around campus used by three discrete user groups: staff, students and visitors. From this analysis representative routes were selected for each user group. A digital camera was used to take a number of 360° panoramas at key points along the routes which were then 'knitted together' using QuickTime software to produce a 2-dimensional virtual representation of the routes. These 'virtual reality' walk-through scenes of the routes were presented to focus groups where perceptions of personal safety were discussed. Possible solutions to personal safety concerns were considered in the form of the design and maintenance of existing facilities. Key findings from the preliminary research have identified a hierarchy of concerns and some practical recommendations that would improve campus safety. These were concerned with improving visibility, the issue of empty spaces and the need for more effective security measures. The methodology forms a cost-effective, versatile and insightful research tool that can be used to explore personal safety concerns in relation to the facilities of any organisation or environment.

Keywords: personal safety, university campuses, perceptions, virtual-reality.

1. Assessing personal safety on campuses

1.1 Introduction

This research focuses on a comprehensive exploration of how campus users perceive their personal safety on and around university campuses with particular emphasis on the physical characteristics of the campus environment. The salience of this research topic has been highlighted by a recent UK Government Home Office study that showed that a third of university students suffered some form of victimisation in the previous year [1]. Students are particularly likely to experience crime and personal safety incidents because they are young and vulnerable and because of the propensity of campuses to have specific crime and personal safety concerns linked to their design and physical layout. Sloan et al [2] observed that “campuses are typically park-like and easily accessible day and night. This openness may create high levels of fear and perceived risk of victimization among members of the campus community.” Universities can also have difficulty reconciling their traditional ‘open access’ philosophy with a safe environment and this inevitably has incidental consequences for the personal safety of campus users.

The University of Glamorgan was used as a case study for the research, and a comparative study will be undertaken at Loughborough University. The methodology used to elicit users’ perceptions on the two campuses was based on the ‘Virtual Reality (VR) Panorama Tool’. Quick Time software was used to develop a two-dimensional virtual representation of routes across campus which were presented to participants in focus groups. This perceptual approach offered profound insights into how the physical environment of the university correlated with feelings of personal safety. This instrument has been successfully used by the SLTRI in a study for a local train operating company, Valley Lines, which explored how station environments were perceived in terms of personal safety. The study by Cozens et al [3] led to a range of modifications to the design of the station environments, including transparent shelters and removal of overgrown vegetation.

The campus study has so far led to the identification of a range of cost-effective, practical and user-led solutions to promote the personal safety of campus users. Initial findings from the research are encouraging and point to the overall portrait of a relatively safe campus during the day. However, the physical environment was decoded differently at night and this had a significant impact on concerns over personal safety. Issues that users identified as influencing their personal safety included lighting levels, landscape, security equipment, the campus perimeter and the institutional open access philosophy.

2. Campus safety and the physical environment

2.1 Previous research

US research into campus crime and student victimisation spans four decades and several studies have explored the prevalence and nature of victimisation risk to students, focusing considerably on their demographic profile and characteristics of the campus environment as possible causes of increased risk. Much of this research is grounded in criminological theory, which centres on attempts to deconstruct why crime occurs and to suggest possible ways as to reduce or prevent crime from occurring. In the UK, such campus research is limited although there has recently been recognition of the salience of the topic [1, 4, 5]. Having established the particular risks to students, the UK Governmental studies have clearly triggered interest in this area. However, it remains that responses to issues of concern on UK campuses are usually reactive rather than proactive.

One of the most convincing criminological theories for explaining campus crime and risk of victimisation is the routine activities theoretical framework. This contends that three critical factors have a decisive effect on the likelihood of a crime taking place: a "motivated offender, a suitable target or victim and the absence of a capable guardian," as devised by Cohen and Felson [6]. It is suggested [7, 8] that on university campuses these critical elements are particularly significant owing to students' characteristics and the nature of the campus environment. The 'problem analysis triangle' is a useful crime reduction framework derived from this [9]. This maintains that any crime requires a victim, an offender and a location and that a crime can be averted by eliminating or adapting one of these key elements. This thesis highlights the crucial importance of location or environment in determining the probability of a crime occurring and it is this latter element that underpins this paper.

Research shows that fear of crime on university campuses can be influenced by different features of the physical environment. Nasar et al [10] argued that students felt less safe in areas with a high number of trees and dense vegetation, which provided locations for potential offenders to conceal themselves, while Robinson and Mullen [11] maintained that areas such as car parks and alleyways, specifically those which were secluded and had little 'human traffic', fostered fear. This stance is given greater credence by extensive supporting research from the criminological literature that correlates crime with the design of the physical environment. This is encapsulated neatly by Nasar et al [10] who suggest that reducing levels of fear on campus may be achieved through changes to the physical environment. An example of campus research that concentrated on ways of redesigning the physical environment was a study by Rengert et al [12]. Using high definition Geographic Information Systems (GIS) they located 'hot-spots' of victimisation on campus by analysing campus crime data and introduced appropriate situational crime prevention measures to improve safety. 'Situational crime prevention' (SCP) is a crime prevention approach that addresses specific ways of altering the physical environment to reduce the likelihood of crime. Examples include improved street lighting, increased natural surveillance by establishing, for example, Neighbourhood Watch groups and modified building design. The main criticism levied at situational crime prevention measures is that they can result in the displacement of crime from one area to another. However, there is also a considerable literature that supports the effectiveness of this approach, such as the work cited by Clarke [13].

2.2 Critique of previous campus research

The main criticism levied at the previous research into campus crime and student victimisation is that most of it uses recorded crime statistics and are underpinned by typically quantitative methodologies. This raises important questions about the accuracy of such data in reflecting reality and their validity in being the basis for underpinning crime prevention strategies and personal safety responses. Understanding crime by using recorded crime data is questionable because it has been found to systematically underestimate real levels of crime. Maguire [14] encapsulates the concern for the 'dark figure' of crime, which refers to unreported and unrecorded crime. Using official statistics as indicators of crime risk give limited indications of the social and situational context of the criminal offences, or the propensity for certain people to be more vulnerable than others [14]. It is therefore arguable whether objective approaches provide a fully representative portrait of victimisation, its causes and effects and accurate insights into possible focal points for campus improvements. For example, Rengert et al [12] sought students' perceptions of safety using quantifiable attitude responses which arguably provided an inadequate and superficial understanding of safety concerns.

In response to these concerns, this research sought to adopt a more rigorous and focused exploration of campus safety. In order to conduct more meaningful research a multi-method approach was adopted that encompassed both a perceptual approach and a statistical approach. Perceptions are arguably a more realistic portrayal of users' concerns than statistical approaches allow for and can lead to environmental improvements that more accurately reflect the needs of end-users. The importance of perceptions has been highlighted in relation to studies of crime and safety by Skogan and Maxfield [15], who found that users' perceptions are a more accurate indicator of safety concerns than simply using objective crime data. Pain [16], meanwhile, suggests that "qualitative and humanistic methods offer the most enlightening prospects of investigating the interactions between identity, social relations and place". This research sought to translate both forms of data into tangible improvements that objective indicators of risk on their own could not accurately record.

3. Defining personal safety

Having established that personal safety on University campuses is a pertinent research area, a thorough exploration of the literature was undertaken in order to gain an understanding of the concept. However, despite 'personal safety' being a term that is frequently and intuitively used in daily life, it is a widely misinterpreted term and lacks clarity. This was confirmed in a review of the literature, which revealed that no studies explicitly defined the term ‘personal safety’. Although Maurice et al [17] defined the more generic term ‘safety’, and Schroeder & Anderson, [18] Bilsky et al, [19] Burckhardt & Anderson [20] specifically used the term ‘personal safety’ in their research, none of these studies provided a lucid definition of the term ‘personal safety’. A review of the criminological literature, however, established a clear link between personal safety and crime. The notion of safety is firmly embedded in the criminology literature and there is a proliferation of the word ‘safety’, sometimes ‘personal safety’ and often ‘security’. Cozens et al [3], Lund & Hovden [21] and Barker and Page [22] all refer to personal safety as the focus of their research yet none defines what this elusive term means. Significantly, however, Austin et al [23] found in their study of neighbourhood conditions on perceptions of safety that “although fear of crime and perceptions of safety were separate concepts, they had significant theoretical and empirical commonalities”, which serves to acknowledge and document the relationship between crime and personal safety and suggests that some established theories of crime may be applicable to personal safety.

In response to the lack of definition, and prior to a campus assessment being conducted, it was necessary to produce a robust and academically useful definition of the term ‘personal safety’, as reported by Waters et al [24]. The Delphi Method was selected as the appropriate technique to attain a definition. The resulting definition of personal safety can be crystallised as relating to *intentionally motivated harm against the individual, their property or their personal effects.* Personal safety was found to be a complex composite of three causal converging determinants - physical, social and personal factors - which interact as an individual’s environment changes; personal safety is thus a transient phenomena. This framework provided further support for the commonalities between personal safety and crime; Pain [16] highlighted the tripartite relationship between individuality, social relations and the physical environment to explain what can cause fear of crime. There are thus clear parallels to be made between personal safety and the fear and risk of harm and the fear and risk of crime. Critically, this study established that personal safety is not a single dimension issue; *perceptions* of personal safety, in addition to *actual* personal safety, were both found to be crucial components of an individual’s personal safety. It was therefore imperative that the methodology for the campus research was designed so as to focus considerably on subjective perceptions because of their ability to reveal how people construct their personal safety in line with changes in the social and physical environment.

4. Methodology for the campus study

The University of Glamorgan was used as a case study for this research, with a smaller scale comparative study being undertaken at Loughborough University. The rigorous multi-method approach consists of three key components. **Questionnaires** asked for respondents overall perceptions of security on campus, whether, where and when they fear for their safety on campus and whether they have been harmed on campus. They were also asked to identify their three most common pedestrian routes across campus on a map. Analysis of these routes determined which routes would be filmed for presentation to the focus group. The **VR Panorama Tool** was used to film representative routes identified from the questionnaires. A digital camera was used to take

16 digital still images at key points (nodes) along the route. These 16 images were 'knitted together' using QuickTime software to produce a fluid 360° panorama, which were then 'knitted' to the other nodal panoramas, resulting in a 2-dimensional virtual representation of the route. This standardisation of the route ensured that participants responded and reacted to a consistent stimulus. These 'virtual reality' walk-through scenes of the routes were used as the stimuli in **focus groups** where perceptions of personal safety were explored. The technology allows for participants to move backwards and forwards through a route as requested, proving a more accurate representation of reality than static photographs. This approach explored how personal safety is influenced by the physical conditions on campus and identified any 'trouble spots' that exist. The study has so far consisted of a pilot focus group consisting of 12 undergraduate students, which explored a day-time and night-time route on and near campus and the analysis of 46 questionnaires (out of 120 distributed) with the following breakdown from each user group: 21 staff; 17 students; 8 visitors.

5. Key findings

Analysis of the questionnaire and focus group data led to the identification of key characteristics of the campus environment that influenced users' perceptions of personal safety along with some possible situational solutions to improve personal safety on campus.

Table 1: Those campus features that invoked concern for personal safety and some suggested solutions for improving personal safety

Risk factor:	Risk caused by:	Possible safety solution:	Risk potentially reduced by:
Low lighting levels and state of darkness	Reduced visibility and reduction in social presence	More street lighting	Street lighting improves visibility and boosts confidence
Landscape concerns such as tall and dense vegetation	Opportunities for potential offenders to conceal themselves	Less dense vegetation	Providing more visibility and reducing opportunities for offenders to come on campus unnoticed
Insufficient security equipment	Lack of help response if victimised	More CCTV	Reassurance that individuals and their property are being protected and, if an individual is victimised, it will be noticed and help will arrive.
Problem of leaving campus and entering local community	Less protection when in local community	Improved lighting Security guards patrolling key routes off campus	Better visibility Security guards provide social reassurance
Open-access ethos of universities	Unable to monitor who comes on campus and enters buildings	ID cards, electronic swipe cards	More control over who uses the campus and easier to identify individuals who aren't on campus for valid reasons

6. Discussion

This discussion involves an exploration and critical evaluation of the five main risk factors relating to the physical characteristics of the campus and the effectiveness of possible situational solutions in reducing fear and increasing personal safety on campus.

Lighting levels

Personal safety concerns were considerably lower during the day, due mainly to high levels of visibility and high numbers of people to provide social reassurance. However, such perceptions changed dramatically at night as light conditions (and subsequent social conditions) changed. The state of 'darkness', it seemed, and what this signified in terms of reduced visibility and a corresponding reduction in the number of people in the vicinity as standard university hours ended, fundamentally changed the dynamics between people and their environment. The campus users generally thought the daytime route would be a lot less safe at night and the lack of illumination (natural and artificial) dramatically increased perceived risk. Some comments from the focus group included:

> *Participant 11: "Feel less safe at night – darker."*

Participant 7: "Lighting is a big issue with making you feel safe."

In the main study questionnaires, 47% of all campus users thought that there was adequate lighting on campus. However, improved lighting was often cited in the questionnaires and focus groups as one possible way of improving personal safety on campus during the *state* of darkness. It would seem that such a security measure works by boosting self-assurance and personal safety levels by improving intervisibility of the immediate vicinity. However, it is generally accepted that improved street lighting only partially improves personal safety. This is supported in the criminological literature by Nair et al [25] who found that improved street lighting can considerably reduce fears and improve *perceived* safety, while Atkins et al [26] concluded that while this is true, the introduction of improved street lighting does not reduce actual risk (in terms of reported crime). Thus such measures to promote personal safety should ideally be implemented as part of a package of solutions.

Landscape

The other principal factor influencing personal safety was the physical environment – natural and built - of the campus. In particular, enclosed, quiet and remote spaces on campus, such as stairs enclosed by dense vegetation, the car park and the smoking shelters, which could present as hiding places for potential offenders, figured highly in respondents' fears and concerns for their personal safety. One location mentioned frequently in the questionnaires as being an unsafe place was the tunnel end of the main car park, which was decoded as being poorly lit at night, surrounded by high vegetation and enclosed on three sides. Some remarks from the focus group included:

Participant 1 "Car park is dark, bushes all around."

Participant 12 "No-one can see anything that goes on so if you are accosted or something bad happens at that point no one can see you because of the trees."

Analysis of the night-time route data showed that the physical environment was perceived to impact on senses of personal safety. A key entrance gate onto campus was perceived as dark and threatening as were back lanes adjacent to the entrance; most students in the focus group would avoid walking down these lanes at night and sometimes even during the day. These insights about the impact of the design and layout of the physical environment are echoed by Fisher and Nasar [27], who discussed how certain physical characteristics of the university campus environment, such as 'blind-spots' and places of concealment, can increase vulnerability and feelings of fear.

Security equipment

The lack of physical security equipment was a concern cited in the questionnaires and in the focus group. There was a degree of cynicism aimed at the current use of CCTV on campus, with some respondents intimating that it is useful only when it is being constantly monitored. However, 24% of users thought there was inadequate CCTV and many focus group participants cited CCTV as one possible solution to personal safety concerns on campus. The lack of security such as CCTV and lighting on the night time route, particularly off campus en route to the local train station, was a primary concern.

> *Participant 1 claimed her personal safety would be improved: "If you had CCTV there knowing that someone's sitting in an office watching the screens."*

CCTV can be effective in increasing perceptions of personal safety because it acts as a deterrent to potential offenders and it provides reassurance that such surveillance, if used appropriately, can immediately alert security personnel if threatening situations arise. This is supported by research carried out by Ditton et al [28], who found that 79% of people questioned thought that they would be less likely to become victims of crime in areas with street cameras. However, Campbell and Bryceland [4] proclaim that "CCTV alone will not reduce crime but …. if properly managed and monitored it will have a lasting effect on crime reduction and community safety." The findings suggest that inadequate lighting and CCTV both play a key role in making campus users feel less safe on the campus and contribute to the sense of a more sinister night-time environment.

Campus boundary

Routes within the campus boundary provided an almost intrinsic safety, a sense that users were better protected on university facilities than in the surrounding local environment. This was particularly an issue as users left the campus via a key entrance gate and entered the local neighbourhood. When participants left the perceived safety of the campus environment they claimed that they experienced different perceptions of personal safety as they entered the local community.

> *Participant 10 claimed that: "If you leave the campus it's a different thing all together – you are outside there and parts of that were very dimly lit and hardly any people. I wouldn't be happy or have a safe feeling at all."*

This relates in part to the issue of control. As Donnelly [29] observed, a common factor that plays a role in influencing fear of crime is the sense of control. Experiencing feelings of loss of control, for example over one's environment, can result in heightened fears and concerns. It could therefore be suggested that users feel they have more control over their environment on the university campus, thereby prompting an increased sense of personal safety on campus. A possible solution is to have security guards patrolling the key routes off campus.

Institutional open access philosophy

While the open access policy of the university can be equated to the lack of literal physical restrictions that prevent people from accessing an environment, it is the consequent impact that this has on the social presence that is perhaps most significant. The result of this is that 'anyone' can come on and off campus unchecked, regardless of whether they are there for reasons connected to university business or not. This was a concern particularly at night, when there were less people available to provide natural surveillance.

> *Participant 1 claimed that: "Anyone can get on and off the campus easily enough regardless of who you are and I wouldn't feel any safer walking around here than around Pontypridd (the local town), I don't suppose."*

However, this is a complex issue since the very ethos of an open access educational environment underpins the whole principle of a welcoming, accessible and creative learning environment which would be dramatically altered if a fortress image was adopted. However, perhaps some compromises have to be sought to try to reconcile the historical and philosophical rights of universities to retain some semblance of an open access ethos with the need to provide effective security on campus that maximises personal safety. Campbell and Bryceland [4] suggest that "the foundation on which to build a safe and secure environment is a tried and tested access control policy." The introduction of ID cards, perhaps initially limited only to certain areas of the campus, is one possible method of monitoring the rightful use of campus facilities without suppressing accessibility for valid campus users.

7. Conclusions

The study has supplied some intriguing preliminary findings that give an interesting indication of perceptions of personal safety on the University of Glamorgan campus and indicated what physical attributes of the campus need to be explored to promote personal safety for users. This provided opportunities for developing solutions that are grounded in users' every-day beliefs, actions and perceptions. The findings encouragingly suggest that the campus is a safe place during the day and there is probably only a limited number of actions that can be taken to improve it during daylight hours. Naturally occurring conditions as a direct result of the university environment such as institutional responsibility, high social presence and, of course, daylight, denote that personal safety is almost inherent to the university during the day. However, perceptions of safety noticeably decrease at night, and this is exacerbated by certain features of the physical environment. Recommendations for possible situational solutions to improve personal safety and reduce the risk of victimisation were therefore mainly in terms of tackling the negative effects of darkness and included upgraded lighting and CCTV, which would provide reassurance to some extent by improving visibility and reducing users' fears. The caveat is that although such measures are often cited as reducing fear, their actual effectiveness in terms of reducing victimisation is uncertain and should therefore form part of a package of solutions rather than stand-alone solutions. Another useful intervention would be to have an increased security presence patrolling the campus, *and* the immediate local environs, to strengthen the image and relationship of security staff with university users and to clarify security guards' roles on campus. Such situational crime prevention measures implemented to improve personal safety should not be viewed as a panacea to all personal safety concerns; rather, they should be integrated into a comprehensive package of solutions that together maximise personal safety on campus.

Beyond its utility in assessing and improving personal safety on university campuses, the methodology developed has considerable industrial relevance. It forms a versatile, insightful and transferable research tool that can be used to explore users' perceptions of personal safety in relation to the environmental facilities of any organisation or environment, including transport nodes, hospitals, schools, recreational services, hotels, banks and retail establishments. The methodology also translates into a sustainable applied research capability that is cost-effective and based on the premise that user groups can be effectively used in decision-making processes. It can also be used to explore issues such as aesthetic preferences and the architectural and design requirements of different user groups. For example, it can be used to explore the relatively unexplored issue of how the disadvantaged and minority groups perceive their environments and their specific needs and how this in turn affects how they use facilities and environmental spaces.

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Developing a New Framework for Infrastructure Asset Management

Masayuki Kurihara,
National Institute for Land and Infrastructure Management, Japan
(email: kurihara@nilim.go.jp)
Kazuhiro Nishikawa,
Public Works Research Institute, Japan (email: nisi awa@pwri.go.jp)

Abstract

Maintaining the infrastructure asset is an important issue. In Japan, there is a large amount of the infrastructure stock constructed during its modernization era and they are getting older year by year. The local authorities who manage the most portion of the infrastructures do not have technical and financial background enough to perform periodic inspection and preventive maintenance of their infrastructure asset. They do not well maintain their infrastructure and are facing the crisis of losing the function of their asset. However, the existing technologies such as bridge management systems require detailed inspection data and high operation cost. So we propose a new framework of asset management which enables the authorities to conduct the asset management with limited technology and financial background. This framework allows the authorities to undertake the asset management and to realize the sustainable infrastructure services.

Keywords: Infrastructure, maintenance, management system, asset management

1. Introduction

Japan has a large amount of infrastructure stock constructed during its modernization era in 20th century. The considerable amount of structures such as bridges and tunnels were formed during 1960s and 1970s so they are getting older year by year. The most portion of the infrastructure is managed by local governments. For example, Japan has a 1,177,000km road network and the 98 percent in length is managed by prefectural and municipal governments. The budgets of them are not enough for the expenditure required for the maintenance and they are facing the shortage of the budget for the maintenance of their asset. It means that they do not well maintain their asset. Furthermore, we cannot expect that in future, the efforts to secure funding for the repair or maintenance of the road structures will be easily provided.

Table 1: Road network system and the expenditures for road maintenance in Japan

Road Type	Length (km)		Expenditures for Maintenance	Expenditure per km
National Highways (Class-A)	6,851	0.6 %	703,267	32.2
National Highways (Class-B)	21,828	1.9 %	178,153	5.6
Prefectural Roads (Regional)	32,028	2.7 %	256,564	4.5
Prefectural Roads (General)	128,409	10.9 %	213,491	3.0
Municipal Roads	982,521	83.9 %	583,297	0.6
Total	1,171,647	100 %	1,934,772	1.7

Unit: JPY Million
Source: Road Statistics Annual Report (Japan)

2. Issues of Asset Management in Japan

2.1 Overview

The stringent financial situations in recent years have forced the authorities to limit the budget for infrastructure, and it has been becoming increasingly difficult to allocate the funds as desired. In other words, as budgets has become to be allocated for specific, higher priority expenditures, it has become increasingly difficult to allocate enough funds for maintenance. Such a situation is severer especially in the local governments. According to the survey held by Japan Society of Civil Engineers (JSCE) on Japanese local governments, the issues of their asset management are summarized as follows.

(1) Issues of Asset Strategy
Only a few local governments have asset strategy. So most of them cannot create the alternatives based on life cycle cost nor environmental effects.

(2) Technical Issues
Only a few local governments perform periodic inspection of their structures and facilities. So most of them do not collect the data of the condition of their facilities including inspection results. They do not have technology for deterioration prediction and maintenance planning.

(3) Financial Issues
In Japan, the funds have been concentrated on new construction, replacement and improvement because the importance of maintenance has not been well understood. The financing system such as subsidies and bonds guaranteed by central government targeted on capital investments may distort the optimal choice of alternatives.

So the infrastructure management authorities in particular local governments need the methods and tools to establish and conduct their asset management and to realize the accountability to citizens, local assemblies and financial authorities.

2.2 Technical Issues on Asset Management

Now there are established methods for routine, standardized inspections and tools to provide the understanding of the condition of the structures and the facilities. There are also the systems for network-level management which assist maintenance and repair planning. For example, the United States has PONTIS system used by highway management authorities inside and outside the US. Japan is now developing management systems proposed by the Ministry of Land, Infrastructure and Transport (MLIT), Public Works Research Institute (PWRI), Hokkaido Civil Engineering Research Institute (CERI) and so on. However most of them are not applicable to authorities like Japanese local governments because the systems require periodical inspection data in detail and considerable operation cost. Therefore the local governments cannot undertake their asset management with the existing management tools. It is required to solve the issues to establish the asset management responding to the era of maintenance.

3. A New Framework for Infrastructure Management

3.1 Objectives

As the solution to the issues of the infrastructure management in Japan, the authorities need the methods and tools of asset management which can be applied under the condition with limited data and low operation allowance. So we propose a new framework of asset management which is applicable to authorities like Japanese local governments considering the following requirements.

The requirement for the framework are as follows:

-The management framework can be applied under situations with limited data which are inadequate for existing management systems.

-The management framework can be easily understood by executives who do not have engineering background and are not familiar with the sites of infrastructure such as citizens, local assemblies and financial authorities.

-The management framework can utilize the existing asset management technologies for maximum regarding strict financial condition.

Therefore, we reviewed the decision making process of the authorities in the management and maintenance, then designed the framework because the existing systems do not necessarily agree with the decision making process.

3.2 Concept

We can state that there are essentially two aspects in the asset management of the infrastructure. One aspect includes the inspections of individual structures, and the repair and maintenance activities. The other aspect is to formulate plans and allocate budgets for maintaining them in the most desirable way considering the overall infrastructure such as road networks and structure groups.

The former is conducted by the local field offices responsible for the operation and maintenance of structures and facilities at site and the latter is conducted by the headquarters responsible for the infrastructure as a whole. In terms of budgets and funding, the most important aspect of the former is securing the funds needed to maintain their structures and facilities in good condition. The responsibility of the latter is determining the optimal allocation of funds regarding the entire asset inventory under the charge of the authorities considering other policies such as capital investments etc.

Different information is required for each aspect of management. While the former requires detailed information of individual structures (degree of deterioration of the structures and their parts and members), the latter needs to know whether the structural conditions are improving or deteriorating as a whole, or whether there is any imbalance between districts or routes. It is not reasonable to consider the degree of deterioration of each structure for the purposes of determining nationwide budget allocation.

Therefore we propose the framework of asset management should include individual facility management and network (or a group) level management as shown in Figure 1.

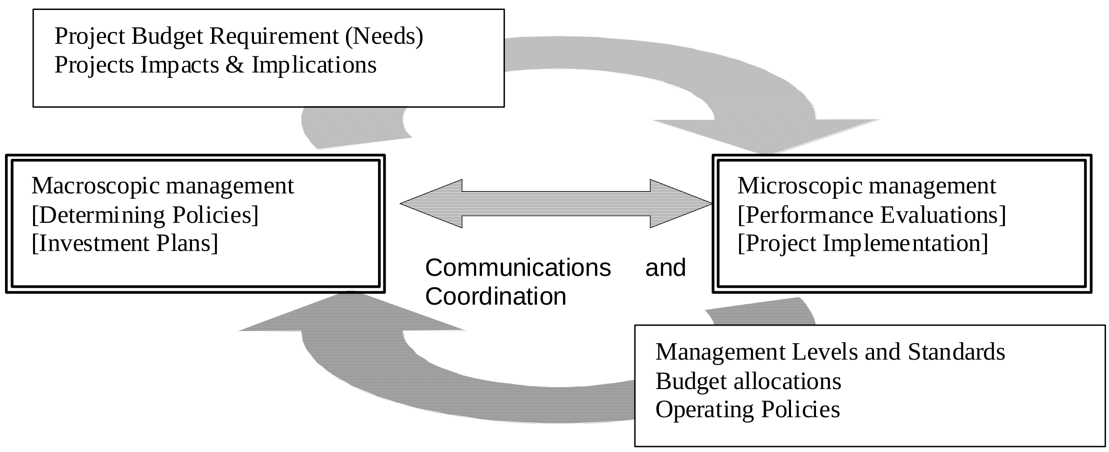


Figure 1: Structure of the new framework of the infrastructure asset management

The concept of the framework is as follows.

- -The management framework is composed of two components, individual facility management and network (or group) level management. We name them the microscopic management and the macroscopic management.
- -Both management components intend to the optimal management within their own scopes. The former is primarily responsible for operation and maintenance of individual structures at site. The latter is responsible for the management of the overall asset inventory, including total management planning and budget allocation.
- -Both management components communicate, cooperate and exchange information interactively, so they form the management cycle to realize the asset management in the most effective way.

3.2.1 Microscopic Management

The objectives of the microscopic management are providing appropriate maintenance and management to each individual structure, for proper structural functions in the face of deterioration and damage due to aging.

The microscopic management process is conducted with two types of indicators, indicator of the health and safety of each individual structure (Health Index) and indicator of the level of deterioration or damage of the parts and members (Damage Degree) of the structure applying deterioration scenarios.

(1) Health Index

The health index indicator reflects the safety of individual structures. It generally refers to how weakened structural functions may have become due to deterioration by aging or other factors. The indicator is expressed either as a percentage against a perfect score of 100 where no deterioration is noted, or five-levels definition.

The structures are composed of parts and members. Therefore, it is assumed that accumulated damage (damage degree) for each parts and members impacts the overall health index of the structure as a whole. With this assumption, for the more damage to parts and members, the lower the health index will be indicated. The health index is calculated with the following formula.

Health Index = (AX+BY+CZ+…) / (A+B+C+…)

Here, X, Y, Z…:numerical value of damage degree of each part or member as 'the lower degree of damage gives the higher numerical value'.

A, B, C… :weight coefficient of each parts and members

(2) Damage Degree

The damage degree is a quantitative indicator defined for each type of damage affecting parts and members of the structures. According to the severity and extent, the damage degree can be expressed in levels as shown in Table 3. The damage degree is used to ascertain the conditions of deterioration of the parts and members, and consequently, for the selection of repair works. The damage degree is also used for calculation of the health index shown above.

The damage degree as shown here is similar to the definition in the guidelines now in use for bridge inspections in MLIT but other measurement rules can be used in accordance with the inspection and deterioration evaluation standard of the authorities.

Table 3: Damage degree of individual structures (example for road bridges)

Damage Degree	Meaning of the Damage Degree	Index*
V(OK)	No problem, not shown below	100
IV	Points requiring attention, damages to similar structures, environmental factors (damage caused by salt), heavy traffic volume, aged.	80
III	Identified as Damages, subject to preventive maintenance measures.	60
II	Survey for Repairs required	40
I	Danger, urgent repair required.	20

* Numeric scale used for calculation of the health index

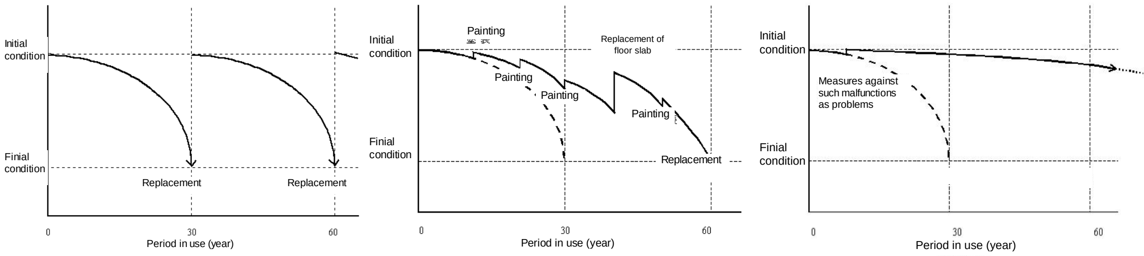
(3) Deterioration Scenarios

In managing structures, it is required to consider that the health index will change due to aging. Therefore, we have introduced the following deterioration scenarios.

It is the progress of damage to each parts and members that determines the health index. However, there is no clear understanding of the deterioration mechanism. So we assume the following three scenarios to predict deterioration patterns. These scenarios are based on expected management patterns and the period of usable life and are to be applied to each structural unit.

- Non maintenance (Disposable) scenario: a scenario to be left without maintenance and repair (30 years usable life)
- Repair when broken (Symptomatic treatment) scenario: a scenario to be repaired when damage becomes severe (60 years usable life)
- Troubleshooting scenario: a scenario in which preventive measures applied, defects completely fixed in early stages, and lifespan extended by new technology. (120 years usable life)

These scenarios enable to predict the usable life of each structure as well as estimate costs for maintenance and repair over the mid- and long-term. The scenarios introduced here are based on a survey on replacements of highway bridges held by the Public Works Research Institute and the Road Bureau of the Ministry of Construction. The survey revealed that relatively many bridges were replaced when they reached either 30 or 60 years of life. According to the more reliable data from inspections and surveys that will be accumulated in future, the scenarios will be adjusted accordingly to make the predictions more precise.



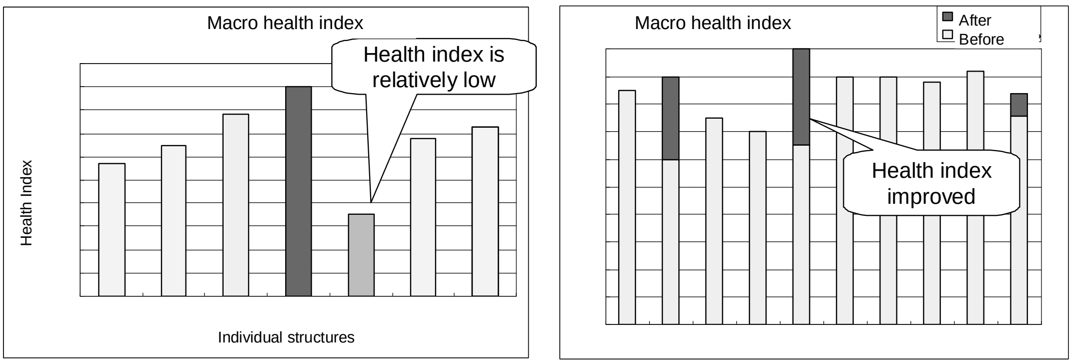
[Non-maintenance scenario]   [Repair when broken scenario]   [Troubleshooting scenario]

Figure 2: Deterioration scenarios applied in the asset management framework

3.2.2 Macroscopic Management

The objective of the macroscopic management is assisting the headquarters of the authorities responsible for the management of the overall asset inventory, drawing up the plans of maintenance and management, and budget appropriation.

Macroscopic management is conducted using the indicators that reflect the health of the overall asset, calculated by the health index of individual structures. In some cases, indicators express the health index of structural stock by routes or regions. The weighted average value of the

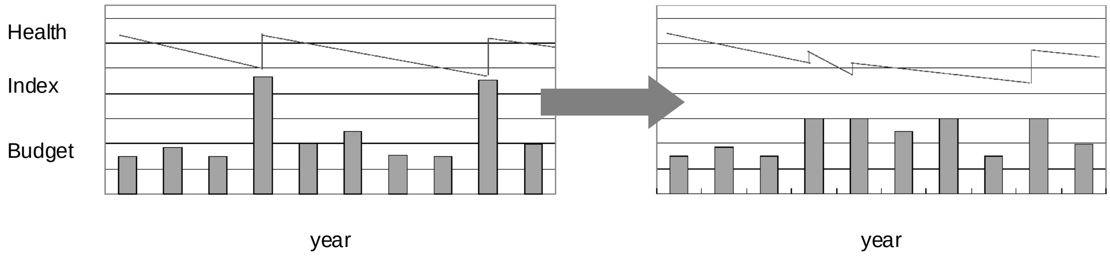


health index can be used as an indicator.

[Evaluation of structure groups]   [Ex post evaluation of repair]

Figure 3: Utilisation of macro health index on the group or network management.

What is required in the macroscopic management is to set middle to long term goals based on awareness of the health index of the complete asset inventory, to enhance or maintain the health index of the overall asset, and to make decisions such as whether or not to prioritize routes and regions with lower ratings in allocating budgets.



[Sum-up of individual structures] [Equating of yearly budgets]

Figure 4: Utilisation of macro health index on yearly budget allocation

3.2.3 Communication between both Managements

The microscopic management conducts the inspection and records damage degree then makes up draft plan for maintenance and repair. It also calculates the health index. After that the budget request and data of condition including health index are transferred to the macroscopic management.

The macroscopic management evaluates priority regarding total budget allowance and asset condition shown by health index and other indicators. Then it allocates budget to the microscopic managements.

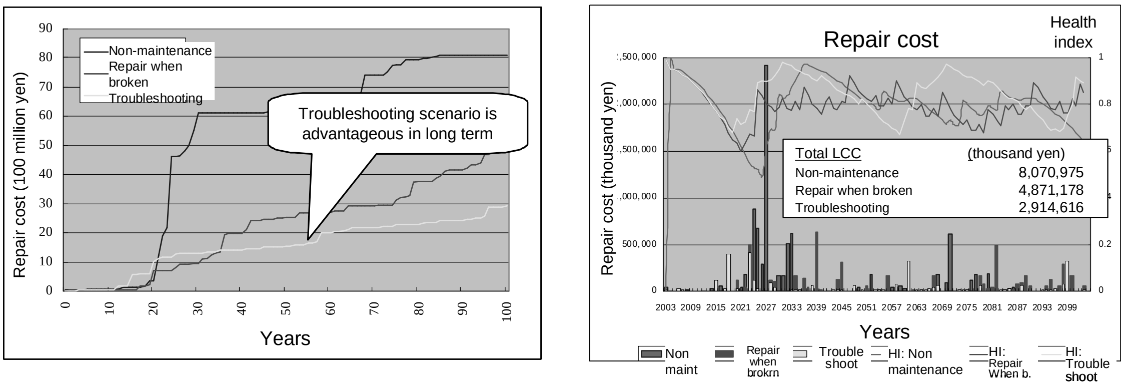
The microscopic managements revise the draft plan according to the budget allocated by the macroscopic management and carry out the maintenance and repair works. The microscopic managements conduct its activities in compliance with a set of certain rules fixed in advance. The results of the maintenance and repair are supposed to be reflected in changes in the damage degree, and further, in an improved health index. The management cycle formed by the two components works in this way.

3.3 Case Study

To show the possibility of the framework, we conducted a case study including the simulation on the data storage, the proceeding of the two management components and the data exchange between them referring the existing inspection data of national highway bridges in Hokkaido region of Japan.

3.3.1 Microscopic Management

At first we simulated the life cycle cost of individual structures applying three scenarios. In long term (over 35 years), the troubleshooting scenario becomes more advantageous than other scenarios on the life-cycle cost. As structure group, the concentration of budget requirement in several years is considerably high in two scenarios other than troubleshooting scenario. This result shows the need for the structure group management.

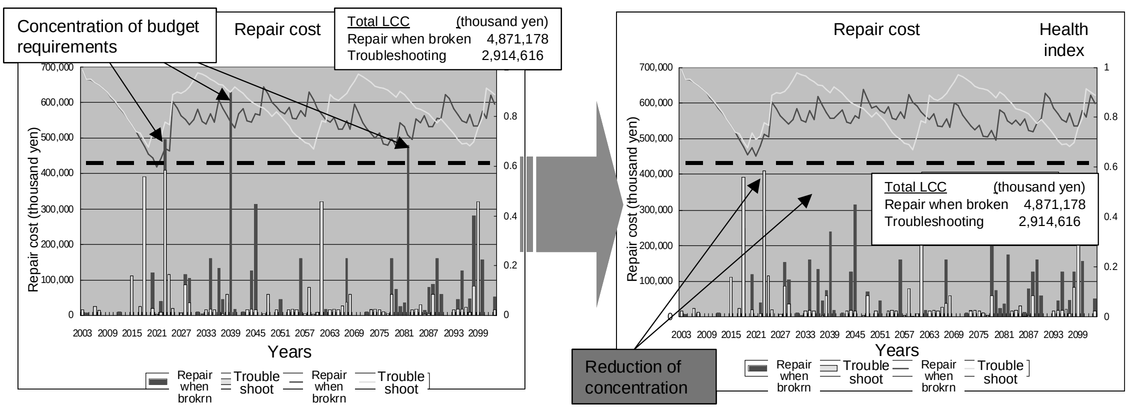


[LCC simulation of individual structure] [LCC and HI simulation of structure group]

Figure 5: Case study on the Microscopic Management

3.3.2 Macroscopic Management

We simulated the yearly budget control for the structure group by changing the scenario of individual structures which are managed according the 'repair when broken (symptomatic treatment) scenario' regarding the health index. The concentration of budget requirement has been reduced and the total health index has been improved after changing the scenario of several bridges. This result shows the effect of the structure group management.



[Sum-up of individual structures] [Macroscopic management applied]

Figure 6: Case study on the Macroscopic Management

4. Conclusions

Responding to the issues of the asset management of the infrastructure in Japan, we have built up a new framework of asset management composed of individual facility management and network (or group) management regarding the decision making process of the authorities in charge of infrastructure management. Then we simulated the framework with the inspection data of bridges of national highways in Japan. The simulation contains the choice of management scenarios with lifecycle cost evaluation and the optimization of long–term management including health index prediction and financial analysis.

The result of the simulation on the individual facility management showed the effectiveness of preventive maintenance and group management. These results were similar to that of simulation by existing bridge management system. So we came to the conclusion that the possibility and effectiveness of the framework have been confirmed. We will make more detailed simulations including decision of the priority between several infrastructure groups and then will make up a guideline of infrastructure asset management for the local governments of Japan.

The combined framework of the macroscopic and microscopic management introduced in this paper is based on some assumptions made for civil structures in the absence of clear information on the deterioration mechanism and it will be applicable to other infrastructure including buildings.

We expect this framework will assist the authorities in undertaking their asset management and securing the sustainable infrastructure services.

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Section III

Needs and expectations of customer

Creating a User Performance Brief: An Action Research Study

Jim Smith,
Faculty of Architecture, Building and Planning, The University of Melbourne, Australia
(e-mail: smithjj@unimelb.edu.au)

Abstract

Pre-design processes and activities are being instituted that work through client strategic and organisational issues, needs and requirements before the design team is involved. The participation of stakeholders in pre-design workshops is a common feature of these project inception approaches. These approaches prepare a clear and workable statement of the project requirements in performance terms that the client and user groups have committed themselves to. This strategic brief (or definition of the business case of the organization) can then provide a sound basis for the documentation of the needs and provide a sound basis for the development of the design. One approach to these early stages of the project is *strategic needs analysis*. This approach uses a workshop setting to focus stakeholder involvement in proposing and identifying a range of strategic options for the proposed project. An action research study of strategic needs analysis involving a new library with community facilities is presented. The process involved with the development of organizational strategic options with the stakeholders is described. The creation and identification of user performance indicators to guide the design development process is illustrated.

Keywords: briefing, strategic needs analysis, performance indicators.

1. Introduction

A number of approaches have been and are still being developed that aim to assist in creating alternative strategies during the development of policy in the early stages of project inception (Best and de Valence, 1999). These techniques aspire to develop a process that converts the organisational strategy into property investment decisions or corporate real estate that support them. Indeed, Green (1992), Latham (1994) and Egan (1998) have highlighted the need for skilled specialist practitioners to bridge the gap between corporate strategy and the development of building projects to realize their strategy.

The literature (Latham, 1994; Egan, 1998; Smith, 1998) has noted an established gap between the design process and the construction activities further down the development process or supply chain as the more recent literature terms it. However, this research focuses on the second gap between the strategic management in an organisation and the subsequent design development activities. A number of authors (Gray and Hughes, 2000 and Walker, 2002) have indicated that there is a gap between the pre-design activities and the design stages.

So, in contemporary terms the supply-chain exhibits discontinuity at two critical points: firstly, when a project passes from the strategic decision to build to the design stage and secondly, when it is translated from a design *model* into its built form at the construction stage. These gaps are illustrated in Figure 1. The emerging solutions to greater integration between design and construction are noted together with the focus of this work, the potential approaches and techniques that are being developed to close the gap between strategic management and the definition of a project for the design stages.

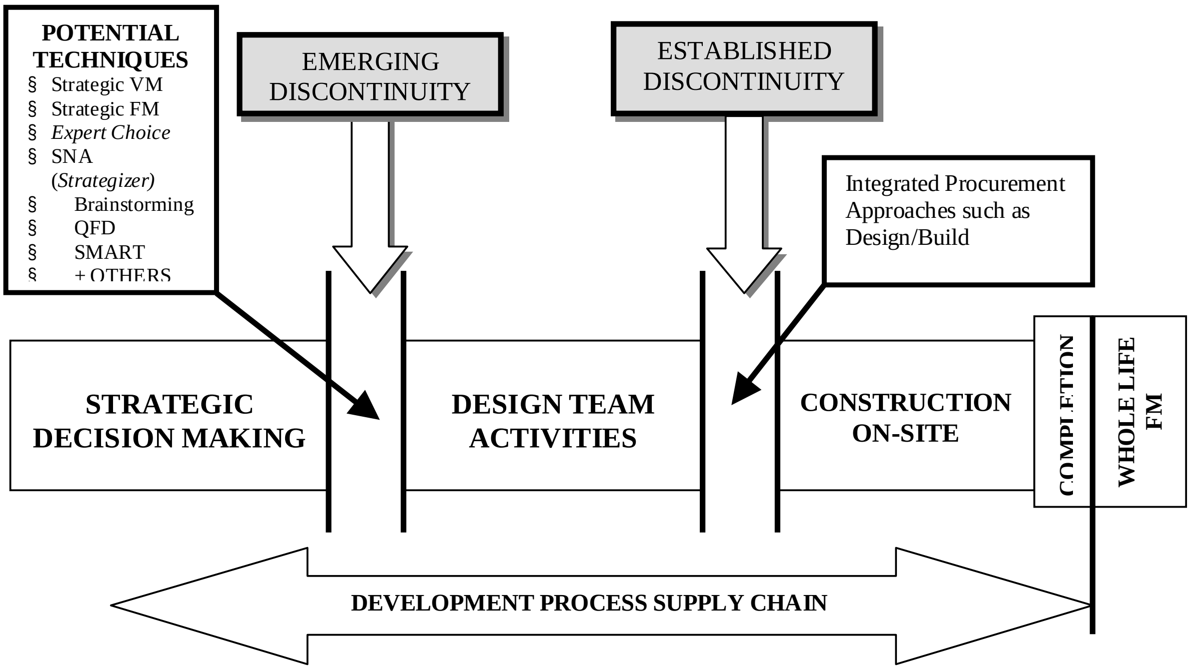

Figure 1: Discontinuity in the Development Process Supply Chain

The consequences of this first gap, between the strategic and design, after the decision to build has been taken at the strategic level, is that this decision may not be informed or supported by senior management or from a broad a range of ideas and views from stakeholders (users) as is possible. The possible insular approach adopted by the senior managers could result in an administratively easy or convenient decision that is not necessarily the best one. It seems to be more difficult for senior management when stakeholders are genuinely involved giving their ideas, views and suggestions for developing alternative strategic options. Senior management often are left with the freedom to make a decision to build, but it is likely to be a decision lacking comprehensiveness, clarity and authority. The design team naturally fills any information voids and makes its own assumptions to provide the necessary performance and user characteristics. So, when the decision passes to the design team it may result in a project decision that exists in a vacuum. It may be convenient for the design team to begin the process with a *clean sheet*, but the alternative view is that to disregard the strategic and stakeholder issues and information that contributes to the design team being poorly briefed and informed on all the factors influencing the project.

The closing of the gap or reduction in discontinuity should be achieved by adopting some of the recommended action for the strategic and stakeholder category attributes for the project inception process given in Figure 1.

A process is needed that can make a valuable contribution to the strategic stages in project inception. The process should confirm and extend the decision to build (new-build, extend, renovate, upgrade, remodel). It must reflect the environment of the organisation by being sensitive to the strategic direction identified in the strategic management process by capturing the mission, vision and values expressed by the organisation (Woodhead and Smith, 2002). These must guide the process of considering alternatives to satisfy the strategic direction already determined. The process must also be useful, flexible, well organised, sensitive to client and *stakeholder* needs and objectives and designed to provide more effective, efficient, innovative and better solutions (Karma and Anumba, 2001). Some notable attempts have been made to import existing techniques such as the *SMART* methodology (Green, 1990), *Expert Choice* or the analytical hierarchy process (Saaty, 1990a, 1990b; Yang and Lee, 1997), Quality Function Deployment (Akao, 1990; Kamara, et al, 1999), AdePT (Austin, et al, 2000) and value management (Thiry, 1997).

2. Strategic Needs Analysis

A number of approaches are listed in Figure 1 and these are expanding as new techniques are being developed. A model termed, *Strategic Needs Analysis* (SNA) was developed and adopted. SNA was designed with the characteristics noted above in mind and with the aim of making a positive contribution to the inception of a project. It also starts with the premise that the solution delivered will be the most appropriate to satisfy the stakeholder’s strategic needs and this is likely to be, but may not always be assumed to be a construction project. Strategic Needs Analysis is designed to make a valuable contribution to this important formative stage of a project. It reflects and is sensitive to the strategic direction identified in the strategic management process and so overlaps it. Indeed, strategic management (Thompson and Strickland, 1995 and David, 1997) and problem solving approaches (Ackoff, 1978) have greatly influenced the development of this approach and it is designed specifically for the concept or project inception stages of a project.

The author used the SNA approach as a means of assisting in closing the gap between strategic decision-making and design team activities. However, from the author's research (Smith and Jackson, 2000, 2003 and Smith and Love, 2004) progress can only be achieved with the cooperation of the senior management that makes and implements the decision to build. A proposed solution to provide greater integration of the strategic with the project inception activities using SNA is shown in concept form in Figure 2. This Figure brings together the disparate elements of decision-making within an organisation at the various levels and attempts to integrate it into a framework that recognizes the decision to build is part of the strategic and operational (and facilities management) environment.

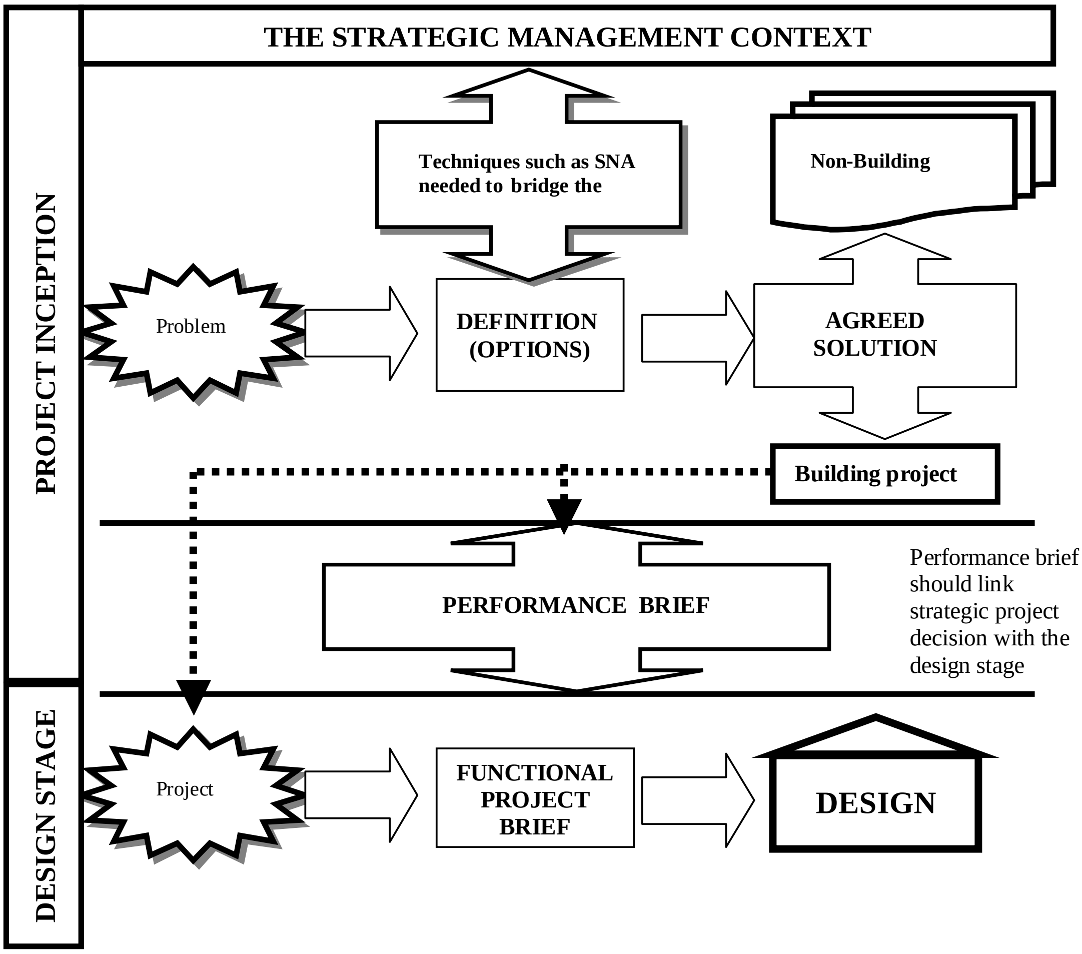

Figure 2: Linking the Strategic to Project Inception

Naturally, after its development and testing the author believes that SNA in conjunction with *Strategizer* can deliver a better way of defining client and stakeholder requirements. These can be captured in a performance brief that properly describes the client group needs and requirements in a form to give direction to the design team, but does not hinder their creativity nor their ability to explore alternative ways to satisfy the strategic performance requirements documented more explicitly by SNA.

3. The Study

This study was based on the analysis of the feedback from the evaluation surveys, the test analysis and personal observations about the process gained from five previous action research studies. (It is beyond the scope of this paper to describe action research in detail. For details of the action research approach see Barton-Cunningham, 1993 and Babbie, 1992). These earlier studies provided the means and the vehicle for the testing and development of SNA and guidance for making changes to the organisation of the SNA workshops and use of the *Strategizer* software in this study.

In this test study the author decided to test and gain assistance from an additional computer software program, *Situation Structuring*. From informal author test trials this software appeared to have the potential to assemble, or cluster, seemingly disparate characteristics and performance requirements (called elements in the software) into related groupings after interrogating participants on their views of these characteristics. The designer of *Situation Structuring* is Dickey (1995) and the software is described in Wyatt (1999). Diverse elements of a problem (people, places, objects) are combined into coherent groups. This enables these simpler and more manageable groups to be considered one at a time. By carrying out such an analysis the process provides a trade-off between simplicity and homogeneity (Dickey, 1995).

The software has been designed for generic problem-solving environments and this author believed that such a process could assist in the grouping of the range of participant identified themes from the workshop brainstorming session. These groupings would then form the basis of an agreed range of options for scoring by *Strategizer* at the end of the first workshop. *Situation Structuring* software could thereby provide the important link and technical structure to the critical process of options development and agreement.

3.1 Project Context

The Corporate Assets Manager of a local government council located in an eastern middle suburb of Melbourne (around 10 kilometres from the CBD) contacted the author. He felt that a SNA would be a useful process in identifying the nature of a proposed Library-Community complex with its potential uses involving a range of stakeholders who may be able to identify new opportunities for the new Centre at this critical stage in the planning and development stage of the project.

3.2 Aim

The aim was to develop a strategy that would take into account the needs and opportunities available from developing a site in a declining neighbourhood shopping area (known as an Urban Village). The wide ranging review required by SNA would involve a number of stakeholders from which the Corporate Assets Division (in conjunction with the author) could eventually prepare a performance brief for the agreed strategy.

3.3 Stakeholders

The Corporate Assets Manager organized the number and type of participants invited to attend the workshops. There were 15 participants in workshop one and 13 in workshop two. No external stakeholders (that is, outside Council employees or representatives) were invited or included in these activities. Four divisions within the Council were represented in each workshop; Corporate Assets, City Development, Business Development and Human Services.

4. Workshop One Summary

This workshop took place in a meeting room at the Council Offices. The process in workshop one is summarized in Figure 3. The participants were encouraged to identify the characteristics and their concerns about the project. No attempt was made at this early stage to limit the concerns. Once the full list of stakeholder concerns were identified and described they were then reviewed and discussed by the group. This produced a more refined and redefined list of concerns with fewer overlaps and repetition of the same concept. The refined list reduced the stakeholder concerns from 17 to 15 in number. These were summarised and are listed in Table1.

The fifteen refined stakeholder concerns above were measured and analysed by the group within the *Situation Structuring* software (Dickey, 1995; Wyatt, 1999). This analysis produced three groups of linked or related concerns. The features of these three common groupings were discussed and eventually placed under working titles chosen by the author to reflect their common approach or relationship. The titles, keyword descriptions and characteristics agreed by the participants under the common groupings are summarised in Table 2.

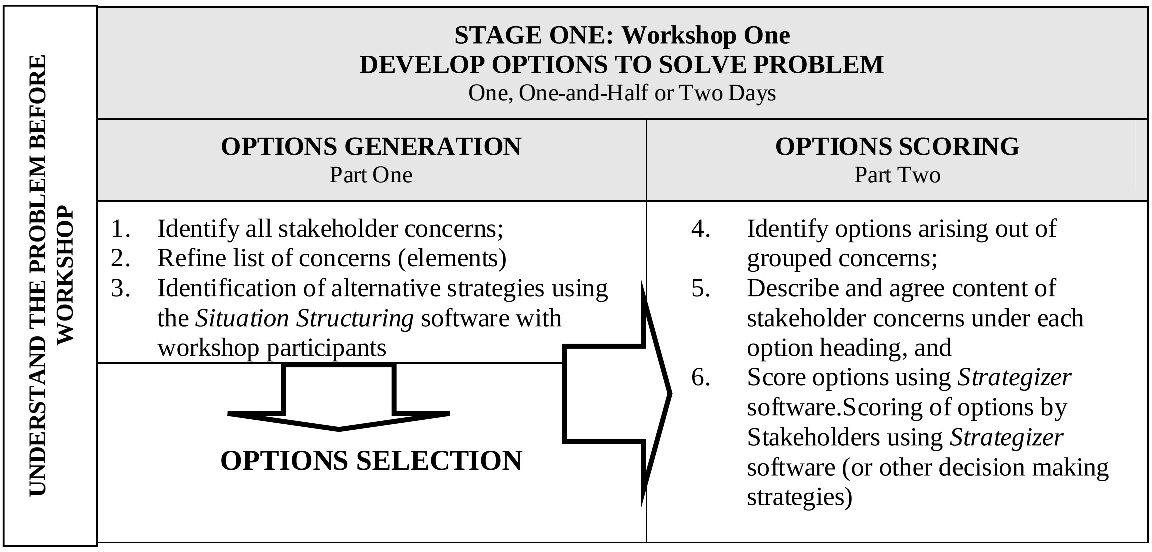

Figure 3: Workshop One Activities

Table 1: Stakeholder Concerns Defined and Refined

Identified Concerns	Refined List of Concerns
• Provide a sense of ownership	1. Interrelationships between uses
• Efficient / effective facility	2. Profile of council
• Adaptable/flexible facility	3. Service delivery
• Civic presence	4. Extent of commercial uses
• Recognition/local context	5. Commercial viability
• Satisfy community needs	6. Council viability
• Help create a sense of community	7. Sensitivity
• Enhance service delivery	8. Community ownership
• Improve/redevelop neighbourhood appearance	9. Accessibility
• Enhance economic viability of village	10. Flexibility
• Improve access	11. Effectiveness of individual service
• Distinctive sustainable environment	12. Sustainability
• Emphasis on people	13. Environmental efficiency
• Expand space for uses	14. Security
• Replace under performing/obsolete facilities	15. Diversity
• Reflect diversity of community	
• Change/grow to reflect community	

The participants concentrated on each stakeholder concern in turn. Details of the content of each concern was discussed, agreed and documented during the workshop using an electronic whiteboard. The finally agreed content of each concern is given under the appropriate option heading in Table 4. The three options (Workable, Council Perspectives and Community Satisfaction) group the stakeholder concerns as noted by the group and listed above in Table 4 were agreed by the participants.

Table 2: Details of Options

OPTION 1 **Workable**	**OPTION 2** **Council perspectives**	**OPTION 3** **Community satisfaction**
Efficient, Effective, Pragmatic	*Building Statement, Civic Presence, Best Practice*	*Integration, Belonging*
• Service delivery	• Profile	• Sensitivity
• Flexibility	• Extent of commercial uses	• Community ownership
• Sustainability	• Council viability	• Accessibility
• Security	• Environmental efficiency	• Diversity
• Interrelationship between uses	• Commercial viability	• Interrelationship between uses
• Effectiveness of individual service		

The participants also believed that in the first section, *Workable*, under the category of *service delivery* there should be further elaboration of uses into of existing uses and of potential uses that should be considered in the development of the new facilities. These were developed, agreed and are shown in Table 3.

Table 3: Service Delivery: Identification of Existing and Potential Uses

EXISTING	**POTENTIAL**	
§ library	§ service centre	§ immunisation
§ youth services	§ business/commercial use	§ information on council
§ playgroup	§ meeting space	§ library administration
§ three-year old activity	§ maternal and child health (outreach)	§ toy library
§ neighbourhood program	§ education training rooms	§ display area
§ senior citizens	§ business *incubator*	§ council adult learning centre
§ open space	§ library program and events	§ coffee shop
	§ residential accommodation	§ internet café
	§ visiting services	§ post office

The Workshop also discussed the inclusion of a number of *wildcard* options to test the demand for a non-conventional approach. A *Do-Nothing* option was rejected because it was agreed that from the ideas and commitment of the group that such an option would serve no useful purpose in the analysis in this situation. The four wild-card options suggested were; Outdoor performance space, Leisure Activities centre, High Rise Approach (with potential for more high density residential apartments) and Transportation Hub (linked with buses and railway station).

After a brief discussion it was decided that the final two options only (High Rise and Transportation Hub) would be included in the final list of options. The *Outdoor performing Space* was deleted by the participants as it was felt not to be a comparable option to the others. All the five options noted include the provision of the library, but with distinctive emphases in the joint development. The final list of options scored by all workshop participants in the *Strategizer* software at the end of the workshop were; WORKABLE, COUNCIL PERSPECTIVES, COMMUNITY SATISFACTION, HIGH RISE and TRANSPORTATION HUB.

Participants then scored each of the five options privately and individually on the *Strategizer* software. The scoring process brought workshop one to an end.

5. Workshop Two Summary

After a short break of five days workshop two was convened to finalise the SNA process. The steps required to complete the SNA in workshop two and to complete the performance brief are summarised in Figure 4. A major activity was to decide on a preferred strategy after the results of the scoring of the options was presented by the workshop facilitator (the author).

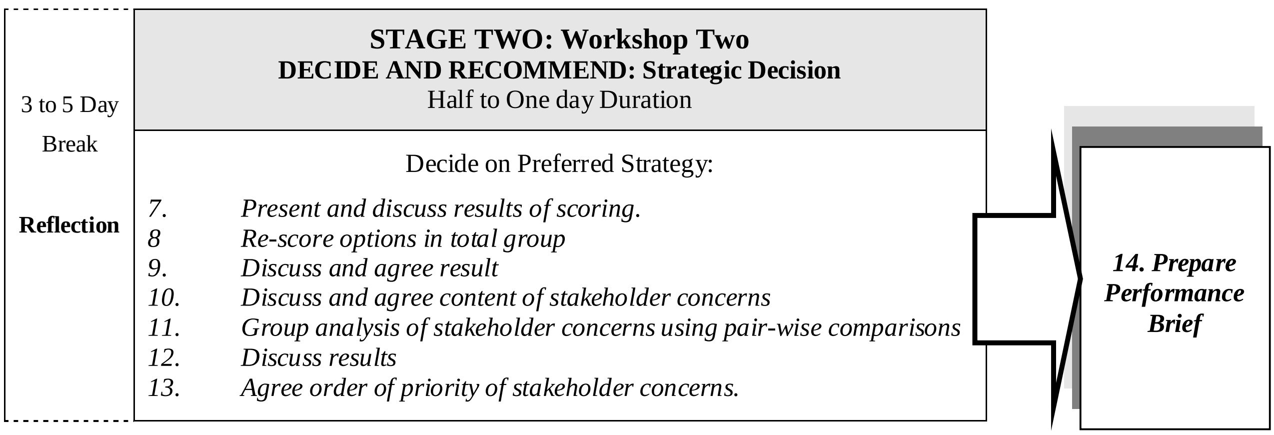

Figure 4: Workshop Two Activities

4.1 Options Scoring

When the Options' scores of all participants were analysed they showed the following results for the five options. See Table 4 for details of the scoring for each option.

Table 4: Options' Scores: All Participants

OPTIONS	WORKABLE	CIVIC	COMMUNITY	HIGH RISE	TRANSPORT HUB
AGGREGATE	3.8	3.5	3.8	-2.5	-1.6

A review of Table 4 indicates that the late entrant options, "High Rise' and 'Transport hub' did not fare well in the scoring. They have high negative scores and compared to the other three options (with positive scores) and so were not considered as serious options in the final analysis.

The participants in the workshop decided that the results were not conclusive enough to favour any single option. All three options were so close it was agreed that the characteristics or concerns from each option should be blended into the final performance brief for the project. The selection of a single option from the ones developed was, therefore, not considered. The workshop agreed to concentrate on first of all, refining the stakeholder concerns developed in workshop one.

The workshop group reviewed the list of fifteen stakeholder concerns and decided to prioritise these to provide the design team with guidance about their strength of feeling towards each one. The group then made a paired comparison of each concern scoring one concern against the others in turn on a ten-point scale running from, *overwhelmingly more* (9) to *overwhelmingly less* (0).

The workshop group then discussed and reviewed the final analysis based on the pair-wise comparison and agreed that it fairly represented the group's order of priorities in their stakeholder concerns. The group then agreed that the listing of stakeholder concerns provided a sound basis for developing the *Performance Criteria* for the proposed project. Rather than give each of the criteria a single priority it was decided to group the criteria into three levels of priority. These are given in Table 6 below with the individual criteria listed against each level.

Table 6: Priority Levels and Performance Criteria

PRIORITY	CRITERIA
1. **Key Performance Criteria:** PRIORITY ONE	Service Delivery Accessibility Security Council Viability Effectiveness of Individual Service
2. **Essential Performance Criteria:** PRIORITY TWO	Interrelationship between Uses Flexibility Community Ownership Sensitivity of Urban Design
3. **Significant Performance Criteria:** PRIORITY THREE	Diversity Sustainability Environmental Efficiency Commercial Viability Profile of Building Extent of Commercial Uses

6. Outcome

A Performance Brief was prepared based on these criteria. The brief was prepared within one week of the completion of the workshops and sent to the client for any additional Council and service department detail to be provided by the participants. The detail on each criterion provided by participants in the workshop provided the basis for the detail included in this performance brief.

The library project reached a hiatus soon after completion of the SNA. The draft performance brief was reviewed by the Corporate Assets Division and few minor changes and additions were made. This brief was then approved by Council a few months later and the agreed performance brief then formed the basis of calling tenders for design consultants. Consultant architects were appointed and outline proposal drawings for the scheme were completed in October 2002. Final documentation of the project was completed in September 2003 after more consultations with the community and delays in the compulsory acquisition of adjoining properties. The tenders were called in early 2004 and construction work started in June 2004. The project is expected to be completed in mid-2005. The activities and interactions following the completion of the performance brief were monitored and analysed by Heywood. A summary of the total process (now identified as the *Glen Eira model)* is given in a companion paper by Heywood and Smith (2004).

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Bridging the gap: Exploring expectations and perception-based performance assessments

Christopher Heywood,
Faculty of Architecture, Building and Planning, University of Melbourne, Australia
(email c.heywood@pgrad.unimelb.edu.au)
Greg Missingham,
Faculty of Architecture, Building and Planning, University of Melbourne, Australia
(email g.missingham@unimelb.edu.au)
Russell Kenley,
School of Built Environment, UNITEC, New Zealand (email rkenley@unitec.ac.nz)

Abstract

The Facilities Management (FM) literature has identified that bridging the gap between expectations and delivery of service (performance) is crucial in successful Facilities Management that meets client needs. This gap between expectations and evaluations of service delivery contains an implicit assumption that both sides of the gap are objective and measurable. However, assessments of service delivery and the facilities themselves are not wholly objective. Assessments contain substantial subjective components, which are frequently labelled ‘perceptions’. The existence of subjectivity makes bridging the gap difficult for FM practitioners when relying solely on objective measures.

New facilities frequently catalyse expectations and perceptions. The research examines the pre-construction phase of the provision of a new local government library-community centre facility in Victoria, Australia. This paper aims to identify the psychological basis of subjective assessments that Facility Managers meet in their practice, and thereby provide a more comprehensive understanding of the basis of performance evaluations in Facilities Management.

The research used a case study based qualitative methodology. Within the methodology a psychologically classified lexicon was used to analyse the case’s data. A variety of data sources was used, including project documents and interview transcripts. This paper concentrates on data pertaining to briefing related activities.

The study’s findings furnish detailed evidence of the affectively based subjective components that exist in assessments of this facility; be that expectations of the facility or evaluations of how it will perform through meeting the brief. These results do show the subjective basis of expectations and evaluations of facilities, and in doing so, provides the comprehensiveness of understanding sought.

While specific to local government, the study is of interest to Facilities Management practice generally where meeting user expectations are key parts of assessing the performance of facilities and their management processes. In addition, the analytic framework used in this study provides a means for analysis to reveal the foundational basis of assessments of facility performance, thereby enabling a bridging of the gap between expectations and subjective evaluations of performance.

Keywords: Expectations; local government; perceptions; performance; psychology,

1. Introduction and positioning the problem

The following statements are probably familiar to many facility, or corporate property managers.

> 'It doesn't matter what facts you give them, the decision-makers decide using their own perceptions with who knows what criteria. The same could be said of our facility users.'
>
> 'In local government perceptions are everything.'[1]

These comments describe informal, subjective evaluations which, from a facility manager's perspective, often usurp their arguments for any given facility management decision. As such, they starkly illustrate the difficulty of bridging the gap between expectations and such evaluations of performance from facilities and their management. The Facilities Management (FM) literature has identified that bridging the gap between expectation and delivery of service is crucial in establishing successful FM that meets client needs and notes the importance of communication in that process [1] but contains an unstated assumption that achieving the service will satisfy. Delivery may constitute either FM service or the facility itself. This paper discusses the delivery, or provision, of a facility but could equally apply to other aspects. Little FM literature has been identified addressing differences in expectations. Hinks and McNay [2] is a notable exception. Means by which expectations are utilised in bridging the expectation-perception gap has been found in other service-based fields, for example Sawin [3].

It is an assumption that that both sides of the expectation-service delivery gap are objective and measurable. The use of management tools such as goals, aims, Key Performance Indicators, and even strategic management are indicative of attempts to objectify business outcomes [4]. FM research and practice has expended much effort in attempting to derive measures of facility and FM performance (Amaratunga [5] is fairly comprehensive as is Hinks and McNay [2]). However, definitiveness remains elusive, especially in light of observations regarding the number of new FM services introduced in a recent year, which is probably not atypical of other years [6].

Expectations and evaluations of performance are rarely wholly objective, as evidenced by the introductory comments, being, at times, quasi-subjective. In such circumstances, reliance on objective measures as proof of performance will invariably fail to completely satisfy evaluators of performance conducting formal or informal evaluations. Furthermore, objective measures of performance count for little if they are evaluated through subjective lenses. In addition, expectations and evaluations of performance exist, not so much as opposite ends of a process but with experience from previous evaluations contributing to expectations carried into future evaluations. To complicate it further the literature shows that professional and lay evaluations differ markedly [7, 8].

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[1] These paraphrase comments made by this research's local government industry partner and are probably not peculiar to local government.

Previous research by the authors has shown the *affective* (emotional) basis to such heated facility evaluations as the ‘Not in my Back Yard’ (NIMBY) phenomenon [9]. For professionals, these are difficult responses to facility matters and often labelled ‘irrational’, or ‘subjective’ [10], or may be thought of as ‘too hard’, variable and unreliable for use [11]. In FM’s case the basis of this thinking may be attributed to the operational and technical origins of the profession [12]; the technical-rational bases of many professions [13]; and the reliance on often financial measures in order to appear business-like [14]. The foundation of such categorisation as irrationality is undermined by Nussbaum [15] suggesting that *affective* (she uses emotional) responses are reasonable, direct indicators of, or responses to, threats to human well-being, or flourishing. For providers of facilities to support well-being, such as local government [16], such responses should be of interest.

The subjectivity of both expectations and evaluations of performance (perceptions) is due to their involving psychologically formed attitudes and beliefs, in addition to the role of psychological functions in processing environmental stimuli. Environmental psychology has worked extensively on evaluations of physical environments, but considerations of environmental management (such as Facilities Management) are largely contained to such issues of ‘green’ or recycling behaviour. A tripartite basis of psychological functions is well established in social psychology [17]. The three functions are – *Cognition*, *Affect* (or emotion) and *Behaviou*r (or conation). These same three functions have also been shown to be constitutive of attitudes and beliefs [18].

Furthermore, psychological processes do not operate autonomously but intervene on each other. For instance, mere exposure to something has been shown to induce *affective* responses (liking) which alters *cognitive* evaluations [19]. Also, *behaviour* based psychological therapies operate on the basis of changes to *behaviour* induce corresponding changes to attitudes and cognitive processes, for example [20]. In addition, the psychological functions show longer-term frames of mind, or more transient states and state-like conditions [21, 22].

2. Aim

New facilities frequently catalyse expectations and provide evaluative situations. This paper examines the psychological basis of subjective assessments within the provision of a new local government library facility in Victoria, Australia. The paper aims to show how *affect* is present on both sides of the expectation-evaluation gap providing an understanding of the foundational basis of performance assessment in Facilities Management.

3. Method

The study’s methodology is a psychological based orientational qualitative enquiry [23]. Case study is the principle research method as this is most suitable for context embedded research such as this [24]. The case is from an inner to middle suburban Melbourne municipality, and is a current construction project. Within the case study a variety of data gathering methods are used – documentary analysis of Council's public statements and Council management documents; interactions with the research industry partner; participant observation in consultation meetings; time as a municipal resident; and interviews with Council service delivery and project management staff (including the external design team).

Coding methods are used to analyse the resulting textual data [25] with QSR's qualitative software *nVivo* used to assist coding activities. An *Affective Lexicon* [21, 22], based on the psychological typological classification in Figure 1, below, was used the basis of coding the *affective* content of language data (text). The *Lexicon* was formed from words the literature considered to be emotions. Text was analysed on the basis that the text acts as a record of emotion, in the absence of emotion's visual, neurological, or olfactory detection. The lexical structure includes categories for *affective evaluations*, the psychological functions (conditions) as *frames-of-mind* (longer-term dispositions), *states* (brief, temporally bounded), and *state-like* (similar to but not explicitly states) conditions. Inter-linked conditions, such as *affective-cognitive conditions*, are also provided.

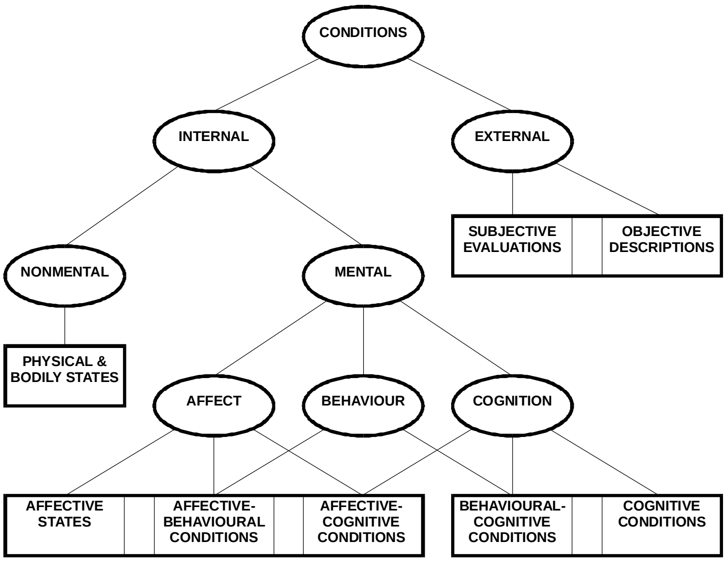

Figure 1: Psychological typological classification (after [21])

Additional categories such as *non-affective evaluations*, *Other cognitive*, and *Other behaviour*, have been added during the course of this research as they are absent from, but are consistent with the lexical structure. In the text below, words from the *Lexicon* are **bolded** while the typological classification is shown in *italics*.

Results for all three stages are tabulated together in *Appendix 1* but they are referred to throughout the paper.

4. Empirical study

The case studied is a new municipal Library-Community Centre to be constructed within a municipal 'Urban Village'. The client, as represented in the facility management function, may be considered a 'Secondary constructor' of a moderately 'Experienced' type (Walker [11] citing Masterman and Gameson [26]).[2]

The facility has, at least, two user-client types with Council service departments (primarily, library and local child services) consisting one, and community groups relocating into it, the second. As the introductory comments indicate the municipal Property Management was aware from previous experience that 'perceptual issues' exist in providing this facility. To address and manage the perceptual issues a two-stage facility provision process was adopted.[3&4]

Construction is not complete at the time of writing, therefore this paper only reports pre-construction processes contained within Briefing activities. These consist of three stages – the project's *Performance Brief*, the developing of that *Brief* with additional information from brief-building consultations with project stakeholders, and thirdly, reporting to stakeholders of how the building design met the brief from both Stages 1 and 2. The three stages capture expectations in the first two stages and, in the third, an evaluation of how they have been addressed. Incidentally, the third stage, also, contributes to the sum total of expectations that will be met in the post-completion evaluations, be they formal Post-Occupancy Evaluations or the 'informal' human assessments that are of interest to this research. Post-completion evaluations are beyond the scope of this paper.

4.1 Stage 1 – Council officer (client) expectations & developing the brief

In the first briefing stage the facility proposal was studied using pre-briefing Strategic Needs Analysis (SNA) methods [27]. Workshops with participants from stakeholder groups within Council administration responsible for possible tenants, or Council's strategic interest groups (such as municipal Business Development) lead to the development of three options with clustered strategic priorities – Option 1: Workable; Option 2: Council Perspectives; and Option 3: Community

[2] This classification system [26] is useful in understanding this municipality & local government generally. Local government falls towards the extremity of being 'Secondary constructors' (with this classification becoming known as Corporate Real Estate in recent years) but the level of the experience may vary and will frequently be linked to the level of experience of individual managers – both asset and service delivery. An issue for local government, and the factor that moves it away from the 'Experienced' end of the spectrum, is that individuals in local government Corporate Real Estate management may be experienced constructors but with limited experience of each type of local government facility, as each is built infrequently. It is feasible that local government 'Constructors' may then over-estimate their experience and assume that they do not need to acquire the experience by type also. This was not the case for the project studied.

[3] Linder and Peters [30] state the selection of such instruments may be traced to the perceptions of individuals in a position to choose about instrumental performance, regardless of its empirical record (similarly to previous discussion).

[4] It must be noted that this process was preceded by previous Urban Village consultations at two levels – overall concept and land use planning changes, so awareness of the facility proposal was at large in the municipality.

Satisfaction [27, 28]. These were then developed into a Performance Brief [29] subsequently adopted by the municipality in briefing the architectural design team for the new facility.

The Council officers, in providing a *Performance Brief* containing these strategic priorities options,' are providing both the performance parameters against which the facility may be assessed, or tested, and documenting their expectations of what the facility will provide for their municipality by way of function and as the embodiment of values. Analysis of these priorities using the *Affective Lexicon* reveals the psychological content of those expectations. Approximately 30% of the terms have *affective* content (Table 2, Appendix 1) Very few terms are psychologically based (Table 4, Appendix 1) but three-quarters of the *affective* terms are *affective objective descriptions* (Table 5, Appendix 1). These are statements that are resolvable by reference to facts [21].

Some of the priority expressions have complex content and have multiple connections with the classification categories. Typical of this is **Security**, which has two *affective* senses. In the first instance, **Security** relates to the sense of keeping something **safe** or providing safety. '**Safe**/safety' is an *affective objective description*. For a facility, the facts of safety may be tested or ascertained with questions such as:

- Does it have doors? Are they lockable? Where are the locked doors located relative to entrances?

These are all questions are all answerable in a factual form.

In the second sense, **Secure** is an *affective-cognitive state-like* phenomenon being an *internal mental (psychological) condition*. It is *affective* in that it has immediacy and value. It is *cognition*, being a way of thinking and the two conjoin in an 'emotionally toned way of thinking' [31]. The sense here for facilities relates to the psychological sense of **security** engendered by the environment, similar to the notion of *Defensible Space* [32].

4.2 Stage 2 – Developing the brief

The second Briefing stage added further input from Council internal stakeholders and groups outside Council – user tenant groups, adjoining residents, and shop-traders. Records of expectations and evaluations in this second stage are harder to find. Memos that record the results of consultation with non-Council stakeholders, by and large, appear to record factual material useful for establishing physical parameters for design. An impression aided in its formation by their introductory paragraphs that states, in part:

'The discussions were directed to focus on the layout and design issues of the facility .This memo is concerned only with those aspects that translate to design and layout.' [33]

However, the introductory paragraph opens with:

The discussions were led around patterns of use and nature of visits to the facility and the adjoining shopping centre; aspects valued about the existing facility, aspects considered able to be improved or **dislikes**, and features considered **desirable** to be included in the new facility [33].

dislike (*affective state-like condition*), **desirable** (*affective-cognitive state*)

Thereby, flagging the *affective* basis of the memo's content.

These memos constitute the record of user expectations, because having been specifically asked it is reasonable for them to expect the needs will be met in the new facility, unless negotiated otherwise.

Analysis of the memos yielded 153 connections between the Brief-building consultation data and psychological categorisation of which 51.0% have *affective* content (Table 2, Appendix 1). This is surprising given the stated purpose as records of matters of fact for design and initial reading as being very 'matter-of-fact' in presentation. Of the statements 32.7% have *affective external condition* content of which the vast majority are *affective objective descriptions* (Table 5, Appendix 1). This conforms to the documents acting as records of facts to be incorporated during design processes. This is augmented by an additional 31.4% that are *non-affective external conditions*. The expressions that relate to *internal mental conditions*, those with psychological content, (31.4%) the majority (18.3%) are *affective* expressions compared with 13.1% *non-affective* expressions.

4.3 Communicating meeting the brief

The third stage of the Briefing process provided data from participant observation notes taken during verbal presentations to stakeholders at the end of tender documentation. The content of those presentations, which the notes record, consisted largely of descriptions of the building made while presenting the project drawings. These constitute the project consultant's evaluation of what the building will be like and how it meets the brief.[5] Analysis of this data provides 143 connections between the descriptions of the building, or a building element, and the categories of the *Affective Lexicon*. The descriptions contain both a descriptor (an adjective) and a described object, which were then coded. In most instances the descriptor was most influential in coding.

The data is almost evenly split between *affective* and *non-affective* categorisations (Table 2, Appendix 1). A few (1.4% of total) *physical and bodily states* exist but have a minor effect on the 50:50 split between the two categories. In this aspect of the Briefing event the vast majority of the *affective* statements are *external conditions* (90.0%) (Table 5, Appendix 1). This is the highest level of *affective subjective evaluation* seen in any of the three stages constituting 90.0% of the *affective*, though in Stage 1 was 84.8% of the *affective* content (Table 5, Appendix 1). Of the *affective external conditions* the majority (28.0%) are *affective subjective evaluations*.

4.4 Affect across the assessments

Examples of *affect* in assessments were introduced in discussion of classification categories in Section 4.1. Exemplifying this across the three Briefing stages illustrates *affect* on both sides of the expectation-evaluation gap. The following example (Table 1) is illustrative.

[5] It is possible to interpret this exercise as 'selling' the design, but given that the presentation observed was the last in a sequence throughout the pre-construction period it is reasonable to state that the design had been 'sold' well before this point.

Table 1: Affective assessments across the expectation-evaluation gap

Stage 1	**Stage 2**	**Stage 3**
Sensitivity Two appearances in the lexicon	**Soften** the visual appearance of building towards neighbours (being considerate)	Domestic (building appearance and scale) Not in the *Lexicon* but usually used in the **Sensitivity (considerate)** sense in environmental descriptions
Sensitive (easily hurt) (*affective-cognitive frame of mind*)	**Comfortable (physically)** (*physical and bodily state*) for the many aged users and occupants (The design is considerate)	**Friendly** to the community (and neighbours) (*cognitive-behavioural frame of mind*). Also a synonym of **Sensitivity (considerate)**
Sensitivity (considerate) (*cognitive-behavioural frame of mind*)	**Serenity** (in the décor) (*affective state*)	**Comfortable (physically)** (stair) for occupants (*physical and bodily state*) Not **offensive** (colour scheme) (a synonym of **bad** (*affective subjective evaluation*) **Serene** (colour scheme) (*affective state*) **Quiet** (environment) (*affective objective description*)

The Stage 1 strategic options **Sensitivity** was re-expressed in Stage 2 by stakeholders requesting the design be considerate of their needs as neighbours and users. The Stage 3 evaluation of the building responds to this expectation with a multi-pronged evaluation littered with *affective* terms.

5. Discussion

The psychological typology and its associated *Affective Lexicon* employed in this paper provides a means of analysing the basis of the formations of assessments – expectations and evaluations – recorded in the language of Facilities Management. Both textual and verbal language forms have been encountered in this research. While the *Lexicon* used in this analysis provides a list of words that are considered in the literature to be emotion words Clore and his co-authors show that not all are emotions but belong to the range of types described in the psychological typology. This *Lexicon* is useful as it enables the psychological basis of assessments expressed in words to be revealed. Some are factually based as *objective descriptions*, some are subject-based internal evaluations and some are mentally formed.

This paper has concentrated on *affect* for three reasons. *Affect* has explanatory value for the warmth (positive and negative) in assessments of facilities. It is useful as an indicator of threats to well-being (related in part to the first point). And, it has a role in pre-emptively altering other mental evaluations. This research demonstrates the presence of *affect* in Facilities Management in the many words that are used in forming and describing assessments.

It is possible that *affect* may be present in all communication but for language that purports to be objective, as in the documentation of expectations, the presence of high levels of *affective* content, in excess of 30% in one stage of expectations and over 50% in the other stage, is remarkable. Thirdly, evaluations or reports of how those expectations will be met in the new facility also have almost 50% *affective* content. This is evidence of the importance of this psychological function in considering human's personal and subjective assessments.

Pure emotion (an *affective state*) was not found to be extensive (Table 3, Appendix 1), yet an emotional basis remains because of the *affective* content in the language. Of the *affective* content the majority are *affective external conditions*, both *objective descriptions* and *subjective evaluations*. The description component is, in Stages 1 and 2, consistent with the factual basis of the expressed expectations. In the Briefing evaluation-reporting stage the level of *affective subjective evaluation* rises in comparison with earlier stages.

Affect can be tracked across the briefing process where an *affective*-based expectation, **sensitivity** in this case, is expressed by both Council officers and stakeholders. Presenting the building design evaluations of how the building meets those expectations contain a range of *affectively*-based descriptions that are a direct response by the designers to the received expectations.

The endpoint in evaluations, to this point in the project, is that the Council officers responsible for delivering the project have assessed that these stakeholders are satisfied and happy (both *affective states*) with the design and the management processes employed thus far. It is this last point that most explicitly of the *affective* basis of human assessments of facilities. This goes towards answering the implied question in the *Introduction* as to why people use their perceptions and that is to achieve a personal *affective state* with regard to the facility.

The paper provides a more comprehensive understanding of the basis of expectations and evaluations, other than just labelling them subjective, through identifying their objective-subjective-psychological bases. These bases have been shown to exist on both sides of the expectation-evaluation gap. Where assessments are *objective descriptive* in form providing facts should support such assessments, and this research has found that many assessments are of this form. But *objective descriptions* may still have value as exemplified by something assessed as **important** (synonym of **unimportant** (*affective objective description*). Where assessments are subjective then the bridge will need to be individually relevant. To achieve this might require consideration of what an individual considers important (see above) or makes them happy (*affective state*). Where assessments are psychologically formed then processes to increase understanding (*cognition*) or **approval-of** (*affective-cognitive state*) facility proposals are likely to be typical of the bridge forms required.

6. Conclusions

This research originated in local government because it is susceptible to parochial politics which influences individual assessments. However, it is of interest generally to Facilities Management practice as meeting user or client expectations has been identified as being an important part of successful FM service. The discipline has struggled with addressing the gap between expectations and evaluations; be they of service delivery or the facility itself because attempts to bridge the gap have tended to rely on objective measures or on attempting to make measures objective. However, this paper has demonstrated the foundational basis of these expectation and evaluation assessments, particularly their psychological (*affective*) basis. Rather than labelling non-objective measures difficult or irrational and therefore opaque, this paper shows how they may be made visible. Such analysis reveals where assessments are factual, where they are subjective, where they are *affective*, or of some other psychological form; thereby beginning to illustrate the form that bridges may be required to have in order to span across the expectation-evaluation gap.

7. Future research

As this paper reports on facility provision up to the end of tender documentation it represents ‘Work-in-progress.’ Further research is required to examine assessments on facility completion. As this paper is concerned with facility provision processes consideration of the role of *affect* in other aspects of managing facilities is warranted, if *affect* is as fundamental to assessments as this research indicates.

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Appendix 1

Table 2: Prevalence of affective content in the expressions analysed

	Affective	**Non-affective**
Strategic options (n=43)	30.2%	69.8%
Brief building (n=53)	51.0%	44.4%
Meeting the brief (n=143)	48.9%	49.7%
Total (n=339)	**47.5%**	**49.8%**

Table 3:Affective conditions (emotion) in the data

	Affective conditions	**Total Affective content**
Strategic options (n=43)	2.3%	30.1%
Brief building (n=53)	5.3%	51.0%
Meeting the brief (n=143)	4.2%	48.9%
Total (n=339)	**4.4%**	**47.5%**

Table 4 Psychological conditions in the data

	Internal (psychological)		
	Affective	**Non-affective**	**Total**
Strategic options (n=43)	4.6%	27.9%	32.5%
Brief building (n=53)	18.3%	13.1%	31.4%
Meeting the brief (n=143)	6.3%	9.1%	15.4%
Total (n=339)	11.5%	12.7%	24.2%

Table 5 Break-up of objective and subjective in external conditions

	Affective external conditions				**Total Non-affective external conditions**
	Objective description	**Subjective evaluation**	**Total**	**% of affective content**	
Strategic options (n=43)	18.6%	7.0%	25.6%	84.8%	50.8%
Brief building (n=53)	28.1%	4.6%	32.7%	64.7%	31.4%
Meeting the brief (n=143)	14.7%	28.0%	42.7%	90.0%	40.%
Total (n=339)	**21.2%**	**14.7%**	**35.9%**	**75.6%**	**36.8%**

Unpacking Performance Measurements of Operational Building Assets – An Integrated Model.

Danny Shiem-shin Then,
The Hong Kong Polytechnic University
Chi-kwan Chau,
The Hong Kong Polytechnic University

Abstract

Performance benchmarking and performance indicators are currently 'hot topics' in conversations within professional circles of both private and public sector organizations. The philosophy behind performance benchmarking is comparative analysis with the emphasis on analysis. The proper practice of performance measurement involves a careful analysis of processes and conscious selection of relevant performance indicators that are meaningful to the recipients who are then motivated to improving their processes and overall corporate performance.

This paper considers performance measurement of building assets as operating facilities. Operational buildings are at the same time, a physical asset, a functional facility, as well as a business resource. Literature on the subject suggests a wide range of views which tended to polarize towards either the measurement of the physical (technical) performance or the financial (cost) performance. Contemporary resource management supports the view that building assets are an essential resource just as human resource, technology; finance and knowledge are business resources needed to achieve corporate objectives. An integrated resource management approach views an optimum real estate or facility solution as one which is derived from consideration of all corporate resources to meet business needs. In this respect, the prime focus in measuring operational building performance must be viewed in the context of the relationship of building assets and their contributions to business outcomes. This is the premise upon which an integrated asset performance framework for performance of operational buildings has been developed. The content is process-focused in that it will unpack the components needed for performance monitoring of operational buildings and discuss some of the key issues that need to be resolved internally by an organization before the process of external benchmarking can be of value. Through a thorough literature review and brainstorming sessions with research collaborators, a framework for considering asset performance of operational buildings is developed and validated through two focused-group workshops in Hong Kong and Australia.

Keywords: Performance Measurements, Building Assets, Model.

1. Introduction

One of the key business performance issues for both business and government is the ability to leverage maximum performance from resources and drive effective management of resources for long term sustainability. Building facilities or assets are business resources in the same manner as technology, people and business capital. Increasingly, the dynamics of modern businesses demand solutions that optimize the utilisation of all these resources in the most effective manner. Hence the performance of building assets as a business resource is increasingly becoming a focus for management in both the private and public sectors.

Competitive pressures and tight economic conditions are driving the search for competitive advantage beyond a focus on costs and budgets alone. Business and government need to develop an informed view of what customers and end-users of services value and the level of performance expectations. These business drivers have a direct influence on the need to explore with a more searching attitude, more effective management of business resources, namely, the key resources supporting the business - people, property and technology [1]. The need and desire to monitor the performance of operational buildings as a class of assets deserves management attention because of a number of unique attributes:

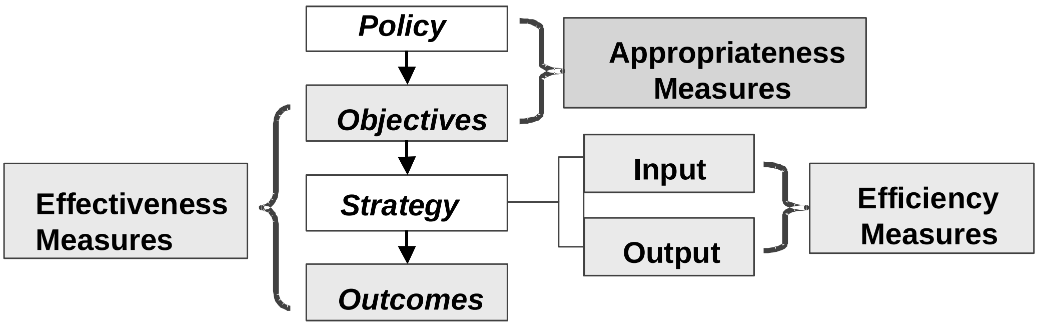
- the capital intensive nature of building assets (usually worth many millions of dollars which could potentially be applied more profitably elsewhere);
- their durable nature (often lasting up to 20-50 years or more);
- their relative inflexibility in responding to changes in business directions and technology;
- the significant accompanying stream of recurrent expenditure burden associated with maintaining and operating them at a desired service standard;
- the potential liabilities due to deterioration and depreciation over time;
- their impact on productivity and business performance; and
- their exposure to a wide range of legal requirements and risks.

The importance of performance measurement as a tool for effective management of such an important business resource is a key driver in the search for an effective performance measurement regime for building assets [2]. However, the practical implementation of a performance measurement regime that delivers the desired management outcomes efficiently and effectively is more problematic [3]. A wide range of methods and frameworks for performance measurement of building assets have been proposed [4]. They range from the detailed technical assessments of physical aspects of buildings to surveys of user satisfaction with the occupied space and quality of the internal environment. Despite this, there appears to be no commonly adopted framework for buildings against which performance measures of operational assets can be established to meet the particular needs of corporate management requirements and user expectations. This paper proposes an integrated framework for assessing building performance [5] and reports on the results of two validation workshops held in Hong Kong and Australia.

2. An Integrated Asset Performance Model

2.1 The Theory

The starting point of performance measurement is a conceptual model that can be applied as a framework for identifying and developing the necessary performance indicators that meet the objectives of any performance measurement effort. As a broad principle, performance measures can generally be divided into effectiveness measures, efficiency measures, and appropriateness measures (Figure 1).



Source: Adapted from Parker, W.C. (1993) *Performance Measurement in the Public Sector* and ANAO. *Best Practice Principles for Performance Information*. pp.8 [6]

Figure 1: Principles of a Performance Measurement System

Figure 1 highlights the need to clearly understand the purpose of performance measurement. Choosing the right measures for the right purpose is fundamental to any performance monitoring system.

2.2 The Need

The development of a conceptual framework for performance evaluation of operational building assets must recognise at least three important characteristics of buildings as a product, and as a business resource:

- Buildings have a much longer life than most other assets in business. A building represents a special class of durable assets requiring high initial capital investment and subsequent running costs and reinvestment – i.e. a regime of life cycle management is required to optimise its efficient operation;

- A building’s value is represented by its effectiveness as a supporting resource in the overall value chain of an organisation’s productive process. Its role as an enabling resource is increasingly seen as crucial in raising staff productivity – i.e. an integrated resource management approach incorporating the delivery of an enabling workplace environment must be acknowledged; and
- Buildings involve a number of stakeholders: owners, managers, service providers and users throughout their operational lives. Existing buildings are also being changed and renovated more often in response to new owners, organisational changes, and new occupant requirements – i.e. buildings as dynamic entities which must be managed proactively in order to respond to changing users’ expectation and rapid technological development.

Evidence from the literature reviewed suggests that building performance monitoring is an amalgam of at least four aspects of facilities provision and their ongoing servicing as functional facilities:

- The appropriateness of the current asset base in meeting business objectives;
- The provision of a satisfactory working environment for occupants and customers;
- The minimisation of operating and maintenance costs by managing the condition of the existing facilities,
- The performance of the facilities as functional, operational assets supporting business processes.

In optimising the performance of building assets, an organisation must balance the interdependent and, often competing, outcomes of the above four aspects of asset performance in order to achieve their optimum service potential.

2.3 The EPFS Model

Taking the above constraints into consideration, Then and Tan [7, 3 & 5] proposed that asset performance indicators used by organisations from both the public and private sectors can be grouped under five broad facets of performance measures:

- **Economic measures -** The *Economic* facet of asset performance is concerned with decisions at a strategic level that optimises on value for money from property resources. Economic asset management requirements are governed by the need to relate physical facilities provision to longer-term business plans. The objective of measurement here is to ensure optimum resource allocation and affordable and economic provision of property resources in line with market offerings and business plans.

- **Functional measures -** The *Functional* facet of asset performance is concerned with management decisions that relate to the creation of the desired working environment in line with the preferred organisational culture and workplace standards. The objective of measurement here is to ensure continuous alignment of supply of appropriate functional space to anticipated service demands as far as possible. Fitness of purpose for property resource in meeting business requirements may be measured in terms of locational distribution, type, form and size of buildings.

- **Physical measures -** The *Physical* facet of asset performance is concerned with efficient and effective management of operational aspects of ongoing asset management. The objectives of measurement here are driven by the need to preserve asset value, ensure asset condition does not lead to unnecessary operational risks and liabilities, and to ensure occupancy costs are reasonable.

- **Service measures.-** The *Service* facet of asset performance is concerned with decisions and actions relating to quality perception by end users and quality of service delivery by service providers. The objective of measurement here is to ensure that the business context and organisational culture are appropriately reflected in aspects of service delivery and are aligned with core business requirements. Measures in this facet of asset performance are generally surrogate, often subjective indicators of performance derived from clients' and end users' perceptions of corporate facilities and support services.

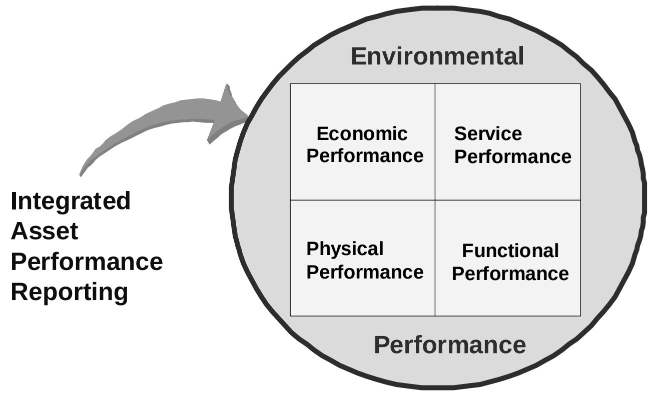


Figure 2: Integrated Asset Performance Reporting (Then & Tan, 2002)

- **Environmental measures -** The *Environmental* facet of asset performance is concerned with the role of building assets and their impact on facilities users, the community and the ecological environment. Measures in this facet are likely to involve monitoring against prescribed sustainability targets at project / state /national levels.

The premise taken is that any integrated asset performance reporting must incorporate these five facets of measurement in order to obtain a balanced view of the contribution of building assets as an operating resource, as illustrated in Figure 2. However, this paper only reports on four of the five facets of asset performance measurement. The Environment facet is the subject of another study.

The above five facets of performance measures form the cornerstones of an integrated asset performance concept that can be applied to:

- Fulfil specific stakeholder perspectives of asset performance;
- Guide selection of appropriate key performance indicators;
- Assist in defining data requirements for specified key performance indicators; and
- Provide a balanced view of asset performance.

Table 1 summarises the key management focus of the five facets of asset performance measures. Each facet of asset performance is governed by a different set of variables with its associated key performance indicators. The proposed model provides a structured approach for considering the many dimensions of built assets performance and critically reviewing the suitability of currently available measures.

Table 1: Asset performance facets and management focus

Performance Facets	Management focus	Focus of performance monitoring
Economic	Value for money	Efficiency in allocation of resources
Functional	Fit for purpose	Effectiveness in utilisation of resources
Physical	Operational risk and liability	Appropriateness in type and condition
Service	Customer satisfaction	User/client's Quality perception
Environmental	Workplace & environmental sustainability	Meeting prescribed targets at project / state / national levels

Then, S.S. & Tan, T.H. [5]

The necessity for a conceptual framework is supported by the need to explain, communicate and justify the need for data collection and analysis. A logical and consistent framework facilitates the process of focusing data collection on the asset performance parameters that are currently deficient or lacking from asset information systems.

Having a performance concept is only the first step in the implementation of an asset performance framework that is useful and cost-effective. There are a number of further steps which have to be navigated before full realization of a credible and sustainable asset performance measurement system [3]. Figure 3 illustrates the parameters within an organisational setting in which an asset performance measurement system must take into consideration. They are the factors that will influence the practice of asset performance management within an organizational setting. (modified from Then & Tan, [5]).

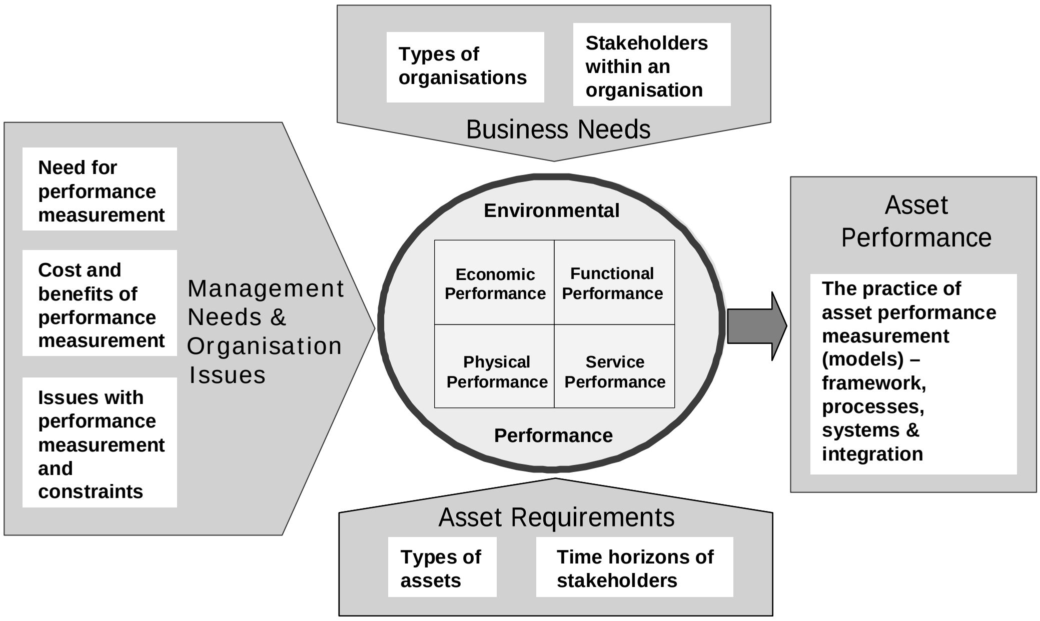


Figure 3: Factors influencing the Practice of Asset Performance Management

2.4 The EPFS Model – Variables and KPIs

Through a series of brainstorming sessions with research collaborators, it was decided that a structured approach is required to identify the appropriate key asset performance indicators. The alternative is a linear approach which has the potential disadvantages of being almost a random selection of measures or a selection that is technically driven by professional inclination.

The structured approach adopted comprised of a two-stage analysis. Stage one involved the identification of all possible variables associated with each of the four facets (i.e. Economic, Physical, Functional and Service performance). These are illustrated in Figure 4. Stage two involved identification of possible performance indicators that are measures of each of the variables identified. A total of 35 Asset Performance Variables and 95 Key Performance Indicators (KPIs) were selected for validation by two focus groups workshops held in Hong Kong (July 2004) and Brisbane (August 2004). The sample of the Hong Kong focus group (N=20) consisted of middle/senior managers with responsibilities for property and facilities services representing commercial buildings, airports, universities and banks. The sample of the Brisbane focus group (N=21) consisted of middle/senior managers with responsibilities for property and facilities services representing public sector facilities. In both locations, initial contacts were made via telephone and email, explaining the purpose of the workshop and who from the organisation should participate.

The deliberation of each validation workshop followed a structured format that comprised the following:

Session 1 – Introduction, background and purpose of workshop - 10-15 minutes,

Session 2 – Concept Validation:

a. EPFS Model Presentation by research collaborators – 30 minutes including questions,
b. Validation of EPFS Model by respondents via structured questionnaire – 30 minutes,
c. Validation of EPFS Variables via structured questionnaire – 30 minutes.

Session 3 – Practice Validation:

a. KPIs Presentation by research collaborators – 10 minutes including questions,
b. Validation of KPIs for each Variable via structured questionnaire – 60 minutes

Session 4 – Summary and Feedback.

In summary, both the workshops were well received by the participants who expressed keen interest in the outcomes of the research and analysis from the workshop questionnaires. A summary of the results of the research were provided as feedback to participants of the validation workshops.

3. Results of Analysis of Responses from Validation Workshops

3.1 Concept Validation of EPFS Model

The concept validation comprises a two-part analysis. Table 1 shows the results of the attributes validation of the combined sample of both sets of respondents from Hong Kong (N=20) and Australia (N=21). Respondents were requested to evaluate the EPFS model on five different attributes, each against a 5-point Likert scale. The model was highly rated against the attributes of *Completeness, Robustness, Importance* and *Practical Relevance,* scoring more than 4.0 on a 5-point Likert scale, with degrees of variation between 4.0 and 4.6.

Table1: Concept Evaluation of EPFS Model

Attributes	Mean	S.D.	Rank
Completeness – Degree of completeness in coverage of elements of asset performance	4.585	0.4988	1
Robustness – Degree of robustness in concept and practice of asset performance	4.439	0.5024	1
Usefulness – Degree of usefulness in making more informed decision on issues in asset performance	4.317	0.7563	1
Importance –Degree of importance in asset management practice.	4.317	0.7563	1
Practical Relevance –Degree of relevance in the practice of asset performance.	4.049	0.669	2

A pairwise analysis was also conducted to evaluate the respondents' opinions on the relative importance of the four different facets of asset performance: *Economic*, *Functional*, *Performance*, and *Service*. Six pair-wise importance questions with a nine-point linguistic scale were used [8 & 9].

The individual respondents' results on each individual pairwise question were aggregated using the geometric mean method before inputting into the necessary computation matrices. The final relative importance weightings of the four different facets of asset performance are shown in Table 2. No significant differences in the perceived importance of the four facets of the EPFS model were found for both groups of respondents in Hong Kong and Australia. A check on the consistency of responses was also performed to ensure the validity of the computed results. A consistency ratio of 0.0067 (<0.1) was obtained from the analyzed responses, which indicated that the responses given by all the respondents were quite consistent.

Table 2: Relative Importance Weightings of the four Asset Performance Facets

Asset Performance Facet	Relative Importance Weight
Economic	0.236
Physical	0.182
Functional	0.319
Service	0.262

3.2 Validation of Asset Performance Variables

For each of the asset performance facets, their potential asset performance variables were identified via a combination of literature review and brain storming sessions by the research collaborators. A total of thirty-five asset performance variables were identified for validation by respondents. A 5-point Likert scale type questions with '1' indicating *not relevant* and '5' indicating *very relevant*, for each of the asset performance variables was included in a questionnaire for the workshop respondents. Figure 4 illustrates the asset performance variables associated with each of the asset performance facets, together with mean relevant values and standard deviations. An asset variable is considered to be relevant if it has a mean value greater than 3.5.

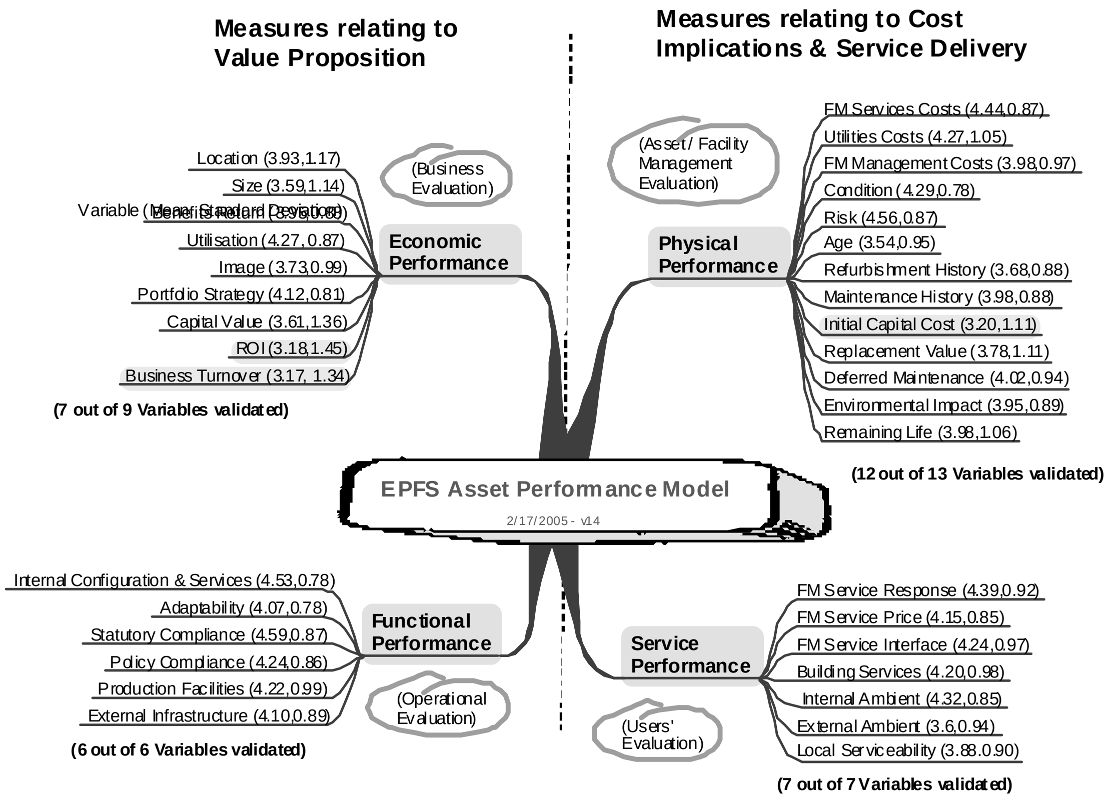


Figure 4: EPFS Model showing Asset Performance Facets and associated Variables

3.3 Validation of Asset Performance Indicators

For each of the asset performance facets, and their corresponding asset performance variables, a set of Key Performance Indicators (KPIs) were identified via literature review and brain storming sessions by the research collaborators. A total of 95 KPIs were selected and workshop respondents were requested to rate their relevance via a series of dichotomous questions with ‘Yes’ and ‘No’ options. An indicator is considered to be relevant if the percentage of respondents choosing ‘Yes’ is greater than 75%. A total of 68 KPIs were validated by the respondents. Figure 5 lists the selected KPIs against each asset performance variable and the corresponding asset performance facet. The sample size for the combined respondents from Hong Kong and Australia is 41 (i.e. N=41).

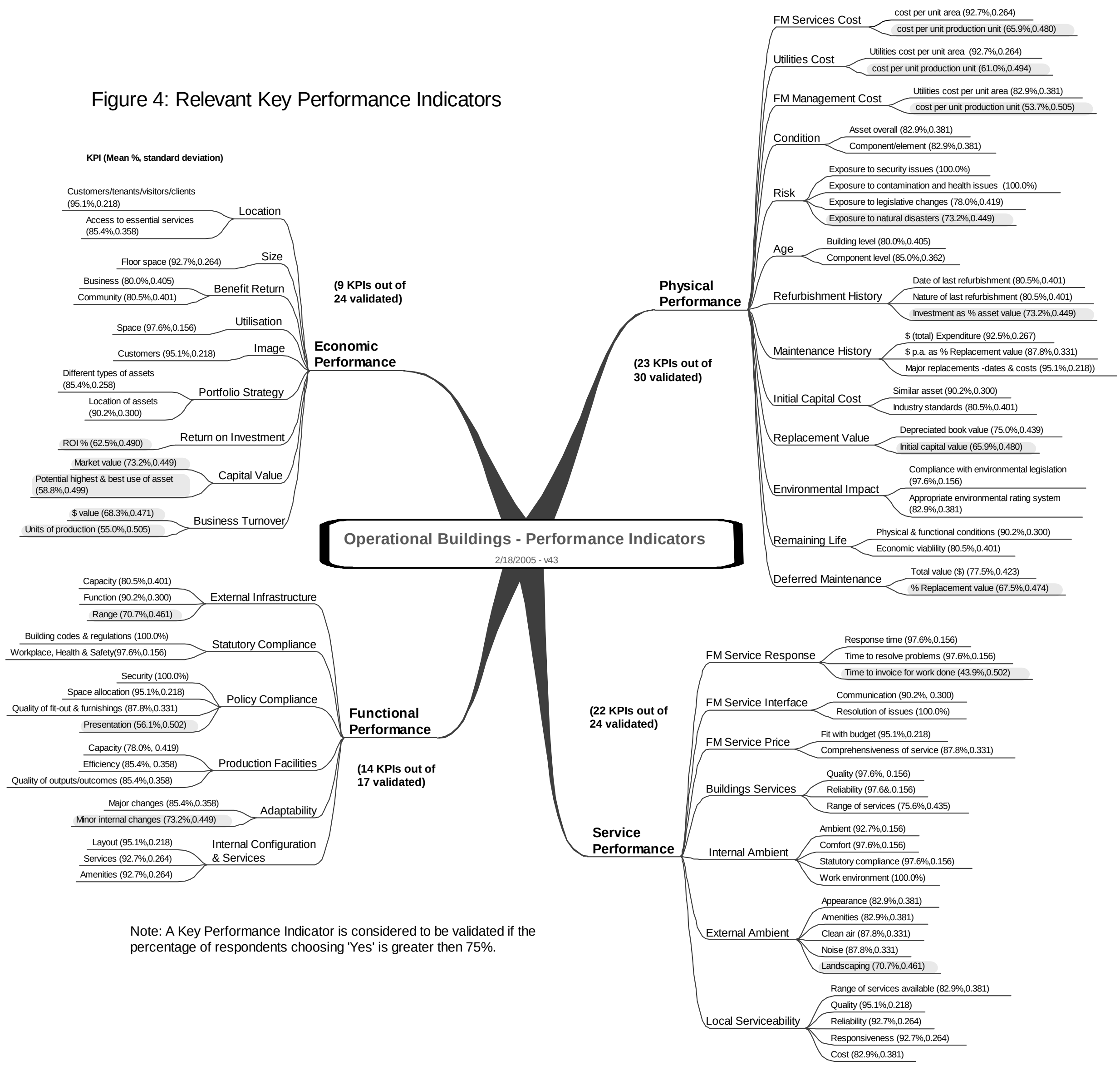


Figure 5: Relevant Key Performance Indicators against each Asset Performance Variable and associated Asset Performance Facet. (Note: Shaded KPIs <75%)

4. Conclusions

The quality of an asset performance measurement regime is subject to the proper definition, selection and organization of KPIs to provide relevant and reliable information for management decisions and actions. An unstructured and haphazard selection of KPIs is likely to lead to a waste of time and effort in data collection and incomplete or misleading performance information. This paper proposes a structured and logical framework for the development and selection of key performance measures. The EPFS Model provides a rationale and robust methodology for the organization of the KPIs selected and justification for the data requirement. Overall, the proposed EPFS model can be considered to be statistically validated relative to the sample of respondents in Hong Kong and Australia. The exercise has opened the doors for further development for practical use of the concepts underlying the evaluation of asset performance and the implementation of asset performance measurement towards best practice. It is anticipated that the EPFS Model will be further developed and refined through detailed case studies. The valuable assistance of the participants in the validation workshops in Hong Kong and Brisbane is gratefully acknowledged by the research collaborators.

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Seeing what you get -Balanced Communication for Owners

Niels Haldor Bertelsen,
SBi – Danish Building Research Institute, Copenhagen, Denmark (nhb@sbi.dk)
Anker Nielsen,
SP – Swedish National Testing and Research Institute, Borås, Sweden
(anker.nielsen@sp.se)

Abstract

Part of a Nordic productivity study is reported here with focus on the owner and end-user and the correlation of price and quality of buildings. A product and a value model were tested on Swedish and Danish cases, which covered both new block of flats, renewal and laboratory. Differences in cost and reduction of deviations between cases are discussed. In the conclusion a structure is given for national or Nordic systems for benchmarking and key-figures and a number of supporting initiatives are presented.

Keywords: Building parts, quality, owner, end user, benchmarking and productivity.

1. Introduction

In 2004 five Nordic research institutes finished a joint study on productivity and benchmarking funded by Nordic Innovation. Through case studies, primarily on new blocks of flats, experiences and models for analysing productivity were discussed from two different angles – those of the construction company and the owner. The Swedish and Danish study is aimed at the owner and end-user, and shows how buildings of different locations, functions, sizes and standards can be compared.

1.1 The Nordic Productivity Studies

The Nordic Productivity Studies [1] was funded by Nordic Innovation (www.nordicinnovation.net), the former Nordic Industrial Foundation, according to the application submitted by the Norwegian Building Research Institute in the autumn of 2000 on behalf of five research institutes: Norwegian Building Research Institute (Norway), VTT Building and Transport (Finland), Icelandic Building Research Institute (Iceland), Danish Building Research Institute, (Denmark) and Swedish National Testing and Research Institute (Sweden).

The application included both building and infrastructure in the project. Early discussions showed that it was impossible to cover the whole area, and it was decided to base the research on case studies of housing and new blocks of flats. Another ambition was to discover common Nordic methods for data collection and comparison of cases based on the national experience. The first presentations of national cases outlined two opposite trends or two different target groups for the methods. One focused on construction companies, the production process on site and studies carried out on a comprehensive and detail level. The other focused on real estate from the end-user's, the building owner's and the customer's points of view, and the approach to the study had a broader and more general perspective. Each participant weighted these two tracks differently.

1.2 Activities in the Nordic countries

The building and construction sector can be divided into two supporting segments and three core businesses. The supported segments or the framework are public regulations (Regulation market) and research and education (Knowledge market). The core business is the three main segments along the value chain: The product market and the production industry; the construction market designing and constructing the building; and the real estate market where the owner, the developer and their advisers run the building as an envelope for the end-user for housing, work and institution (Figure 1).

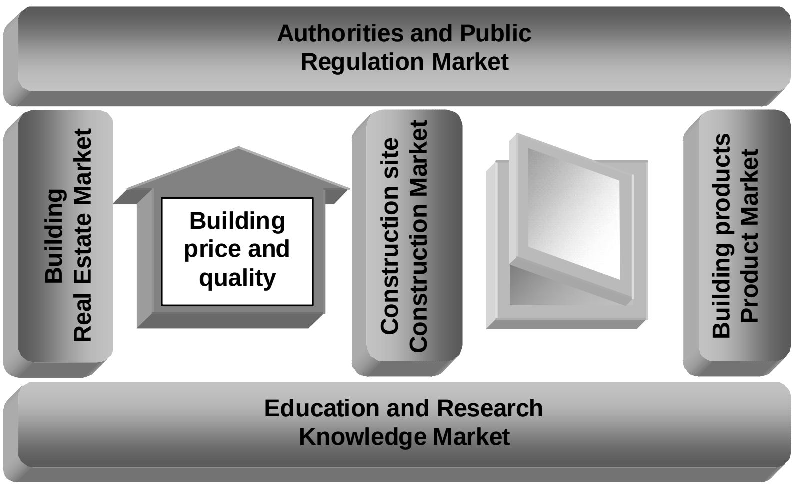

Figure 1: The building and construction (B&C) sector can be divided into five different markets and into two main types of 'products' – the building and building products.

Like in most industrial countries, the building and construction (B&C) in the Nordic countries is a major part of the GNP. In the European countries the B&C typically lies between 5 to 15 % depending on the market situation and on how the B&C sector is defined. The effectiveness of the B&C sector has an important influence on other sectors, the national economy and our well being and health. And the money invested and the capital tied up in real estate for housing, production and services are enormous.

Table 1: Construction companies (CC) in Nordic countries, 2002 (National statistics).

CC and part of total	Finland	Sweden	Norway	Denmark	Iceland
Turnover in CC in mill. EUR	139,700	312,340	190,091	156,590	8,952
Part of national total	14 %	7 %	10 %	5 %	7 %
Number of CC	224,847	842,000	429,910	297,706	8,184
Part of national total	13 %	7 %	9 %	9 %	8 %
Employees in CC in thousand	2,372	4,272	2,055	2,692	157
Part of national total	6 %	6 %	7 %	6 %	8 %

Table 2: Construction market (CM) in Nordic countries, 2002 (Euroconstruct).

CM in billion EUR		Finland	Sweden	Norway	Denmark	Iceland
Residential	New	3.6	2.2	3.3	3.0	0.4
	Renovation	3.2	4.3	3.7	3.2	
	Total	6.8	6.5	7.0	6.2	
Non-residential	New	5.3	2.2	4.3	4.0	0.3
	Renovation	3.4	4.6	3.7	2.6	
	Total	8.7	6.8	8.0	6.6	
Total		15.5	13.3	15.0	12.8	

1.3 Challenges for benchmarking productivity

The data collection and use of data seems to be similar in the Nordic countries, but the published data varies from one country to another depending of tradition. Statistical knowledge about the building and construction sector is in general based on national statistics. Most of the available data are macro economical, which means that the pictures given are rough and not very suitable for control and decision-making at company level. Nevertheless, the information is useful for the industry as general background. But when it comes to measuring productivity, the need for project level data is crucial.

The building processes in the five Nordic countries have a great deal of similarities. This should ease the benchmarking activities; if all other conditions of investigation were taken care of. Only few major research and development works have been carried out wit respect to measuring productivity, efficiency, value and quality. There is a need for productivity information in Nordic building and construction sectors on the micro level like in other sectors. To achieve similar statistical information about the B&C sector, the condition is to make project data available for common statistical studies. Till now this resource demanding challenge has not been taken. Instead there have been carried out local price- and costs studies to simply follow the change and ‘explain’ it in plain words.

2. Models for the Swedish and Danish study

The Swedish and Danish study focused the owner and his balanced communication with the end-user and the construction market from the early planning stage through the whole construction period into use and renewal. Based on experiences from different case studies a model was established for benchmarking the building more detailed than price per square metre. First level in the model is to make a comparison between buildings at different locations and building time – **the space model**. Second level is to analyse the deviations in price according to the different size, form, content and functions of the building – **the product model**. The third level is the correlation of differences in standard and quality including aesthetics and comfort – **the value model**. The fourth level is the differences between companies in industrialisation and level of changes, defects and claims – **the process model**. In the study focus was put on the product model and the value model.

2.1 The product model

In the product model the building is divided into different rooms, functions and building parts that are comparable across locations, type of building and the lifecycle of the building. The product model is a hierarchic of objects which build a bridge between real estate, the total building and the detail building product, and price and quality (the value model) can be connected to each object in the product model. Real estate is first divided into 'The ground and site' and 'Building and rooms'. For each type of real estate a limited number of rooms and functions are defined (Table 3). In the next level the building is subdivided into 'Building construction', 'Installation in building', 'Furnishing and equipment' and 'Common activities'. The last includes common activities for the building and construction process. VAT is separate in a single entry.

Table 3: The product model divides real estate in levels of objects in a hierarchic system, which builds a bright to building products and is visible for the end-user.

The real estate	**1. Ground and site**	**3. Building construction**
- Block of flats		
- Single family house	**2. Building and rooms**	**4. Installations in building**
- Office building	- Kitchen	
- Production	- Bathroom	**5. Furnishing and equipment**
- School	- Living room	
- Other examples	- Office	**6. Common activities**
	- Laboratory	
	- Other examples	**7. Value added tax (VAT)**

Each of three main building parts can further been divided into subparts (Table 4), and each of these can in turn be subdivided into different types if it is required. These subparts are directly related to the international classification systems for construction parts and materials, and real estate is related to the methodology in international statistic.

Table 4. Each main building part (here 3, 4 and 6) is divided into subparts, which can be common for all buildings and connected to the international classification systems.

3. Building construction	**4. Installations in building**	**6. Common activities**
- Foundation and ground floor	- Drain installation	- Construction site
- Exterior walls	- Water installation	- Design and planning
- Windows and exterior doors	- Heating installation	- Construction control
- Internal walls with doors	- Gas installation	- Project administration
- Story separations	- Ventilation	- Insurance of the project
- Roof and roof construction	- Electric installation	- Financing of the project
- Balcony	- Communication	- Other examples
- Other examples	- Other examples	

2.2 The value model

Building and constructions are normally benchmarked by comparing price per square metre gross area of the total building. In the value model price and quantity are connected in a unified price for each of the building parts and rooms described in the product model above. In addition the value model also describes the aesthetics, functions, standards and qualities as well as the delivery conditions. The main structure of the hierarchic value model is shown in Table 5.

Table 5. The main parameters in the value model. They can be divided into sup-parameters and connected to the actual objects in the product model.

Economy	Price, cost, profit and life cycle cost
Quantity	Unit, number, size, length, area and volume
Aesthetic	Design, form, texture, colour and appearance
Standard and quality	Function and applications of building and rooms
	Technical standards on constructions and installations
Delivery	Conditions on where, when and how each object is delivered

The first level is to measured price in relation to the quantity for each building, room and building parts in the product model. The unified price parameter can be calculated and used as a comparable key figure for benchmarking. Next level is to correct the unified price in relation to differences in technical standard, function, quality, aesthetics and delivery conditions. Measurable number, classification or a short description can be used to specify the value and explain the deviations between key figures or correct the key figures. An example of three typical rooms in housing is given in Table 6.

Table 6: Example of key figures and unit price on three types of rooms in new terrace houses for housing built in 1994 in Denmark [2].

Room	Standard and quality		Units	Unit price	Price
Habitable room	Paint ceiling and walls. Inner walls of 100 mm gas concrete. Floors of solid beech wood.	2,367	m^2 floor area	629	1.5 mill. DKK
Kitchen	Standard HTH kitchen. 10 m^2 floor area per kitchen.	400 40	m^2 floor area Kitchens	1,765 17,647	0.7 mill. DKK
Bathroom	4 m^2 floor area per room. Tiles on the walls and quarry tiles on the floor. Normal standard of inventory.	160 40	m^2 floor area Bathrooms	6,272 25,089	1.0 mill. t DKK

3. The Swedish case study

The Swedish case study included 32 different building projects of blocks of flats in Sweden. Twenty-seven of the projects came from a report from Boverket [3]. The cost data were given in applications for environmental subvention funding ('Eko-bidrag'), and the data were collected before the buildings were finished. The projects therefore do not represent typical Swedish buildings. The next four projects came from the national committee report [4], and the last project was from the Svedala project [5]. The data from the last five projects were all final cost after the building was finished.

3.1 Distribution of different type of costs

Five of the projects were small student flats and one was located in the centre of Stockholm. All six differed in use, location and costs from the other 26 projects and were therefore removed from the case study. The rest of the projects were built in the period from 1998 to 2003, and a correction was made of the cost using 2002 as a reference. From statistical data it was found that the average price was increasing by 7 % per year. Each project was described by type of building, size, time and cost as given in Table 7.

Table 7: Type of data collected on each of the 26 Swedish cases.

- Type of building as name and community or town where the building is located.
- Size of building as number of flats, heated area (total gross area, BRA m^2) and useful area (gross area for flats excluding common area, BOA m^2).
- Time and date of starting and ending of building time.
- Production costs divided into 1) cost of site, 2) fees and taxes (not VAT), 3) financial costs, 4) building owner costs, 5) consulting costs, 6) contractor costs, 7) value added tax (VAT) and 8) total production costs.

The average size of flat in useful area for the 26 projects was calculated to be 72 m^2, and the smallest and largest flat were respectively 43 m^2 and 119 m^2. The average production cost per area was calculated to be 14,443 SEK/m^2, and the lowest and highest total cost were 9,658 SEK/m^2 and 20,139 SEK/$m^{2,}$ respectively. The average production cost per flat was calculated to 1.05 mill. SEK per flat, and the lowest and highest total cost were 0.58 mill. SEK per flat and 2.01 mill. SEK per flat, respectively.

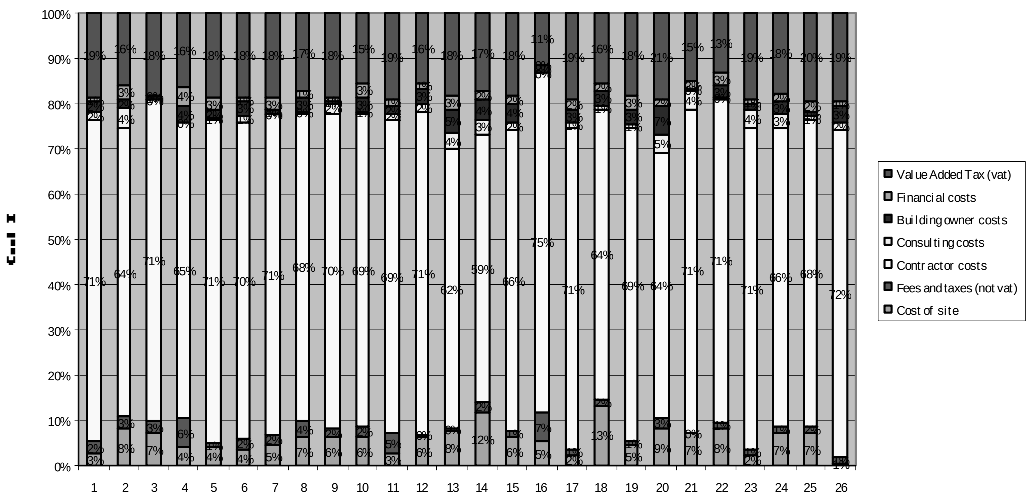

Figure 2: The distribution of seven different costs in % of the total cost for the 26 cases.

Table 8: Average value for the different costs.

Type of cost	***Cost in %***
1) Cost of site	6 %
2) Fees and taxes (not VAT)	2 %
3) Financial costs	2 %
4) Building owner costs	3 %
5) Consulting costs	2 %
6) Contractor costs	68 %
7) Value added tax (VAT)	17 %
8) Total production costs	100 %

As seen in Figure 2, the distribution of the different costs varies a lot from case to case. For instance, cost of site varies from 1 % to 13 %, fees and taxes from 0 % to 7 % and construction costs from 64 % to 75 %. The average value for the costs is in Table 8.

3.2 Benchmarking total costs

The next step in benchmarking building projects is to compare the total cost or the contractors cost per heated area (BRA). Normally a Salter diagram is used. Here (Figure 3) the columns are sorted in increasing cost per square meter heated area and the width of the column is the number of flats for the specific case. In Figure 3 it does not look like larger projects are cheaper, and we can see that the lowest price is 9,658 SEK/m^2. The Salter diagram can also use cost per flat and other values for the height of the columns and total cost as width of the column.

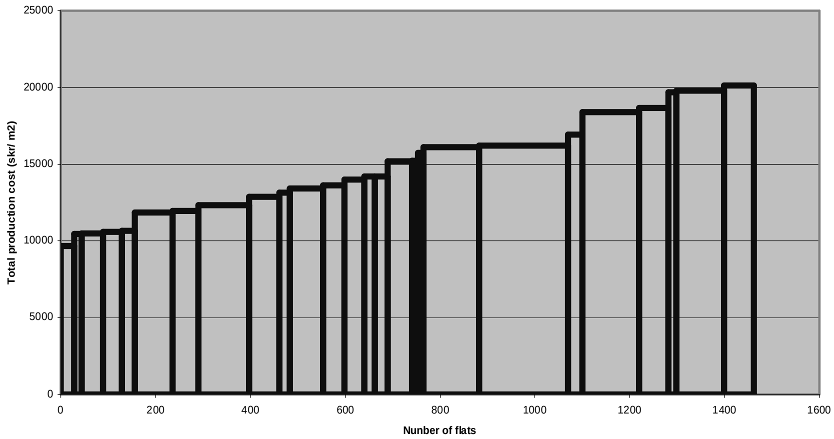

Figure 3: Salter diagram in increasing total costs in relation to number of flats.

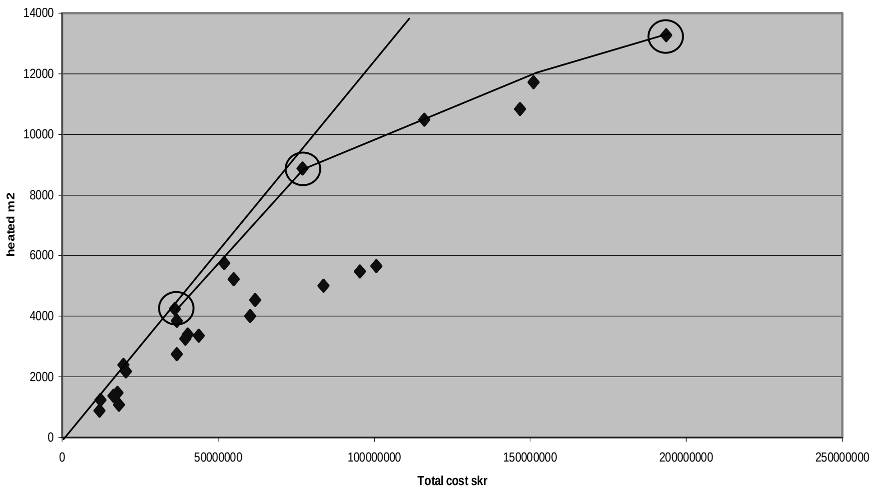

Figure :. Data Envelopment Analyse (DEA) for the 26 Swedish cases. Input is total cost in SEK and output is heated area, and the upper boundary is marking the best practice.

We can also use a Data Envelopment Analyse (DEA) [6] of the cases, where the production result (output) is analysed against the resources used (input), and the best practice is found as the upper boundary of the analysed cases. In the DEA of the 26 Swedish cases the output is the total heated area and the input is the total cost in SEK. As seen in figure 4 the upper curve is forming a boundary of best practice, and the following 3 cases (36.1 mill. SEK, 4,239 m^2), (77.0 mill. SEK, 8,873 m^2) and (193.5 mill. SEK, 13,269 m^2) are all representative of the best practice boundary.

4. The Danish case study

Experience gained from several studies shows that it is difficult to compare productivity between buildings because they differ in function and content. It is also evident that the variation in price per square metre indicates more than dissimilarity in productivity. Another cause is the difference in quality and value for the end-user, which moreover is difficult to measure and evaluate. When we compare buildings in cities with buildings in the country, we also find a marked influence from the location. In the Danish study the models are tested against these parameters on different type of cases in the search for a simple structure which fits international standards and the national opportunities.

4.1 Benchmarking against national statistic

Table 9: Benchmarking new terrace house against public statistics on housing. The benchmark is the median February 2003 and all costs include 25 % VAT.

Building parts and main accounts	**Benchmark**		**Danish case 1**		**Comparison**	
	Cost per gross area DKK/m^2	Part of total	Cost per gross area DKK/m^2	Part of total	Absolute Difference DKK/m^2	Benchmar k index
Foundation	643	5,0 %	354	3,1 %	-290	55,0 %
External walls	1,231	9,6 %	1,262	11,0 %	30	102,5 %
Internal walls	1,260	9,8 %	830	9,8 %	-430	65,9 %
Ground and site	3,224	25,0 %	2,266	19,7 %	-958	70,3 %
Construction total	7,775	60,4%	6,898	59,9%	-877	88,7%
Common costs	1,874	14,6 %	2,345	20,4 %	466	124,8 %
Total costs	12,878	100 %	11,509	100 %	-1,369	89,4 %

Every six months the National Agency for Enterprise and Construction (Erhvervs- og Byggestyrelsen) publishes updated key figures on publicly supported housing on www.ebst.dk/-Boligmarked/Nøgletal. The statistics are divided into four different locations, five different functions and types of occupants and three different types of building. The cost per square metre gross area is distributed on 55 different accounts under the three main accounts: Ground and site costs, construction cost and common costs. Each of these 55 accounts is specified by lower quarter, median and upper quarter.

The first case is a study on a new terrace house and cost and gross area are compared with public statistical data on non-profit family housing in a municipality with a population below 50,000. Table 9 gives an example from the benchmarking of the three main accounts, the total cost and three different building parts. It is seen from the last column that the foundation is 55.0 % of the benchmark, the external walls are 102.5 % of benchmark, the ground and site cost is 70.3 % of the benchmark and the common cost is 124.8 % of the benchmark.

4.2 Comparing renewal of block of flats

The second case is a comparison of 88 different cases of renewal of a block of flats in Copenhagen. Data were collected on costs and units on 20 different building parts or common accounts. For each building part the type and renovation level was described and the average value for cost per unit and the corresponding standard deviation were calculated for similar types of renewal. For most building parts no change was found in cost over a period of 8 years and the standard deviation was as high as 25 % to 50 %. But renewal of windows showed another interesting profile.

Of the 88 cases 78 had had new windows installed and the total cost per installed window had decreased by 30 % from 1987 to 1994. In Table 10 the figures show a cost reduction from 624 DKK/m2 to 436 DKK/m2 gross areas. In the same period the standard deviation was reduced from 25 % to 17 %. It was concluded that the improved productivity was caused by industrialisation of both the window and assembly on site. Normally the cost figures are divided by the total gross area as shown in Table 10, but if we want to compare for instance the cost of renewal of the roof it is better to use the unit ‘cost per m2 of covered roof area’. In Table 11 one project is benchmarked against the rest.

Table 10: Cost of new windows for three periods in the renewal of block of flats in Copenhagen. The costs are in July 1995 prices (DK index 138) without VAT.

Type of renewal	Cases		Cost per unit	Standard deviation
New windows 1987-90	27	31 %	624 DKK/m^2	25 %
New windows 1991-92	31	35 %	500 DKK/m^2	21 %
New windows 1993-94	20	23 %	436 DKK/m^2	17 %

Table 11: Four building parts in the project 'Oehlenschlægersgade 40' benchmarked against 88 renewal of the block of flats in Copenhagen (same index as table 10).

Building parts	Benchmark		Oehlenschlæger..	Oehlen.. per benchmark
	Cost per unit	St.dev	Cost per unit	
New bathroom	52,198 DKK/room	31 %	62,011 DKK/room	119 %
New kitchen	40,050 DKK/room	37 %	34,489 DKK/room	86 %
New heating system	423 DKK/m^2 gross	26 %	676 DKK/m^2 gross	160 %
New roof construction	2,759 DKK/m^2 roof	33 %	5,412 DKK/m^2 roof	196 %

4.3 University building and 3D visualisation

The third case is to determine key figures on different building parts on university buildings. The value model covering price, unit and level of standard is connected to the product model in 30 different building parts and accounts. Key figures are found on each building part and subparts as shown in Table 12 for external walls and windows.

In addition tests have been made on using a simple 3D visualisation in the communication in the early planning process with the end user. The 3D model was based on the collected key figures and colours showing different type and standard of rooms and building parts. Area, volume, total price and cost on the individual building parts were automatically calculated, and it was possible to replace building parts with other levels of quality and see directly the impact on the total price. The 3D visualisation has also been tested with success on new and renewal of block of flats **together** with the occupants.

Table 12. Key figures for different types (a to e) and the average price of external walls and windows on a new pharmaceutical university in Copenhagen built in 2002.

Standard and quality	Units		Unit price	Price
a) Walls and end walls of concrete covered with Swedish limestone.	1,045	m^2 facade	4,202	4.4 mill. DKK
b) Walls and end walls in concrete covered with blue subdued brick tiles.	845	m^2 facade	2,373	2.0 mill. DKK
c) Facade sections in steel and aluminium with sunscreens.	895	m^2 facade	4,828	4.3 mill. DKK
d) Walls and end walls in penthouse in steel with blue subdued brick tiles.	570	m^2 facade	4,909	2.8 mill. DKK
e) Walls in the basement in cast concrete on site and heat insulated.	900	m^2 walls	1,400	1.3 mill. DKK
Concrete walls, insulated and covered with bricks and tiles. Windows and glass sections of steel and aluminium.	4,255	m^2 facade	3,472	14.8 mill. DKK

5. Conclusions

The first rough benchmarking showed a deviation of 25 % to 50 %, and it could not be explained by differences in productivity alone. It was demonstrated that it was possible to split up the building in building parts and type of building parts, which could be compared between types of buildings. Connecting the individual object in the product model with values of cost, quantity, standard and quality the deviation could be reduced to more than 20 %. Based on the study it is recommended that a system should be improved if the deviation exceeds 25 % or smaller if the process is industrialised.

It is clear from the Nordic studies that it is difficult to introduce a common benchmarking system which covers the major part of the marked, different types of buildings and more countries and in addition can be accepted by the owner and construction companies. If an open system is preferred, it could be difficult to get information from contractors, and a system based on the owner must be preferred. Through the Nordic studies we formed a basis for future benchmarking systems which should have time and support to develop.

More international co-operation tailored to national options is proposed, and more research and innovation should emphasise: Simple 3D visualisation of the product and value model, methods for measuring standard and quality on different building parts, classification of type of rooms and building parts, which fits the purpose of the owner and end user, definition of units and key figures of rooms and building parts and network for exchanging experiences on benchmark system and use of key figures.

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Partnering with user participation – as a means of better functionality

Ib Steen Olsen,
National Agency for Enterprise and Construction, Denmark, (email: iso@ebst.dk)

Abstract

The construction industry provides society with physical products not only in the form of finished buildings. It also provides the background for a number of basic living conditions and experiences in modern society such as forms of living, urban space, commercial centres, cultural activities, work places and transport facilities. This goes for new buildings as well as renovation of existing buildings.

Thus the building industry is a key factor in the efforts to create better living conditions. This was emphasised in a recent report to the EU regarding future research and development of building, cf. European Network for Construction Research (E-CORE) (1).

To accomplish this task it will be necessary for the enterprises of the building industry to develop new forms of planning which facilitate working on the basis of the interaction of the building with the activities that the building is to serve - during its whole service life. In this work users and their values could play a crucial role.

In Denmark a basis has been developed for improving collaboration – partnering – in a building project. This basis also opens for the possibility of involving the users far more constructively than has been the case up till now.

Keywords: Partnering, users, collaboration, service life

1 Clients create values

1.1 Overview

'Clients create values' is a development programme running for four years from 2002 – 2006 which at present includes 35 clients and experimental building projects organised in a network.

Elements that can improve collaboration are tested in each single building project. Examples of such elements are the use of workshops, elaboration of common objectives for the participants in the building project, common economic incentives, rules for conflict management, selection of participants/partners on the basis of competencies and budgeting based on open books. Altogether there are up to 15 elements that can be adjusted to fit the individual building project.

In 2004 the network submitted a proposal for a procedure for partnering based on reports on finalised experimental buildings projects (12). The proposal has received the general backing of the Danish building industry and the Government now demands that in every new building project the clients of public building projects should carefully consider whether partnering would be suitable for the project in question.

Guidelines have been elaborated that give directions and summarise the experimental results.

1.2 Industrial relevance

Based on the experimental building projects and the evaluations, the following picture of the advantages can be drawn:

- Collaboration promotes the possibilities of uniting architectural quality with buildability
- The close collaboration provides a better opportunity for involving the users and the values connected with the use of the building
- The transition between design and execution can be implemented with fewer misunderstandings, with more buildable project documents and more time to plan execution and cooperation on site
- Efficient control of economy/quality, survey of risks and improved conflict management are promoted for the whole process

2.What is partnering

2.1 Focus on dialogue

In practice partnering can be organised in a number of ways, but its core characteristics are reflected in the Danish *definition* which has found a general backing from clients and the organisations of the building industry:

”The concept of ’partnering’ is used to describe a form of collaboration in a building project and is based on dialogue, confidence, openness and with early involvement of all parties. The project is implemented with common objectives formulated by common activities and based on shared economic interests” (2) and (3).

In a preamble it is added: “ Partnering should be established as a minimum between client, consultant and contractor”.

The Danish Association of Construction Clients stresses “project optimisation in the programme and project phase with a view to create a better starting point for the building process and consequently a better product” as being a primary target (4).

2.2 Common characteristics and tools

In practice the definition provides the possibility of choosing between a number of procedures with some determining common characteristics such as:

- -An active client who decides to implement collaboration with partnering and who participates in a dialogue with selected enterprises about the design of the building project.
- -Dialogue and interplay where the contractors’ knowledge is incorporated in the design. Economy, extent and quality are optimised in this open process between client, consulting and construction companies.
- -A partnering agreement, which includes a description of the common objectives of the parties, determines the framework for the collaboration and describes the tools that have been chosen for following up on the collaboration. This could be the establishment of a steering group, use of incentives and/or key figures, arrangement of workshops and methods for conflict management.

Partnering can therefore be described as a **number of tools**, which can be used to establish an individual procedure that matches the conditions and preferences in the individual project.

Here tools are mentioned in the form of keywords like: elaboration of *common values and objectives*, specification of the parties’ *success criteria,* establishment of a common *steering group*, development of *competencies* before and during collaboration, agreements about the use of *incentives and incentive earnings,* follow-up through visible results and *benchmarking,* use of *open calculations* and books, arrangement of *workshops*, design with *participation* of construction companies, rules for *conflict management,* establishment of cooperation *on site* and keeping key persons.

The basis for the implementation of the building project is the traditionally used contractual agreements, cf. Section 6.

3. Focus on users' values

3.1 Value-based collaboration

Value-based collaboration has already for several years been used as a management form in business enterprises. The use of values in now spreading also to the building industry.

The client is the pivotal point when a building project should be developed that satisfies the users' needs. The client gets a new tool for planning by formulating the users' needs as the values credited with importance in the daily use of the building.

It is a tool that gives everyone involved in the building project – users as well as companies – better opportunities for communicating than traditional means like drawings or descriptions. Therefore dialogue and the formulation of values is the way ahead if new building projects are to be developed that provide higher satisfaction for all involved parties.

An issue for example might be whether it is open space , a good indoor climate, a low noise level, good daylight or other conditions that are the most important, and how they should be prioritised if it should become necessary – which it usually does. And during implementation of the project – is the most important value respect, punctual information, responsibility or other conditions, or all of them?

3.2 Different user groups

All relevant users should be involved. Examples are staff or persons with special skills. If the staff is not known, knowledge and experience from corresponding organisations can be obtained. Skilled persons can be persons with specialist knowledge of technical conditions. Finally users who only spend a short time in the building should be mentioned.

The organisation of user participation should be carefully considered in consultation with the users who could be represented by individuals or groups – and the framework of their work should be known.

The parties – not least the client of course – must beforehand consider well their own value base as well as wishes to the common values (5). Next they should jointly assess what benchmarks would be suitable for follow-up and for showing that the project is heading in the right direction. And finally, the desired level of ambition to be achieved.

The values should be understandable, meaningful and determining for decisions as well as social relations.

4. What competencies are needed?

4.1 The need for competencies

It is a necessary precondition for a successful collaboration in connection with partnering that the client and the enterprises possess basic technical and economic competencies. However, they should be applied in other ways in partnering, for example by letting designers work in a more interrelated way with the construction companies than is the case in traditional collaboration.

Moreover, collaboration in connection with partnering implies that a need exists for special supplementary competencies that can support and promote the collaboration. Especially for the tools previously mentioned under the characteristics of partnering (6).

At the same time it is crucial for a successful collaboration that the entire group functions well as a team intent on implementing the actual building project as “Project Partnering Inc.”

4.2 Pivotal role of the client

The client should begin by assessing whether the client organisation possesses the competencies necessary for its daily operation in relation to collaboration in openness and confidence. It is also important that the organisation has an overview of which methods and tools that can promote collaboration in partnering.

The client can choose to supplement his organisation with a consultant with knowledge of the practical organising of partnering and tools for supporting the collaboration.

A distinction could be made between three forms of competencies in connection with partnering: *managerial, technical and personal*. The client – and the client’s consultants – are in a central position to ensure that the competencies necessary for the implementation of the building project are available.

4.3 Selection of partners

Through the selection of design and construction companies, the client can see to it that persons with basic competencies participate. And later *during collaboration,* for example in a dialogue with the partners and in workshops, the client can initiate a survey on a more detailed level to establish the need for competencies and establish agreements about development or incorporation of lacking competencies, if it is considered necessary.

In practice the client can at first *select* the companies through prequalification that are considered suitable due to their general – basic – references. At the same time the client signals that the tender documents will include a closer description of the need for competencies at the implementation of the actual building project.

When *awarding* the design task and subsequently the task of executing the construction work, or both at the same time, the client could as a next step let the description of persons participating in the collaboration, which has been prepared by the companies, form part of the assessment to select the companies.

In a large building project, the sub-criterion for organisation was given the weight 20 % and based on the CVs of key persons. It was further subdivided into design, execution and sub-contractors, each with 1/3 and marked on a scale from 0 to 13.

5.Establishing a collaboration

5.1 Tendering at partnering

It is important that the client as a **first step** at an early stage - before or during the brief – assesses whether partnering will be a suitable procedure for the actual project. By early assessment it will be possible to choose between several procedures, in particular between early or late partnering, cf. below.

The client's assessments must be made within the framework conditions in force. The most important for public clients are the EU Directive on Tendering and the Danish Act on Tendering. In 2004 the EU adopted two new directives. The Danish Act on Tendering is expected to be revised in 2005 (7) and (8).

Overall these changes support the possibility of partnering and specify some conditions in connection with tendering like the use of sub-criteria.

5.2 Early or late partnering?

When the client has chosen partnering as the form of collaboration for a building project, the **next step** is to find a partner. The basis for the tender (selection of partner(s)) could be the brief**,** outline proposal or scheme design.

A distinction can be made between early involvement of the construction companies, meaning before the scheme design (”early partnering”) or later for example after the client has had an outline proposal prepared (“late partnering”).

The client should decide which form is the more suitable for the individual building project. At the outset “early” cannot be considered better than “late”.

At present early partnering is used in approximately 60 % of building projects and late partnering in approximately 40 % according to one survey (9). For early partnering, design and build contractors are typically used, while for late partnering for example smain contractors or trade contractors are used.

In the background material for the tender the client must describe the demands and wishes to the collaboration, for example in the form of a proposal for a partnering agreement which includes requirements to competencies, cf. above. The client can choose to request the tenderers to provide proposals for items in the agreement and let the proposals be incorporated in the assessment of the tenders and thereby the award.

The **third step** is to enter into a partnering agreement, which will remain in force until tender and contract – and as a rule form part of the contract.

6 Partnering agreement

6.1 Traditional contractual arrangments

It is normal practice – and it is recommended – that collaboration aims to use one of the traditional contractual arrangements. There are no examples of joint and several liability that also include consultants/contractors. But it can be included in a partnering agreement that a later contract should include specific provisions for the cooperation with consultants in connection with the implementation of the contract like for example contact to the client.

The partnering agreement can involve the users and as a minimum it contains a description of how the users’ knowledge and values should be included in the planning.

It is recommended that the partnering agreement runs until handover. And it should for example include the socalled lean production, which could involve foreman and workers in the collaboration.

The agreement will also need to include an agreement on how to manage possible conflicts. Known methods are a bottom-up process for solving disputes, dispute Review Board, pre-emptive conflict management and mediation.

6.2 Main items of the agreement

Main items of the partnering agreement will typically be: a description of the *parties* and *the purpose* of the collaboration, a concrete outline of the collaboration with the establishment of some *success criteria*, the framework for the *economy* and the time schedule, a *programme* for the future building project with an indication of targets for quality and the environment, the *basis* for the collaboration and the contribution to the partnering of the parties, conflict management and possibilities for *cancelling* the agreement, the basis for the contract(s) and possible contracts concerning incentives/incentive earnings (10).

There are different views of where the partnering agreements should be placed in relation to the actual contracts regarding its implementation. One way is first to make the agreement with a description of the conditions for its implementation. This is a conditional agreement, which will be continued in a contract if the conditions are met. Another way is to make the agreement in connection with the contract. The agreement should decide the possibilities and conditions for termination of the collaboration.

7. Implemention of the collaboration

7.1 How to create a good collaboration?

The basis for the implementation of collaboration is the partnering agreement, which has decided the objectives and framework for the collaboration together with the tools will be used by the parties.

The collaboration can be organised in different ways with regard to the structure of the brief, time schedule for workshops, user participation, utilisation of competencies and establishment of groups.

7.2 Steering group

Large building projects should establish a steering group with the overall responsibility that the objectives of the agreement are met with regard to the design of the future building project as well as for daily collaboration. The steering group could be seen as the 'board' of 'Project Partnering Inc.'

The steering group should be a non-executive body and strike a balance between being a controlling and an inspiring factor for the collaboration. The steering group should function during the whole building project.

In the previous section on 'Characteristics of partnering', keywords are used to indicate a number of tools that can be used to support the collaboration. It should be assessed from one project to the next, which of the tools are relevant just as the actual wording should be agreed between the parties.

7.3 Tools in practice

The three tools most frequently used are: *elaboration of common objectives, shared economic interests and common activities*, including workshops. These are used in nine our of ten building projects (3) and (9).

Common objectives have been agreed in approximately 85 % of building projects. In less than 10 % of the projects, they were agreed before consultants and contractors became involved.

In 65 % of building projects consultant and contractors are paid a fixed price. Here *incentives* are used such as keeping the time schedule, budget. In just under 70 % of the agreements with contractors and approximately half of the agrements with consultants this is used.

Regarding *conflict management* the most applied method is the bottom-up process for solving disputes/level model, where disputes as a starting point should be solved at the 'lowest possible' level. This method is used for seven out of ten building projects.

A particular characteristic of the partnering agreement is that it involves collaboration during execution on site. There are several experimental building projects, for example where lean construction is applied and a number of common activities are carried out as well, not least regarding safety and health.

7.4 Utilising experiences

During the whole course of the collaboration – from the client's considerations concerning the future building project via the tender to handover – the parties will be gaining experience. Most will be continuously utilised, but a status after finalisation of the building project can make the experiences of a more general nature stand out and can therefore benefit the partners' participation in a future building project – with new parties.

This could be effected through a workshop – maybe several for large projects – arranged when the building project has become operational, for example three months later (11).

8. Conclusions

The building industry provides the background for a number of basic living conditions and experiences in modern society. The interaction of a building with its users and their values during its whole service life will therefore become increasingly important in coming years.

In order to accomplish this task, it is necessary to develop forms of collaboration that ensure that the users' values are incorporated and their knowledge utilised. A first step has been taken in Denmark with a new form of collaboration called partnering.

A number of tools or elements are being developed, but already a picture of this form of collaboration is taking shape. The most important characteristics are an active client, dialogue and interplay between the parties of the building project and a partnering agreement including objectives for the collaboration, elements to ensure the collaboration and the contribution of the parties to the collaboration.

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The Role of the Client in Best Value Procurement

George Ang,
Government Building Agency, The Hague, Netherlands
(email: george.ang@minvrom.nl)
Ryan van de Ven,
Government Building Agency, The Hague, The Netherlands
(email: ryan.vandeven@minvrom.nl)

Abstract

Clients with focus on end-users expect buildings to facilitate their business objectives. The increasing importance of end-users satisfaction creates the need for a performance based approach as to allow the management on end-results, and to provide a language they can understand. With such an approach the match between the clients' business objectives and the buildings will be facilitated and as a consequence buildings can be treated as factors of business rather than a capital asset only. A holistic approach is helpful in monitoring and assessing the output during all phases of the process, from project initiation to use and facility management.

In many countries all over the world programmes are ongoing with the aim for more or less radical reforms in the building and construction sector, and procurement appears to be a key factor for improvement in delivering added value for clients. A significant future trend is recognised in an explicite role of clients and focus on end-users, and consequently, the need for best value procurement of the built asset as a whole is apparent. This, in turn, calls for innovation through more co-operation, because such an approach drives prime attention towards whole building performance rather than to technology of parts and components. In doing so, managing added value should be addressed explicitely in the interrelation of product, process, and people.

When best value procurement is the leading ambition, the price-quality ratio of the output should be in the selection criteria rather than the focus on lowest price of tender only. Clients should approach industry in a way that stimulate the vendors to launch their best professional performers for the job required, which in turn requires a professional outsourcing client attitude. This will stimulate the development of instruments that allow monitoring and improvement of the output over the lifetime of a building, and consequently enhance building and construction process innovation.

Key-words: Clients, End-users, Best value procurement, Performance-based approach, Reform

1. Introduction

The need for reform in building and construction is recognised worldwide. In particular the public client is a very significant client for construction and it is therefore essential that public sector procurement practices reflect the objectives of reform. If the large public principals, and also the large private principals set the trend, the rest will follow. These large organisations have buying power, and they can take advantage of that.

From the clients perspective, a building can provide substantial return on the investment, but to enhance this return the building must be seen as an asset that exists to facilitate the client's objectives with focus on end-users. Value is a crucial concept in the procurement of a building and is difficult to measure in numbers, means or technical solutions. A performance-based approach may be helpful because it focuses on end results with regard to the asset rather than on means with regard to the technology of parts and components.

It is crucial to identify the stakeholderships of the construction client in its diversity from real estate investors to property managers and principals on to 'once-in-a-lifetime-clients', in order to treat the role of 'the client' in best value procurement. Value creation should be enhanced for both client and industry, and a shared vision from the perspectives of clients, industry, and government may be developed on added value of building and construction. Such a vision can be implemented through the development of a method of performance based briefing, that can explicitely be related to best value procurement.

2. Procurement is key-factor for improvement

Procurement practices are of crucial significance in building and construction reform. Traditionally, procurement has been based on price. The introduction of 'non-price' factors and best value procurement in the award of contracts and of 'value for money' criteria and innovative approaches to tendering can have major impact. The central place of procurement in reform leads naturally to much greater focus on client requirements and on the need to raise the capabilities of construction clients [1].

2.1 An international trend

The Proceedings of the 1st Revaluing Construction Conference in Manchester UK 2003 [7] revealed an international trend towards more value and quality driven competition, and also public client leadership in procurement. Meanwhile interesting construction reform initiatives are found abroad, many of those taking a lead with the UK Rethinking Construction Programme. A Dutch programme 'PSIBouw' (Process and System Innovation in Building and Construction), designed to encourage innovation in the construction industry, is currently mobilising all those involved within the building and construction sector [1]. This research programme has secured substantial funding of approximately € 43 million from both government and industry for a 4 year period.

The first PSIBouw project was an inventory of international reforms in construction, including a study tour to Australia, Denmark, Finland, Hong Kong, Norway and Singapore. In total, around 75 meetings were held with key individuals and representative bodies in these countries, and the lessons learned revealed major findings on the fields of procurement, the role of the clients with end-user focus, and the need for an integrated approach in building and construction.

The international trend shows a consistent move towards non-price and value-based procurement, away from focusing on lowest price only. Examples from Australia and Norway revealed the advantage of qualifying and selecting parties on their competence in co-operation in high performance teams. Life cycle costing is an item of topical interest in the Norwegian building industry, and indirectly it does enhance value-based procurement, in particular because LCC assessment is now mandatory for all public buildings, following a Norwegian standard.

2.2 Best value and non-price factors

New procurement processes were developed in Australia, Hong Kong, and Singapore, with greater emphasis on past performances and introducing best value and non-price factors in tender evaluations [1].

The National Museum of Australia was constructed using alliancing principles in which risks were shared between the client and the supply side, and a trust and no-blame culture was promoted. Major infrastructure projects, like the extension of the Hong Kong Kowloon Canton Raiway Corporation have similarly been constructed under partnering arrangements, allowing close liaisons between demand and supply sides.


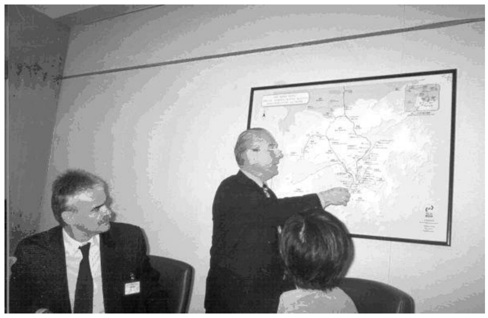

Figure 1: National Museum of Australia (left) and CEO Hong Kong KCRC Ian Thoms

The role of public procurement is evident in all countries visited, and public sector procurement practices reflect the objectives of reform. Some programmes, for example in New South Wales Australia, focused on the power of public sector procurement in developing a Code of Practice and a Code of Tendering, both applied in pre-qualification procedures.

The Department of Public Works in Queensland Australia improved the value for money effect by introducing rigorous pre-qualification standards, and new forms of contracts like non-adversarial, alliancing, and keeping regular dialogue with the industry. Leading private sector clients in Hong Kong and Singapore have adopted the same procurement principles as the public sector and so reinforced the reform process.

3. Clients with end-user focus

A significant future trend is the increasing role of clients with end-user focus.

The increasing importance of end-users satisfaction creates the need for a performance-based approach as to allow the management on end-results, and to provide a language they can understand. With such an approach the match between the clients' business objectives and the buildings will be facilitated and as a consequence buildings can be treated as factors of business rather than a capital asset only. There are good practices with the ASTM functional and serviceability requirements developed in Canada [5].

3.1 Construction Client Associations

In order to empower the position of the client in enhancing innovative construction practice effectively, clients should be properly identified and organised. In doing so a diversity of client systems related to types of clients, such as end-users, 'once-in-a-lifetime' clients, and professional clients may be distinguished. The so called 'intermediate' client – operating between client/end-user and industry – is particularly characteristic for the work of government building agencies. There are successful practices with Construction Client Associations in Denmark, Sweden, and Australia, all focusing on end-users, principals, and owners [2].

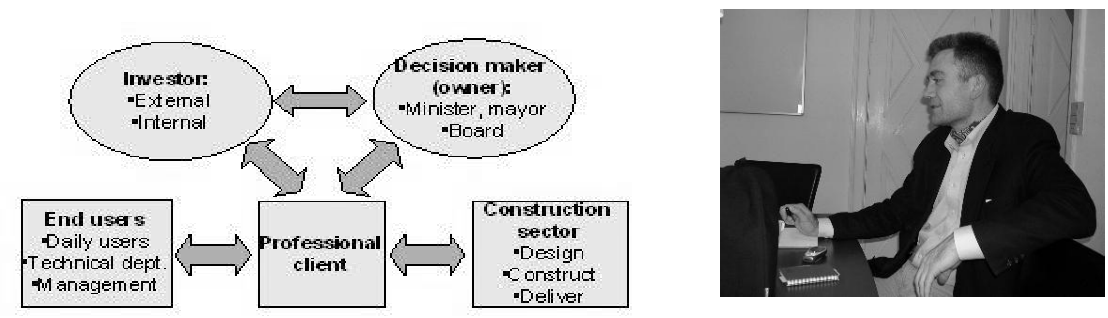

Figure 2: Professional client relationships – CEO Danish Construction Client Association Henrik Bang

These client associations, enhancing professionalism in clients, are currently developing as powerful driving forces for reform within the sector. Representing the majority of large construction clients, they have a sound impact on the development of improvements of products, process and services of the building and construction sector.
Demand driven research programmes are pushed by these client associations in Sweden, while acting as a Change Agent in construction, and professionalising their members, funded by the Swedish Research Council for Environment, Agricultural Sciences and Spatial Planning [6].

The associations membership ranges from every leading institutional investor, pension fund, property trust to private investors and developers, and as such, these associations can strongly influence the process of policymaking in procurement.

3.2 Client briefing methods

In order to facilitate understanding in client briefing methods, it is proposed to agree on an appropriate context that covers all the stages in the sequence of a building and construction process. This context is determined by three characteristics (Figure 1):

Firstly, briefing is manifest in all phases of the building and construction process, from project initiation on to use and facility management. It is in the nature of this process that alterations do occur all the way from the start to the hand-over of the built asset. Secondly, core competences affecting demand, production, and use and facility management are distinguished, and in doing so, domains of competences can be determined accordingly. For instance, demand competences are manifest within the phases of project initiation and definition, while product competences generally are in the phases of design, design documents, and construction on site, followed by the phases and competences of use/facility management.Thirdly, there is this continuous process of learning and ever improving expertise by effectuating the benefits from the process'life cycle, and as a matter of fact, the briefing process should start with the evaluation of the existing housing situation.

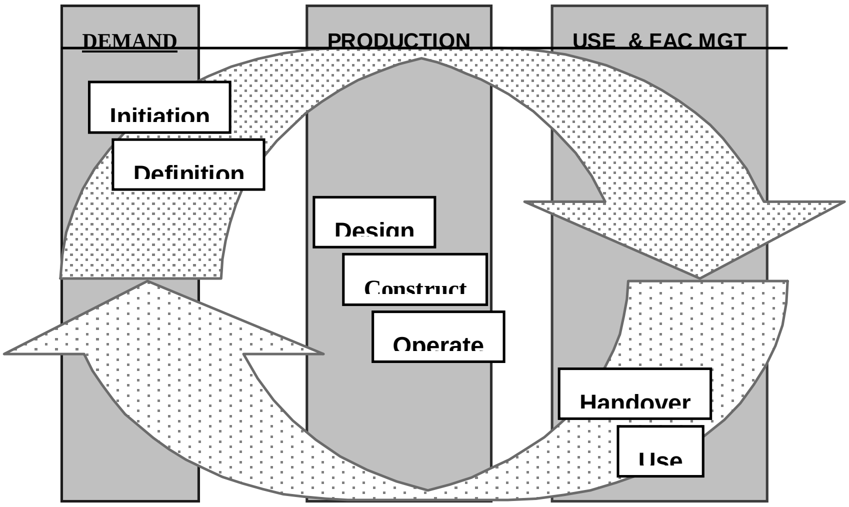

Figure 3: An appropriate context for the briefing process

Within this context new ways of briefing are developed using modelling techniques that provide client-organisation based functional outputspecifications, and can link these systematically to service quality, facility management, design, and costs [8]. The brief is converted into a digital model, that provide performance criteria in terms of organisational goals and ambitions, functional requirements, performance specifications, verification methods, and references of acceptable solutions. The method is applied in practice in behalf of the Dutch Treasury in the Hague, a € 200 million project, to be tendered in a concession form of PPP (Figure 4):

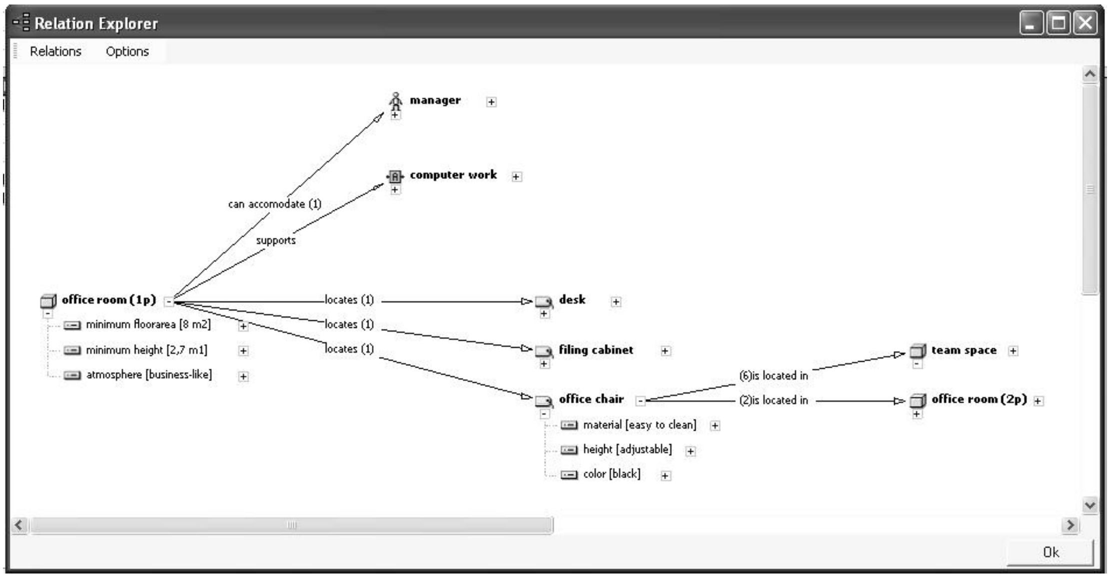

Figure 4: Modelling outputspecifications with focus on service quality [8]

3.3 Client assessment methods

Within the building and construction process from design on to hand-over, specific moments of risk for client dissatisfaction occur at the moments of transaction from one phase to the next one. One reason for failing causes is that the quality control traditionally relies on explicite assessment of technology of building parts and components (which not directly affect the clients expectations of performance), while the quality of the built asset as a whole (which indeed affects the client's organisational, economic and functional performance expectations) is being assessed 'pretty implicitely' beyond proper control, causing client dissatisfaction [9].

As a consequence, moments of risk are determined when matching assessment between the client brief and design, between design and construction documents, between desgn documents and construction on site, and finally, between hand-over and use within the so called domain of production competences, mentioned in 3.2 'Client briefing models'.

Each match is characterised by a different way of expressing (total) building asset performance, and in the traditional design and construction process it is definitely difficult to make sure that the constructed result matches the performance, that was initially expected by the client [3].

There are two causes to this situation: the lack of a systematic approach to the subject as an end result during the design stage, and the absence of a defined party that should be responsible for its implementation [10].

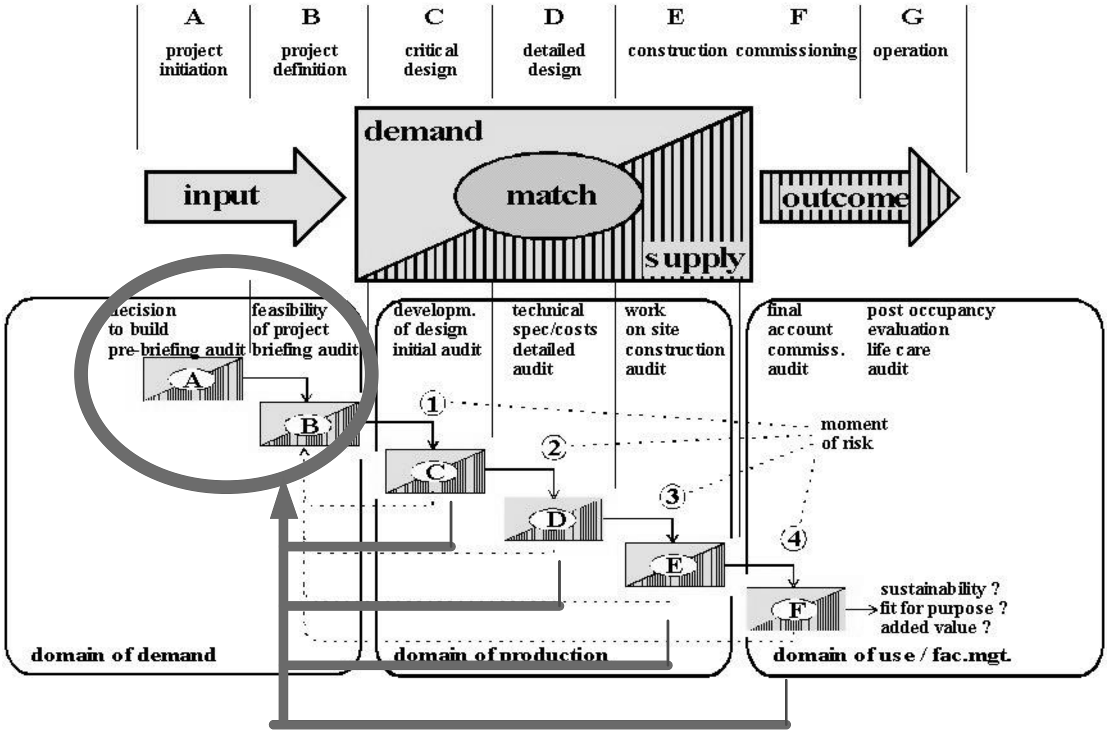

Figure 5: The moments of risk and assessment of brief [3, 4]

Therefore it is suggested to monitor and assess at all transaction moments between the phases during the process of production, and to focus all assessment, no matter in which phase, with reference to the initial perfomances required in the client brief rather than to the results of the result of the previous phase (Figure 5). The application of such a process enhances a systematic approach to the end result during the process of production, and it also stimulates the commissioning of a defined entity responsible for its implementation.

4. Best value procurement

Central to best value procurement is successfully recruiting the high performers in the design and construction industry. This way of recruiting is based on the Information Management Theory (IMT), followed by the Performance Information Procurement System (PIPS) and the application of the Six Sigma Model in construction [11].

If clients keep selecting vendors on lowest price only, these will consequently launch their cheap in-hired low performers, as to keep in business. But if clients act as ‘professional outsourcing clients’and select on inventiveness, creativity and sustainability, vendors will launch their high performers in order to keep in business.

4.1 Procurement strategies

From the viewpoint of the construction client, it may be obvious that procurement strategies start considering which services and activities to keep and to outsource when purchasing a built asset. Central to the clients'view may be the value for the end-user, and how to purchase this in best value procurement:

Clients may want value for money from their buildings by achieving a clear focus on meeting business needs; their immediate priorities are to reduce capital costs and improve the quality of the built asset by the right procurement strategy. A longer term, and more important, issue is reducing running costs and improving the standard of eventual existing buildings.

A specific trend is that best value procurement seems to be the leading ambition [2], and the price-quality ratio should be in the selection rather than the focus on lowest initial price only, because it will enhance product- and process innovation, and stimulate the development of instruments that allow monitoring and improvement of the output over the lifetime of a built asset.

These considerations are often part of the internal conditions of a projectspecific situation, and of course the market situation plays a substantial role in terms of external conditions prior to decide upon procurement strategies.

4.2 Decision support models

Recently in 2004, a projectspecific procurement decision support model was developed in co-operation between the Delft University and the Government Building Agency in the Netherlands, based on ex-post experiences and evaluation and ex-ante analysis of a few governmental real estate projects, i.e. the so called 'PAIR'model, which stand for Projectspecifieke Afweging Inkoop Rijkshuisvesting [12].

The model generates projectspecific recommendations for the strategy of procurement, as a result of an input of 11 procurement themes with an average of three procurement options each, considered within a projectspecific context of given project criteria (time, budget, organisation, quality expectations etc.), internal conditions (such as parties involved within the project, type and ambition of client in terms of involvement in the

project) and external conditions (such as the context of the project in terms of site, European regulations, market conditions etc.)

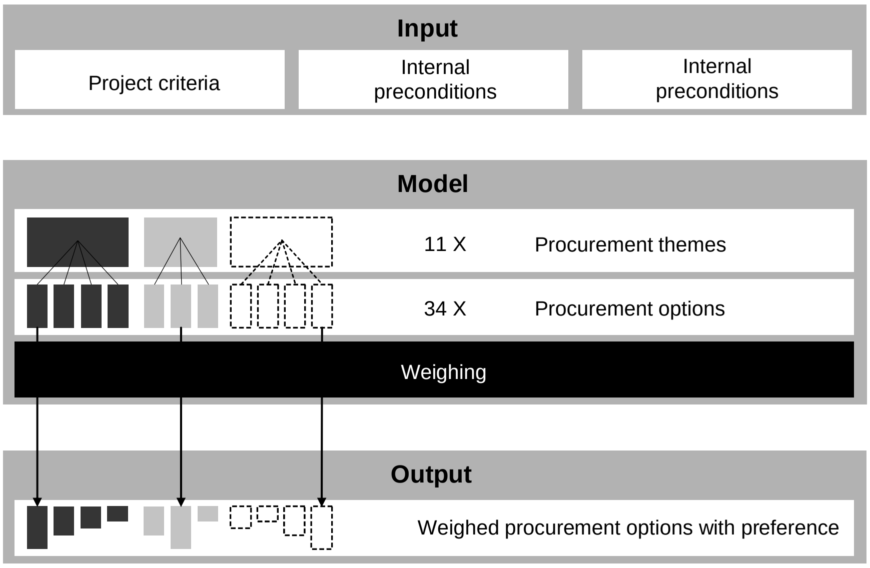

Figure 6: The 'PAIR-model', procurement decision support system [12]

The output of this PAIR model consists of weighting the projectspecifically selected procurement options within the 11 procurement themes, such as the division of project or process, number of vendors to co-op with, contractual relation between principal and vendor, design responsibility, risks and finance responsibility, criterion of selection, demand requirements, system of contracting, and reward sytem. In theory, there are 165.886 combinations of procurement options and strategies [12].

5. Conclusions

On the demand side, clients need to develop a greater ability to express the requirements and aspirations of end-users and society in a consistent and comprehensive way. Furthermore, they need to bring these requirements to the market in a way that challenges the supply side to produce solutions that maximise value for clients, while launching their high performers. Finally clients need to be able to assess the added value of different solutions. These changes may be summed up as the development of professionalism in clients. The creation of Construction Client Associations may promote more professional procurement. In some countries, existing organisations can form such associations, and in other countries, a special new initiative may be required.Training and educational courses can support dissemination of best practices and experience developed through these associations.

Procurement practices are of crucial significance in reform of the building and construction sector. They are the meeting point of demand and supply, through which the supply side responds dynamically to the demands of the clients side. Therefore, procurement processes need to encourage behaviour that is in line with aims for industry, placing emphasis on quality, performance, value, and the development of learning opportunities. To do so, however, implies a move away from traditional selection methods based on 'lowest price'. International experiences can provide a guide to the ways in which new procurement mechanisms may be introduced while maintaining proper safeguards against malpractice. Registration systems, together with transparent and accountable pre-qualification procedures, may play a major role in these new procurement processes.

Last but not least, there appears to be a large need for demand-driven research practices in order to support client professionality and innovation in best value procurement. A network of international knowledge, and experts, should be initiated on these fields, eventually by a starting initiative of the Dutch Knowledge Centre for Process Innovation in Building and Construction, CRC for Construction Innovation in Australia, Salford University, The Centre for Total Building Performance in Singapore, and VTT Finland.

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Perceived Quality in Buildings: Human Factors in Global Quality Approach

Erminia Attaianese,
University Federico II of Naples - Dept DICATA (email: erminia.attaianese@unina.it)
Gabriella Duca,
University Federico II of Naples - Dept DICATA (email: duca@unina.it)

Abstract

To control integrated and complex dimension of building quality, we need to expand references to further cultural and scientific field, able to integrate technical aspects with human factors, in both design and management activities. Turning to human factors methodologies and tools we would be allowed to design and control global quality of building environment. The rising of user's expectancies level, the role of user's characteristics, and the variability joined to the specialization of activities, make so that an effective quality control must include human factors and user interaction with buildings.

Keywords: End users, Needs, User centred design

1. Introduction: a different approach to building quality

1.1 Overview

Observing the development of the idea of buildings quality from 70s up today, we notice that its control is moving towards systems more and more complex. In fact, we overcome a concept of quality as correspondence between performance and requirements applied of technical elements and we get to a new and more complex quality idea including the whole of building global performances, evaluated in relation to end user's needs. Users do tasks characterized by a rising involvedness, determining use models of architectural spaces even more specialized and composite, with a consequent increasing final quality demand. We can state that building quality is evolving in terms of all-in quality, even if user's expectancies are not clearly expressed in relation to the end-users perceptions. All that means that users expectations are referred to the human life-quality offered by buildings, also including behavioral, organizational and psycho-perceptive factors in human-building- interaction. At the present, quality aims coming from each specific field lead apparently to broken down and diverging visions, also because of the high-specialized competences and functions involved in building process.

1.2 The human centred approach

The new quality vision that comes out from most recent standards directions emphasizes the role of user's satisfaction. This point of view implies that quality has to be considered not only as a correspondence between building's performances to a set of predetermined requirements, but it results from the rate of motivation, support and gratification –in one word: satisfaction- felt using a specific system. Then, quality is anymore referable to the sum of all single performance, but is clearly related to the whole of combined effects of a system on its users, and so the quality has to be reported to the users' perception of system use. Moreover, the increasing relevance attributed to users' expectancies and their physical and behavioral characteristics, the variability of preferences and ways in everyday activities make so that an effective control of perceived quality should be based on human factors consideration and their interaction with built environment.

Methodologies and tools coming from human centred design provide an useful contribution to the built environment global quality. This approach, that requires competencies in ergonomics science, is able to improve all these field, today controlled separately one from the other, best fitting the current idea of building quality. In fact, ergonomics highlights relations among technical, organizational and human factors affecting -implicitly and/or explicitly- buildings' planning, design, fulfilment, fruition and management. User centred methodology founds on some basic steps:

- all users profiles definitions
- users goals in relation to each user's category
- task analysis of each user's activity
- definition of use requirements of product/service
- conversion of use requirements in technical requirements and details.

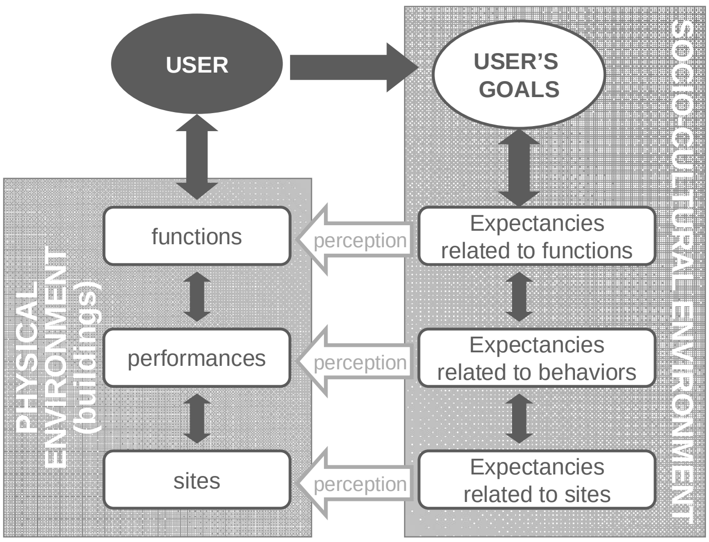

Figure 1: Relationships among context of use elements in built environment quality perception.

Operative techniques of User Centered Design produce many iterative processes in which users participate directly or indirectly to the design through simulations, interviews, observations, etc.

In fact, the user centered approach focuses the quality assessment on relationships establishing between systems and its users; then, following the user centered approach, quality means quality in use, appraisable through the usability measurements. Effectiveness, efficiency and satisfaction [1] are the three parameters allowing to define and measure specific markers for each observed system. Moreover, the wide variability of users' goals and characteristics make so that the usability or quality in use is not an intrinsic and absolute performance of a system, but it will depend on its different modality of fruition or, in other words, on the context of use [1].

2. Users and building quality

According the proposed approach the building quality topic is rather matching the building usability, that means the quality of interaction humans-built environment. The complexity characterizing a built system implies many multiple interaction levels, from a "sensorial" sphere to an "intentional" one, that is connected to goals pursued by users in buildings fruition. Following points are going to specify logical steps resulting from the user centred methodology applied to architectural design.

2.1 Users

First step is the definition of users' profiles. Already from this early stage, users' categories shall be defined considering the global use of buildings, therefore needs and expectancies of all users groups come up from the analyse of direct and indirect users, specific users (adults, older peoples, children, …), occasional users (cleaning or maintenance personnel, visitors, …). Each user's category is characterized by different physical and cognitive abilities or variables socio-cultural background that have to be taken into account when deciding building's technical requirements or evaluating its performances. For instance, we could think to diverse colours perception in aged peoples, to balance or orienting difficulties in children and elderly peoples but also to the potential way finding and orienting weakness in casual users of an environment [2].

2.2 Users' goals

Goals are explicitable according many different keys and can result differentiate and specifically oriented for each users' profile. For instance, we could look at some "cross goals", generally related to built environment; this kind of goals can be: adequate safety and security conditions, climate protection, pleasantness of spaces, environmental comfort, maintainability, etc. All these needs often are already considered in a traditional design process, but in a user centred approach they are enriched with many immaterial values and meanings. As an example we can quote the safety: user is not fully satisfied if its safety conditions are objectively assured by buildings, rather, in its opinion, the safety performance will result actually guaranteed only if user will feel safe and protected in a space.

Then, the quality control focused on users and their emotional and sensorial sphere affects perceived quality level and leads to rates diverging from a traditional evaluation measurement. Textures, orienting, wayfinding, identity of a places, are just some of aspects touching the actual level of user expectancies satisfaction that means the quality value according users [3].

About needs related to function hosted in a building, the user centred approach supplies some methodological tools able to highlight existing link between space-functional layout and organizational systems: in fact relationships and interferences among functions or actions and time, flows, rules can be clearly detected thanks to UCD. Therefore, a building quality meant as match between activities and living model is strongly supported by the UCD methodology that, on the other hand, stress the link existing between dwelling quality and the ability of building to support and make easier users activities (with reference to many useful concepts such as affordance, constraint lack, …).

2.3 Activities and tasks

From the task analysis of all users' categories is possible to understand their expectancies towards physical environment, strongly connected to their preferences and mode in tasks execution. In fact, through a tasks' analysis, a basic tool in usability field, designers can define what users need in term of actions or cognitive processes, to achieve their goals when interacting with any system. The task analysis consists in a task breakdown structure, where all actions are logically and hierarchically related to each other. Moreover, some specific analysis such as link or layout analysis, allow to observe modality of tasks carrying out and makes designers able to specify all that factors in built environment so that favour or hinder users life condition as regards to their goals [5, 6].

2.4 Use requirements

All data gathered and analysed in previous steps supply information on those characteristics of built environment necessary to satisfy the whole of users expectancies. So, general and technical requirements definition step become a strategic phase in building process because in this moment, and on the basis of all prior analysis, the quality process can assure that all actual users demands -and not those ones supposed by designers- will be transposed in technical requirements and building's detail characteristics. In fact, technical standards, designer experience, conventions and cultural references give to designers a "hybrid" model of users' needs, hardly controllable without a specifically user oriented design methodology [4].

3. Managing the building process through perceived quality

Building process in characterized by a plurality of involved actors, expressing different and, sometimes, opposite quality aims. In fact, in end use phase, quality perceived by end user coincides with the life quality offered by buildings, but during design and construction stages the different subjects have priority, and then quality aims, very dissimilar to end users' ones. This intersection and overlapping of dissimilar quality aims, joined to the process complexity, make so that each subject recourses to its own control criteria and evaluation system, from which could come contrasting solutions. Instead, the user centred approach, thanks to the possibility to recognize and relate needs and expectancies according more point of view, is an useful support to an unitary management of building process.

It seems now useful to report how ergonomic competencies support each process actor, contributing to improve the all-in process efficiency. First of all we have to consider that user oriented analysis is very helpful for customers, because they can better express they needs and, then, formulate in a more appropriate and not generic way their requests; moreover, if customer is not end user (i.e. the case of public buildings) UCD techniques allow the respect of end user "mental model" [7] for spaces rather a stereotyped or unreal one. Finally, the initial clarity about needs makes plain and effective the communications among customers and other involved subjects, reducing mistakes and ongoing modifications.

On the other hand, designers' activities are facilitated by UCD because this approach supplies a well defined set of needs and requirements. This condition allows to save time and resources carrying out planning activities, thanks to the high quality and quantity of input data; besides the user centred approach focuses the choice among many spatial or technical alternatives respecting not only management aspects (durability, maintainability, …) but also fruition ones (layout flexibility, psychological effect of environment, …).

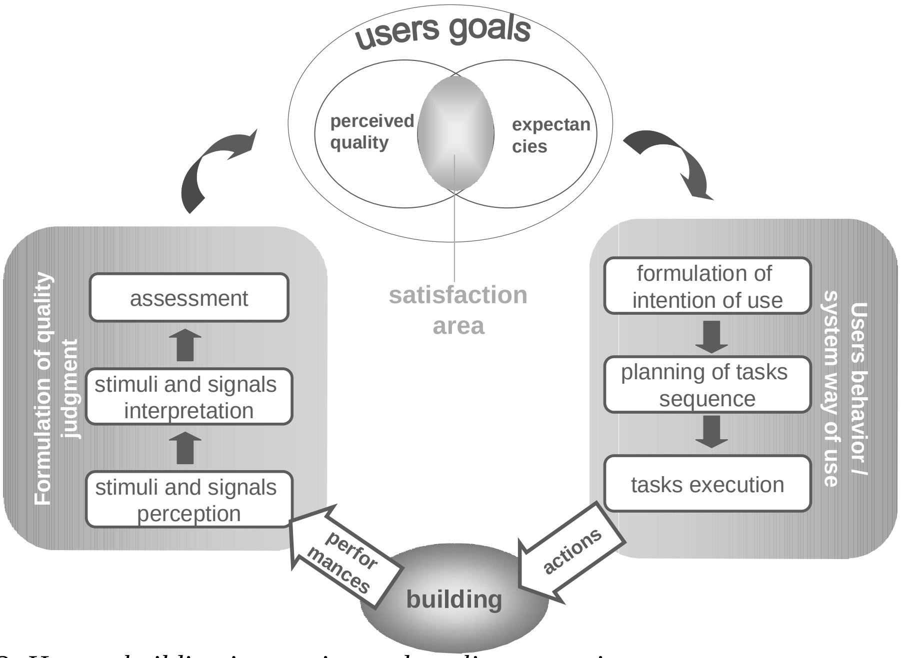

Figure 2: Human-building interaction and quality perception

4. Conclusions

Contribution of ergonomics to each step or function in building process allows to highlight relationships between human, technical and organizational aspects establishing in planning and design of buildings, benefiting and managing of real estate. Therefore, basing the building quality control on quality or qualities actually perceived by users is a strategy to improve building quality in either its aspects: formal and substantial ones. In fact, to the increase of efficiency levels in building process can correspond also a life quality improvement for direct and indirect users. This approach is tangent the TQM one and offers operative tools and theoretical references able to control the relations setting among many variables of building system and, finally, allowing to reach a global quality.

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How Do PCTs Measure Users Experience?

Bashir Abusaid,
Research Institute for the Built & Human environment, University of Salford (email: B.A.A.Abusaid@pgr.salford.ac.uk)
Margaret Nelson,,
Facilities Management Graduate Centre, Faculty of Organisation and Management, Sheffield Hallam University (email: M.Nelson@shu.ac.uk)
Sezgin Kaya,
Centre for Facilities Management, Research Institute for the Built & Human Environment, University of Salford (email: S.Kaya@salford.ac.uk)
Keith Alexander,
Centre for Facilities Management, Research Institute for the Built & Human Environment, University of Salford (email: K.Alexander@salford.ac.uk)

Abstract

The National Health Service (NHS) sector in the UK will be undergoing dramatic changes in the next few years. This is due in part to changing service user requirements and the implementation of the Agenda for Change programme, Department of Health [1]. Many healthcare providers within the NHS have lost track of the true needs of their service users and are trapped in outdated views of what healthcare delivery is all about. This is evidenced in the report by Nigel Crisp (NHS chief executive) in October 2002, published by the Department of Health. This report [2] clearly stated that the NHS needs to refocus its management efforts, engage with patients, staff and the public and build momentum to manage for excellence.

This paper describes a post-graduate research study into service user experience as a key element of service excellence in Primary Care Trusts (PCTs) in the NHS; and the notion of user-based 'healthscape'. The study employed the use of literature review and a case study approach to the collation of data. Analysis was primarily undertaken through content analysis.

The paper presents the results of a thorough examination of the impressions of the users through the entire healthcare experience identified through a survey of healthcare users in the case study trust, and a review of the current measurement techniques in the PCTs, which suggest that the current system is not representative of user experience. It also suggests how to move forward in capturing and measuring user experience in the pursuit of service excellence.

Keywords: Service User Experience; Healthscape; Service Excellence.

1. Introduction

1.2 Aims and Objectives

The aim of this paper is to investigate the construct of user experience as an integral part of service excellence within the NHS healthscape. Its objectives are to recognise and scrutinise the methodologies currently used within PCTs in the NHS to measure user experience in pursuit of service excellence; and recommend more effective ways of measuring user experience.

1.2 Overview

It is not so clearly accepted within the NHS that user experience is a critical indicator reflecting the strength of healthcare delivery. This is evident in the findings of Hwang *et al*, [3] who attributes these deficiencies to the lack of clarity and consistency in understanding the determinants of user approval. While service excellence assessments based on user experience is a useful guide, it is important to continue to strive for improvements which reflect the changing marketplace. Against this backdrop it is important to continue to reassess user experience.

Given the central role that service users can play in the excellence of any organisation in general and in the NHS in particular it is, perhaps, surprising that the current state of knowledge regarding user experience seems somewhat limited. There is no consensus on the definition of user experience or what it constitutes. This ambiguity also extends to its role within the evaluation process of service excellence, conceptualised as driven by the user experience. Users do form impressions about a range of service excellence constructs and these impressions vary across service providers and individual users. What is not clear is the extent to which these impressions are used, if at all, once the service has been experienced in a user's evaluation of service excellence.

2. User Experience

2.1 What is User Experience?

User experience is a journey through which the user senses the core benefits and the pleasurable performance of the service transaction in finding and approaching the service, interacting with other users in the right environment and departing from it, Abusaid & Alexander [4]. This definition implies that in order for users to experience the service, they have to go through a multifaceted cycle. This cycle starts from the moment that the user seeks to approach the service, makes a connection through the telephone/ internet and goes all the way through until the service is actually experienced and the user leaves the 'servicescape'.

According to the Oxford Advanced Learners` Dictionary [5] a user is "*a person or thing that uses something*", whilst experience is "*an event or activity that affects some one in some way: enjoyable, exciting, unusual or unforgettable*". Experiences can be classified into four categories, Pine II and Gilmore [6]:

Entertaining experience - a passive way to engage a customer and attract an audience of shoppers.

Educational experience - where the customer immerses in the event developing before him. This type of experience requires an active participation of the customer in the event to increase his knowledge and skill.

Escapist experience - where the customer is completely immersed and actively involved in shaping the experience.

Aesthetic experience - where the customer is immersed in an environment but has little or no effect on it, leaving it untouched.

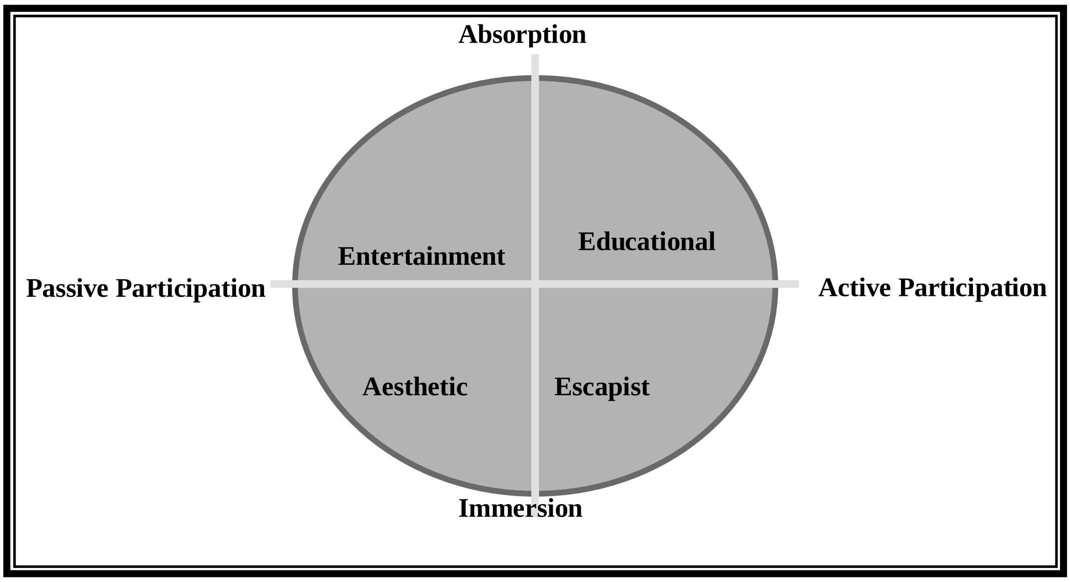

Figure 1: The Experience Realms, Pine II and Gilmore [6]

The escapist experience is the type of experience that should be promoted and encouraged within the NHS, because the user is completely absorbed and actively caught up in influencing the experience.

2.2 How does user experience differ from user satisfaction?

The NHS in the UK has witnessed the introduction of numerous quality initiatives over the past decade; driven by the realisation that patients were not satisfied with the health care delivery, and the necessity for the NHS to restructure in order to better respond to patient demands. The general consensus is that there are too many initiatives following on one after the other. Furthermore, most of these initiatives seem to lack two important features: relationship with each other, and the integration of all aspects of the organisation's activities into focused action on continuous improvement and customer desires, Stahr [7].

User satisfaction within the UK NHS tends to be based on assumptions about users needs from the NHS perspective. Many approaches deployed to measure user satisfaction neglected the impact that the process of healthcare delivery may have on the user satisfaction.

User experience differs from satisfaction in the sense that it allows the user's own interpretations to be discovered. Research to date has been regarded by the researchers as questionable because it does not address issues that directly matter to the service users. Furthermore, the researchers identified that most established methods of measuring user experience are within the secondary healthcare sector, which has a different role to PCTs. In addition, the current measurement system imposes issues that are of concern from an NHS perspective, and not from the user perspective. It was felt that this was an issue of concern for the rigour and reliability of the measurement of user experience in the primary care setting.

2.3 Factors affecting user experience

Rowley [8], [9] applies factors that contribute to the user experience to liberalities and museums. These factors are: speed of service delivery, convenience, age, choice, life style, discounting, value adding, customer service, technology and quality (see table1 for further details).

Table 1: Users impressions of PCT healthscape

Healthcare Provider		Impressions of Service	Impressions of Environment
GP	Single-handed ( )		
	Group practice ( )		
Practice Nurse	Single handed ( )		
	Group practice ( )		
Dentist's Practice	NHS ( )		
	Private ( )		
Chemist's Shop	Incorporated ( )		
	Not incorporated( )		
Opticians	NHS ( )		
	Private ( )		
PCT: physiotherapy, paediatric, district nurse, out of hour, health visitor, minor surgeries, speech & language therapy, contraceptives			

Some of these factors may not necessarily apply to all organisations, although there are some common factors that can be shared. For example, discounting can be more influential in profit driven organisations and less so in non profit making organisations such as the NHS. Furthermore, organisations that rely on handcraft work would be less affected by technology than those that are heavily dependent on technology such as the NHS.

2.4 A typical user experience within NHS PCT

As mentioned earlier**,** user experience is defined as a journey, which implies that the user will go through a sequential process. This process varies depending on the type of healthcare provider and also on circumstances that a user may experience (see figure 2). The user journey according to the figure 2 consists of eight sequential phases. Phase one is initial contact where the user will contact the doctor's surgery either by telephone or the Internet to make an appointment. The second phase involves the way in which the user will get there for the appointment. This involves physical appearance at the surgery either by walking or by any other means of transport. The third phase is entering the surgery. This phase is important because the user starts to engage with both the service and the 'servicescape' at this point.

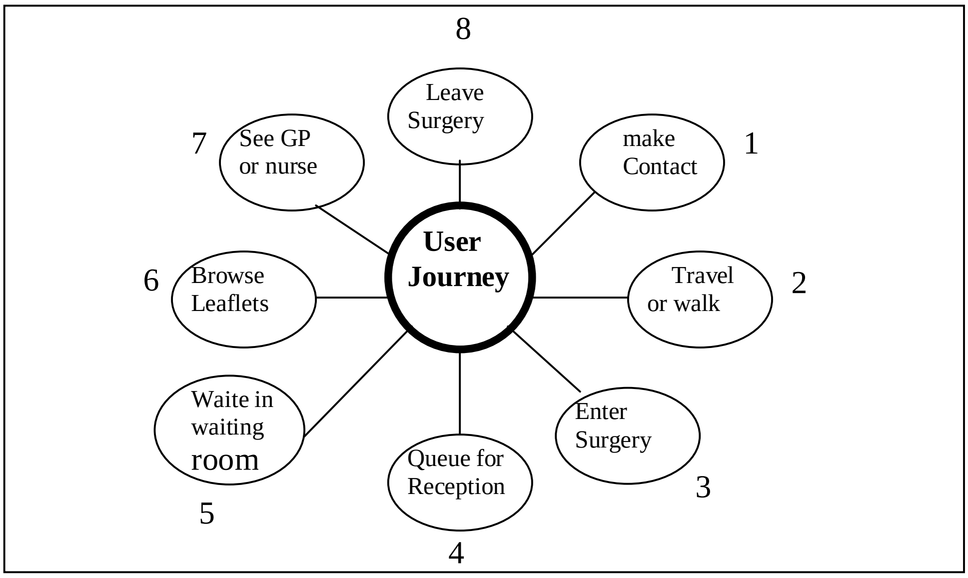

Figure 2: A typical user journey to a doctor's surgery

Having walked into the surgery, the user will interface with the receptionist. This can take the user a while until they are attended to because of the queue. At stage five, the user is asked to take a seat in the waiting room to be seen by either the GP or practice nurse. Once the user secures a seat, they then tend to wander around, usually looking for something to keep them occupied such as browsing through the surgery leaflets or a magazine. The user will then be seen either by the GP or practice nurse and departs the surgery either with a positive experience or otherwise depending not only on the quality of care received but also on the quality of process of accessing and exiting the 'servicescape'.

2.5 How do PCTs measure user experience?

The key role of a PCT within the NHS is the development, administration, provision and delivery of healthcare to the local community, in conjunction with its partners. Improving the health of the community is not simply about providing the best health care services, but also about delivering the right mix of health promotion activities and social care services. This differs from the key role denoted to other trusts such as acute and mental, which is the treatment and curing of illnesses, rather than the initial prevention, Salford PCT [10].

A review of PCT services to make them fit for purpose for staff and patients, rather than systems, has led inevitably to a radical rethink in the way that the PCTs' healthcare services are provided. This new way of thinking about primary healthcare has affected almost every area of the PCTs activities, as health and wellbeing cannot be separated from housing, employment, the environment and a thriving local economy.

An examination of previous work carried out on behalf of the Commission for Health Improvement (CHI) and Patient Environment Action Team (PEAT) has shown that the basis on which patient experience was interpreted cannot be traced back to their roots. From a research perspective, an understanding of the basis is important to ensure the reliability and validity of the outcomes. Many questions currently remain unanswered which impact on the reliability of current measures.

CHI identifies five domains for measuring patient experience [10], namely:

- Access and waiting;
- Safe, high quality, coordinated care;
- Better information, more choice;
- Building relationships;
- Clean, comfortable, friendly place to be.

Their definition of patient experience is based on the following:

- Preliminary discussion with stakeholders in the NHS and Department of Health (DoH) about issues to address in the surveys;
- Review of the existing literature and surveys;
- Focus groups with Acute Trusts' users to identify what matters to them; and
- Drafting, testing and piloting the questionnaire for 2003/2004 carried out with patients who recently experienced Acute Trust services.

Further investigations indicated that the development of the questionnaire used by CHI to assess user experience within PCTs has followed the same developmental process as for other NHS Trusts. This process is regarded by the researchers as highly alarming, because it does not address issues that directly matter to the service users in PCTs.

3. Research Methodology

3.1 Methodology

The purpose of this study was to explore how NHS PCTs service users experience 'healthscape' in pursuit of service excellence. A mixed (phenomenological and positivist) approach was used, allowing the user's own interpretations to be discovered. Further, this study sought to explore key impressions of service user experience as an integral part of service excellence in NHS PCTs, initially through a pilot study, and subsequently through a questionnaire-based study. Hence the mixed approach involving a combination of both qualitative and quantitative methods has been used for this research. Qualitative and quantitative methods can be seen as complementary, with different emphases in different disciplines, but sharing a heritage of logical thought and empiricism, Preece [11].

Case studies have been employed as a part of the research strategy embedded in a positivist and phenomenological framework, Yin [12], which does not show a concrete use of single or multiple case studies, but rather the whole research process as the case. By using multiple approaches, the researchers were able to triangulate the data gathered in order to generate better judgement on their interpretation. Yin *et al*, [13] supports this view stating that the case studies that adopt such methods are rated more highly than those that rely only on a single source of data. In addition, the case study approach as Yin [12)] suggests, is the preferred strategy when 'what', 'how' or 'why' questions are being posed, and when the focus is on a contemporary phenomenon within a real life context.

Five methods of enquiry are employed for data collection, and as a means of examining customer (service user) experience and views in pursuit of service excellence within the case study organisation. These are: literature survey, pilot study, focus groups, questionnaire and workshop.

3.2 Literature survey

The literature survey was based on text books, historical research and refereed journals on a number of relevant topics including performance management, service quality, customer satisfaction and service excellence. Literature review of existing and publicly available reports and documents regarding current user satisfaction measurement was also undertaken. This represented the first phase of the research and` set the background for future work.

3.3 Pilot study

Pilot studies refer to either a mini-version of a full-scale study, or a specific pre-testing of a research tool or method, van Teijlingen and Hundley [14]. The aim of this pilot was to identify service user experience. The study required an exploratory case study to be undertaken.

Preliminary data was acquired through face-to-face semi-structured interviews with eighty residents in the catchment area of Salford. This provided an opportunity to explore and gain insights into, and clarification of how impressions of 'healthscape' experiences were formed.

The semi-structured interviews consisted of two parts. The first part compiled general information such as local gender, age, employment, home ownership, ethnic background, disabilities and the use of PCT facilities (doctors' surgeries, dentists, chemists opticians, other) in the last six months.

The second part addressed the users' overall impressions of PCT 'healthscapes' in Salford. It addressed issues related to both their impressions of the service as well as of the environment in which services are delivered (see table 2).

Table2: Key impressions of service user experience

Issue	Service	Frequency	Environment	Frequency
Politeness of receptionist	√	78/80		
Waiting Time	√	77/80		
Friendliness of receptionist	√	67/80		
Understanding of receptionist	√	65/80		
Helpfulness of receptionist	√	62/80		
Quality of care	√	57/80		
Comfortable Waiting area			√	49/80
Appropriate furniture			√	41/80
Children play area			√	37/80
Quantity of care	√	35/80		
Choice	√	34/80		
Cleanliness			√	36/80
Up to date magazines and news papers			√	33/80
Car parking			√	29/80
Lighting			√	27/80
Communication			√	20/80
Colour			√	25/80
Security			√	18/80
Disabled facilities			√	10/80
Access			√	07/80
Signage			√	03/80

3.4 Focus groups

The next phase of the research would be based on a number of focus group sessions facilitated with users of Salford PCT 'healthscape'. This is deemed to be crucial for the rigor and reliability of the measuring instrument. According to Miles and Huberman, [15] the best way to improve credibility and acceptance is through the improvement and the rigor of techniques for data collation and analysis.

3.5 Questionnaire

The fourth phase involves the use of postal questionnaires to measure customer (service user) experience in Salford PCT, based on issues identified in the interviews and focus groups. Postal surveys are a powerful, effective, and efficient alternative to the telephone survey and personal interview. The postal survey was deemed appropriate as it enables easy access to population samples. Respondents are more likely to provide honest answers than they do to other interviewing methods, ASA Series [16]. Writers perceive that the biggest disadvantage to postal surveys is a low response rate, ASA Series [16], which is not necessarily true. Good planning can lead to response rates as high as those obtained in telephone or face-to-face distribution techniques, ASA Series [16].

3.6 Workshop

The final phase of the research would involve the validation of the findings through a workshop with a panel of experts and participating PCTs. A major benefit to be derived from this will be to gain an understanding of what has already been done, what needs to be done, and where potential opportunities and/or barriers may lie. It would also assist with the verification of data, and help generate a rich picture of FM service excellence practices and the impact that they may have on the user experience in NHS PCTs.

4. Case study

4.1 Case Study Organisation

Salford is the fourth most deprived local authority area in the North West of England, and 28th nationally. The city has considerable health inequalities as a consequence of lower educational attainment and unemployment, access to services and huge differences in lifestyle.

Salford PCT serves a population of around 234,000 people who are cared for via 61 GP and 41 dentist practices. Children born and raised in families of lower socio-economic groups are more likely to experience declining health later in life, and Salford residents have a life expectancy almost three years below the national average for men and almost two years below for women.

The PCT is a key participant in Britain's biggest ever project to improve frontline health and social care facilities and services and has been driving forward radical plans for new health and social care centres, funded via the Manchester Salford and Trafford Local Improvement Finance Trust (LIFT).

4.2 Research Findings

The interview schedule took place between June until September 2004. The lead researcher visited each venue, and the duration of the interviews varied depending on the number of users at the different venues. In order to ensure complete and accurate records of interviews, hand written answers were taken. Each user was asked for the details of their impressions formed about the healthcare delivery and the environment in which it took place. Several key issues were identified, and the users were asked for more details wherever necessary. After the interview schedule, all the notes were transcribed to analyse the interview findings. These were compiled in table 2, and highlight the fact that user impressions reveal important facts as to whether the PCT is responding to the needs and desires of the healthcare service users, and helping to facilitate the provision of 'healthscape'.

However, as with any investigative process, there are always potential difficulties to be encountered somewhere along the line. Therefore an evaluation was made by the lead researcher to identify any difficult elements to the study that could hamper the progress and successful outcome of the research. It was found that some of the service related elements detailed above may be difficult to determine because of the subjectiveness of some of the measurement criteria. For example, in determining how polite and friendly the receptionist is, it may be difficult to analyse real-life scenarios and quantify how much politeness and friendliness have been dedicated by the receptionist.

The next step in this research was therefore to identify and prioritise the demands of the service users of healthcare delivery within Salford PCT through a questionnaire, based on the outcomes of the pilot study. From this basic mapping (table 2), and the data set that underpin it, it was possible to prioritise and show the service delivery related impressions in terms of importance.

As table 2 demonstrates, out of eighty service users interviewed, politeness of receptionist was the most highly cited occurring seventy eight times. Waiting time came second with seventy seven citations, friendliness of receptionist scored sixty seven citations, and so on. Quality of care came sixth with fifty seven citations, and choice came eight with thirty four citations. This highlights that an improvement in the politeness of receptionist, will greatly improve the perception of healthcare services in the PCT.

On the other hand, an analysis of key environment-related impressions (table 2) shows that a comfortable waiting area was most important with forty nine citations. This along with appropriate furniture (forty one), children's play area (thirty seven) and cleanliness (thirty six) were more important to healthcare service users than choice (thirty four).

5. Conclusion

Although changes in healthcare performance measurement in the NHS are currently in the process of being implemented, the earlier findings of this study still apply in terms of the relevance and reliability of previous measurement tools in use for measuring PCT performance. Previous measurement criteria did not truly reflect user needs and requirements to ensure the measurement of user experience or service excellence.

The mixed approach adopted by this study has enabled the in-depth exploration of user experience in the Salford PCT using a variety of research tools. These highlighted the fact that users found the highly subjective areas of politeness, friendliness and comfort very important. These have never been previously measured in determining user experience.

From a Facilities Management (FM) point of view, the emergence of FM related issues from seventh position down on the grid (table 2), with the exception of choice, may be taken in two ways. The first is that they are not as important to users of PCT services as the people and quality and of care issues. However if we consider the fact they represent thirteen out of the top twenty-one citations for user experience, we begin to see the importance and contribution of the FM function to user experience in this sector.

Another emerging concept is that of the healthscape, i.e. viewing the delivery of healthcare services in the user's perception of enjoyment of consumption. This forms the basis of future work to be undertaken in this research. It also represents for Salford PCT, the first step from delivering a quality service towards service excellence.

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Usability of Hospital Buildings - Is Patient Focus Leading to Usability in Hospital Buildings?

Monica Jensø,
NTNU, Faculty of Architecture and Fine Art, Department of Architectural design and Management, Alfred Getz v 3, N-7465 Trondheim, Norway. (e-mail: Monica.jenso@sintef.no)
Tore Haugen,
NTNU, Faculty of Architecture and Fine Art, Department of Architectural design and Management, Alfred Getz v 3, N-7465 Trondheim, Norway. (e-mail: tore.haugen@ntnu.no)

Abstract

Global Engineering and Manufacturing in Enterprise Networks, GLOBEMEN, is a three-year (January 2000- January 2003) research project with an estimated effort of 1000 person-months. It is part of the global Intelligent Manufacturing Systems (IMS) program and the project consortium has 19 participant organisations dispersed across different IMS regions ....

Experience from several hospitals indicates challenges according to usability of hospital buildings, associated with the rapid and continuous changes in the hospital organization and use of technology. Experience also shows that the hospitals are having difficulties in adapting existing buildings due to new requirements and user needs. The quality of hospital buildings depends on the buildings ability to absorb organizational, operational and technical changes.

Usability is defined as the *"….effectiveness, efficiency and satisfaction with which a specified set of users can achieve a specified set of tasks in a particular environment"* (ISO 9241-11, 1998). According to this definition, a product's usability is determined by 3 key factors:
Effectiveness – whether users can achieve what they want to do with the product.
Efficiency – how long it takes them to achieve it
Satisfaction – their feelings and attitude towards the product

Hospital buildings are characterized by major complexity, and hospital operation are affected by rapid changes and trends. Planning and design of hospital buildings reflect a view of society, humanity and patients at all levels, from the location, overall concept and urban plan, down to the architecture and design in the immediate surroundings of the patients and staff. In recent years there has been a changing trend in cultural and ideological aspects due to hospital operation, and an increased focus at the patient, patient's rights and participation in the treatment situation.

Will this ideological change affect usability of hospital buildings? This paper is discussing some of those challenges arising according to the relationship between usability of buildings and a patient focused hospital, and is discussing whether patient focus is leading to usability of the

hospital buildings. These issues are discussed in relation to planning and design of the St. Olav's Hospital in Trondheim.

Keywords: Building performance, hospital, patient focus, usability.

1. Challenges in hospital buildings regarding technical and functional aspects

Hospital buildings are characterized by major complexity, and hospital operation are affected by rapid changes and trends. In accordance to Jonassen et al. [1] the supply of health and care are continually changing world over, and the speed of change is ever accelerating. In the last decades the hospital sector has been influenced by a tremendous development within ICT and medical technology. This has led to more focus on adaptability of existing buildings.

Planning and design of hospital buildings are on all levels reflecting a perspective on the society, human beings and the patients, from localization, concept and town planning, down to architecture in patients and hospital employees close surroundings. A brief summary of hospital organization and design in the different eras is given below, based on how changes in this perspective have affected organization and physical surroundings within the hospital.

In recent years there has been a changing trend in cultural and ideological aspects due to hospital operation, and an increased focus at the patient, patient's rights and participation in the treatment situation. This paper is focusing how ideological changes due to patient focus is affecting usability of hospital buildings. Will a stronger patient focus in the planning, design and daily hospital operation lead to greater usability of buildings? We will discuss some challenges in handling the relationship between usability of the buildings as physical surroundings, and whether a stronger patient focus is leading to usability of the hospital building. In the paper we will use the case St. Olav's Hospital in Trondheim, and the planning and design of this project. St. Olav's Hospital is a large ongoing redevelopment project of the old regional hospital in Trondheim, and the project has a pronounced objective of a high degree of patient focus in the hospital development.

Our studies are based on literature studies, the theoretical framework developed by CIB TG51 "Usability of buildings" [2], and studies of project documents and interviews from the St. Olav's Hospital project. This is a preliminary study, where we develop the research questions for a following PhD-study.

1.1 A brief historical summary

In the 18th century a demographic growth in the population, wars and epidemics resulted in establishing institutions with a diffuse distinction between treatment, detention and penalty.

Gradually the treatment aspect appears more and more clearly, foundation of medical science gains greater scientific understanding, and hospitals arise as separate institutions [3].

The physical surroundings in hospitals were a large problem in the public health service in the 19th century. Florence Nightingale wrote in her “Notes on Hospitals” (1859) that the death rate at the largest hospitals in town was considerably exceeding that of patients suffering from the same diseases, treated other places. In her “Introductory Notes on Laying-in-Institutions” (1871), she pointed at several cases of illness caused by physical surroundings, and referred to design, light, air and ventilation as important elements in hospital buildings [4].

The development within the hospital sector in recent decades has gone from the pavilion hospital, via the block hospital, to the “neighbourhood hospital”, representing the hospital model of today. This has happened based on the development in medical technology, and the changes in main nursing philosophy have been the driving forces behind this development.

The pavilion hospital emerged as a consequence of the problems at the 19th century, and was focusing daylight, air, ventilation to offer satisfying hygiene for the patients. The hospital buildings were divided into separate pavilions, which were gradually connected with glass corridors, to simplify the work for the employees and transportation of the patients.

The major hospital development in Norway has taken place periodically, being at its maximum in the 1950ies and the 1970ies [5]. There was a large expansion in the health sector in the 1950ies, and the planners adopted organizational models from the industry aiming to increase the efficiency and productivity in the hospital sector. The nursing philosophy was based upon specialization, hierarchy, centralization and top management, and this hindered communication between the patients and the employees. Satisfying the patients’ physical needs was in focus, and little attention was shown the psychological, social and spiritual needs of the patients. The block hospital was developed as a response to the quantitative objectives related to efficiency and requirements due to the technological development at that time. This was also the dominating trend internationally, among others in Germany, where “medicine in focus” was the leading ideology. In the 1960ies and 70ies the functionalism was the predominant style in the hospital architecture. Hospitals were designed and built as “nursing factories” in high-rise blocks, focusing quantity and centralization of the hospital activity. Esthetical quality was not given priority.

In the 1970ies a critical debate related to the hospitals as “nursing factories” arose, and the basic attitude towards hospital planning started to change. Bad working conditions and mechanical treatment of the patients was focused in the media, and the centralization and the de-humanifying due to the physical surroundings in the hospital was strongly criticized. This lead to a search for new operational models in the hospital, and a development towards hospital projects of smaller scale, decentralization, and a higher degree of intimacy and tighter contact between the employees and the patients [6].

1.2 Patient focused hospital

As mentioned above, in recent years there has been a changing trend in cultural and ideological aspects due to hospital operation, and increased focus at the patient, patient's rights and participation in the treatment situation [7]. Hospitals have moved from being focusing efficient treatment to a higher degree of patient focus. The patient is no longer regarded merely as a "product" being in hospital to get "fixed", and respect of the patient is in a higher degree ensured in the hospitals of today. Besides scarce economical frames has been leading to further focusing efficient examination and treatment, a high exploitation of the resources and productivity, and this is changing the way the hospital is being operated.

An option of freely choosing hospital for treatment, competition from private actors within the hospital sector, together with the threat of outsourcing of services, affects the requirements of change within the public hospital sector. On this basis, the hospitals planned and built today give the expression of being founded on another fundamental attitude towards health and care than the traditional, by putting the patient in focus.

The organization and design of several projects is based on the Planetree philosophy, which is a philosophy especially focusing the patient and seeks to improve the medical treatment seen from the patient's point of view [8]. The fundamental values of the Planetree philosophy is trust, intimacy, dignity, security and confidence, holistic care and treatment, information, participation in decision-making, health promoting physical surroundings, and network support. The philosophy emphasizes to personalize and humanize the hospital treatment, and make it less unfamiliar both for patients and relatives. The Planetree philosophy is besides representing a value based and holistic patient perspective.

1.3 Usability of hospital buildings

Experience indicates challenges according to usability of hospital buildings, associated with the rapid and continuous changes in the hospital organization and use of technology. Experience also shows that the hospitals are having difficulties in adapting existing buildings due to new requirements and user needs.

The quality of hospital buildings depends on the buildings ability to absorb organizational, operational and technical changes. To meet these changes it is necessary to design buildings with an appropriate physical and organizational adaptability over a time period. Hospital projects are characterized by an extensive planning and construction period, often lasting 10 – 15 years. During this period the project assumptions and the user organizations needs are changed, due to rapid development in technology, organizational changes and treatment methods. Not seldom we experience a mismatch between the user organization and the building at the completion time, resulting in continual building changes.

2. Operationalizing the concepts

Both the terms usability and patient focus are hard to make operational, and are according to this often difficult to measure and evaluate in a completed hospital building.

2.1 Usability of buildings –theoretical framework

Until lately it is written and done little research on usability in buildings. Several research projects are done due to aspects concerning this concept, but few are studying the connection and dependence between the aspects. The term is vague and little tangible. The concept of "usability" is widely known in relation to applications within product design, information technology and web-design, related to user friendliness and user interface of the system.

A CIB Task Group 51 "Usability of buildings" has been created to apply concepts of usability, to provide a better understanding of the user experience of buildings and workplaces. Usability is here defined as the *"….effectiveness, efficiency and satisfaction with which a specified set of users can achieve a specified set of tasks in a particular environment"* [9]. According to this definition, a product's usability is determined by 3 key factors:

Effectiveness – whether users can achieve what they want to do with the product
Efficiency – how long it takes them to achieve it
Satisfaction – their feelings and attitude towards the product

Usability means that systems are easy and fast to learn, efficient to use, easy to remember, allow rapid recovery from errors and offer a high degree of user satisfaction. It also means bringing the user perspective into focus. The term usability describes whether or not a product is fit for a specific purpose [10]. Usability, or functionality in use, is concerning the buildings ability of supporting the user organizations economical and professional objectives.

The concept of usability of buildings can be approached in four ways [11];

1. Criterions and parameters affecting usability
2. Usability from different stakeholder's point of view
3. The time perspective
4. Workplace and context

According to the patient in focus it is especially interesting to discuss the second approach, usability from different stakeholder's point of view.

2.2 The patient in focus

The organization and design of several projects is based on the Planetree philosophy. The last project in this development is new St. Olav's Hospital in Trondheim, a project designed in accordance with the hospital ideals of today. According to Dilani [12] no hospitals has so far been implementing the Planetree philosophy as extensive as this project. The architectural competition for the project, accomplished in 1995, was based on treatment, nursing and care to be done with the patient in focus. The term “patient in focus” is defined as a holistic view of the patient and a production oriented view on the organizational structure in the hospital. The solution for St. Olav’s Hospital is a decentralized hospital with smaller, partly autonomous units in separate buildings; integrated centres in independent blocks. The fundamental idea is that the patients needs and wishes is the basis for all planning. Emphasis is made on dignity and participation of the individual patient. Through a patient focused treatment the patient is to experience continuity and connection during the treatment.

The staff is brought together around the patient, as opposed to earlier, when the patients were transported from department to department to receive the necessary treatment. The patient needs to deal with less people, giving a more humane atmosphere. Every building unit is of a smaller scale than a traditional centralized hospital complex.

2.3 Case: St. Olav’s Hospital

St. Olav’s Hospital is based upon a transformation of the existing buildings at the original site. 80% of the existing buildings are being demolished, and the remaining is rebuilt. The project contains 197 500 sqm new buildings. Rehabilitation and new building is done step by step over a period at 11 years.

The main objective of the project is to create an efficient and professional hospital. The development plan for the project [13] states “the patient in focus” as a main objective, and is also describing seven other objectives for the completed hospital [14], among them flexibility, which can be related to usability. The hospital is based upon a decentralized centre model, where each centre is representing self sufficient units. Necessary changes are assumed to be solved within the centre, giving few effects and consequences for the rest of the hospital.

Several concepts are affecting usability and patient focus in the hospital project [15];

- Area flexibility (possible extension and addition of buildings)
- Generality (standard design solutions)
- General centre (basic principles for building structure, communication, organizing, functional division, volumes, exterior facades, use of materials)
- Structural flexibility (focusing possible rebuilding and functional changes)
- Technical flexibility (possible changes in capacity)

In this context it is especially interesting to describe and discuss the topics *generality* and *general centre*, due to patient focused hospitals.

2.3.1 Ideas for developing patient focused design solutions, with the bed cluster as an example

The bed cluster (“sengetun” in Norwegian) is a physical and organizational model representing one way to organize patients’ rooms in the wards. According to the principal architect in The St.

Olav's Hospital Development Project, part of the challenge in planning and design of the new hospital is to transform an existing physical and organizational structure into a modern hospital according to the objectives for efficient operation and patient focused care.

The holistic model "Human and material resources" (figure 1), is developed to discuss, together with other aspects, generality in physical solutions. According to this model, hospitals can be divided into two sectors which have different sets of resources. One sector is based on human resources, and the other sector is based on material resources (buildings and equipment). Achieving value in hospital planning and operation can similarly be described in two ways. One sector describes quantifiable objectives, such as the number of health services delivered, while the other sector is based on values associated with the human experience of quality, including user satisfaction.

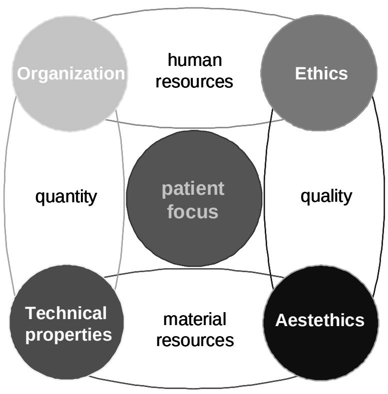


Figure 1: The holistic model "Human and material resources" [16].

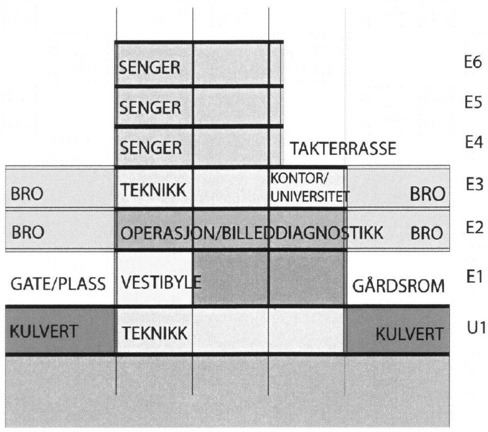
The hospital organization can be placed in the intersection between the human resources and the quantitative resources. In St. Olav's Hospital one of the goals are to build up an organization for best possible use of the combined resources of human capacity and competence in the hospital. In the intersection between the human resources and the qualitative values, we find ethics, where visions about attitudes and the human perspective must be defined. This is, among other philosophies, put into system by the Planetree organization. In the intersection between the quantitative and the material, we find the technical properties, defined as functionality and technical quality of buildings and equipment. In the intersection between the qualitative and the material resources aesthetics are created.

This holistic model describes various aspects of the hospital organism, and shows how various aspects affect each other in a development process. According to the principal architect, the development process will include all the aspects, whether they are taken into account or not. Objectives and visions for developing the hospital organism are placed in the centre of the model, so that all the secondary aspects are directed at a common focus. In St. Olav's Hospital, the vision has been defined as operational efficiency (production focus) and patient focus (customer orientation). This involves awareness of both quantitative and qualitative values, and the whole model is activated.

The bed cluster design provides, according to the principal architect, an opportunity to develop a more practical, social and building-related environment for patients and staff. The patients' rooms are grouped around stores for supplies and workstations for the staff which care for the patients. At St. Olav's Hospital there are 6 – 8 patient rooms per bed cluster, and the clusters are placed in series with common supporting rooms in between.

2.3.2 General centre

The concept "general centre" is developed as a part of the hospital project. The target of this has been to develop a model to take care of common qualities and solutions in the project, general for all centres, corresponding with the superior objectives. "General centre" includes basic principles for building structure, communication, organizing, functional division, volumes, exterior facades, use of materials and so on, to assure superior structure, character and totality. The concept introduces guidelines for physical design, and is meant to be a "prototype" for the development and design of each centre. This is considered to be an important feature in gaining flexibility (figure 2).



3rd - 5th floor;	*wards*
2nd floor;	*mezzanine level for technical services over medical functions requiring technology*
1st floor;	*connecting bridge, theatre, radiology, recovery*
ground floor;	*policlinics, day areas, cafeteria, kitchen for the centre, auditoria, rented areas*
Basement;	*underground passages between centres, technical functions, bed equipment stores, locker rooms and cleaning unit.*

Figure 2: General centre [17].

The concept of general centre comprises the following principles;

- identical localization of functions on the floor plans (figure 2)
- functions belonging to one centre can easily be expanded into the adjacent centre
- logistics due to transverse function is improved
- concentration of activity at inconvenient time
- a continuous surgery area at the 1st floor
- a continuous university area at the 2nd floor

3. THE BUILDING VERSUS THE EFFECT OF THE BUILDING

The relationship between usability of a building and a user focus is discussed in a case study draft report [18], carried out as the Swedish part of the CIB TG51's work in 2003. In the report, which is a work in progress, it is expressed that *"We can define functionality as a property given to an artefact in order to create a practical effect. An important effect can be described as usability. (…) We all know that functionality alone does not make a certain artefact usable. The technical and physical properties of the artefact and its theoretical potential to deliver a certain effect do not automatically make it usable in the real world."*

The same aspect is discussed by Granath [19]. According to Granath the Swedish society traditionally are based upon production of goods. The rationalist way of thinking is the dominating, and it is focusing at what theoretically should happen if the product is produced in a specific way, rather than focusing the result of what is done. There is however also another knowledge, even if it often is secondary. In state of being a user, we confirm how the products are working for us, whether we like them or not, in what way they are affecting our lives, and whether we think they are beautiful or ugly and so on.

Granath says that in the first perspective we are talking about buildings and products (the artifact in figure 3), in the other perspective people doing things (the effect of the artifact). We are measuring and evaluating the shape, quality and quantity of the product, but should rather be talking about how the product is meeting the users needs and requirements. We are focusing functionality believing this will lead to what really is crucial, being usability. We believe that the problems are solved when we succeed to develop tools for solving them, and think that the effect always is the desired. In figure 3 these two perspectives are visualized;

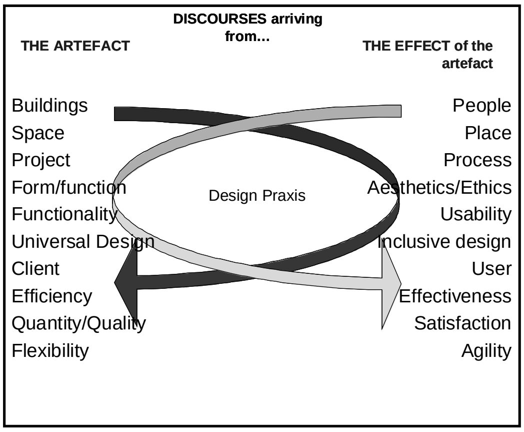


Figure 3: The artifact versus the effect of the artifact. [19]

The traditional way of thinking is visualized by the dark arrow in the figure, where the range of ideas is based on the product, and where the conclusion is a technical solution to a humanistic problem. The new and needed way of thinking is that there always is, in both new buildings and in a buildings phase of use, a need for developing knowledge starting on the right side of the figure, based on the core organization, and further to use tools and techniques on the left side of the figure to develop relevant solutions judged based on the thinking of the right side in the figure. This new way of thinking is represented by the light gray arrow in the figure. To achieve this, a change of attitude is crucial.

The model in figure 3 gives a good picture of the traditional versus the new way of planning and operating a hospital. Traditionally it has been usual to develop hospital projects in line with the red arrow, and focusing “the nursing factory” and “the medicine in focus”. St. Olav’s hospital is based upon a fundamental reorganization of the hospital activity. As we see in section 2, the planning and development of this project is based on the right side of figure 3, in a higher degree than most of the other hospital projects the latest years, by emphasizing the patient focus in the degree that is done. This can however cause some challenges related to the traditional way of building a hospital and organizing the hospital activity [20].

3.2 Possible challenges that might arise

3.2.1 Different actors – different perspectives on usability of the buildings

There are several approaches to the concept of usability. In the paper *“Usability of buildings. Theoretical framework for understanding and exploring usability of buildings” [21] four approaches to the concept are described. The second approach describes how different stakeholders and organizational levels have different perspectives considering usability of buildings; “The terms usability, effectiveness, efficiency and satisfaction is interpreted and understood in different ways. Productivity and effectiveness are generally emphasized as a strategic management issue, while individual workers are engaged with user satisfaction and practical aspects in their daily working situation.”*

In a hospital project “the users” consist of several actors, both hospital employees, patients, primary health service and so on. It is impossible to involve all these actors directly in the planning of the project in a high degree, and the user involvement in the project is due to this often based mainly on participation from the hospital employees.

The planning process in St. Olav’s Hospital is accomplished with extensive user participation, consisting of mainly hospital employees. As mentioned earlier patient focus is emphasized as crucial in the new project, and the challenge is therefore whether the hospital employees and the architects designing the project have the necessary knowledge and ability to take the patients’ perspective in the process of planning a patient focused hospital. Do the actors represented in the planning phase manage to represent other actors’ perspectives in a good way, so that the new hospital buildings are usable for the patients? Interviews done in 1999 indicates that several actors are sceptical to whether this is sufficient to gain a patient focus, because of the medical employees being mostly engaged in focusing their own medical discipline and specialization; *“The hospital employees think they are patient focused, but they are too close to the patient to see that they are not really patient focused.”* [22].

The Örebro case study, accomplished as the Swedish part of the CIB Task Group 51 work, still points at the value of user participation in the process, and concludes that *"From this case we might conclude that participation has a large value for performance and satisfaction in the near future after the move in."* The results of the case study confirm the importance in longer terms of user participation in these kinds of building projects; *"Örebro County has a long tradition of involving the users in the design of places for work. It is a natural part of the culture and is not regarded as an event. It is interesting to discuss how this culture of participation has an impact on trust between employees and employer and how that in turn makes it possible to impose even more drastic changes like the change of technology in the radiology department."*

3.2.2 Involvement of the users in the planning – leading to usable buildings?

We have seen that rather extensive user participation is used as a mean to implement the concept of patient focus in the new St. Olav's Hospital. Some actors are questioning the user participation in the project, and whether this is contributing to tailor made buildings rather than flexibility and usability in a long time perspective. In an evaluation of the project done in 2003 [23], it is concluded that the experience so far is that the users not are sufficiently farsighted. They are mainly concerned about their situation and activities ongoing today, and relate their own transferring of information to this, instead of being visionary and future oriented. The result is often too much focus at reaching solutions, at the sacrifice of focusing functional claims. An important challenge is therefore to balance the individual users need for tailor made solutions with a more superior need for long-term future solutions.

Via the evaluation project some actors also express that the concept "general centre" has had too little validity in the first phase of the building project. It has been too easy to do changes and exceptions from this standard, and this has resulted in different solutions in different centres. This might be an indication on that the guidance developed due to generality and general centre have been influencing the design of each individual centre in a less degree than desired

3.2.3 Is the patient focus affecting the traditional hierarchy in hospitals?

The interviews unveil a disagreement related to fully base the new hospital project on a patient focused ideology, due to the organizational changes needed to be done. Professional arguments are used against this ideology, and it seems like a number of hospital employees, especially within the medical profession, experience the increased patient involvement and openness in the hospital organization as a threat against their own professional integrity and expertise. It is expressed that a hospital organization according to patient focused thinking will cause a fragmentation of specialist environments and offer jobs being less professionally attractive.

Accentuating patient focus as something new and revolutionary is comprehended as provocative by the medical profession; *"The patient focus is not something new. We have done this all the time!". "It is a provocation to the doctors to say that they so far not have been doing patient focused work."*

The patient focused thinking is assuming increased communication and cooperation between the different professional disciplines than earlier. This will be crucial to develop common knowledge beneficial to the patient. The hospital is traditionally based on disciplinary development of knowledge, because it is this that gives professional status. Some actors within the medical profession are afraid this transdisciplinarity will fragment existing specialist environments, and establish interdisciplinary areas in competition to the existing specialist environments.

Implementing a patient focused thinking and the Planetree philosophy in the hospital assumes development of a socially robust knowledge within the organization. Patients and relatives must perceive the knowledge developed in the hospital as credible and functional, and an assumption for this is increased openness, access, participation and involvement than the traditional.

A change in the hospital organization considering patient participation and involvement in the treatment situation promises that it is necessary with a general change in attitude in the hospital organization, according to the traditional view of the patient as an object or a "product". These kind of changes seems to feel like a threat for the traditional hospital organization, since the existing organization is needed to be questioned critically.

4. CONCLUSIONS

In this paper we discuss some of the challenges for planning, design and operation of patient focused hospitals. Usability forms the basis for this discussion. We are using a theoretical framework for exploring usability presently under development by CIB Task Group 51 and the Planetree philosophy regarding patient focused hospitals. The theoretical discussion is related to the new university hospital project in Trondheim, where the project organization has an expressive goal of achieving both a greater efficiency and a more patient focused hospital.

Usability is defined as the "*….effectiveness, efficiency and satisfaction with which a specified set of users can achieve a specified set of tasks in a particular environment*" (ISO 9241-11, 1998). According to this definition, a product's usability is determined by 3 key factors:

Effectiveness – whether users can achieve what they want to do with the product
Efficiency – how long it takes them to achieve it
Satisfaction – their feelings and attitude towards the product

In this paper we have discussed some aspects considering how these 3 key factors are connected to a patient focused ideology. The dominating discussion is related to user satisfaction, as an important element of gaining usability of a building. Evaluations show an immediate relationship between a stronger patient focus and satisfied patients. Implementing a patient focused ideology might however cause some challenges related to usability of the building, and thus both the hospital building and organization;

- Different actors have different perspectives on usability of buildings. The planning process in hospital projects is often accomplished with extensive user participation, but this is consisting of mainly hospital employees. The question is due to this whether the hospital employees and the architects have the necessary knowledge and ability to take the patients' perspective in the process of planning a patient focused hospital.
- Will involvement of the users in the planning lead to usable buildings? We have seen that rather extensive user participation is used as a mean to implement the concept of patient focus in the new St. Olav's Hospital. Some actors are questioning the user participation in the project, and whether this is contributing to tailor made buildings rather than flexibility and usability in a long time perspective.
- Another question that is important to emphasize is the relationship between efficiency and a patient focused ideology, and whether these are incompatible. Parts of the medical profession fears that founding the new St. Olav's Hospital on a patient focused ideology will result in a fragmenting of specialist environments, and that this will cause a decrease in efficiency.

These questions and topics will be taken further as part of a PhD-study at the university. This PhD-study will be focusing usability of buildings related to a stronger patient focus, and will be discussing the relationship between efficiency at the one side, and a patient focused ideology on the other side.

5. ACKNOWLEDGEMENTS

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Exploring tenants' perceptions of their homes in the UK social housing sector

Ritsuko Ozaki
Tanaka Business School, Imperial College London, UK
(e-mail: r.ozaki@imperial.ac.uk)

Abstract

In recent years, many researchers in marketing have stressed the importance of the need for satisfying customers. They believe that a better understanding of customer requirements leads to successful business. In 1998, the Egan report identified key drivers which needed to be addressed if the UK construction industry was to benefit from the radical change experienced in other industries. The UK housebuilding industry has long had difficulties in satisfying its customers and has now been put under pressure to make strenuous efforts to modernise itself. Egan specifically considered social housing as an area where significant improvements could be achieved. In reviewing the sector, the potential to lead change in housing via the social housebuilding programme was highlighted. As part of this initiative, a set of 12 key performance indicators were identified, and one of them was customer satisfaction.

In this context, a four-year research project began in 2001. The project includes 12 registered social landlords, which have formed a consortium, and one of the objectives is to achieve higher customer satisfaction through using a new procurement system. In order to investigate the satisfaction level of those who lived in the consortium's schemes a post-occupancy questionnaire survey was designed. Five themes for the customer satisfaction KPI were identified prior to the project: space and facilities, ventilation, sound insulation, ease of use, and after-care. These themes form the main part of the questionnaire. The questionnaire also contains questions as to general satisfaction and satisfaction with service provision/decision-making participation.

This paper first presents the survey results. The survey was conducted in two stages in 2003 and 2004, with 3 RSLs and with a total of 8 schemes that reached the end of the 12-month Defect Liability Period. Ninety-five questionnaires were sent out and 34 were returned (the 35.8 per cent response rate). The findings will be fed back to the consortium to improve the products and performances. Then, the present paper discusses organisational problems in terms of the management of the survey. There has been difficulty in conducting the survey across the housing associations. In order to understand the nature of the problems, informal discussions were carried out with relevant officers in these housing associations. It has become clear that there has been a lack of understanding between the consortium and the member housing associations. An analysis of organisational problems will help the consortium to act more efficiently.

Keywords: Post-occupancy evaluation, tenant satisfaction, housing quality, communication

1. Introduction – background

In recent years, many researchers in marketing have stressed the importance of the need for satisfying customers. They believe that a better and deeper understanding of customer requirements leads to successful business. This is because it is more profitable to keep the same customers than to do one-time sales with different customers. Customer satisfaction leads to a higher customer intention of returning to the same provider and of making positive referrals; and such customer loyalty and referral lead to an increase in company profits. Customer retention, therefore, ensures a steady stream of future cash flow. Conversely, dissatisfied customer may switch providers and be a source of negative advertisement. In this regard, an analysis of 'defectors' and their views on the company provides useful information to improve the business [1, 2]. There is, however, one aspect that should not be forgotten in this 'satisfaction – loyalty' formula: some people are forced to remain as customers because they have no or little choice. This concept of *false loyalty* tells us that we should not neglect investigating customer satisfaction even though they remain with the company [1, 3].

So, what makes customers satisfied? There are several elements that underpin customer satisfaction: customers' perception/evaluation of tangible service performance, such as staff's willingness to help and provide information, attentiveness, friendliness and ability to understand customer needs [4]; employees' satisfaction because it affects their responsiveness to customers [5]; and problem resolution [6]. Therefore, a good understanding of the significance of customer satisfaction is crucial to success in any business organisation. The housebuilding industry is no exception.

This concept of 'customer focus' is an approach that the service industry has been applying for some time, and these customer-oriented attitudes offer lessons for the housebuilding industry. This is a new idea for the industry, but as Normann [7] puts it, companies that used to think of themselves as mere manufacturing firms have to see themselves as service organisations and to accept the consequences of this new view. The step that they should take will be a shift towards a service, and therefore, customer orientation.

In 1998, the Egan report [8] identified key drivers which needed to be addressed if the UK construction industry was to benefit from the radical change experienced in other industries. Whilst these drivers were considered applicable to all sectors of the construction industry, Egan specifically considered the social housebuilding sector as an area where significant improvements in performance could be achieved. In reviewing the housebuilding sector, the potential to lead change in housing via the social housebuilding programme was highlighted, and the Housing Forum was established for this task as a government-funded body. Its objectives included: agreement on targets for improvement and performance indicators, simplification of procurement processes and standardisation of component linkages, encouragement of long-term partnering arrangements. A set of 12 key performance indicators (KPIs) were accordingly identified; one of them was customer satisfaction.

The UK housebuilding industry has long had an image problem, but its difficulties in satisfying its customers are now being exposed to greater public scrutiny than at any other time. The industry has now been put under pressure to make strenuous efforts to modernise itself [9]. Consequently, improving the 'customer focus' of the industry has become something of a holy grail for housebuilders [10]. Research conducted so far in the context of housebuilding has indicated that there are gaps between what customers expect and what housebuilders offer in three main areas: the quality of workmanship, service provision, and house design; and these gaps suggest that customers are not satisfied with the products and service provided [11].

In order to bridge such gaps, and consequently to make the customers more satisfied, it is crucial for housing providers to communicate with the customers. Customers' views must not be neglected and a feedback chain of information should be incorporated into the business process. Feedback from customers, such as comments and complaints, helps the company to know when something goes wrong [12]. Thus, communication has to be dialogue, not monologue: not only does the company talk to customers, but it should also listen to their opinions. This is how the relationship between the company and the customers can be built. This relationship is particularly important in the competitive market. In order to survive the turbulent changes in the market, the company has to develop relationships with end-customers, as well as with suppliers and distributors. As customer requirements influence the market, the feedback from the customers is essential in adapting to changes in the market. Everyone in the business process has to take part in this 'relationship-marketing' [13].

In these contexts, a four-year research project began in 2001 to evaluate the social housing sector's performance [14]. This paper reports on the outcomes of the post-occupancy tenant satisfaction survey that was carried out as part of the project. The present paper deals with two issues: the result of the questionnaire survey, and an analysis of organisational problems that were encountered in conducting the survey.

2. Benchmarking performances

The present research project includes 12 registered social landlords (RSLs; i.e. housing groups/associations) in the UK, which have formed a consortium. The consortium aims to improve the quality in terms of amenity and performance for the residents and to eliminate defects, in line with the government policies and associated initiatives within the industry described above. In order to achieve these, the consortium introduces lean production methods to housebuilding, with the following objectives:

(a) To try out a new construction method (using factory made pre-fabricated timber-frame, as opposed to the traditional brick and block method);

(b) To work on the 'partnering' agreement (as opposed to tendering, through which a contractor is traditionally assigned for a project) between the consortium and a particular housebuilder/off-site manufacturer; and consequently,

(c) To achieve higher customer satisfaction.

As part of the research project, a questionnaire survey was designed to investigate the level of satisfaction of tenants who lived in the consortium's schemes which had been built with the new procurement system. Five themes were identified for the customer satisfaction KPI in the benchmarking workshops held by academic researchers, consultants and the consortium at the beginning of the project. These five themes form the main part of the questionnaire: (1) space and facilities, (2) ventilation, (3) sound insulation, (4) ease of use, and (5) after-care.

The questionnaire also contains questions as to:
(6) general satisfaction to see if participants are basically happy with their homes; and, (7) satisfaction with overall service provision by the landlord and opportunities for participation in decision-making.

These questions are called Best Value questions, set by the Housing Corporation (the funder for RSLs) to be included in any tenant satisfaction surveys.

3. The survey results

The survey was conducted in two stages – in June 2003 and in January and February 2004 – with 3 RSLs and with a total of 8 schemes which reached the end of the 12-month DLP (Defect Liability Period). Ninety-five questionnaires were sent out and 34 were returned (the 35.8 per cent response rate). Seventy-one percent of the participants were female. Forty-four percent were aged between 18 and 35, 21 per cent were between 36 and 50, and the rest were over 50.

3.1. General satisfaction with the home

Participants are satisfied with their homes and generally think that their new homes are better than the last ones (Table 1).

Table 1: General satisfaction with the home

		Frequencies	**%**
Satisfaction with the home	Very satisfied	18	52.9
	Fairly satisfied	14	41.2
	Neither	1	2.9
	Fairly satisfied	1	2.9
	Very dissatisfied	0	
Compared to the last home	Better than	28	84.8
	Worse than	2	6.1
	No opinion	3	9.1

Disable participants seem to be pleased with the adaptation that the housing provider made for them:

> 'Being disabled, [I find that] this house has made life a lot easer for me due to the space of rooms, hand railing and a downstairs shower.'

Indeed, more flexible internal design is possible because of the timber-frame method which does not rely on walls to support the weight of the house. The use of this new building method could enhance the flexibility in the internal plan for different users with different needs [15].

3.2. Satisfaction with space and facilities in the home

Questions about satisfaction with space and facilities in the home were asked by using a 1-10 scale (10 = very satisfied and 1 = very dissatisfied). Table 2 shows participants' satisfaction levels with different features in their homes.

Table 2. Satisfaction with space and facilities in the home

	Mean score	Frequencies of low scores (4 or below)	%
Space in the kitchen	7.12	8	23.5
Kitchen fittings	7.94	5	14.7
Space in the bathroom	8.03	3	8.8
Bathroom fittings	7.65	5	14.7
Space in the living room	7.94	5	14.7
Space in bedrooms	7.94	3	8.8
The no. and location of electrical sockets	8.45	3	9.1
Internal doors	8.06	3	9.1
External doors	7.36	5	15.2
Windows	7.25	7	21.9
Internal storage space	6.33	9	27.3
External storage space	7.29	4	12.9

Participants are generally satisfied with space and facilities in their homes with some exceptions. Typical reasons for dissatisfaction are:

- Lack of storage space (mainly internal, but also external),
- The small size of the kitchen,
- Poor fittings and finishes (doors, windows, door handles, showers, etc.),
- External design and maintenance (landscape, garden, parking, etc.).

These negative comments are valuable. Social housing customers tend to have little choice in their housing situations. In order to avoid false loyalty from the customers, it is important to analyse the customers' negative views. Furthermore, it is useful to analyse the discrepancies between customer expectations and the management's perception of their customers' expectations, and between the managements' perceptions and the translation of those perceptions into specifications. By identifying differences in views, a housebuilder can reduce guess-work and improve value to its customers (Winch et al., 1998).

3.3. Satisfaction with ventilation

Three-quarters of the participants feel warm in their homes on a cold day, and most of them find it easy to keep their homes sufficiently ventilated (Table 3). The typical reasons for disagreement are: draught from doors and windows, and temperature varied within the home. In addition, participants claim that the running costs for their new homes were about the same as they had expected.

Table 3: Perceptions of ventilation

		Frequencies	**%**
Feeling warm on a cold day	Yes	26	78.8
	No	7	21.2
Easy to keep the home ventilated	Yes	32	97.0
	No	1	3.0

3.4. Satisfaction with sound insulation

The majority of the participants say that they are bothered by noise from outside (e.g. traffic and children playing), and about one-third say that they are bothered by noise coming through the wall from next-door neighbours. Noise between rooms and floors, as well as squeaky floors, also appears to be a little problematic, for about 40 per cent of the participants mention that they are bothered by noise within the home (Table 4).

Table 4: Perception of sound insulation

		Frequencies	%
From outside	Often	14	42.4
	Sometimes	11	33.3
	Rarely	6	18.2
	Not at all	2	6.1
From internal communal space (e.g. staircase and corridor)	Often	1	3.3
	Sometimes	2	6.7
	Rarely	4	13.3
	Not at all	13	43.4
	N/A	10	33.3
Through the wall from next-door	Often	6	18.8
	Sometimes	6	18.8
	Rarely	9	28.1
	Not at all	11	34.4
From flats upstairs	Often	3	10.0
	Sometimes	1	3.3
	Rarely	0	
	Not at all	4	13.3
	N/A	22	73.3
From flats downstairs	Often	0	
	Sometimes	2	7.4
	Rarely	0	
	Not at all	6	22.2
	N/A	19	70.4
Between rooms within the home	Often	6	18.8
	Sometimes	8	25.0
	Rarely	3	9.4
	Not at all	14	43.8
	N/A	1	3.1
Between floors within the home	Often	4	13.3
	Sometimes	8	26.7
	Rarely	3	10.0
	Not at all	9	30.0
	N/A	6	20.0
Squeaky floor boards	Often	12	36.4
	Sometimes	4	12.1
	Rarely	5	15.2
	Not at all	10	30.3
	N/A	2	6.1

3.5. Satisfaction with ease of use

With regard to ease of use of the home, although most participants say that it is easy or relatively easy to clean the home, to garden and to use the heating/hot water systems, there are a few who find it difficult to use those systems and to garden (Table 5). There are also some detailed features that participants find inconvenient, such as the location of the hot water and/or central heating switches.

Table 5: Ease of use

		Frequencies	%
Running cost of the home	More than expected	6	20.0
	About the same	21	70.0
	Less than expected	3	10.0
Easy to clean	Easy	27	79.4
	Relatively easy	4	11.8
	Relatively difficult	3	8.8
	Difficult	0	
Easy to garden	Easy	18	56.3
	Relatively easy	11	34.4
	Relatively difficult	0	
	Difficult	3	9.4
Easy to use the heating system	Easy	23	67.6
	Relatively easy	8	23.5
	Relatively difficult	2	5.9
	Difficult	1	2.9
Easy to use the hot water system	Easy	24	70.6
	Relatively easy	8	23.5
	Relatively difficult	1	2.9
	Difficult	1	2.9

3.6. Satisfaction with after-care services

Participants generally give high scores to after-care services (a 1-10 scale; 10 = very satisfied and 1 = very dissatisfied), except to speed of responses to queries (Table 6). As the following comments show, there are some dissatisfied tenants in terms of repair works. When problems are not promptly resolved, the level of dissatisfaction of customers become high [6]. So, this is a warning sign:

- I have been waiting for a repair work for months. I have phoned twice and supposedly had it logged both times.
- Any repair works that have been done are broken again.
- Contractors in some circumstances have been very poor in response time and completion. I had a loose roof tile on my property for two months, which could have blown off and injured someone at any time.
- [Contractors] don’t come out within time, don’t knock or ring bell. They put paper in door and walk away. Contractors can be blunt.

Table 6: Perceptions of after-care

	Mean score	Frequencies of low scores (4 and under)	%
Ease of contact with the landlord	8.00	3	9.1
Helpfulness of the staff	7.94	3	9.4
Speed of response to queries	6.76	7	21.2
Information the landlord provides	8.16	3	9.7
The time period repair works carried out	7.28	5	15.6
Contractors' attitudes	7.64	5	15.2
The quality of repair works	7.91	5	15.6

3.7. General satisfaction with services provided by the landlord

Participants are satisfied with overall services provided by their landlord and are not dissatisfied with opportunities for participating in decision making (Table 7).

Table 7. Satisfaction with overall services

		Frequencies	%
Overall services	Very satisfied	17	50.0
	Fairly satisfied	13	38.2
	Neither	3	8.8
	Fairly satisfied	0	
	Very dissatisfied	1	2.9
Opportunities for participation	Very satisfied	9	29.0
	Fairly satisfied	11	35.5
	Neither	5	16.1
	Fairly satisfied	2	6.5
	Very dissatisfied	1	3.2
	No opinion	3	9.7

3.8. Summary

Overall, the participants are satisfied with their homes and the services provided. However, there is more housing providers can do, as residents would like better quality workmanship and design than currently offered. For example, high-quality off-site manufacturing should be able to cope better with quality problems, such as draught and noise. Also, although some attributes and features (e.g. the provision of storage space, the design/location of central heating/hot water switches and the maintenance of the garden) cannot be controlled by off-site manufacturing, they need to be considered in the design stage. In order to improve features that are currently seen as negative in the next generation of design, good communication between customers, housing associations and building contractors is necessary. Also important is the staff's attitudes towards, and attentiveness to, the problems that the residents are facing. Prompt problem resolution is very important to achieve customer satisfaction. People want to feel being looked after by the house provider; and satisfactory 'looking-after' leads to customer satisfaction [11, 17].

4. The management of the survey

There was some difficulty in conducting the tenant survey across the housing associations. In this survey, there were three housing associations involved. ‘A’ Housing Group is based in Kent and consists of several housing associations according to the nature of business. ‘H’ Housing Group, based South East London, has also a number of housing associations according the regions they cover. ‘B’ Housing Association is a single entity, based in Norfolk. Each organisation presented different attitudes towards the survey initiated by the consortium.

In order to understand the nature of the difficulty experienced, informal discussions were carried out with relevant officers in the three RSLs that carried out the tenant satisfaction survey (a meeting and discussions over e-mail with A and H Housing Groups respectively, and a telephone interview with B Housing Association). It then became clear that there was lack of understanding about the aims of the survey and of the consortium by the participating RSLs.

Firstly, the complex organisational structure has turned out to be a problem in this particular survey exercise. The questions to be asked in the questionnaire were agreed by representatives from several RSLs and academic researchers after a number of meetings. However, as A Housing Group has several housing associations under its umbrella, it seemed more difficult for the housing director who had attended the meetings to get consensus on the content of the questionnaire from different sections of his organisation:

> ‘I needed agreement from colleagues before writing to tenants, and they [the colleagues] were seeking to meddle.’ (Housing Director, A Housing Group)

It is understandable that, if a RSL is going to carry out a questionnaire survey, they would also like to include the questions that they want to ask the tenants, as they know that their tenants do not like to receive too many questionnaires. The issue here is that the purpose of this particular survey was not really understood within the housing group in question. The questionnaire survey had a specific aim to find out the tenant satisfaction level in relation to the finished products constructed by the new procurement procedure as well as to the services provision. But this message was not communicated.

B Housing Association, on the other hand, was a straightforward case. The development support officer took full responsibility for carrying out the survey and no one questioned her within the organisation as she had been in charge of all the tenant surveys in the organisation. She understood that it was a decision made by the consortium which her organisation was part of and followed the order, sending out the questionnaire to relevant tenants.

Lastly, There was misunderstanding about the survey procedure, rather than its purpose. The development director instructed some of the agreed questions to be included in their own tenant survey to cover the 5 themes mentioned above. Although the dates for the survey had been agreed between the customer manager who was going to conduct the survey and the project researchers, this misunderstanding delayed the whole exercise for two months:

> I was told that I did not have to conduct your survey. The director said that they had included most of your questions in our satisfaction survey. (Customer Manager, H Housing Group)

These examples show the importance of communication between the consortium and participating RSLs, as well as within the RSL. It is especially difficult to achieve an understanding when an organisation has a complex organisational structure, involving a number of different housing associations that have different issues and agendas. A better understanding of such organisational problems would help a group of RSLs to conduct cross-organisational surveys more efficiently.

Currently, the consortium is withholding its activities. When the consortium originally started, there were 22 RSLs participating, but the number of the member RSLs became 12 by the time this research project started. The reason why it has not worked well is still to be investigated, but the different agendas that the participating RSLs and their internal sections have seem to have contributed to its failure. Furthermore, for those who actually do surveys, there is little difference between their own surveys and the consortium's surveys. The latter is just additional work for them and more surveys for their customers. Unless the idea of being part of the consortium is disseminated and understood within and across the organisational boundaries, even a joint survey appears to be difficult to carry out.

5. Conclusion

This is a small-scale study and the results cannot be generalised. However, it has identified tenants' perceptions of the quality of their homes and of the services provided, indicating some problems. Firstly, regarding the physical quality of the homes, the timber-frame construction method, off-site manufacturing and on-site assembly seem to have succeeded in providing a better building design and quality to some extent. Nonetheless, there are still a few problems to be sorted out (e.g. storage space, draught and sound insulation), which should be taken into consideration in the design of the next generation.

Secondly, on the quality of services, although the satisfaction level is generally high, there is still room to improve. As seen above, customer satisfaction is determined by employees' performance. Customers want attentive responses to their problems. Thus, responsiveness to enquiries and repair works, for example, do affect the way in which customers feel about the service provider and its services.

Lastly, with regard to the management of the survey, it has become clear that there has been lack of understanding about the aims of the survey and of the consortium among the participating RSLs. Furthermore, the importance of communication between the management and the front-line employees who actually carry out the survey has also been shown. These organisational issues need to be taken into account when a similar cross-organisational survey or project is conducted.

An innovative procurement system (i.e. the use of pre-fabricated timber-frame method, and partnering agreement with a single contractor/off-site manufacturer) that this group of housing associations employed, still has room to improve. The above findings – the survey results and the analysis of organisational problems – will be fed back to the consortium, so that the member RSLs can understand their strengths and weaknesses and improve their products and performances. It is also hoped that the findings provide any social housing providers with a lesson to learn in order to achieve higher customer satisfaction and consequently successful business.

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Client Requirements Management in Low-income House Building Projects in Brazil

Luciana Inês Gomes Miron,
Ph.D. Candidate, Building Innovation Research Unit (NORIE), Federal University of Rio Grande do Sul (UFRGS), (email: lumiron@cpgec.ufrgs.br)
Fernanda Lustosa Leite,
M.Sc. Candidate, Building Innovation Research Unit (NORIE), Federal University of Rio Grande do Sul (UFRGS), (email: fleite@cpgec.ufrgs.br)
Carlos Torres Formoso,
Associate Professor at the Building Innovation Research Unit (NORIE), Federal University of Rio Grande do Sul (UFRGS), (email: formoso@ufrgs.br)

Abstract

This paper describes the main results of a multiple case study concerned with client requirements management in the product development process (PDP) of seven low-income house-building projects, carried out in the South of Brazil. These projects were developed in two different forms of Brazilian housing provision: four in the Residential Leasing Program (*Programa de Arrendamento Residencial – PAR*) and three in the first phase of the City Entrance Integrated Program

(*Programa Integrado Entrada da Cidade - PIEC*). Both are new forms of housing provision in Brazil and have created different client relationships, which have never been experienced in Brazil before. The main objective was the comprehension of the PDP of both forms of housing provision as well as the identification of a potential client requirements management in public instances, in order to improve the quality of these products without raising costs. This investigation was based on the analysis of design, production control and legal documents, semi-structured interviews carried out with design and production professionals, as well as the evaluation of user's satisfaction. The main contributions of the study are concerned with the understanding of the relationship between the PDP improvements and the product performance according to the perception of the various clients (users, construction companies, design and budget professionals, financial agents, as well as Municipal and Federal Government professionals) involved in the PDP. The four case studies presented in this paper are part of a larger research project, which is being developed in a network of six Universities in Brazil. The main objective of this larger research project is to propose guidelines for client requirements management in the PDP of low-income house-building projects.

Keywords: Client requirements management, value generation, product development process, low-income house-building projects

1. Client Requirements Management in the Product Development Process

1.1 Overview

The design process can be understood as a sequence of steps and activities that make the construction of a building possible. Design and construction can be analyzed as a product development process (PDP) because it describes the activities needed for the development of a determined product, for example, a building. The main benefit of analyzing design and construction as a PDP is that it gives a more integrated view of the whole process. In manufacturing, the PDP is understood as a sequence of steps or activities necessary for the conception, design and commercialization of a product. According to Ulrich and Eppinger [1], the PDP is a series of activities needed for the conception and design of a product, from the identification of a market opportunity to its delivery for the final client. When compared, the necessary steps for the development of a product in construction and manufacturing, many similar points stand out: the importance of client requirements capture and the translation of these requirements into design specifications [2, 3]; the product is developed by teams of various areas, therefore, there is a considerable variety of people with different abilities and knowledge involved in the process; the main phases of the process are similar, as identifies in the work of Kagioglou et al. [4] and Ulrich & Eppinger [5]; there is a great amount of information, information flow and trade-offs during the process [6, 7]; and many uncertainties in the process.

But many different point are also identified between the development of a product in construction and manufacturing, such as: in manufacturing, a prototype is made during the development o the product's concept [5]; for a building, each productive cycle involves a new piece a land [8], therefore, a new location, what makes a prototyping not as useful as in manufacturing [9]. Among the various types of building, a house building is destined specifically for a basic need: residence. For this reason, the house building is a product that has attributes that commonly generate a more complex consumer behavior, because it is a more expensive product with unique characteristics and considered as a product of long-term use [10]. On the other hand, manufacturing products have a shorter life-term than a building.

For the points that make the development of a construction and manufacturing product similar or different, the analysis of the design and construction processes are here considered in a wider context, which is the PDP. A wider view of the PDP is a necessary prerequisite to systematically consider the needs of the various clients involved in the process.

In the construction industry, due to the long use time of the constructed facilities, the client has no prior expertise [9]. Therefore, the outward orientation should be given more attention, in order to obtain more information from the final client. The expression of the needs of a client in a form that describes the facility that he/she desires involves "processing" to ensure that the information is presented in a format that enhances adequate understanding of what the client desires, and which facilitates their implementation by designers [11].

The systematic management of information on client requirements consists of finding the knowledge applicable to a problem situation and formulating it in project objectives and constraints. The client requirements management consists of the identification, analysis, prioritization and availability of information about the client's necessities and preferences. Such tasks can potentially result in a better definition of possible design solutions, consequently increasing the perceived value by the client. Concurrently, a great challenge for a designer is to define the best solution to meet the client's needs [12].

According to Kalay [13], the need for collaboration arises when the limits of their abilities prevent individuals from completing a given task on their own (due to the lack of knowledge or power), or when collaboration can help them to complete the task more quickly and efficiently. Therefore, the communication is a prerequisite to collaboration, being a means by which the intents, goals and actions of each one of the participants are made known to the other participants in the collaborative effort, thereby forming the basis of their own actions [13]. This poses new demands on communication and cooperation in design practice [14].

The collaborative group must, therefore, establish a definition of the team, identify their outcomes, ensure there is a purpose of the collaboration and clarify the interdependencies of the members [15]. Therefore, collaborative work is not the only mechanism to generate value, but it can make the team more capable of better managing client requirements in the product development process (PDP).

1.2 Low-income house building in Brazil

According to the Brazilian Federal Government's Cities Ministry [16], the Brazilian social debt related to the housing deficit is impressive. Over 7 million families need new homes and over 10 million homes have basic infrastructure problems. The social differences and income concentration, characteristics of the Brazilian society, are manifested physically in the segregated spaces of the cities in the country. In these, the housing needs constitute a greater problem: the lack of decent homes for the poorer citizens represent 91.6% of the total Brazilian housing deficit [16]. Besides being concentrated among the population that has the lowest monthly income, the housing needs are also increasingly concentrated in urban areas.

According to the Fundação João Pinheiro [17], the housing needs include the deficit and housing inadequacy. For this same institution, deficit is understood as the need for the construction of new homes, because of both the replacement and increment of the housing stock. All of these complex housing needs have lead, in the last decades, to a change in the Brazilian Government's role in offering low-income housing. Nowadays, there is greater interaction between public and private sectors. This has lead to growing financial, regulatory, environmental, social and technical complexity, which has made the construction process of low-income house buildings highly decentralized in Brazil. A great number of professionals are involved, resulting in requirement conflicts and in the need to manage trade-offs.

This situation is even graver when it comes to the complete housing provision. The term housing provision is understood as the group of specific actions developed by various governmental and non-governmental agents, that result in one or many types of dwelling units [18]. Moreover, the same authors define complete housing provision as a set of actions, developed by various agents, understood as the supplying of a dwelling unit in an area with urban infrastructure, giving complete inhabitance conditions. Also, the provision of a complete dwelling unit demands the involvement of many agents and created different forms of relationships among them.

The Residential Leasing Program (*Programa de Arrendamento Residencial – PAR*) and the City Entrance Integrated Program (*Programa Integrado Entrada da Cidade – PIEC*) illustrate two representative forms of housing provision in Brazil. They were selected for this research project because they focus on a population with a monthly income that represents the largest part of the Brazilian housing deficit, as shown below in table 1. The PIEC concentrates a population with a family monthly income of zero to three minimum wages and PAR, a population with a family monthly income of three to five minimum wages. The sum of both represents the poorer citizens (91.6%) of the total Brazilian housing deficit, according to the Brazilian Cities Ministry.

Table 1: Brazilian Urban Housing Deficit [17]

Region	**Urban Housing Deficit**	**0-3 Min. wages (%)**	**3-5 Min. wages (%)**	**5-10 Min. wages (%)**	**Over 10 Min. wages (%)**
North	411,600	84.0	7.2	6.9	1.6
Northeast	1,729,100	91.3	5.1	2.1	0.7
Southeast	2,257,500	77.6	11.0	7.1	3.0
South	589,100	80.9	9.4	6.7	2.5
Center-west	427,600	82.9	7.8	6.5	2.0
Brasil	5,414,900	83.2	8.4	5.4	2.0

2. Reserch method

2.1 Overview

This paper describes the main results of a multiple case study concerned with client requirements management in the PDP of seven low-income house-building projects, carried out in the South of Brazil. These studies are part of the Requirements Management and Quality Improvement in

Social Housing (REQUALI)[1] Project, which is still in its early stages. This investigation was based on the analysis of design, production control and legal documents, semi-structured interviews carried out with conception, design, production and financial agency professionals for the PAR and PIEC projects.

For the PAR projects, four house-building projects were analyzed: Alta Vista, Guerreiro, Marcílio Dias and Sul América. The first three are located in the city of Pelotas and the fourth, in Porto Alegre. For the comprehension of the PDP of PAR projects, 8 interviews were carried out with professionals from design and construction companies, as well as from public institutions, such as the Brazilian Public Savings Bank (*Caixa Econômica Federal)*. Other sources of evidence include: evaluation of user's satisfaction in the four PAR projects studied, in which the research team conducted interviews in 20% of the dwelling units, using multiple sources of evidence, such as: open questions (critical incident technique) and closed questions (level of satisfaction), photography and drawing, characterizing this evaluation as predominantly qualitative.

For the PIEC projects, three housing allotments were analyzed: Vila Tecnológica, Pôr-do-Sol and Progresso. All of them are located in the city of Porto Alegre. In order to comprehend the PDP of these projects, 16 interviews were carried out with professionals from various areas and institutions, such as: Brazilian Public Savings Bank, all the eight secretariats that comprehend the Municipal Executive Unit, part of Porto Alegre's City Hall. Other sources of evidence were: designs and reports supplied by the City Hall for the Bank, visits to the informal settlements and new allotments and photographical registers.

2.2 Brief description of two housing programs in Brazil

2.2.1 Residential Leasing Program

The PAR exists in Brazil since 2001 and has been bringing benefits to families with a total monthly income of two to six minimum wages. The program is destined for the construction or refurbishment of buildings in metropolitan areas, capitals and urban centers, with a population of, at least, 100,000 inhabitants. This program is managed by the Cities Ministry of the Federal Government of Brazil and is carried out by the Brazilian Public Savings along with the participation of construction companies, which design and construct these projects. The

[1] The REQUALI Project started in 2003 and its conclusion is previewed for 2006. It is being carried out by a network of six Brazilian universities in the states of Rio Grande do Sul (Federal University of Rio Grande do Sul, Federal University of Pelotas), Ceará (Federal University of Ceará, Ceará State University), Paraná (Londrina State University) and Bahia (Feira de Santana State University). The main objective of the REQUALI project consists of establishing criteria and directives for client requirements management in low-income house building projects, aiming at the improvement of these projects' quality. The studies are focuses on existing programs in Brazil, such as PAR and PIEC.

Residential Leasing Program (PAR) is one of the most important programs for low-cost housing provision in Brazil. This program is a new form of housing provision and requires innovative roles for both public and private organizations in product development, and a new form of relationship with the final user, which has never been experienced in Brazil before.

It is important to point out that the main client is the Bank, since it plays a major role in the conception of projects. Its technical staff is responsible for establishing the main parameters for the product (cost yardstick, design parameters, criteria for choosing technologies, etc.), design evaluation, final user selection. Moreover, the Bank owns the dwellings for a minimum period of 15 years. The users have an incipient participation in the process, being selected only during the production phase, when the design has already been concluded. This characteristic might cause future conflicts, during the 15-year leasing period, since the Bank prohibits any irreversible change in the dwelling unit. In this sense, it is essential to identify the user's requirements in order to minimize these conflicts and raise the product's value, since they can become the owners after the leasing period.

In the state of Rio Grande do Sul, 58 PAR projects are either already in the use phase or in the production phase. Only in the year of 2004, 3.4 thousand dwellings were built in 11 cities: Bagé, Cachoeirinha, Novo Hamburgo, Parobé, Passo Fundo, Pelotas, Portão, Porto Alegre, Rio Grande, Santa Maria e Sapiranga. Of these 11 cities, two of them stand out: Pelotas (with 12 projects) and Porto Alegre (with 9 projects, including 4 refurbishments). Because these two cities in the state of Rio Grande do Sul present the largest number of PAR projects, they were chosen for the development of this research. Four projects were selected, three in the city of Pelotas (projects Alta Vista, Guerreiro and Marcílio Dias) and one in downtown Porto Alegre (project Sul América).

2.2.2 City Entrance Integrated Program

The City Entrance Integrated Program (*PIEC*), which was started in 2002 in Porto Alegre, in the state of Rio Grande do Sul, has been bringing benefits to families with a total monthly income of zero to three minimum wages. When totally concluded, the PIEC will benefit 3,775 families, who live precariously in 22 informal settlements. In the first phase of PIEC, that has already been concluded, 413 families received new dwellings in three allotments: Vila Tecnológica, Pôr-do-Sol and Progesso.

The PIEC is integrated by four projects: road infrastructure, landscape valorization, housing and social work. Besides the importance of the housing provision, that program also represents the restructuring a significant urban area, especially because of the road system upgrading and environmental recovery. Another difference from that program to PAR is the development of the social work, which aims at the inclusion of those people in the formal city by means of work and income generation, besides community participation in some phases of the development of house building projects.

The program's conception was a complex process that lasted about 6 years. The intervention area is of three neighborhoods in the city of Porto Alegre (Humaitá, Farrapos and Navegantes). The selection of this area was made according to the life quality indicator, which was very low for this area, and the community needs that live in 22 irregular settlements.

Besides, the evolution of the PIEC is linked to demands of the process of the Participatory Budget (*Orçamento Participativo - OP*), which was initiated in the beginning of the 1990s in Porto Alegre. According to Fruet [19] the need to solve urban problems (lack of urban services, secure tenure, transportation, education and health services) has motivated people to organize and adhere to this new space of participation. In this sense, the OP and other mechanisms previewed in the Master Plan, such as the integrated projects and the Special Social Interest Areas, allied to international finance agent's demands and to the experience of the City hall in housing provision, which resulted in a new format for low-income housing provision in Porto Alegre.

PIEC is different than PAR because its main client is the population to be served, aiming at the inclusion of the people who live in the 22 irregular settlements in the formal Porto Alegre. The social project involved, among others, a detailed register and, through the area identification in the city, the City Hall's priority was to serve all of the registered families. Another important client in PIEC is the City Hall itself, because of its involvement in the conception and development of the entire program and in the future management of the settlements.

3. Results of the multiple case study

3.1 Results related to PAR´s case studies

Initially, the product development process for PAR projects was analyzed, with the identification of the main phases, activities, clients, as well as the products that separate each phase in order to better identify problems and opportunities for client requirements management. Four main opportunities for client requirements capture were identified in the process, one in the first phase (concept and design phase), two in the second (production phase) and one in the last phase (use and occupancy phase). They are: initial registration of interested families, selection of registered families, social project and evaluation of user satisfaction. Also, some positive and negative characteristics were identified in this program, in the main phases in with client requirements management can be developed.

3.1.1 Positive and negative characteristics in conception

The product development starts with the search for a terrain, which is analyzed by the Bank's technical staff. The terrains must be located in urban areas, close to services and public transportation. This is one of the main positive characteristics of PAR projects. In the case of the PAR refurbishment, the location is an even greater positive point, because the refurbished buildings are located in city centers. Another important point is that the program is an opportunity for low-income families to obtain their house after the 15-year leasing period, which represents an important asset in a country with a history of unstable economics.

An improvement opportunity identified in the program is that the registered families are only selected after the project has been designed, during the production phase. These families requirements are, therefore, not captured and used in the design process and the construction company, which designs and builds the projects, do not know who they are designing for. Another negative point identified for PAR refurbishments is the environmental and sound pollution existent in city centers, contrasting the fact that these buildings are very well located when it comes to services and public transportation.

3.1.2 Positive and negative characteristics in design

In the design of the common areas, an important point identified is the leisure areas, playground, sports court, community center, with are normally only present in middle-class projects. The families also feel safer in this pleasant environment with 24-hour security guards, which are not common, not even in middle-class condominiums. The dwelling units are small, around 39 m², but are considered better than other dwelling units in the local construction market.

The negative points identified in the design were mainly in the dwelling unit. The users considered the laundry room too small, with no area for hanging and drying clothes. This might be a regional characteristic, since the humidity level is very high in the South of Brazil. The users also pointed out the integration between the kitchen and the living room as a negative point. About 40% already have or wish to separate the kitchen from the living room. In PAR Sul América, about 25% of the dwelling units are studios and most have been vacant for almost three years (the entire use phase). This demonstrates that the Bank did not know who their final client was before the design phase. In PAR Sul América, the lack of open areas for leisure, especially for children, leads to a smaller number of families (29%) with children interested in this project. In the projects in Pelotas (two-bedroom apartments), there are 48.6% of families with children.

3.1.3 Positive and negative characteristics in use

In the use phase, the main positive point identified if the community life that the program makes possible for the families. Most of them did not know what it was like to live in a condominium before, with common leisure areas. Also, because these projects are well located, they loose less time commuting from home to work, therefore having more time to spend with their families and friends.

The main problem is the maintenance of these projects. The Bank contracts a building administration company, which manages the contracts, common areas and dwelling units. This company has created a barrier between the users and the Bank. In some cases, such as in PAR Sul América, the maintenance tax has already equaled the leasing tax, probably because this building has two elevators, with high maintenance cost.

3.2 Results related to PIEC's case study

Initially, the main characteristics of the program were identified, especially the one that points out the differences between this program and other existing Brazilian housing provision programs, especially PAR. In this sense, the main points identified in the PIEC were: extent of the program, integrated program and social project.

3.2.1 Positive and negative characteristics in the program's extent

One of the main characteristics of this program is its extent. The large sum of money invested (55 million dollars) reflects on the number of families that is served. The PIEC represented the first opportunity for a complete register of a large area in the city's urban space. All of the infrastructure conditions were surveyed, as well as a detailed profile of the population in the 22 settlements. Moreover, viability studies were developed for new investments capable of absorbing workers in the region, surveying the companies in the region, identifying their needs. In this sense, the program's extent is a stimulus to partnership among the City Hall and NGOs (non-governmental organizations), universities, associations, public institutions and private initiative.

On the other hand, in relation to the negative characteristics there are many aspects to be considered because of the high complexity of investment of heavy resources that result in: slow conception (around 6 years, according the professionals of the City Hall), difficulties for development and execution, difficulties to control and plan. Another important point is a great contrast between the slow development of a formal housing program and the reality of the life dynamics of registered communities. The families change very quickly, the birth rate is very high and the new necessities grow very fast.

3.2.2 Positive and negative characteristics in the integrated program

In order to make this thorough intervention viable, there is the need to integrate in the City Hall the various secretariats and professionals that participate in the development of a project as big as this one. In search of integration, a multidisciplinary approach was used among secretariats and, especially inside the Municipal Department of Housing (DEMHAB). The need for this integration is explicit by the projects overlapping in the territorial space: infrastructure, road structure, sanitation, housing, work and income generation equipments.

On the other hand, in relation to the negative characteristics there are many aspects to be considered related to alternating program coordination among City Hall secretariats. This results in fragmentation of the process view by professionals involved, late creation of the Municipal Executive Unit and difficulties for attending the priorities of the program and fragmentation in some actions, for example contracting of outside professionals. The program demands a new form of working that breaks the organizational structure of the City Hall leading to difficulties in DEMHAB projects to be approved by another secretariat in the same City Hall.

3.2.3 Positive and negative Characteristics in the Social Project

The social project deserves special highlight in this program because it represents an important opportunity for client requirements management. Besides, it is a project that tries to guarantee an effective social inclusion of the served communities. PIEC was the first program with specific resources for the social project in the city of Porto Alegre. This resulted in the first application of a social-economic register which permitted a more detailed knowledge of the community's reality (income, educational level, activities, relationship with animals, handicapped people).

On the other hand, demands of too many reports by HBB take too much time for the professionals. Also, the requirements of communities were incompletely identified, such as when they opened a computer course, not knowing that most of the population was illiterate. A specific challenge for the communities is changing the people's lives, giving them conditions to maintain themselves in this new life (paying accounts, taxes, living in a condominium, etc). In a few months of use, depredation was already noticed in these condominiums, because they steal community equipments in order to obtain money with their sale. Which demonstrated that the social project is not giving a fast answer to the social problems that this population faces. Also, there is the need to break pathological relationships present in these communities, such as sexual exploitation, slavery, oppression and drug trafficking.

The program is still small if compared to the urban housing deficit in Porto Alegre and the continuous flow of poor people to the capital. But it represents a new trend in Brazilian housing interventions, being more thorough when compared to traditional interventions.

4. Conclusions

The multiple case study for both forms of housing provision indicated that client requirements management must be considered from the initial phases of building projects. There are clear signs of client requirements capture for the PIEC projects during the social project, but these are not well processed during the PDP. On the other hand, in the PAR projects, there is no client requirements capture in the beginning of the process, leading to a design following the logic of mass production, not considering specific requirements of the final clients. The register of the families, carried out during the social project in the PIEC, is an example of client requirements capture that could be used for PAR projects. Nevertheless, the processing must be improved.

Also, a need for a more thorough view of the PDP as well as collaboration between the actors that develop the products and those that inspect them for both forms of housing provision is needed. For the PIEC projects, there should be a more intense collaboration between the Bank and the City Hall. Moreover, for the PAR projects, there should be a more intense information flow between the Bank and the construction companies that develop the products, avoiding re-work.

Among the agents that conceive the programs (the Bank for the PAR projects and the City Hall for the PIEC projects), an improvement opportunity was identified when it comes to the integration among the various sectors in these institutions. In both institutions, because of the traditional fragmented structure, the technicians have difficulty in viewing the entire PDP because they only work in parts of it. The development of an organizational structure that permits and enables conjoint actions can be reached through the use of training and approaches that can help these professionals to view the process as a whole. This integrated view of the processes is a pre-requisite for client requirements management. Besides this, the use of approaches to manage trade-offs and establish communication interfaces, as well as specific training for collaborative work, is needed for client requirements management and, consequently, value generation for the main clients involved in the processes.

Specially related to the communication interfaces, another negative point identified in the public institutions that conceive the products (the Bank and the City Hall) is the lack of integration between the databases and software used by the various sectors. In order to have a more intense information flow, the sectors should be more integrated through an efficient information system.

Finally, another important point in value generation is the participation of the final client in the development process. For the PIEC, there is an intense participation of the final client in the process, from conception phase, through the identification of their demands by the participatory budget. This participation goes through the development of the design, production until the management of use of these projects. On the other hand, in the PAR, the final clients have no effective participation in the process and the families are only selected in the end of the production phase, when the design has already been completed. Therefore, their requirements are not captures in the beginning of the process. The experiences from both forms housing provision could be used in order to improve them both, specially related to client requirements management, with the final objective of raising value from the user's perspective.

5. Acknowledgements

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Section IV

Workplace management

Usable workplaces: action research

Professor Keith Alexander,
School of Construction and Property Management, University of Salford, United Kingdom;
Michael Fenker,
Laboratoire Espace de Travail, La Villette, Paris, France
Dr Jan Ake Granath,
Chalmers University, Gothenburg
Professor Tore Haugen,
NTNU, Trondheim, Norway
Kari Nissanen,
VTT Building and Transport, Finland

Abstract

Conventional approaches to building performance focus on technical, functional and operational aspect of their use. More recently, building performance appraisal has focused on functionality, serviceability and accessibility in an attempt to assess buildings-in-use. Post occupancy evaluation seeks to relate building performance to the design intentions. However, occupying organisations consider buildings from a different perspective, as workplace settings.

In contrast, usability is one of the most important, but most often neglected, aspects of buildings and workplaces. CIB task group (TG51) was created to apply concepts of usability, commonly used in the fields of IT and engineering, to provide a better understanding of the user experience of buildings and workplaces. Work to apply these concepts in building design, construction, management and use is in its infancy.

The work of the task group proceeds through a programme of action research, comprising an intensive series of case studies and workshops, in association with occupying organisations, to produce research findings within a 'business' timeframe, to satisfy a practice audience, and to identify the scope for further collaboration amongst research partners.

The paper introduces a theoretical framework, identifies key concepts and discusses methodological issues raised by this novel research approach, which aims to generate new knowledge for use in design and management in the built environment. The paper describes the selected cases, from five European countries, presents the results of a series of associated workshops and raises methodological issues arising out of the work. The cases consider the use of particular techniques for usability - community-based planning, design-for-all and facilities management. Final results of the two-year programme of work will be presented at the conference.

The work addresses a mixed audience of practitioners, researchers and academics and highlights the opportunities for collaboration in ‘new knowledge production’.

Keywords: sability, workplaces, appraisal, action research

1. Introduction

Usability is one of the most important, but most often neglected, aspects of building performance. Work to apply these concepts in building design, construction, management and use is in its infancy. A new CIB task group (TG51) has been created to apply concepts of usability, commonly used in the fields of IT and engineering, to provide a better understanding of the user experience of buildings.

The agreed objectives of the task group are:

- to conduct out a series of case studies and associated workshops, involving users, practitioners and researchers in a programme of action research
- to develop concepts of usability for application in practice
- to promote, develop and share methods, processes and techniques for the evaluation of buildings-in-use;

The task group has been formed with the commitment of the following research-based partners:

- Laboratoire Espace de Travail, La Villette, Paris, France
- Norwegian University of Science and Technology (NTNU), Trondheim, Norway
- Chalmers University, Gothenburg, Sweden
- University of Salford, Greater Manchester, UK
- VTT, Transport and Buildings, Helsinki, Finland

Each research-based partner facilitates the involvement of a cluster of ‘industrial partners’, representing different stakeholder perspectives as owners, occupiers and operators of buildings and workplaces.

The work of the task group proceeds through a programme of action research, comprising an intensive series of case studies and associated workshops, in association with occupying organisations, to produce research findings within a 'business' timeframe, to satisfy a practice audience, and to identify the scope for further collaboration amongst research partners.

This paper sets out the aims and objectives of the research, clarifies some of the key terms and concepts and describes the exploratory case study framework that has been created in two preparatory workshops held amongst the research partners. The programme of case studies and workshops that comprise the research will be completed and reported in the next six months and initial findings and conclusions will be available at the congress.

2. Usability

Usability has been described as the ‘effectiveness, efficiency and satisfaction with which a specified set of users can achieve a specified set of tasks in a particular environment’ (ISO 9241, 1998).

There is a growing body of work on usability in related fields, particularly engineering (Neilson, 1993) and computing and web design (Cooper, 1999). Usability refers to the many aspects of human interaction with a man-made system. The user interface is everywhere where people have to use something: from process control systems to office software, from VCR's to ticket vending machines, from buildings to traffic systems.

User experience encompasses all aspects of the end-user's interaction with an organisation, its services, and its products (and its buildings and workplaces). The first requirement for an exemplary user experience is to meet the exact needs of the customer, without fuss or bother. Next comes simplicity and elegance that produce products that are a joy to own, a joy to use.

User experience goes far beyond giving customers what they say they want, or providing checklist features. In order to achieve high-quality user experience of an organisation, there must be a seamless merging of multiple service disciplines, including engineering, marketing, graphical and industrial design, and interface design.

Successful products have two key characteristics:

Functionality - the product will offer functions and features that users need to complete tasks.
Usability - these features will be used easily and efficiently during task completion.

A product's usability is determined by three key factors:

Effectiveness - whether users can achieve what they want to do with the product.

Efficiency - how long it takes them to achieve it.

Satisfaction - their feelings and attitude towards the product.

Usability means that systems are easy and fast to learn, efficient to use, easy to remember, allow rapid recovery from errors and offer a high degree of satisfaction for the user. Usability means bringing the usage perspective into focus, and facing the user.

A focus on usability can bring many important benefits: improved productivity, innovative designs, reduced risk of costly design errors, shorter development time and effort, high competitiveness and high customer satisfaction! Tools are being developed to represent, measure and evaluate usability and to demonstrate the value and benefits of improvement.

The task group will the share an understanding of the concepts of usability, assess applications in the built environment and evaluate available tools and techniques.

2.1 Usable buildings and workplaces

When these concepts are applied to facilities and buildings, there are important distinctions to be drawn between usability, functionality (International Centre for Facilities, 2003), serviceability (Davis et al, 1993) and accessibility (Travis, 2002).

Functionality has been defined as ‘performing or able to perform a regular function’ and is concerned with the functions and features of the product and has no bearing on whether users are able to use them or not. Increased functionality does not mean improved usability!

Serviceability focuses on 'the capability of a facility to provide a range of performances for which it is designed, used, or required to be used, over time' (International Center for Facilities), usability focuses on user perceptions of the ease and efficiency with which they can use the facility. The concepts can be seen as the 'flip sides of the same coin', serviceability from a supply perspective, usability from a demand perspective. Davis and Szigeti suggest that serviceability combines functionality with quality, which they define as the ‘totality of features and characteristics of a product or service that bear on its ability to satisfy stated and implied needs’.

Accessibility is a key dimension of usability. Travis has clarified the objectives of ‘accessibility’ audits, which concentrate on meeting the needs of disabled customers and a usability audit, to meet the needs of all customers. Travis argues that there is little point having an accessible (website) if it is unusable by both disabled and non-disabled people. By following a customer-centred approach, a usability audit can achieve both goals.

Research into ‘buildings-in-use’ has recognised that 'building users quickly recognise when things they need are absent - usually comfort, health and safety, ease of use and quickness of response when they want to change something. A lot of research and legislative effort goes into the first three, but much less for the last two - the essence of usability.' (Leaman, 2000)

Usability was however identified as a key concept in Facilities Management in the first issue of the International Journal of Facilities Management (Alexander, 1997).

Kernoghan et al (1997) used the development of guidance on building access and usability to describe well developed techniques for building evaluation. They suggested practical difficulties for structuring knowledge databases and address ways of making best use of hard won feedback. They presented facilities management as a dynamic process, requiring a dialogue between building providers and users, and building quality as a matter of ongoing negotiation.

The key role of facilities managers is to allow such negotiations to operate both openly and effectively.

Beech (1997) developed the theme of usability in the context of a 'virtual organisation', Reuters. He argued for enhanced teamwork and a more supportive style of leadership. The focus was on organisational culture - the artifacts, values, basic assumptions and normative practices which underlie organisational life. The new approach requires a non-hierarchical, non-judgemental team-working ethos, and a reward system that promotes collaborative working at all levels.

The task group will continue to explore the theoretical underpinning of usability concepts in an action learning approach that ensures practical relevance and applicability.

2.2 Changing the perspective

Applying the concept of usability implies a change from the traditional construction and property perspectives, which focus on the building as a project and a product, and consider technical and functional aspects of performance.

A clear example of these different perspectives is provided by the contrast and focus of the work in two separate centres of excellence at the Building Research Establishment in the United Kingdom, each with an interest in Facilities Management.

On the one hand, the Centre for Whole Life Performance focuses on the built asset and considers'the various issues surrounding facilities management, risk assessment, residual life assessment, functional performance and obsolescence - to ensure best value is achieved for a built asset'.

In contrast, the Centre for Productive Workplace focus on issues involved in evaluating the productive workplace, which cross a number of disciplines - engineers, architects and psychologists. This Centre offers help to organisations to 'get the most out of your workforce by an evaluation of the environmental and organisational aspects of workplace design and operation'.

In both cases the focus is on the capability of the building as an asset and it functional performance without direct reference to the end user. The working group on Usability seeks to redress this imbalance by promoting independent post-occupancy studies, with the direct involvement of users, and the management of feedback and feedforward.

2.3 Buildings as a factor of production

There is now much greater recognition of the need to consider buildings in the context of business, and from the perspective of end users. Buildings are a means to an organisational end and an instrument of use.

The workplace concept is used broadly to relate considerations of the physical setting in which work happens, to the services that support people in those settings and, perhaps most critically, the management processes that enable their effective use. These relationships need to be considered in the context of particular organisational contexts (culture) through cycles of time. The concept also embodies many types of work activity, not only the administrative and clerical work conventionally found in offices, but also health-care, education and industrial production, in a variety of settings and in dispersed locations.

There is considerable interest in the United Kingdom in establishing the links between the quality of the environment, health and well-being and productivity in the workplace. A number of practice-based research groups, eg Office Productivity Network, Workplace Forum, and Building Use Studies, are actively engaged in studies of buildings in use. The BRE has established a Centre for the Productive Workplace.

Similar work is also being undertaken in other European centres, including the Norwegian Building Research Institute, TU Delft, and Chalmers University and, in the United States, at Comell University and MIT.

Perhaps the best example from practice is provided by the work of Leaman and Building Use Studies. The aim is to 'help improve buildings, with hindsight from studies of past performance and foresight from well-considered strategies using simple but powerful tools to get useful results quickly'.

Building-in-use studies have created a usable buildings web-site as a resource for practitioners, managers, building owners, developers, students and anyone else who wants to make buildings more suitable for the people who use them, less damaging to the natural environment and a better long-term investment.

The task group will seek to identify and assimilate related research and to evaluate its application to case examples, in discussion with the industrial partners.

3. Research programme

The background provides a conceptual basis for developing and applying Usability concepts, but a concerted programme of activity is required to test their robustness and applicability in the context of organisations.

The programme of work for the CIB Task Group focuses on studies of the user experience of buildings and research on buildings-in-use and on the workplace, rather than on laboratory or theoretical studies, and will focus on concepts of usability and manageability.

The overall objective is to seek to improve buildings and workplaces through a better understanding of their performance in use, and more care with their design, construction and management. The working group will promote independent workplace appraisals and the management of feedback and feedforward and make the findings generally available where possible.

The task group has a limited two-year life, during which each research-based partner will host a workshop, involving all research-based and industrial partners, to present and discuss a usability case study.

4. Methodology

The project adapts and develops a methodology previously used in an EU research project entitled Workspace (EuroFM, 2000), by working through a series of interactive 'best practice' workshops to consider the results of case studies of buildings-in-use. The workshops involve the participation of organisations, organised as clusters of 'stakeholders' to represent the interests of owners, occupiers and operators of buildings. The clusters are organised as action learning sets, providing the opportunity to share learning and experience in the business context of the case study organisations.

The overall project uses a multiple case study approach. An initial set of four case studies will be carried out to test the adequacy of the framework, survey methods and to identify the overriding issues, which are of concern to different stakeholders. Material for the main case studies will then be gathered through interviews and analysis of documentation at different levels in each of the organisations involved. The data was being assessed at the level of holistic cases (projects), embedded cases (incidents within projects) and through cross-case comparisons at both of these levels.

A descriptive model will be developed for considering usability in the context of facilities management and business performance. Individual cases to be analysed using a standard framework to include:

- overall assessment of the usability of the workplace;
- assessment of the extent to which original business objectives have been met;
- assessment of changes to the business objectives, adaptation of the workplace;
- identification of the processes through which business objectives were translated into user requirements and usability criteria;
- comparison of design intentions and assumptions with the way buildings are being used;

The case studies focus on the processes by which the client organisation translates business objectives into process and operational performance requirements for the building, during the briefing development, commissioning and occupancy stages of a building. Initial business objectives, assumptions and design intentions will be compared with the buildings-in-use study. Evidence of changing business requirements, the consequences for usability and building performance, and resulting adaptation of the building will be collated to provide a longitudinal study of each case, and provide feedback to all stakeholders.

A 'best practice' workshop will be held in each host organisation to evaluate the cases and to draw out lessons and conclusions.

5. Case Studies

A usability case study framework has been devised, for the purposes of the research, comprising six inter-related dimensions of an organisational system and describing the context of the case study organisation in its business environment and the relationships amongst people, processes and settings, through time. The case study framework has also been related to an assessment for business excellence, the EFQM model, to facilitate discussion with business leaders and managers in the host organisations. The case study framework will be further developed during the project.

Three case studies have been selected and are being prepared, one each in the United Kingdom, Sweden and Finland and a fourth is planned in Norway. All four case studies and associated workshops will be completed in the initial programme of work to be completed by May 2003.

The UK case study focuses on the development of R & D facilities for NCR in Dundee, Scotland. Contribution to the Usability Task Group is demonstrated through the use of novel planning processes. Features of the project include the relocation and change process in such a tight timescale, Community Based Planning process, integration of Business Unit and Facilities Management as well as NCR ‘Discovery Centre’ being selected as one of the World Class FM practices.

Örebro University Hospital has been chosen as the Swedish case study and focuses on the users experience of functionality and usability of the surgery centre, built 1997, at Örebro University Hospital. Contribution to the Usability Task Group is demonstrated through the analysis of the planning process, the effects of incorporating new technology and new work processes as well analysis of the building configuration/layout. The case also enables a discussion on ongoing development of hospital work and its relationships to clients and premises.

The Finnish case study takes place in the area of Turku Science Park, which is the core of the innovative environment in Southwest Finland. In this area ‘Old Mill’ offers companies versatile services as well as functional and interesting premises with an atmosphere reminiscent of an old factory. There is a need to enlarge the functional and Old Mill 2 is in a planning phase. The case- study in Old Mill goals firstly to understand the elements of usability in refurbished environment and secondly to produce the elements for the use of planning process of Old Mill 2. The method used is a workplace survey for users of the building and database information about the requirements of the building. This data is analysed in order to find out the relevant components of usability.

The workshops provide the opportunity for participants to share their experience and for the presentation of similar cases. Other workshops are planned in Norway and later in France.

6. Usability processes

A particular focus of the case studies will be the processes by which the organisations ensure improved effectiveness and how successfully they manage organisational change associated with the workplace. These processes include usability planning, design and management and processes of workplace appraisal and audit.

The workshops will provide the opportunity of evaluating the application of particular processes and systems and tools for usability. Processes will include for example community-based planning (ref), universal design (Center for Universal Design, 1997), and particular tools for performance measurement, such as design quality indicators (Gann, 2003).

These tools will be assessed in the context of the organisations, from a facilities management perspective, with a particular interest in the manageability of the workplace (Alexander and Murphy, 1993).

7. New knowledge production

The task group will also reflect on the working of the task group, with particular attention to team working and collaboration.

Cooper (2002) has considered similar collaborative projects as examples of the ‘new production of knowledge’. He describes such production as ‘short-life inter-disciplinary teams collaborate by engaging in a dynamic form of research characterised by practical problem solving through negotiated and consensually produced knowledge.’

New knowledge production increasingly transcends discipline boundaries (Nowotny et al, 2001, Cooper, 2002). New means of knowledge production, mediated electronically over the Internet (Mansell et al., 1998; Cooper, 2002), will be able to unify the cross-disciplinary boundaries working in dispersed locations. Network based collaboration gives organisations the opportunity to share knowledge and hence allows the partners’ cooperation and team approaches to problem solving more quickly (Rifkin, 2000).

8. Conclusions

The results of the four case studies, reports of the associated workshops, and initial findings and conclusions will be presented at the congress. Key issues will be highlighted to generate an initial discussion about the application of usability concepts and techniques to assessing buildings and workplaces in use.

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Workplace planning and target costing techniques in project and facility management

Ari Pennanen,
Dr., Project manager, researcher. Haahtela Group. (email: ari.pennanen@haahtela.fi)
Yrjänä Haahtela,
Lic.Sc., Researcher, managing director of Haahtela Group (email: yrjana.haahtela@haahtela.fi)
Harri Väänänen,
M.Sc, Researcher, managing director of Haahtela- research (email: harri.vaananen@haahtela.fi)

ABSTRACT

This paper presents a project management concept for programming and designing workplaces in relation to facility user's strategy and operations. The concept includes the target costing product model that defines the life cycle costs basing on spaces needed and workplace planning product model which links spaces to business operations. They enable the definition and costing of working environment in client activity level.

The strategic management of the organization investing in the spatial facilities expect that the investment will support the business idea. The facility user's require working environment with such performances that enables their operations. During programming the building as a solid object can not be predicted; the user activities, extent, mass and materials of the building are unknown. Problem is complex and inductive since there are several correct answers.

Initial information are the values of the customer; "what are the valuable activities for the strategy?", "do they require spatial resources?". Design deals with connections of activities, theme and mass with which the building is connected to built environment. Combining those orthogonal variables in decision making cause more iterations and can be called unnecessary complexity. When dealing with orthogonal, complex and temporally hierarchical information, the information flow in decision making should be one-way. Unnecessary complexity would be reduced if the valuable activities for strategy are defined first, the performances of the working environment for those activities are determined then and the design solutions are looked for after these decisions.

However, some information that is realized in construction–in-site would be crucially needed in programming, namely the life cycle costs that will be caused by decisions. When deciding whether an activity would deserve spatial investment, it would be worth to know if the activity can afford it. Power must be linked to accountability. Target costing principles such as define functional criteria, determine target cost, design to the targets fit perfectly to construction. But the methodologies from the client needs to target cost must then be solved.

Keywords: Project management, knowledge management, workplace planning, target costing, customer needs

1. Target costing in Finnish construction

In the 1980's in Finnish construction sector facility owners thought that there was a lack of concern for their needs on the part of architects and project managers. Building costs seemed to be out of control, unpredictable in relation to their functional needs. Yrjänä Haahtela was working in the National Board of Building, and he was in charge of developing cost economics theory for building construction projects. It was explored that the variance of building costs was big and it was caused by complex set of variables: functional requirements, conditions in site, fluctuations, regional factors and design solutions. The way the design solutions affected to final costs seemed to be partly random. The questions for further research were: "Is it possible to separate those variables in a practical steering model ?", "Is it possible to set a cost target for a building project basing in client's functional needs?", "Is it possible to steer the design solution to the target?" , "How does target costing and steering the design affect to architectural quality?". Haahtela published the theory of target costing for construction in 1980 [1]. In this theory the target cost is set by using the room program (list of rooms) the client requires. The practical method fir target costing and steering the design was published next year. In the 1990's it was completed also to use room performances as initial information. Target costing has been in use for two decades and he benefits of method has been proved indisputable.

In the 1990's Ari Pennanen of Haahtela Research group started to construct a theory to link the need of rooms to the client activities and client business strategy. In this research it became evident that but the geometrics of the functions, also temporal strains of the functions and operation degrees of the rooms are important variables. The conclusion was that client functions and temporal planning of the functions are possible to steer, and this steering process will produce the needed rooms and stakeholders commitment to the result. The theory was named "the theory of workplace planning" and it was published in 2004 [2].

At the moment the research is continued to combine Target Costing and Workplace Planning theories to enable activity based costing management, to trace life cycle costs of the spaces to the user activities.

2. Target costing in other references

Target costing has been in use in Japanese automotive industry since the 1960's. Target costing aims to influence to the product costs (investment costs or life cycle costs) during the design phase by cost planning and cost control. As conventional product development practice converts costs into design outcome, target costing prices rather the design criterion. Since target cost is set before design solution, the price is usually driven by the market [3], i.e. the price is for specified product functionality, which is determined from understanding the needs of the customer and the willingness of the customer to pay for each function. After the product is designed, estimated costs of production are compared with target cost. If the estimated costs are higher than target cost, cost planning is employed to help achieve the target; the Cardinal Rule of target costing is: "The target cost must never be exceeded" [3].

In the 1960's target costing aimed to reducing cost through continuous improvement, "cost kaizen". This is becoming relatively less important in automotive industry, because the efforts made throughout the company will inevitably lead to fewer opportunities to cut costs [4].

According to the study of seven Japanese companies, the target costing discipline has been structured into three sections [3].

- the company's long-term sales and profits objectives in current market conditions
- product level target costing
- to component level target costing, i.e. decomposing product level target to the major functions or subassemblies

3. Target costing suitability to construction

3.1 Needs of the client

The strategic management of the organization investing in the spatial facilities expect that the investment will support the business idea. The facility user's require functional environment with such performances that enables their operations. The client need should be derived from the customers business strategy and the customers operational requirements. There are numerous stakeholders and decision makers in building process. Therefore, in the initial stage of programming, there are a lot of specifications and wishes. Most of them can be considered "right" or "entitled to", many of them are in contradiction to each other and, when combined, they are generally in serious competition for the resources available. Programming is a complex system [2].

3.2 Functional criteria information versus design information

Information used in the programming deals with the values of the customer; "what are the valuable activities for the strategy?", "do the activity require spatial resources?", "does that spatial investment support the strategy?". During programming the building as a physical object can not be predicted. The activities that require spaces, extent of building and materials are unknown. Design deals with connections between needed activities and theme and mass of the building that connects it to the environment. Before construction-in-site the materials, equipment and details will be determined by design (of course, parts of building can be designed after construction has begun, but all the components are designed before their production).

If a problem "do we need to invest in an activity?" is dealt simultaneously with a question "where would it be located in a plan?", there are limitless possible alternatives. If we first answer "no" to the first question, there are no alternatives left. Does answer to question A: "Where will it be in a plan?" create more valuable information to the question B: "Do we need it?" It will not as the problem B is linked to business strategy and problem A to steering the design process. Combining orthogonal variables in decision making cause more iterations and can be called unnecessary complexity [2]. Both programming and design last long, months or years, and unnecessary complexity leads to loss of money and time and offers very little benefits. Design problems should not be mixed with programming problems, one should not seek for a solution while defining the needs. Differentiating needs definition from the design solution is supported also in Suh's axiomatic design concept. It states that good planning require reduction of information content. Therefore customer needs and functional requirements must be determined in a solution-neutral environment [5].

Target costing principles such as:

- define functional criteria
- determine target cost
- design to the targets

fit perfectly to construction. But the methodologies from the client needs to target cost must be solved.

4. Target costing criteria and construction

4.1 Client criteria in construction

In automotive production target costing is often used as a tool between manufacturer and its supplier (external or internal). The manufacturer defines the functional criteria and willingness to pay, supplier designs the product below the target price to ensure the profit. The product criteria can usually be described in measurable way, e.g. the engine must have certain dimensions, power, fuel consumption etc. In construction, when operating in component level target costing, similarities with automotive industry can be found, e.g. main switchboard must have certain dimensions, power, ability to distribution and air exhaust apparatus has to provide certain amount of air, it must heat, cool and filter the air etc.

When operating in product level target costing, when the whole building is a product, conversation with client can not be done with traditional construction language. The client do not want cooling beams, switchboard or columns. Instead the client may want a library for 15 000 volumes and good internal climate in rush hours. The buildings tend to be unique. If we name a building as “an office building”, we don’t know whether they park cars, make food, have conferences, have a library or do fitness exercise in a building. Client functionality description is a complex problem.

In construction there also are soft values that can not be described in measurable way. The building must “hath three conditions: firmness, commodity, and delight” as Vitruvius expressed.

4.2 Quantitative criteria and target costing

In construction most of the functional criteria can be described in measurable way. The customer needs can be defined as a path from customer activity need to workplace spatial needs and finally to performance requirement description like in following example [1,2]:

- customer activity needs: library for 15 000 volumes
- workplace spatial needs: shelving areas 125 m2, pc:s for inquiry 12 m2…
- performance requirement needs internal temperature within +- 2 degrees, load 10 kN/m2…

The target costing techniques to price quantitative functional values by market information can be solved as it will be shown later in this paper.

4.3 Non-quantitative criteria and target costing

There are soft values (e.g. beauty) that can not be controlled in a quantitative way. The non-quantitative values of building, such as pleasantness, beauty, etc. are culturally bound and evolution is essential to culture. People mirror concepts of beauty against their cultural background (their experience, reading, learning. etc.). The basis of European’s taste in music is in accordance with western cultural heritage, interval division and chord techniques. Cultural heritage makes it difficult for an European to find Arabic, Chinese or Indian music beautiful, even though this music, like western music, includes its own culturally specific notions of beauty. Personal judgments of beauty are in accordance with personal inclinations and levels of education. The media (the press, television etc.) usually concentrate on those areas, where the values of individuals concur (how beauty is generally conceptualized) [2].

Culture and pleasantness is a problematic combination, because cultural heritage is cumulative and changes over time. Impressionism in the arts at the end of the 19th century was for the most part considered incomprehensible by both critics and collectors, whereas currently both Monet and Renoir are widely regarded as masters. Many of the buildings currently regarded as beautiful (for example functionalistic) were once beautiful only to a small elite. On the other hand most of the buildings that are currently considered ugly, will, in the future, still be considered ugly, and we do not know the direction evolution will take. The Museum of Modern Arts in Helsinki by Steven Holl delighted many when it was finished, but at the same time many felt it ran counter to modern cultural evolution. Only time will tell if it will become part of the accepted cultural stratum [2] (14.9.2003 The museum of modern arts was voted one of the ten most remarkable buildings in Finland. It was also voted the most unattractive building. The poll was conducted by the Helsingin Sanomat newspaper).

How does target costing deal with soft values? To answer that question we have to find out what is the correlation of architectural quality and costs. Architect Niukkanen has studied the correlation of architectural quality and building costs [6]. The population of the study was design & build competitions in Helsinki City residential building production. The competitors competed with architectural design solutions and price tenders. The architectural quality (external beauty, internal comfort, habitability) was analyzed by a delphi-group and value analyze matrix. The result of the study can be seen in figure 1.

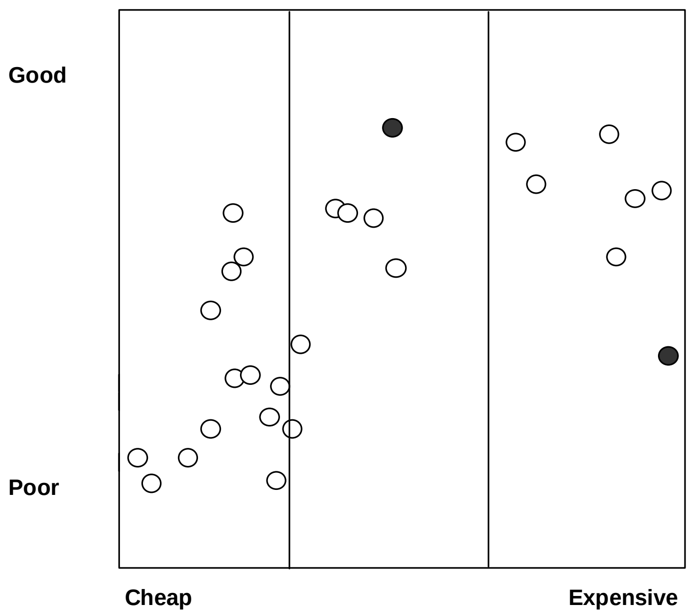

Figure 1: Architectural quality and building costs

If we aim at a minimum price, it might lead to poor quality. But very soon when moving to average price production, the correlation between quality and costs disappears. The most expensive design solution was quite poor in terms of quality and the best quality was achieved with a reasonable price (of course, high price did not prevent good quality). When moving from minimum to reasonable costs the architectural quality can not be assured by allocating more money to production, indeed, this may just as well lead to a poor quality solution as a high quality one. It seems that architectural quality is linked to creativity and artistry of the design group in interpreting our culture and it's changes rather than to money [2]. If we operate within reasonable cost area the building cost don't affect to architectural quality and information from possible future design solutions is not necessary to pay regard to in programming.

If we have methodologies to set the target cost by using quantitative criteria and set target cost in a reasonable area, then the costs can be considered as a fixed variable (a criteria among the others) and the architectural quality is the variable that is managed.

5. Target costing management and project management in construction

In simple "manufacturer and its subcontractor" situation the target cost is defined by market and by target profit. If negotiations are successful, agreement can be done and subcontractor starts design. This also can be done in component level target costing in construction. But acting in this way with "client – contractor" relationship is quite seldom in Europe. Because the client needs are complex and because there are soft values in design, the client don't normally want to lose his power in programming and design. The concern is that the contractor would add his profit by giving up the values that can not be described in measurable way. It is normal in Europe that programming and design is carried out by client's consultant.

Instead of observing customer – supplier relationship, target costing has been used in Finland to make project management more effective by observing internal customer relationships in production. The rest of the production can be considered as a customer of the programming process. The next internal customer would be design. Vague requirements of the stakeholders harm design (and production) [2]. By target costing the client can test fast several requirement combinations and finally commit to one specification and one target cost. It is design's duty then to achieve requirements and target cost. Target costing management is very widely used technique of project management to handle client – design relationship in Finland.

In Japanese automotive industry target costing has been used to reducing cost through continuous improvement. As it can be seen in figure 1, there is potential to cut costs in construction. But total effectiveness in reducing costs might lead to poor architectural quality. Target costing can also be used to prevent expensive solutions and to ensure resources to the best quality.

6. Target Costing Application

Target costing management require reliable methodologies to describe customer needs and to price customer needs. The methodologies must be descriptive in customer language and tested with market information. The Target Costing Application [1] has been developed in Haahtela Group project management. At the moment it is widely used among project managers, contractors and facility owners in Finland. The Target Costing Application calculates the life cycle costs of a project based on the rooms and the requirements for those rooms. The Target Costing Application is a mathematical model that creates the link between the requirements the client sets on the rooms and the possible distribution of elements + use of resources connected to running costs (energy, cleaning…). The budget can then be addressed back to the activities by tracing paths back in the Workplace Planning Procedure.

Target costing must be based in market information, not design information [1,3]. It is easy in component-level target pricing (e.g. air exhaust apparatus) but somewhat difficult in product-level as the buildings tend to be unique and complex in regard to client needs. Suh's Axiomatic Design concept [5] states an axiom: "A good design is made up of design parameters that result in the independence of the functional requirements from each other". It means that unnecessary complexity can be reduced if each design components satisfy only one functional requirement. Let's have a look at two requirements for internal climate: CO2 content and air cooling. They both can be controlled by

- variable air volume system (VAV) or
- CO2 content can be handled by constant air volume (CAV) system and the air temperature by water circulation system and cooling beams.

Suh's axiom argues that latter solution reduces complexity of whole system. Haahtela's Target Costing Application have similarities to Suh's axiom. It is modeled to link one widely used design solution, "reference solution", for each client requirement, as far as possible. By that means it has been possible to price each requirement by market information. This kind of modeling can describe the cost differences between the client requirements, but not the cost level as whole. It is hard to describe the entity by means of little pieces and on the other hand, the contractor's tenders are influenced, but by the costs of components, also by their current situation in the markets. Therefore Target Costing Application used also black box modeling [9]: differences between the client requirements are modeled by reference solutions, the level of target cost is calibrated by comparing continuously the modeled result to the actualized tenders. If these two results act regular, the difference is stored in black box. If not, model has to be improved.

■ TOTAL RENT ON ROOM SCHEDULE

Sec.	User	RoomN	Function area	m2	Capital (8%) €/m²/a	Maintenance €/m²/a	Total rent €/m²/a
A			Clinical treatment	60	126	86	286
A			Operating theatre	35	306	261	861
A			Martins room	15	93	43	143
A			Car parking hall	3 000	27	7	42

Figure 2 : Sample of output data of life cycle costs, expressed as a rent of a room.

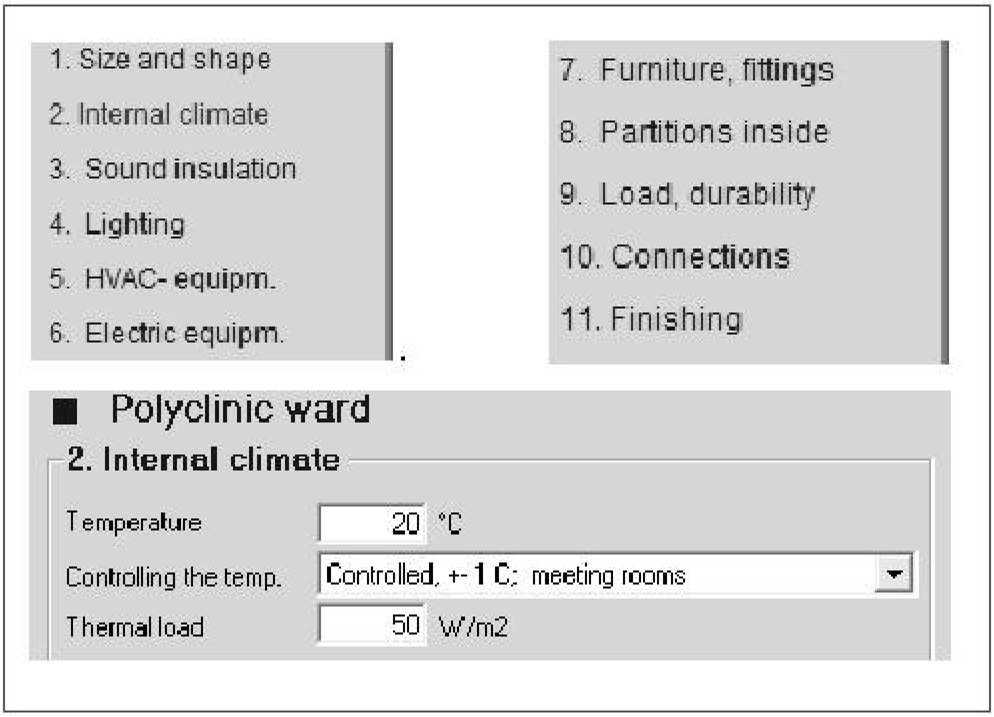

Figure 3: Classification of criteria of the application and sample criteria for internal climate.

7. Workplace planning application

Workplace Planning Application is based on the Workplace Planning concept that was developed in Haahtela Group project management in the 1990's [2]. The concept uses TFV- production theories [7] and ABC –management concepts [8] to construct a workplace planning theory. The Concept of Workplace Planning links workplace production to client's production. A spatial investment in an operation competes for the same recourses as the other investments in the operations. Workplace planning brings spatial investments and the values of the spaces into line with the other factors of client's production. Workplace planning is a process where valuable requirements for workplace production are determined through observing and evaluating the values of stakeholders against the organization's strategy.

The size of a space is determined by the operations taking place within that space (working at table, sleeping, teaching, playing tennis…). Spaces are a scene of temporal flow of operations and non-use time. The number of spaces is determined by the temporal utilization of the spaces. The concept of workplace planning defines value adding spatial investment (or here: no-value-adding) as follows:

- Investment to the operations' time is value adding and the non-use time is non-value adding with regard to the strategy
- Spatial investments in operations that are not needed for the organization's strategy are not value-adding.

The Workplace Planning application describes spatial environment:

- for strategic management as activities that require spatial resources
- for operative management as working environment for operations

Application computes the spatial need and their temporal utilization degrees basing on the factors shown in the table 1.

As the application uses only client activity information as initial input, and the spaces and utilization degrees are the outcome, the project manager knows who or what activities use a certain space, why they use, why it is that size and is there temporal resources left in a space. This information enables Activity Based Costing, if the costs of the spaces are known (previous chapter: target costing application). The application is continuously tested in market. Performance results are tested, but against reference books, against reference buildings. Outcome utilization degrees are tested by post occupancy evaluation. Space lists are tested to already made buildings.

Table 1. Space Quantification Example

Quantification Factor	Description	Example of Education Institution
The total volume of the sector.	No. of Customers or Products.	Two hundred design students.
The activity bill programmed for the sector.	Core Activities Supporting Activities	Teaching & Research. Administrative activities. Dining.
The temporal strain of functions and goals for the use of time in the space i.e. utilization degree.	Temporal Strain. Operating Degree.	Teaching Design Theory 4 credits, 30 h/ credit equals 120 h temporal strain/ student during 3 years. Facility management sets a 75 % utilization degree target for learning environment spaces.
The people working and the geometrics of the objects to be placed in the space.	Each function requires space expressed as a performance result.	Lecturing requires 10sq. Meters of lecture area. Students require standard seating and 1,2 sq. meter workspace. Material shelving require…
Regulations.	Regulatory society defines the quantification of space.	A basketball court have certain dimensions

Workplace planning operates in a complex area. It does not aim for an optimum because an optimum does not exist in a complex system. There are numerous working environment solutions that can be considered acceptable. It aims for a "good" solution. Once the workplace planner has presented the workplace measurements, the facility owner develops an understanding of the present or desired state of the system; i.e., what kind of working environment the owner groups need and value, and what the subsequent consequences will be to their resources. The information presentation allows transparency in that the client stakeholder can trace organizational activities to their origin.

If waste of space for unneeded operations and waste of non-use-time can be reduced, more resources will be available to the other investments for operations, spatial or non-spatial. Seeking for alternatives in value generation is an allocation process. Allocation deal with the questions

- can activities be combined within the same environment?
- is the activity really needed ? Compared to the others ? Are other activities needed ?

What is the criteria that differentiates the chosen solution from the bad ones and from the other good ones? It is the commitment of the participants to something achieved. The product of workplace planning for the rest of production is the stakeholders commitment. Indeed, stakeholders' commitment to the common values and requirements is an absolute necessity in all production to enable value generation. Thus it is a crucial part of the production.

8. Conclusions

Target costing and Workplace planning applications have been made to clarify and intensify internal customer relationship management, particularly between programming and designing. Target costing application enables pricing the rooms needed. Workplace planning application enables the definition of needed rooms on the basis of client activities. When combined, the enable target costing in client activity level.

Target costing application has been widely in use for two decades. It has been proved that it is possible to price the requirements the client sets on the room before design, and it is possible to steer the design to targets.

Workplace Planning application combined with Target Costing has been in use for five years, and the results have been encouraging. In recent cases the building costs have been reduced during the process without losing important activities. In Cygneaeus high school case and Jyväskylä Polytechnics case the "traditional programming" had already been done when the customer asked for workplace planning process. In both cases costs were reduced more than 15 %, decisions were made both by operative and strategic management and stakeholders committed to the result. In Cygnaeus case the process led to so low costs that operative management could add spatial investments. They did not add anything that was removed during the process; discovered waste remained waste. Both the cases has been designed to the targets [2].

Workplace planning and target costing have been used to wide range of lines of business; offices, hospitals, churches, assembly halls, universities, day care centres etc. The concepts have been universal. Better understanding of client values and costing them have not prevented good architectural quality as it has been shown in Synapsia- rehabilitation centre case [2]. The building was named "one of the best pieces of Finnish architecture during 1998…2002" [10]. It is possible to deal with values, money and activities during workplace planning and target costing and to create the best architectural quality

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Usability Walkthrough in Workplaces – What, how, why and when?

Suvi Nenonen,
Turku Polytechnic, Finland (email: suvi.nenonen@turkuamk.fi)
Kari Nissinen,
VTT –Technical Research Centre of Finland (email: kari.nissinen@vtt.fi)

Abstract

The usability of workplaces is a challenge – how then does one investigate it? Usability walkthrough as a method in general can be cognitive or pluralistic. Cognitive walkthrough is a task oriented usability inspection method. Cognitive walkthrough is based on a theory of learning by exploration according to which users try to infer what to do next using cues that the system provides. Pluralistic usability walk through is a method, which combines elements from a usability test and usability inspection.

This paper concentrates on the usability walkthrough methods in the context of a workplace as a system. A pluralistic usability walk-through session involves participants from three groups: group of users representatives, architects and usability professionals from facilities management. Together the participants gather information about the workplace usability by inspecting it. At the end of the session the whole group discusses the findings they have made. The application of cognitive walkthrough is also significant for development and evaluation of workplaces – there exist many components, which are relevant to test from the perspective of continuous learning. The technique is suggested as a tool for a process to evaluate workplaces, identify the gaps between the original design concepts and the current use, and to provide a platform for different parties to communicate.

The paper presents a case study from the business park for IT-companies in Finland. The process of usability walkthrough is described and conclusions include the proposal for developing the method further.

Keywords: usability walkthrough, workplace, usability profile

1. Introduction

The easy use of workplace is one of the main tasks for customer-orientated facilities management. The user of the workplace and his or her experience differ from the experiences of designers, architects and construction teams. There is no use to ignore this diversity but however there is an interesting challenge to develop ways to get benefit out of this diversity. This multidisciplinary approach in practice might be difficult to achieve but it this effort is worth to do.

There are challenges in the method and processes of usability walkthrough and one of them is the shared language and common understanding. The understanding of customer's or end-user's need sounds like different languages even though the focus is on the same object, workplace. The second challenge is the timing in the building process. The third challenge is: who is finally responsible of the usability?

These challenges have been a matter of interest in the research project of Usability of Workplaces. The Usability of Workplaces as a research project of CIB51 Task group includes five different case studies in five countries: England, Sweden, France, Norway and Finland. The Finnish case study focused on the elements of usability in a refurbished working environment of Old Mill Business Park. The Old Mill is located in Turku Science Park area and offers services as well as premises with an atmosphere of an old factory for ICT companies.

The Finnish case study among others developed the method of the usability walk- through. Besides the European research project there are several case studies conducted as part of the studies of facilities management in Turku Polytechnic. The paper aims to create an overview for the usability walkthrough as a method.

2. What is Usability Walkthrough?

2.1 Usability

Beyond all definitions, office usability is about the usage phase and end-users of the office. According to ISO 9241 [1]. "A system can be said to be usable when specified users in specified circumstances with specified goals, can use it with effectiveness, efficiency and satisfaction." Effectiveness means the accuracy and completeness with which users achieve specified goals. Efficiency is described as the resources expended in relation to the accuracy and completeness with which users achieve goals. Thirdly the satisfaction is the comfort and acceptability of use. To make it simpler the effectiveness means doing right things, the efficiency means doing this right and satisfaction is the level of comfort and pleasure in doing things.

According to Nissinen (2004) the high quality working environment is not only functional but also usable. It is well known fact that the costs of office environment constitute only a small part of the total costs of a typical organization. [2]. However, the importance of working environment quality is essential for any organization due to several reasons, for instance: High quality working environment enables the office workers – the most important resource of the organization - to do their best every working day and every working hour according to today's business challenge: to do more, faster and better, with less time. For any company a high quality working environment is an important advantage when competing for the best and satisfied workers.

The methods to evaluate and measure the workplaces from the usability point of view include more than only a survey of customer satisfaction. The effort is to find out the quality and content of the user experience of the usability.

2.2 Usability walkthrough

Pluralistic usability walk through is a method, which combines elements from a usability test and usability inspection. A pluralistic usability walk-through session involves participants from three groups: the users (present or potential) of the workplace, system developers like architects, designers and constructors and usability professionals. Together the participants gather information about the usability by inspecting the workplace. All users who try to accomplish given tasks participating the usability analysis. In the end of the session the whole group discusses the findings they have made.

Cognitive walkthrough is a task oriented usability inspection method. Its focus is on ease of learning. Cognitive walkthrough is based on a theory of learning by exploration according to which users try to infer what to do next using cues that the system provides. Users do not read manual or want any formal instructions before they start to use new systems. Instead users learn by doing and exploring. The method is applied in ICT field. [3, 4, 5, 6, 7]

Riihiaho (2000) describes the usability walkthrough as the method, which guides the analysts to consider users' mental processes in detail instead of evaluating the characteristics of the actual interface. The method can be used very early in the design process to evaluate designers' preliminary design ideas and hence no running version of the systems required. On the other hand the context of the tasks and the users' characteristics must be well specified so that the analysts are able to consider the users' mental processes. [3]

In the walkthrough, the analysts comment on the sequence of actions that the users should execute to accomplish their tasks. The walk-through should always follow the right sequence of actions, that is the sequence that the designer has planned the user to follow. If problems arise in this sequence, they are recorded but the analysis's continued as if the problem did not exist. [3]

3. Why to make Usability Walkthrough?

The usability walk through can serve several purposes. It can indicate the components of usability of the workplace. It is essential to point out the factors, which are causing the high or low usability in order to improve it. Secondly it is important to get information about the factors, which are significant for usability. Thirdly the factors of usability and evaluation of them seems to be a source for interesting process of understanding and discussing about the workplace. According to Horelli (1992) the human beings are very adaptive to the environment [8]. This explains why the usability is not self evidently the elements which people demand in the workplaces. The tendency is to take the workplace as granted instead of demanding the high usability. But the increase of the awareness around usability of the workplace is a change to get into the learning process both in individual and organizational level. The process will lead to the improved usability and at its best, the process is continuous learning and evaluation cycle and an important part of organization's functions. The usability walkthrough technique is suggested as a tool to evaluate the workplaces, identify the gaps between the original design concepts and the current use, and to provide a platform for different parties to communicate.

The object of the usability walk through varies in different situation. It can focus on the use of the new workplace. It can be done in the workplace, which has been long in use or it can goal to the refurbishment of the workplace. In all these settings it is a way to investigate the relationship between the workplace and the workplace behavior and human cognitive maps. The logic in environment is a component of vital environment [8].

4. How to make Usability Walkthrough?

4.1 Usability Walkthrough in case study

This Chapter presents a case study where the usability walkthrough was used. The usability walkthrough was a challenge in the case study target, which was the Old Mill business park, which is located in the Kupittaa area of Turku close to three universities, the polytechnic, the railway station and the increasing Turku Science Park. The building itself is an old ceramic factory renovated for the use of ICT-companies. In Turku the area development strategy includes an important center for ICT-business. Consequently, the decision was taken to renovate the old factory as a modern center for ICT-companies The interior of the building has been left exposed in the renovation giving the estate its unique feeling combining modern technology with the building's historical features.

The Old Mill includes a number of additional services alongside its functional and interesting office space. The building is equipped with latest data network connections to provide the best setting possible for the ICT-companies in the estate. Tenants also have access to a number of meeting rooms as well as an auditorium for their use. Sodexho manages a restaurant in the building providing the perfect setting for business as well as private functions. Petrasol Business Centre oversees the running of the Old Mill's reception area, switchboard, as well as the building's Intranet.

The building of the Old Mill presents the imago and brand in a similar way as the name, slogans or logo. The Old Mill has its own profile and identity, which differs from the surroundings and manages to provide something unique for the companies. The expression in www-pages "From a ceramic factory to a technology center – a glance into Old Mill's history" and **"**New technology in an old factory " make the brand of the building exciting, unique and valuing tradition

The usability walkthrough was thought carefully and some framing was done. The interesting character of business parks encouraged concentrating in the usability walkthrough fully in shared, common and public parts of the building instead of the individual workstations. In order to clarify the objectives of the usability walk through the diagnosis of high and low usability was made by the survey for user's of the building.

In usability walkthrough itself the end users, on various levels, evaluated those objectives, which had scored with high or low usability in the diagnosis survey. The balance of the participants is important. The team for usability walk through included

- The architect of the present structure in Old Mill
- The service provider of help desk services
- The service provider of catering services
- The facility manager
- The end user
- The usability researchers

Using the former data from the diagnosis phase the route for usability walkthrough was identified. The results were described briefly and the participants have had the chance to prepare. They got some guiding questions beforehand.

Participants were encouraged to reflect their views on the facilities and open-ended questions were asked to collate different point of views. Discussions were tape-recorded. During the walk through, the participants observed the facilities and began to discuss the causes and effects of use of spaces. Participants were encouraged to give feed back according to their own experiences on predetermined milestones:

- The entrance space
- The restaurant
- The meeting room
- The parking area

Table 1 Usability walkthrough results

VIEW	FACT	RECOMMENDATION AND FINDINGS
The entrance space	The entrance space is large and the reception/ help desk is located on the other end of it. As the desk is relatively distant from the entrance itself, it is not immediately noticeable when you enter the building. This sometimes causes confusion for visitors. *“We often need to catch visitors attention, because they don’t notice us”* – reception	Make the help desk service visible. Hospitality (of reception staff) increases usability – service is an intangible attractor.
	It is assumed that visitors approach the help-desk/reception first in order to provide security (limited access to offices). Therefore there is a limited amount of signs and guidance.	People should be encouraged to **learn** to use the help desk. Host should inform the visitor about norms.
	The “lobby-area” is in low use *“People are not familiar with using such a open entrance spaces”* - architect People are not utilising this space for other purposes (multi-use), such as meeting, displaying products, events etc. *“People don’t want to be seen to sit in a lobby as this means you are lazy”*’- FM	To provide information about multiuse possibilities The attractors: vending machines and touchdown desks The furniture solution - Encourage for communication and interaction (greeting and informal meeting) - Should the space be divided to provide more privacy? - Focal point to the entrance (
	The design of the space creates a “wow”-effect. *“I chose to work here because I was impressed with the design of the building”* - user	A lively and dynamic atmosphere should be created to sustain the positive and attractive impression. (From the first impression to the total experience – “wow, here is a pulse”-effect) Maintaining the ‘wow’ effect throughout the building -
The restaurant	*“The layout of the lunch buffet is illogical - wrong way round”* – service provider	Use the towards the clockwise Arrangements Change the location of the cashier
	The lack of information about “traffic” rules	Signs

	Limited use of two meeting rooms after the restaurant closing time	Information Room booking arrangements
	On-peak time queuing is time consuming and frustrating *"I sometimes turn back when I see the queue and come back later"* - *user*	Encouraging people to have their lunch on off-peak times – rewards (free coffee and dessert etc.)
The meeting room	The light and ventilation switches are illogical: Red light indicates that the ventilation is switched on – confusing message (red = danger) To control the level of light you need to press rather than turn the switch – Delay in the change of the level of light - difficult to achieve desired level. *"It is embarrassing when the lights turn off in the middle of a important customer meeting"* - user	Guidance for, and information about, efficient use.
	As a consequence after combining two smaller meeting rooms, the light and ventilation switches are not next to the new main door (having to find the switches in the dark)	Investigate new solutions (Remote control etc.)
	It is difficult to serve food and beverages in the two small meeting rooms.	Consideration of furniture solutions
	The need for larger meeting spaces has increased – more training sessions	Use of entrance space?
	ICT system and security – the same phone line for two rooms. *"We need an absolute confidentiality also during the tele-meetings"* - user	Under assessment.
The Parking area	Not enough parking space for customers. *"I sometimes have to go and re-park our customers' cars because the allowed parking time is only 2 hours – less than most of the meetings. "* – user	Help desk service can be developed

The status of usability Old Mill is quite high, but some areas of improvement have been identified. The aims for improvements include:

- Customer orientation in the car parking area. (Serviceability)
- Smarter' (multiple) use of the entrance hall - focus on different options and communication of these to the users. This encourages them to use this space more efficiently. (Usability)
- Efficient use of the restaurant lunch buffet by improving the logic of the layout.can be improved (Learnability)
- Better guidance of the ways the meeting rooms are used. The amount of information for the use of meeting rooms. (Functionality) [9]

4.2 Learning points for developing the usability walkthrough method

The usability walkthrough in the public and shared places in the business park kind of setting gave interesting results. Anyhow it caused several questions, which are worth to consider further. The user's experience of the public areas are always linked to the context of the workplace as a whole setting. The whole setting in usability walkthrough could give different results from the perspective of the user. On the other hand the group of service providers as end-users in the business park is an important group within a usability investigation.

The second issue is about the targets of usability. To the usability walkthrough in the presented case study the targets based on the results of the survey. The targets should be based on the user's experience of usability. Because the experience has its soft kind of nature it might be worth to explore if the usability attributes created by Keinonen (2000) could be a matter to apply. [10]

Keinonen (2000) has developed a model of usability for consumer products but many of the attributes he defines are also relevant with workplaces. The usability attributes are:

•Functionality (FNC)
•Logicality (LOG)
•Information presentation (PRE)
•User manual, documentation (DOC)
•Usefulness (USE)
•Ease of use (EoU)
•Affect on emotions (AFF).

The attributes described are connected to either personal preferences of the consumer, or directly to the product, or to its functionality. The first level of usability has to do with how the user perceives the concrete characteristics of the user interface of the product (LOG, PRE, DOC, and FNC. [10]

The two other attributes documentation and functionality have a lot to do with the instructions and their achievement according to the functional properties of the building. The use of lightning, regulation of room temperature, the air-conditioning – how do their function, how they can be used and how the use of them is informed. These are essential points of views of usability of workplaces.

The next level of usability evaluation contains the consumer’s feeling about the quality of the interaction between her and the product (USE, EoU) [10]. In addition it might be relevant to mention two more criteria for vital environment by Horelli [8]. Besides earlier mentioned logic of the environment the vitality included the feeling that the workplace can offer an exit from daily rush, disturbances and mental requirements –it is refreshing environment. As well it offers the sense of belonging for the user – it helps a person to include oneself to the organisation, profession and goals of the work. Nevertheless it is attractive. This comes close the third level of usability, which is also the most common in use when usability is evaluated, is the interactions general effectiveness on users’ emotions. This level is emphasised by consumers’ personal aesthetic and value based criteria (AFF). [10]

Instead of the objects like entrance hall or meeting room it could be possible to concentrate more in the description of the qualitative aspect of the usability experience. This approach can then end up to concrete objects as indicators and visible artefacts for the usability experience.

5 Conclusions

The usability walkthrough is a relevant way to approach usability, its evaluation and development. The existence of diversity in participants characteristics and needs in relation to usability walkthrough has all the potential to impose significant challenges. Two questions still remain: whose responsibility is usability? and secondly how to attract usability experts to the organization to share usability experiences?

The method of collecting and disseminating information about usability of work places is one issue that requires further investigation. Such investigation would make it possible to build a usability profiles for workplaces. This profile can illustrate the characteristics, which make the workplace suitable for doing right things in right way and with the ease and satisfaction. The usability profiles from different workplaces could together produce interesting material to compare and classify further the elements of usability.

One other difficulty with investigating usability at workplaces is that it is impossible to create a controlled environment within which usability data can be collected. Usually usability walkthrough is carried in a workplace environment and is quite different from a designed environment on a smaller scale. This is largely because of the impracticability of designing such physical smaller scale usability environment. However there are possibilities for simulation especially in the virtual environment. This is an area that has not yet been fully explored or applied. Such usability lab is possible given the existence of supporting technologies and requires more investigation.

The usability, based on the experience of the user, is one element in the discussion about the workplaces, which support the total well being of the user. The effectiveness, efficiency and satisfaction in the workplace increase the productivity of the user – not only as a ratio between input and output but also as a quality of the work performance.

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The Impact of Hi-tech learning Environments on Pupils’ Interactions

Túlio Tibúrcio,
The University of Reading, Reading, UK, (email: t.m.d.s.tiburcio@rdg.ac.uk)
Edward F. Finch,
The University of Reading, Reading, UK (email: e.f.finch@rdg.ac.uk)

Abstract

This study focuses on the intelligent ‘classroom of the future’ which characteristically make extensive use of information technology and flexible environments. The UK Government has recognised the need for radical changes to classroom environments and their facilities in order to improve learning. As an outcome of these new ideas, proposals are being developed and implemented through the UK’s “Classrooms of the Future” project [1]. The behavioural analysis method described in this is used to critically examine the efficacy of the “Schools of the Future” concept.

Research suggests that students are positively disposed to new technology in the classroom environment [2]. One study has used behavioural mapping to analyze the effect of the classroom environment on the practice of teachers [3]. The purpose of this research is to determine whether these novel intelligent classrooms will affect the behaviour of children in their new learning environments. Behavioural mapping was used to observe and monitor the classroom environment and analyse usage. Two new classrooms designed by INTEGER (Intelligent and Green) in two different UK schools provided the case study environments to determine whether intelligent learning environments can enhance learning experiences.

Keywords: Learning environment, classroom environment, intelligent classrooms, behaviour, behavioural mapping.

1. Introduction

1.1 A Hi-Tech Learning Environment

The discussion about learning environments extends beyond the boundaries of a single room to a variety of settings. Learning can occur in numerous environments. Information and communication technology (ICT) are integral to this learning experience and the flexibility it affords. The measurement of successful learning can be a very complex task to accomplish. [4].

The classroom is also a complex space [2]. He states that “the classroom environment is a complex environment which poses a number on methodological problems for any researcher” [page 22]. However, observing and understanding a space can provide an indication of how well learning resources and interactions are being explored.

Figure 1 A technology-based flexible classroom

This study focuses upon new technology-based classrooms (see Figure 1), referred to as intelligent classrooms. It aims to investigate the impacts of these new environments on pupils and whether pupils’ behaviour is affected by the change of environment. Methods from environmental psychology underpin the research.

The UK government is seeking improvements in education both in terms of learning acquisition and school facilities. New learning spaces have been built or renovated. In UK about 31 new classrooms of the future were designed and are being built around the country [1]. However, some fundamental questions remain to be answered. What are schools of the future going to be like? What will be the impact of technology in early education? What changes are needed in the learning environment? Annesley et al. [5] argues that the design of a school affects the way pupils and staff interact, their motivation and self-esteem – this in turn has an effect on learning.

In this study the focus will be restricted to single classroom spaces, although it is acknowledged that other issues such as grounds and circulation areas may also play a significant role. The study explores key factors that seem to have some influence in this process: the flexibility of the space, the mobility of the teacher and the use of new-technology. New technology enables flexibility and mobility, both of which are analysed in the study. In addition, human interactions in the classroom are analysed in order to find out if technology-based classrooms enhance learning.

1.2 An intelligent classroom

Study by Underwood [2] already indicates that students are willing to accept information and communication technologies (ICT) in the classroom environment. Dudek [6] argues that schools and their educational needs are changing and that information and communications technologies are expected to transform the classroom. School facilities, including the classroom, are already facing changes to meet the needs of the ‘communications age’. Figure 2 shows the use of information and communication technology in one classroom took as case study.

Figure 2 A n intelligent classroom environment

There is a belief that “in the classroom of the future the learning environment will look and feel different” [1, page 79]. The intelligent classroom, in this research, considers two aspects: technological (or technology-based) and sustainable. The technological aspect looks at the building as a product that: **a.)** makes extensive use of information and communication technologies such as wireless computing, video-conferencing, interactive whiteboards, that enable individual and group work as well as electronic links to other schools and facilities; **b.)** has flexibility as a central theme to enable a variety of different learning environments; **c.)** provides movable, attractive and adjustable furniture suitable for a wide range of ages and sizes facilitating use of the new learning technology.

The other aspect of the intelligent classroom concept is linked to sustainability or green buildings. According to Edwards [7] “sustainability is increasingly seen as the only legitimate architectural design issue for the 21st century” [page 83]. He also tries to establish a link among productivity, technology and sustainability and states that these three factors “are quickly being recognized as an important package of interactions, especially in working environments” [page 83]. Environmental (green) issues in the workplace are also discussed by McGregor and Then [8]. They argue that both providers and occupiers of buildings are realizing, increasingly, “that workspaces need to be provided in an environmentally responsible way” [page 121]. This research investigates these sustainable workplace ideas by looking at school environments which were conceived as intelligent *and* green buildings.

2. Multi-Method Approach

A multi-method approach was employed in the research in order to avoid bias (as advocated by Zeisel [9]), who argues that using several methods to attack one problem achieves higher-quality research, suggesting that “the appropriate mix of methods will be the one that enables you to achieve your ends with the greatest control over side effects” [page 229].

This research is based on comparative case studies of two new classrooms and two traditional classrooms at different schools. Two main methods were used: behavioural mapping (through class observation) and questionnaires. In addition, two other tools were used to elicit information: interviews were carried out in the beginning of the field work and a feedback box was set up in the studied environment.

2.1 Behavioural mapping

Rivlin and Rothenberg [10] define behavioural mapping as a naturalistic time-sample technique for describing patterns of activities and the use of physical space. Zeisel [9] describes similar technique named as behavioural plan annotation in which information about the relation between the environment and behaviour is recorded.

Horne [3] explored the behavioural mapping technique in her observations in classrooms. She argues behavioural mapping is an efficient tool to get a clear understanding of the classroom environment. It is generally believed that behaviour is affected by the environment and the environment in turn is changed or adapted to accommodate different behaviour.

Behavioural mapping was chosen since it allows several graphic maps to be produced during an observation session. Every 5 minutes a map of the physical space or physical settings (as defined by Proshansky [11]) was produced and information was registered. Ittleson *et al* [12] suggested time intervals of 15 minutes, but variation is possible. The observations were mapped on floor plans of the classroom, annotating layout, teacher's movement, interactions among users and with the environment, record of activities and their duration.

2.2 The Constructs and Terminologies

Various constructs were developed by Horne [3] to help class observation techniques. Some of them are described here. *Lesson profile*, *flexibility of the classroom*, *mobility of the teacher*, and *density* are constructs being used in this research. Another factor, *interaction*, was added and is being investigated in order to check the relation of the new learning environment with possible interactions among users. This factor has also been used before by Horne, but from the teacher's perspective. In this research the focus is on pupils.

Some constructs and terminologies described in this session were used in the research and originate from Horne [13] with some adaptations: **a) Lesson profile** is a column that identifies the clusters of activities (introduction, teacher teaching, pupils on task, transition, and conclusion; identified to describe the different activities that occur in the classroom. **b) Flexibility factor** of the classroom "is the total area in each room that allows change to be made by the teacher with varying degrees of effort" [page 143]. **c) Mobility factor** of the teacher is the total area covered by the teacher during the lesson in relation to the total area of the room. **d) Density** is the amount of space per pupil in a classroom measured in square meters per pupil**; e) Interactions** mean relationship between users and the new learning environment. These interactions were classified in 5 categories in order to be quantified and to investigate if there is any relationship with the other factors. As the focus of this study is the pupils, the possible interactions were identified: 1. pupil-to-pupil, 2. pupil-to-teacher, 3. pupil-to-equipment, 4. group interaction, 5. no interaction; **f) New-Technology** is introduced to refer to leading information and communication technology (ICT) which includes interactive whiteboards, laptops, web-tablets, video-conference, scanners, printers, and digital cameras. This equipment is available for pupils and teachers alike and can be used to support both group and individual working.

2.3 Physical Settings

Two new classrooms designed by INTEGER-Intelligent and Green as part of UK Government project named "The Classroom of the Future" provided the case studies for this research. The goal of this government project is to enhance learning acquisition through innovation in the school environment. Several such classrooms have been designed and built around the country. Telford and Wrekin Local Education Authority (LEA) has these two new classrooms in two different schools: The Lord Silkin (secondary school) and Wrockwardine Wood Church of England Junior (primary school). Two locations were used for class observation in this research. In addition, pupils were observed in both traditional and new classrooms to provide a control.

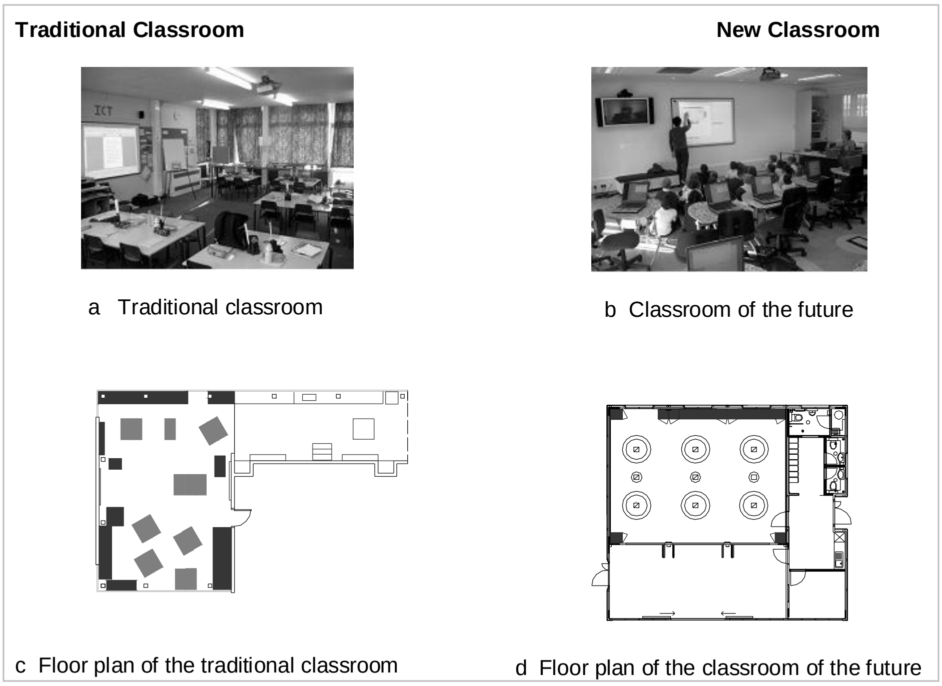
Table 1: Summary of the school classes studied.

Case Study	*School*	*No. of pupils* Male	female	Total	*Age group*	*Stage**	*Year*
01	Wrockwardine Wood Church of England Junior School	15	14	29	7 - 9	Key Stage 2	Year 3 and Year 4
02	The Lord Silkin School	20	17	37	15 - 16	Key Stage 4	Year 11

* Related to DfES (Department of Education and Skills) [14]

Location 1 Wrockwardine Wood Church of England Junior School is a primary school attended by pupils at Key Stage 2 with 10 classes from Year 3 to 6. The classroom of the future built in this school was in use by all school pupils. One class of 29 pupils who were 7-9 years of age was chosen for class observations (Table 1). This choice was based on the convenience of matching the schedule of the secondary school observations. Students were observed in the new learning environment and in the traditional classroom (see Figures 3). The same group of pupils, the same teacher and the same subject were observed in both environments.

Location 2 The Lord Silkin School is a secondary school built in Telford and Wrekin Local Education Authority. This school is now applying to become a specialist school in business. The classroom of the future built in this school has been used by these business students. It is the same original design with slight differences in terms of cladding, decoration and different external deck. One single class of 37 pupils, 15-16 years of age (Table 1) was chosen as the second case study. Students were observed in this new classroom and in the traditional learning environment (Figure 4). Again, the same group of pupils, the same teacher and the same subject in this school being observed in two different environments.



Traditional Classroom

New Classroom

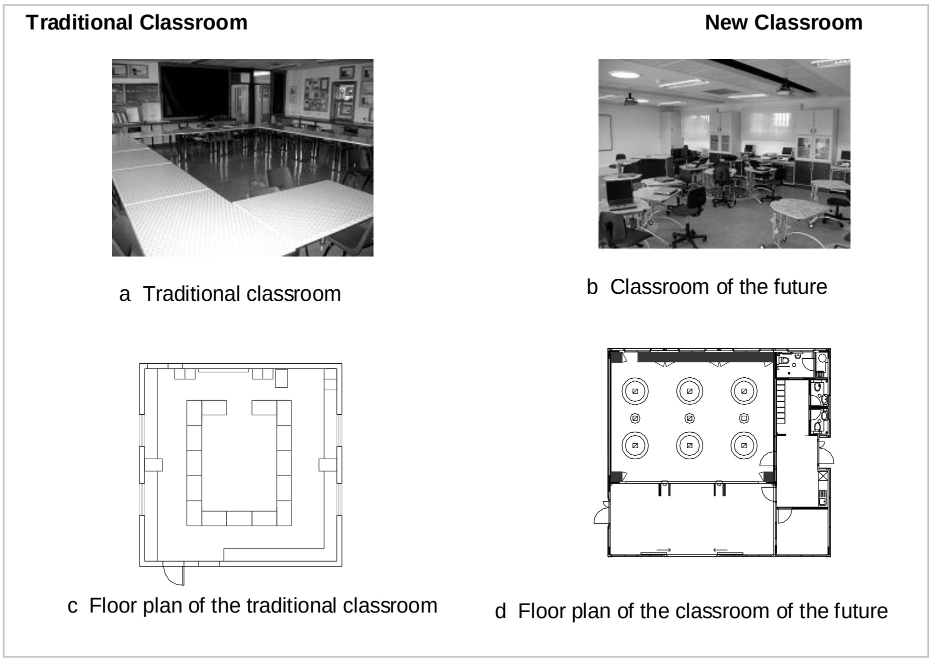
a Traditional classroom

b Classroom of the future

c Floor plan of the traditional classroom

d Floor plan of the classroom of the future

Figure 3 The two physical settings at Wrockwardine School



Traditional Classroom

New Classroom

a Traditional classroom

b Classroom of the future

c Floor plan of the traditional classroom

d Floor plan of the classroom of the future

Figure 4 The two physical settings at Lord Silkin School

2.4 Methodology

Interviews were carried out a few months after the launching of the classrooms which occurred last September 2003. Data gathering was structured based on the case studies described above.

A total of 64 class observations were planned. Pupils and teachers were observed in the new and in the traditional classroom for comparison purposes. In this way the sample has 4 physical settings (4 classrooms: 2 “classrooms of the future” and 2 ‘traditional’ ones) in two different schools. Each lesson observed would generate 10 behavioural maps in a total of 640 maps, considering that it could be reduced due to school dynamics.

Questionnaires were also used in the study. Considering a classroom a space where behaviour is an important observable factor, the behavioural mapping technique allows information to be gathered about this learning environment. However, observation in turn relies on interpretation of what was observed. Swetnam [15] argues that case studies are often classified as qualitative by definition. “Observation is essentially observer-oriented” [16,, page 9] having thus a degree of subjectivity. It means observation has limitations and information can be missed by the observer. Zeisel [9] states that it is crucial that the observer be aware of what he is looking for and what needs to be observed.

With research focus on teachers, Horne [3] used interviews to validate the data originating from observation. In this research, another technique was used since the focus is on the pupils. The use of questionnaire at the end of the observation process allowed the validation of the data collected from observations. The focus of the questionnaires was the users’ views of their experiences in the new environment. All pupils in the classes were given a questionnaire. The sample size for questionnaire in a qualitative study, as suggested by Allison et al.[16], needs to be only large enough to ensure a wide variety of answers. It was agreed with teachers that questionnaire would be a class activity, which produced a large number of responses.

Other tools were used to get feedback from users of the classroom of the future in both schools. A feedback box was set in each ‘Classroom of the Future’ and open-style forms were made available for users to give their feedback about the new environment. These boxes were collected at the end of the academic year. Interviews were also undertaken. Some teachers and pupils were interviewed at the pilot study stage to get impressions and expectations about the space.

3. Results and Discussion

3.1 Findings

Only initial findings were available at the time of writing. However the study has already shown some preliminary results that seem to support the hypothesis that ‘intelligent learning environments can enhance learning experiences’.

Figure 5 illustrates how some of these factors have been observed and recorded. Interactions were mapped graphically. Each five-minute map has tracked the teacher's movement and by overlapping them it is possible to calculate teacher's mobility. Furniture movements were measured to allow for calculation of the flexibility of the classroom.

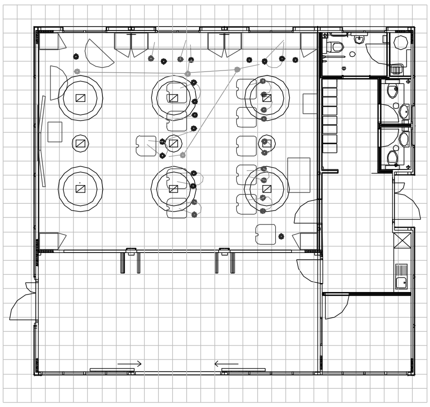


Figure 5 An example of a 5-minute map showing interactions in various categories, the layout for that lesson and teacher's tracking

Initial analysis of the behavioural maps has shown that interactions occurred more frequently in the classroom of the future as shown in Figure 6. This figure represents two observation sessions of the same group of pupils (secondary school) involving the same teacher and the same lesson subject in the two different learning environments: the traditional classroom and the classroom of the future. Four major factors that relate to interactions and their relationship have been identified: (1) interactions, (2) flexibility, (3) mobility, (4) technology.

The flexibility of the space in the classroom of the future is much higher (93%) than the traditional classroom (85%), encouraging more mobility from the teacher. Although the traditional classroom has a sizeable flexibility factor it has not been made use of.

Also the new technology in the classroom of the future has permitted the teacher to move around the classroom much more in the new environment (66% mobility). In the traditional classroom, where technology is limited, the teacher tends to be less mobile (15% mobility). Both use of technology and mobility seems to generate more interactions to occur in the new environment.

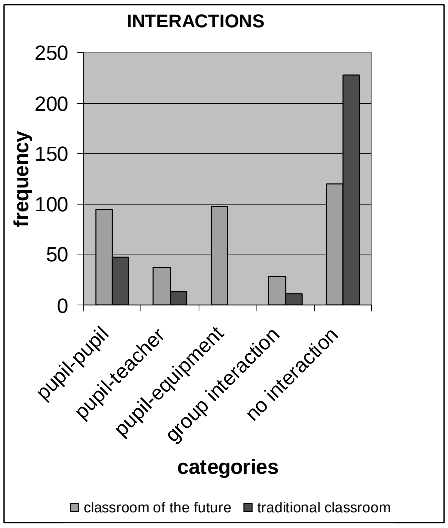


Figure 6: Interactions observed during 2 sessions in the secondary school

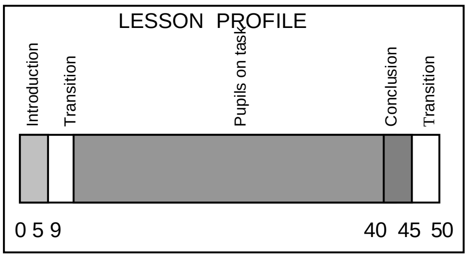


Figure 7: Lesson profile in traditional classroom at Lord Silkin School

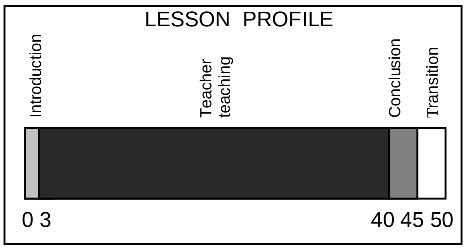


Figure 8: Lesson profile in classroom of the future at Lord Silkin School

Another important finding from the maps is the lesson profiles. They indicate that, in the classroom of the future, there is a tendency to have a more child-centred lesson as can be seen in the lesson profile in Figure 7. Pupils spend more time on tasks. In the traditional classroom the lesson profile (Figure 8) shows that the teacher spends most of the time teaching in the context of a teacher-centred lesson.

3.2 Relationships

Findings from the observations indicate that relationships exist between factors being investigated in this research. These relationships suggest that more interaction is stimulated by the new technology-based classroom.

Mobility and Flexibility The observations showed that flexibility seems to be directly linked to the mobility of the teacher. By comparing teacher movement in the traditional and new classroom it is possible to identify greater support for mobility in the new classroom. Furniture layout is routinely rearranged and equipment is relocated.

Mobility and Technology The new classroom has more equipment (laptops, web tablets, printers, interactive whiteboard, video-conference equipment) available for pupils to use (each student can have one piece of equipment for his own if necessary)

and evidence suggested that it was being used. The teacher was significantly more mobile in the new environment. Pupils only use the technology if the teacher invited them to do so. Only the teacher was tracked and mapped in terms of movement, but through observation it was possible to identify that there was also more movement of pupils in the new classroom due to new technology available.

Mobility and Interactions It was found that the more mobility the teacher had, the more interaction occurred amongst pupils. This was most obvious in the secondary school. In the traditional classroom the teacher spent most of the time teaching in front of the classroom while in the new one the teacher moved around interacting with individuals or groups. This was also apparent in the primary school. Observations indicated that the layout also influences the likelihood of interaction.

Interactions and Technology The technology available in the classroom of the future allows more teacher-pupils and pupil-pupil interactions. There was a belief at the beginning of this research that interaction may drop off when students used their own individual equipment. However, observations indicated that interactions seem to increase. The teacher was inclined to move around to teach and help pupils with the equipment. Pupils also interact more with each other and often worked in groups to help each other with the equipment.

Interactions and Flexibility By comparing the layout in the traditional and new classrooms (mainly in the secondary school) it is possible to state that the flexibility allowed by the new classroom has encouraged meaningful interactions. The traditional classroom in the secondary school has a horse-shoe shape layout that encourages the teacher to stay in the front of the room and the students to sit quietly around the horse-shoe shape desks arrangement. It produces few interactions. Most of the interactions that occur are teacher-group or one-to-one. In the new classroom a more flexible space has allowed more interactions as the teacher has more mobility. Pupils also have greater opportunity to interact with each other and in groups.

Flexibility and Technology A relationship was observed between 'flexibility' and 'technology' found with wireless technology together with movable furniture creating more flexibility in the observed classroom.

All these relationships can be summarized in a diagram as illustrated in Figure 9. It indicates that the use of new technology, flexibility and mobility all allow more interactions to occur.

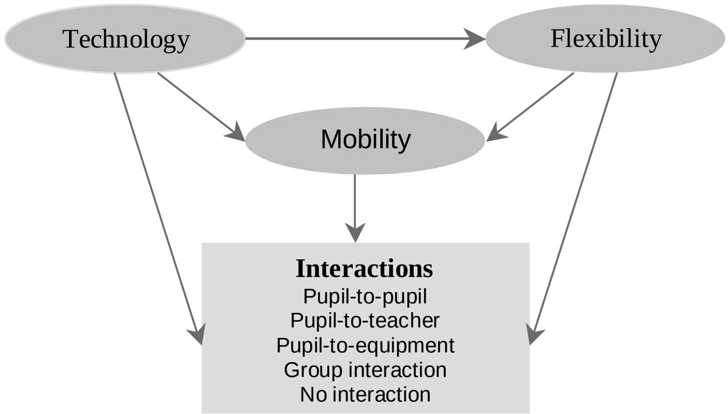


Figure 9: Relationship among key factors

4. Conclusions

This research sought to investigate the impact of new classroom environments on pupils and whether pupils' behaviour is affected by the change of environment. The research also shows a new way of examining the classroom environment with the focus on pupils.

The study has shown that developments in classroom design needs to consider technology as a key factor. Pupils are comfortable and become familiar with the use of new equipments and technology. Teachers are being trained and encouraged in the use of technology in their classes. The use of new technology-based environments seems to have positive effect on the learning process, in the delivery, interpretation and reuse of information. Pupils' behaviour was observed to improve in these environments. The pupils seemed stimulated by the new technology and also by the appeal of the classroom spaces. Teachers also felt pupils were stimulated by these new learning environments. Interactions seemed to increase as discussed previously due to factors such as flexibility, mobility and technology. This confirms flexibility as another important issue in building design and workspace design.

Further studies in this research will investigate productive interactions as suggested by Littleton [17]. It is expected that it will allow some understanding of whether learning acquisition has any relationship with interaction levels. The assumption that high levels of interaction are necessarily 'good' needs further analysis.

It seems to be clear that an intelligent classroom will demand more investment, maintenance and management. It becomes a more complex environment and needs to be well planned and designed in order to attend to the demands of teachers, pupils and the community at large.

Intelligent classrooms present a new approach for learning environments. These environments seem to be a new way of stimulating pupils' curiosity, initiative and autonomous learning. The flexibility existent in these classrooms facilitates interaction and it seems to help group and independent learning. The accessibility to and use of information, made easier through technology, introduces new practices in the classroom. A new way of learning is brought about by the intelligent classroom. In order to discriminate between effective and ineffective innovations in such environments, analytical tools such as that described in this paper should be adopted.

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Architectural design as an enabling resource for end users in K-12 schools

Erland Flygt, MArch,
KTH Syd Campus Haninge, Dep. for Design, Work environment, Safety and Health
Marinens väg 30, 13640 Haninge, Sweden. erland.flygt@syd.kth.se

Abstract

This paper discusses architectural design as an enabling resource for end users in K-12 schools. It also presents work in progress and preliminary results from a doctoral program project that investigates the relationship between architectural design and educational outcomes. The main focus lies on a case study concerning a K-12 school built in the late 1960s and situated in a socioeconomically deprived and mainly immigrant catchment area in Sweden. There is surprisingly little research done in this field so far. The author argues that there is potentially valuable knowledge to be gained through this research for all actors involved in school design, development and maintenance. The proposed research would focus on client and end user perspective through continuous evaluation of the fit between organizational goals and results, end user experience and architectural design. Prior to the doctoral program the author had been working with development of ICT environments and applied ICT projects for higher education, research and development since graduation in1997.

Keywords: Architecture, Design, Evaluation, School buildings, Educational outcomes

1. Introduction

1.1. Industrial relevance

The industrial relevance of having access to scientific research about the relationship between architectural design and learning environment is imagined as follows:

- The development and application of ICT is one of the major drivers for change in societies all over the world. Good educational systems becomes a strategic asset as we move into a global knowledge society with a knowledge-based economy demanding life-long learning [1].
- There is a rising demand for international benchmarking and national school quality assessments. This demand constitutes a new incentive for clients, such as local authorities, to try to connect the cost of facilities and activities to educational outcomes [2]. Facilities may get a new role in adding value (or the opposite) to learning activities for the client responsible for educational facilities. At the same time globalization and increased interdependence, such

as within the EU, create an international marketplace for the construction industry. The industrial contender who has the best understanding of the evolving end user needs and expectations down to the local level will then gain competitive edge.

– Educational reform in Sweden increasingly put the individual learner in focus. Learning is perceived as taking place in a socio-cultural context where interaction and communication is essential [3]. At the same time educational activities are to be adjusted to meet individual needs and thus calls for various modes of tuition and self-studies. The bulk of existing schools however was not designed to meet this need and does not always offer the necessary flexibility.
– As ICT becomes more and more integrated into building systems on all levels it is safe to say that professional architects and builders will have to learn more about how end users interact with and benefit from ICT application in real-life contexts.

1.2. Research horizon

1.2.1. Molecular level research

Many scientific research studies have been done on a molecular level about how factors in the physical school environment affect prerequisites for learning and health. Standards and recommendations regarding environmental factors such as noise levels, air-quality, temperature and lighting have emerged. Still there seem to be difficulties in the application of the very same standards and best practice. For example, in 2001 ventilation was still the single most common object for complaints in Swedish educational facilities, as it had been for 10 years, according to a study in by the Swedish Work Environment Authority [4].

1.2.2. Molar level research

Hitherto there has been very little architectural research about educational facilities at all in Sweden [5] [6]. The most well-known example is probably a study by Skantze from 1990 about how children view their school work environment [7]. Another more recent example is a PhD thesis in architecture by Patrik Bjurström on modern Swedish school buildings, their meaning and the ideas behind them studied through a series of case studies. Unfortunately there is even less scientific research done about how architectural design relates to educational outcomes in formal learning environments.

In a study initiated by The Swedish Association of Local Authorities the question was: “Does better facilities give better educational quality?” [8]. An initial survey with questionnaires was distributed to pupils, teachers and principals in about 100 compulsory schools in Sweden. According to the study nearly 25% of the schools had good facilities, but in general the facilities were unsatisfactory. For the statistical analysis they created an educational quality index to which various factors were tied and related to educational outcome in terms of results. The authors point out that it was difficult to find appropriate measurements for educational outcomes in Sweden and that they had to settle with grades in year 9. The four factors that had the greatest importance to explain variations in the index was, in falling order: 1) management and organisation, 2) teacher competence, 3) the physical school environment and 4) textbooks and teaching aids. Even if the physical environment does have an effect on variations in this index, the conclusion in the study is that it is of little use spending more resources on facilities in order to improve educational outcomes. Despite being a promising initiative the study is problematic for several reasons. One is that the resulting report included a quality development tool targeted at politicians and employees in local authorities responsible for education. The text in the report might persuade readers to actually believe that by following the model to allocate resources you will improve school quality (and thus educational outcomes) accordingly with an accuracy down to two decimals. This seems particularly problematic since the study only used questionnaires to establish casual relationships about a complex real-life situation. Facilities are treated in very general terms and the study does not, and cannot, describe differences between different schools in any detail. This paper argues that research about the relationship between architectural design and educational outcomes need a combination of methods, both quantitative and qualitative, and perspectives to be of practical use for school development.

In the USA an interesting approach to studying the relationship between architectural design and educational outcomes have developed over the last couple of decades. It is a design patterns concept that stems back to the investigations by Christopher Alexander and his colleagues in the 1960s and 70s [9] [10] [11]. Basically the idea is that to any well-defined design problem it is possible to create a design pattern that captures the essence of the solution to the problem. It should then be described in such a way, through text and diagrams, that the pattern will be generic and practically useful. Lackney and Moore (architectural researcher and behavioural scientist respectively) have developed sets of design patterns and design guidelines for educational facilities that they suggest promote learning [12]. These patterns are primarily based on meta-analysis of scientific studies and best practice literature within behavioural science, pedagogy and architecture as well as on their own empirical studies. The patterns that Lackney and Moore considered the most strongly supported were used as a starting point for items in the initial survey among principals as part of the doctoral program project that this paper describes.

Evaluation research of school buildings has been around for some time, but is still not very common. As early as in the late 1960s the Building Performance Research Unit (BPUR) at the University of Strathclyde, Scotland carried out post occupation evaluations of some 50 comprehensive schools in Scotland. Later the POE concept was developed, primarily in the USA, into handbooks through the work of researchers like Preiser, Rabinowitz and White [13]. Different versions of POEs are now in use for evaluation of buildings all over the USA. According to Lackney there were still very few POEs conducted on educational facilities in 2001. A promising way forward for POEs in educational settings seems to be through institutionalisation, as proposed by Zimring in 1988 [14]. POEs become a standard operating procedure for local authorities, such as the New York City School Construction Authority

[15]. In his paper Lackney also mentions the State of California and their Department of General Services (DGS) as an example where state policy has potential of institutionalise the POE in educational design practise. In 2002 the California DGS have named their own POE version FPE, or Facilities Performance Evaluation (see http://www.poe.dgs.ca.gov/default.htm).

1.3. Approach and methods

1.3.1. Applied research approach

This case study is part of a doctoral program project that also has a practical, or applied, purpose. It might therefore be considered applied research. This purpose is: to contribute to the knowledge of local authorities and schools in general, and one specific municipality and school in particular, with recommendations for application in development of formal learning environments; and to contribute to the knowledge of practitioners / architects with recommendations for design of formal learning environments. It is common practise for architects to take a holistic stance to the design problem at hand and try to merge technical, economical, functional and other aspects into an aesthetic whole. The author also takes a holistic stance in approaching the case in order to investigate the research question from several angles.

1.3.2. The case study research strategy

Given the applied research approach and the opportunity to investigate the research question in a real-life context a case study research approach seem feasible. Robert Yin is an authority within case study research and his handbook is widely used [16]. In his view the method is what characterize a case study. His approach includes both qualitative and quantitative methods but with an emphasis on quantitative analysis. The focus is on the instrumental case study and deductive theory testing. In this particular case the objective is to try to learn as much as possible about, and from, the case in itself, not necessarily to strive for universal generalizations. That makes Robert Stakes approach to case study research relevant as a complement to Yin's. In Stakes view the case itself is what characterize a case study [17]. Compared with Yin, Stake is an advocate for a more qualitative focus, but does not exclude quantitative methods. His model of thought is based on hermeneutics, on abduction and induction through grounded theory, striving to create a whole picture. In terms of generalizations Stake uses the term "Petite generalizations" to mark the kind of generalizations that you can do within the specific case. Outside of the case it is possible to make Naturalistic generalizations according to Stake. Every practitioner builds a repertoire of cases that can be referred to in problem solving. This notion is also supported by Donald Schön in his work on reflection-in-action [18]. Stake claim that the repertoire of cases can consist of conclusions made from personal real-life experience, but also of stories about cases that are so well told that it feels as if you had experienced it yourself. Stake prefers the story as the format for reporting on the case study.

This case study primarily makes use of Stakes approach, as it fits the background, purpose and context of the case with regards to the research question. Stake works with issue questions for negotiating the study. Etic issues that the researcher brings in from the outside, and emic issues that emerge from the case and the people inside the case. As the work develops these issues are restated and transformed into tentative assertions that take form of the Petite generalization. These may in turn develop into Naturalistic generalizations made by the readers of the report themselves. Stake use the term progressive focusing to describe how the researcher moves through the issues during the study. At this time the issues relevant for the paper will be divided in two categories: initial issues and issues under development.

1.3.3. Data collection

- 10 interviews, including one group interview, have been recorded in digital audio format and transcribed for coding.
- Each interviewee filled out a questionnaire identical to that of an initial survey among the K-12 principals in the municipality. Each questionnaire was completed in the presence of the researcher who could answer questions about the items, definitions etc.
- Data from the end users were also gathered on three occasions through the walk-through evaluation method called “Gåtur”, described by Ambrose and DeLaval [19] [20]. In this particular case the Gåtur consisted of eight stopping points on the premises that the researcher found considered as key locations for understanding the case. Two was done with faculty and staff and one with pupils. The material from protocols, notes and recordings will be coded for an aggregated data analysis.
- Observation notes were taken both from classroom sessions and walking around the school.
- Protocols have been made with notes from various conversations and improvised interviews.
- Some 500 digital images were taken of the facilities. A photo album with comments from the construction period in the late 1960s is borrowed from the principal.
- A large number of documents have been collected from both the school and the local authorities. These include for example: drawings, diagrams, statistics, rules and regulations, instructions for teachers, internal reports and protocols.

2. An empiric example

2.1. Main context

2.1.1. Background for the study

The study referred to in this paper has both an intrinsic and an instrumental character. It is intrinsic in that the main object of study, the K-12 school, was given beforehand due to an agreement between the university and the local authorities to make a joint effort in a local, real-life context. This particular school was chosen for several reasons. One reason was the fact that it has a tough setting, situated in a socio-economically deprived and mainly immigrant catchment area. The school was also considered by the local authorities to be worn down after 35 years. The Swedish National Agency for Education specifically called for improvement in terms of educational outcomes in this municipality. The study is therefore instrumental in the respect that the issue of the importance of the physical environment as a prerequisite for the learning activities can be studied.

2.1.2. The case study school

The main building was built in the late sixties and complemented in the 70s with a separate pavilion to house additional classrooms. The pavilion is still there, even if it had to be demolished and rebuilt due to health hazards in the 1980s. Today there are about 350 pupils from kindergarten to year 5 and about 80 adults in faculty and staff. The main building layout has an E-shaped plan where classrooms are located in the wings. Each classroom is connected to a small lobby/group space/corridor section with a door to the outside. In between each wing is a small yard mainly covered with asphalt. But there are also small patches of grass with a couple of young trees, a few large sandpits and a climbing structure. The predominant features of the exterior are the low one-storey profile and long rows of windows on all sides. In recent years the kitchen has been renovated and expanded and a ventilation system has been installed that slightly breaks silhouette of the roof.

2.1.3. Surroundings

The site is flat and has modernist residential building complexes from the late 1960s on three sides. The location towards the periphery of the small community put the school only a couple of hundred meters to the forest. Some teachers pointed out in the interviews that the relative close proximity was a major, if not the major, asset of the schools physical environment. The teachers enjoyed taking their pupils to the forest on excursions. The local community where the school is located has a small modernist centre with a few shops and basic service.

2.2. Initial issues in the case study

Initially there were a number of larger and smaller etic issues in the study and the following still seem relevant for this paper:

– How does architectural design affect the prerequisites for learning in this K-12 school?
– How can architectural design be an enabling resource for learning?
– How do the end users react to malfunctions in the physical environment?
– How does the design matter according to the principals in the municipality?
– How does design matter according to teachers and staff in the case study?

- Which of the supposedly supportive American design patterns can be identified in this case?
- Are these design patterns a relevant concept for developing architectural design that work as an enabling resource for learning in K-12 schools?
- What expectations do the staff and faculty have about the importance of ICT for their future learning activities and physical learning environment?
- Which design factors seem the most important to the end users?
- Which are the specific end user needs and expectations in this K-12 school?

3. Preliminary results

The case study format lends itself rather badly to account for results before the final report exists. Aggregation of data is underway through coding of transcribed interviews that, at the time of writing, only can be analysed through direct interpretation. Also the data has not yet been studied enough for deciding the necessary data source triangulation and method triangulation. In the following sections the "preliminary results" comprise of issues under development.

3.1. Issues under development

- So far there is no evidence in the data that the facilities are part of the school quality assessment. A tentative assertion from the interviews is that a strong incentive for design evaluation of municipal K-12 schools has been missing until now.
- Analysis of interviews done in connection with the initial survey among principals suggest that potential health hazards are their most powerful argument for change in the physical environment. How would design evaluations in relation to added value for the learning environment affect the argumentation?
- Crowding seems to be a substantial problem to some teachers. In interviews and conversations members of staff and faculty express the notion that disturbing noise levels among the pupils are a direct result from crowding, but also a result of the catchment area characteristics with a lot of anxiety among the children. The integration of pre-school activities and classes that is now taking place at the school is also related to this issue.
- At the moment of writing it can be noted that the protocols contain a total of 209 negative observations and 119 positive observations in total. There are also 127 suggestions for change. The pupils' observations will have to be complemented by analysis of the sound recording since they did not always use their protocols.
- Why does the individual fail to notice things that actually work well? It is not until something actually malfunctions that some end users seem to notice the physical environment.

– The end user expectations seem to be somewhat restrained by a general notion of cut back economic resources for municipal schools over the years and the specific notion that the school is in low esteem due to its history and current situation with a socio-economically deprived mainly immigrant catchment area. This observation gets some support in a book from 1999 about planning school buildings in Sweden. There the architect Lena Dranger Isfält claim that within Swedish school traditions there is an attitude towards facilities and furniture that it is something that is provided for you, and that it is something you yourself cannot do anything about [21].

– Even if some teachers express that they have given up hope for improvements of their physical work environment, they still have the feeling that it should be in another way. Many teachers have experience form other situations and schools that serve as references when thinking about the current situation.

– Data from interviews and walk-trough evaluations suggests that some end users finally give up. They stop taking initiatives to do the little things they actually can do by themselves to improve the situation. As committed professionals they have been adapting and trying to overcome the limitations of the physical environment. They say "Well, I am the kind of person who always try to make the best of the situation, but…" In essence they claim that it takes to much resources (time and stamina) away from their teaching and learning activities. It is no use making small efforts since the school needs substantial improvement and they feel that they really cannot do anything about that.

– Future educational facilities are likely to include a mix of real, augmented and virtual environments for learning activities. How can ICT be used to expand the use of educational facilities?

– There seem to be conflicting views on the approach towards the children in carrying out the schoolwork. Some people would like to give the children more freedom to choose for themselves and more responsibility while others stress the importance of keeping a "short leach" in order to create a safe and sound environment that minimize the level of anxiety and unrest among the children who are considered (by all interviewees) as being more lively and out-acting than average. How does the attitude towards the children regarding their need for regularity and rules affect the way the facilities are being used?

– Interviews indicate that, just like medicine, teachers must act in the right conditions to have the desired effect. They must have a chance to set the scene and interact with the children in a way they consider appropriate for the situation and task at hand. If the current faculty cannot work efficiently due to a cramped space situation, would adding yet more qualified teachers have the desired effect?

– ICT equals a PC and an Internet connection according to the interviews and the conversations. The notion of for example interactive thin displays on furniture and/or building parts in their learning environment is a very distant thought for most interviewees.

– Why is it that even though everybody seems to agree on that the need for substantial renovation and redesign has been around for a long time, nothing has happened?

- The canteen, as well as other common and worn down spaces, seem to provoke negative emotions and frustration among the interviewees. The colours are ugly, the lighting is bad, the acoustics are bad, the general layout is not functioning well etc. The same description would apply to several other places, such as their own classrooms, but it does not seem to provoke the same emotional response. Could it be related to a feeling of responsibility – or guilt? That in “your own” room you are somehow more to blame for every shortcoming in the environment, while in the shared spaces no one seems to take the full responsibility?
- So far no data in this case study contradicts the notion that the local authorities do not have access to reliable and updated information about the building performance in relation to the needs and expectations of the end users. How do those responsible to make informed decisions with respect to quality go about to prioritize in the educational facility budget without seemingly necessary information? Some people in the study claimed that it was due to the fact that the school is in a mainly immigrant catchment area, but the school do receive extra resources in terms of teachers for the same reason.

4. Discussion

In economic terms municipal schools does not have the purpose to generate money. The goals are described in the national curriculum that changes over time. The activities aim at letting young people obtain valuable knowledge and know-how, but also to give them the opportunity to develop as individuals in a social setting that prepares them for adult life. Therefore it is safe to say that the output of school activities is complex and difficult to measure. In terms of results there are some variables that can be measured, such as; academic achievement through test results, grades and the amount of pupils that obtain results that meet minimum requirements.

A protracted design phase, or a continuous design cycle, means smaller interventions and more often. There might be a market for flexible design solutions with multiple utility spaces that can expand and contract smoothly. In some cases it might be a matter of organization and co-habitation of clients/end users. In other cases the solution might involve ICT for tele-presence and virtual reality (or virtual space rather)

Most POEs (and other facilities evaluations in Sweden) still seem to focus on “hard” technical issues of building performance. The focus on the technical issues brings forward easily measurable variables. This might obscure more complex issues and variables concerning the activities and interaction that also have substantial impact as a prerequisite for learning in formal learning environments. I suggest the added value that Ang, Wyatt and Hermans discuss within the domain of use and facility management should also apply in the municipal context, even if the “business process” are somewhat different [22].

Preliminary results indicate that there are a lot to be learned from studying the problem out in the field and collecting data first-hand. Design solutions and interventions benefit from knowledge about the actual end user. Every country and possibly every municipality down to the single school will have slightly different prerequisites concerning all variables that are thought to affect educational outcomes. From a pragmatic viewpoint it would make good sense to address the issue of design and evaluation on the lowest possible level and to assemble all relevant data in databases for cross-case analysis and reference.

Minor changes in maintenance do not seem to be a big issue or matter that much in the whole. However, many small changes made in a patchwork manner will affect the whole. Each little alteration might be perfectly rational in the short term. The long-term consequences will risk getting out of our control unless there is continuous and updated documentation and evaluation available for analysis. On one hand there are serious ethical problems building schools as scientific experiments. On the other hand, building and running schools without employing scientific knowledge or evaluation is also a kind of experiment with the end users life in the workplace. It is just not stated as such. Continuous design might be one strategy to deal with changing prerequisites and to achieve better fit between design and end users needs and expectations. Perhaps not all economic resources need to be spent at once. Some resources could be put in a redesign fund for each school. Every space in a novel building might not have to be “finished” or furnished to the highest standard at once, but could retain a slightly more rough or robust character.

There might be other ways of improving the fit between design and learning. The initial analysis of interviews and conversations also suggests that clients and end users would benefit from having access to an “expert end user” or, perhaps better formulated, an “environmental coach” who would assist and coach the clients and end users in the possibilities and limitations of the physical environment of their school. Another approach would, in line with the notion of continuous design, be to use a “learning solutions designer” who could access a municipal best practise reference database and provide each school with individual solutions while keeping track on previous alterations.

Finally it is striking how teachers and staff were pleased with someone asking them for their experience, what they think about their physical work environment and what they would change if they had the opportunity. In several cases the interviewees stated that this research was important and that it was about time someone looked into the matter. The interviews indicate that talking about the physical environment also provided a good starting point for discussing a wide range of other issues related to organization, identity, values and culture.

5. Conclusions

As mentioned in the results section it is rather a awkward business trying to extract traditional results, or conclusions, from a case study of this kind before a final report exists. Still, it is important and valuable to share reflections and assertions above in relevant forums, even if the format is not ideal. The conclusions at this stage would be that there seem to be a need for research about architectural design of formal learning environments in relation to educational outcomes. As for the direction of future research the issue of incentives for evaluation seems most important, but that it is necessary to look for the criteria in the local context. The question of accounting for added value, or how well the facilities support learning processes, in the eye of clients and end users may well be a key to future success for both architects and the construction industry.

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Place Attachment and Sense of Belonging in the Offices

Goksenin Inalhan,
The University of Reading, School of Construction Management and Engineering (email: g.inalhan@reading.ac.uk)
Edward Finch,
The University of Reading, School of Construction Management and Engineering (email: e.f.finch@reading.ac.uk)

Abstract

Organizations are often forced to modify their physical environment and relocate employees in response to new business strategies. However, the impact of these changes on employees is rarely considered. Many organisations are acutely aware of the costs associated with high staff turnover, staff alienation and recruitment. Recent innovations in workplace design such as hot-desking have further undermined our sense of belonging. This research considers the attachment employees have for their established work place. It is argued that this attachment may influence people's response to the new environment and the move process. Issues of place attachment, personal expectations and perceptions can affect a person's response to a changed environment, which may be at odds with a strong organisational imperative for a move. To date, however, our understanding of how these factors relate to each other is limited. This study seeks to expose the gaps in our understanding of 'attachment' as a phenomenon. It describes the methodology that will be used for a subsequent case study, which attempts to quantify and qualify the phenomenon of place attachment in the workplace. In particular it suggests how design elements can be introduced that nurture a sense of belonging in an organisation.

Keywords: Change Management; Place Attachment; Relocation; Sense of Belonging; Workplace Design

1. The Research on Workplace Attachment

1.1 Overview

Change has become a way of life for organizations, as the business environment has become increasingly dynamic. Many organizations are being forced to re-examine every way in which they can improve their performance. Workplace redesign and relocation has been used as a catalyst by many organisations to introduce many elements of organisational change. However such change can have a significantly undermine performance and can cause long term damage to work relations. For this reason, thought needs to be given to the ways such changes are perceived by employees, and the consequences of such changes [1].

Despite the best efforts of corporate managers, 25 per cent of major change initiatives fail because employees are fearful of and resistant to change [2].Most changes fail because the soft aspects of change are not properly managed. Employee resistance can pose significant obstacles to the planning and development of office space relocation, particularly for projects that attempt to change the way people work.

Office renovations and relocations are one of the most challenging aspects of a facility professional’s job to resolve growth and space constraint problems in organisations. Yet, to employees, the change can be seen as threat, disturbing and emotionally alienating. These placements can have serious negative and emotion-laden consequences when seen from the point of view of environmental deprivation [1].

Many organisations are acutely aware of the costs associated with high staff turnover, staff alienation, and recruitment. The cost of not overcoming the resistance to change can be enormous [3]. The negative attitude can affect the bottom line. The Bureau of Labor Statistics estimates that U.S. companies lose $3 billion a year to the effects of negative attitudes and behaviours [4].

The research is particularly focused on the concept of place attachment to understand better the person’s response to a changed environment. In particular it suggests possible mechanisms for using the work environment as a way of accelerating our sense of belonging in the new workplace. In order to combine place attachment theory with practice, the research will undertake a case study analysis in which the research quantifies and qualifies the phenomenon of employee place attachment.

1.2 The Relevance of the Research

Psychologists and others concerned with work behaviour have long been interested in employees’ feelings in terms of outcomes such as satisfaction, stress and fatigue. In contrast to research on the expression of emotion, research on the experience of emotion is relatively underdeveloped [5]. Even though recent interest on affectors in the workplace has been intense, ignorance regarding the emotional significance of the physical environment remain.

Routinized interactions in a given location typically result in place attachment. An emotional bond is formed by an individual with a physical site. Having developed a ‘secure’ place attachment, the loss of such an attachment creates a stressful period of disruption. The move is often a ‘loss experience’ for employees. Employees place attachments often go unrecognised by management involved in such transition processes [6]. Ignoring the emotional charge given by these employees has the potential to undermine the success of the move project and the organisation itself. The focus of this research is to expose the current gaps in our understanding of 'attachment' to previous workplaces as a phenomenon.

However today, social theorists are often skeptical about the importance of place and place attachment, as people seem to be increasingly mobile, and their social relations and other experiences become disembodied from physical location [7]. Far from reducing the importance paid to physical space, the focus on knowledge work and increasing productivity in the new economy lead to more increased emphasis on creating the “right” working spaces. Although technologies have the potential to enable people to work anywhere, people still need to choose to work somewhere [8].

Much of the previous research about psychology in work environments is largely defined by the outcomes and facets of the physical environment. For the individual employee, such research has focused on the outcomes of satisfaction and performance and their association with the ambient environment. For interpersonal relationships, it has focused on the outcomes of communication and group formation, cohesion, as well as their relationship with features of the workspaces and layout. For the organisation, the focus has been on organisational effectiveness and its association with the features and layout of buildings [9].

These studies with their behaviourist approach assume that change is best achieved by considering “external” factors. For example a change agent working on these assumptions would look for those reinforcements which are producing the current behaviour. Having specified the new behaviour precisely, the object would be to set up a schedule of reinforcement to encourage the necessary change [10].On the other hand the cognitive approach is based on the belief that behaviour is controlled by “internal” factors, such as the individual’s beliefs, assumptions and theories about the situation. To change behaviour, therefore you have to change these internal theories [10].

This research is concerned with the cognitive, affective and behavioural processes which contribute to a person’s attachment with a place. Issues of place attachment, personal expectations and perceptions have a significant bearing on a person’s response to a changed environment, even when a move provides a path for economic improvement. To date, however, our understanding of how these factors relate to each other and place attachment is rather limited in move projects in organisations.

After describing the aims and objectives, the paper will reconsider previous work done on place attachment phenomenon. Empirical research findings are drawn from a broad-ranging literature review. The resulting research model will be applied to the proposed case study and the validity of this model assessed.

1.3 Aims and Objectives of the Study

Change and transition recur in the lives of people and are part of human development. Although for some people change is positive, for others it is difficult to accomplish without disruption and distress [11].

The main aim of the study is to determine the impact of place attachment in employees' perception of change. It seeks to describe the socio-psychological and behavioural effects of changes in the physical environment on employees.

The second aim of this study is to explore the meanings such adjustments hold for employees exposed to changing environments over time. And discover how these meanings influence to adopt new environment.

The third aim is to examine the extent of employees' place attachment in old and new environments. This involves isolating aspects of the person–place transactions which have affected their ability to detach from the old environment and attach to the new.

The objectives of the study are:

- To expose the current gaps in our understanding of "attachment" as a phenomenon
- To investigate human reaction to change in the environment
- To measure the significance of this reaction to business performance
- To obtain tools for communicating concepts of change management.

There are pragmatic and facilities management implications arising from the phenomenon of place attachment. Further investigation of the affective relationships that all employees have with their workplace will aid in appropriately designing and managing facilities.

2. Previous Research on Place Attachment

2.1 What is place attachment?

The psychology of place is an emerging area of research that explores the association between individuals and their immediate environment-setting. The psychology of place assumes that individuals require a “good enough” environment in which to live. People are linked to that environment through three key psychological processes: (1) attachment; (2) familiarity, and (3) identity. Displacement breaks these emotional connections. The ensuing disorientation, nostalgia, and alienation may undermine the sense of belonging and mental health in general [12].

Familiarity refers to the processes by which people develop detailed cognitive knowledge of their environs. Place identity is concerned with the extraction of a sense of self, based on the places in which one occupies in life [12].

Place attachment is the pattern of reactions that a setting stimulates for a person. These reactions are a product of both features of setting (what settings are) and personal processes (what the people bring to it) (Figure 1) [31].

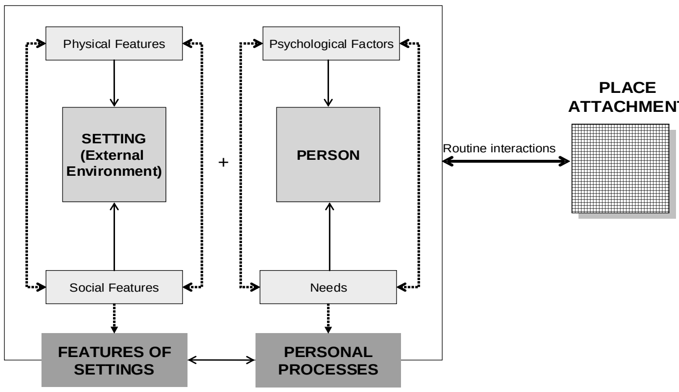

Figure 1: Place Attachment, the link of features of setting and personal processes (adapted from Steele F., 1981)

Milligan (1995) defines place attachment as “the emotional link formed by an individual to a setting that has been given meaning through interaction, comprised of two interwoven components: the interactional past and the interactional potential of the setting” [13].

The *interactional past* refers to past experiences: in other words “memories” associated with a setting. Places have the power to recall emotions and stir memories that have been dormant while the person was away from the place. *Interactional* potential refers to the future experiences imagined and anticipated to be possible in a setting, or in other words “expectations”. An individual’s experiences within and in relation to a specific setting, result in a set of expectations for future interactions in the setting.

In forming people–place interactions, what people bring to their setting is as important as the place itself. A particular setting becomes a place to an individual specifically because of the activities that have occurred within its boundaries, which then come to be associated with the setting. A history develops that is tied to the experiences of people that have occurred within the setting. At the same time, specific features of the setting shape, constrain and influence the people's perceptions and expectations for evaluating new settings [6].

Setting acts as also as a facilitator of needs. Place is important in the extent to which it satisfies a need. Stokols and Shumaker (1981) suggested that the degree to which a particular setting satisfies the needs and goals of an individual determines his or her judgement of its quality [14]. This quality judgement regulates the attachment to a place.

Within the past few years, place attachment has been studied by scholars from several disciplines such as: anthropology; architecture; family and consumer studies; folklore, gerontology; landscape architecture; leisure and recreational studies; marketing; psychology; sociology; social ecology; and urban planning. This diverse research is bringing to bear different philosophical approaches, theoretical formulations, and research methodologies. Perhaps, the most important challenge for researchers in this area of inquiry is to integrate different viewpoints and approaches [15].

Giuliani et al. (1993) group the differences in the researchers' definitions of place attachment according to several characteristics [16]:

- the content of the bond: affective, cognitive, and/or symbolic
- the valence of the bond: positive or negative
- the specificity of the bond. Some researchers choose to consider attachment as a broad concept, a super-ordinate category whereby affects are designated as part of an entire system such as 'set of feelings'. Others seem to consider attachment a specific affect that is distinct from other kinds of affects which are part of the same system.

Problems arise if we accept a broadened definition of place attachment. Such definitions of the phenomenon become so general that they fail to explicate the nature of the cognitions and affects that characterise psychological bonds, linkages, ties, and so forth with places. It also obscures the conceptual distinctions between different affective bonds and their dynamics.

As a result, the role of place in people's lives is more complex than we understand. Attachment can be viewed as a multilevel person–place bond that evolves from specifiable conditions of place and characteristics of people. This fact has implications for the attitudes and behaviours of individuals toward their socio-physical environments [17].

2.2 The Process of Place Attachment

Place attachment operates in the background of awareness. It is difficult to assess. Shock of disruption helps to clarify what has been disrupted. A study of place attachment starts with an understanding of disruptions of place attachment.

Repeated interactions in specific settings including organisational locations typically result in place attachment. An emotional bond forms between an individual and a physical site. After the development of secure place attachments, the loss of normal attachments creates a stressful period of disruption followed by a post-disruption phase of coping with lost attachments, followed by the creation of new ones [18].There are discernible patterns across the phases of attachment and disruption (Figure 2).

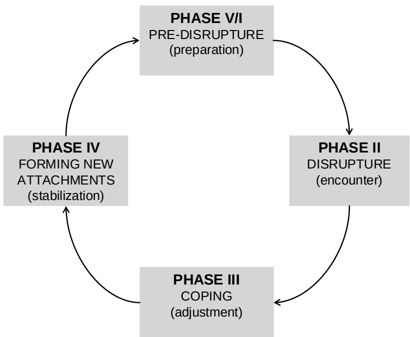

Figure 2: The transition cycle (adopted from Nigel Nicholson (1990)

Place attachments develop slowly but can be disrupted quickly and can create the need for a long-term phase of dealing with the loss and repairing or re-creating attachments to people and places. These three phases are interdependent, as qualities of the initial attachment or disruption can ease or exacerbate the stress of loss and difficulty of re-creating attachments. Much of the challenge facing those with disruptions of place attachment is to negotiate reconciliation between the past (what has been lost) and the future. Certain aspects of pre-disruption attachment may forecast the extent and severity of the disruption and the availability and effectiveness of coping mechanisms [18]. Therefore attachments are important for their long-term consequences. Place attachments are continuous and form a dynamic model of people-place bonds [16]. The most stabilised conditions contain the possibility of future change, and therefore embody varying states of readiness for the onset of a new transition cycle [32]..

There are two important studies that specifically address the process by which place attachment is formed. Fuhrer and Kaiser's (1992) work entitled "Attachment to the home place: the emotional bases" is important as it explores the aspects necessary for the formation and maintenance of place attachment [19].

Fuhrer and Kaiser (1992) advanced the field of people–place relationships by thinking of place as a facilitator of emotional needs. They adapted Bischof's model of social motivation which suggests that "four emotions represent the core of social regulations: security, arousal, autonomy and libido. Thus, "places are experienced in terms of these emotions and represent the basis for regulating both identity and social interaction" [19]. They developed and tested a model involving three processes of place attachment. Place was described as a facilitator of emotional needs, based on the emotions of (1) security, (2) autonomy and (3) arousal. Significant relationships between social and physical qualities of the home place and of the emotional dimensions were found. The results revealed that these emotional meanings represent the bases of attachment to the home place.

Gerda Spellers' (1996) work has expanded Fuhrer and Kaiser's concepts on the aspects of place attachment, including external stimulation, emphasizing the importance of appropriation and place congruence [20]. These aspects not only seemed to lead place attachment but also play an important role in order to maintain it. However, she also argues that further research is needed to establish whether these five aspects of place attachment are apparent in other research contexts, such as work environments.

2.3 The Models of Place Attachment

Several models of people-place relationships have been put forth in an effort to provide framework for how people develop ties to places and some has received limited empirical tests.

Gerson et al. (1977) in his structural alternative model focused on attachment at the individual level [21]. They define attachment as "an individual's commitment to the neighbourhood and neighbours". This commitment takes the form of both social involvement and subjective feelings. According to this model, attachment develops as a result of an explicit cost/benefit analysis. The individual is believed to evaluate the neighbourhood based on what he or she is giving up or gaining by living there. As long as the benefits outweigh the costs, an individual feels some attachment to the area. Both people and place characteristics are considered within this comparison and contribute to attachment [22].

Stokols and Shumaker's (1981) in their model of place dependence relied heavily on Gerson et al.'s (1977) model of place attachment and extrapolating directly from Thibaut and Kelley's(1959) model of comparison level and comparison level for alternatives [23]. They hypothesized that persons may become dependent upon their current dwelling and neighbourhood through comparison process. The individual considers the number, range, and salience of needs being met by the current home, including the quality of resources available in the area, and this analysis yields a "comparison level". The individual goes through a similar process in considering alternative places. If the current locale compared unfavourably with potential alternatives, the person was not considered to be dependent upon the current place, and was in fact more likely to move.

Stokols and Shumaker (1981) develop the concept of place dependence or an "occupant's perceived strength of association between him or herself and specific places". They proposed that the assessment of "strength of association" involves a two-component process, including an individual's judgement of: the quality of current place; and the relative quality of comparable alternative places.

Stokols and Shumaker expanded their model of place dependence to include integration of satisfaction. Attachment derives from a positive evaluation of the quality of the place vis-à-vis one's needs to what extent the environment allows certain functions to be carried out. Attachment will be all the stronger the greater the number and the more important the needs satisfied. But the basis of the model remained more cognitive than affective [24].

Stokols at al. (1983) reported empirical support for the place dependence model of person-place transactions. However dependence as described by Stokols and Shumaker (1981), can be affectively different from attachment Stokols et al. (1983), these researchers did not maintain this distinction in their empirical research. Instead they used a direct measure of attachment, as well as their measures of place dependence, to examine the effect of person-place bonds on outcomes of interest.

Prohansky (1978) took a totally different approach in his discussion of the relationship between people and places [25]. Whereas the other two models operate attachment in a functional sense with reference to places, symbolic attachment can also be found for places that have only symbolic value, which embody group identity, etc [17]. Prohansky defined place-identity as an individual's awareness and perception of the world as represented by a collection of "memories, conceptions, interpretations, ideas, and related feelings about specific physical settings as well as types of settings". And attachment derives from the meaning the place has for person's identity [26]

The model does provide a useful theoretical explanation of why people may need to develop attachments or bonds to their socio-physical environments. There are problems however, with the breadth of the theory as there are very limited empirical studies to test the relationship of place to the development of self identity. In addition, Prohansky argues that place identity is both cognitive and affective; yet it is unclear how these separate systems operate in defining place identity.

The purpose of this review is to obtain an understanding of the vast volume of theoretical and empirical work on place attachment in order to clarify the relationship between and person and place and provide the background for the research design.

3. Research Design

Change is an experience which can be threatening in advance however very little is known about why change should be threatening. Personal meanings are important determinants of the impact of change [10]. A key to the meaning of place lies in the expressions that people use when they want to give it a sense carrying greater emotional charge than location or functional node.

The question which must always be raised is whether the new environment produces demands and situations which are different from the individual expects. What practices should organisations undertake to maximize the benefits and minimise the costs of the rising tide of transitions? The conceptual framework of the study aims to answer such questions.

The relocation projects provide the opportunity for a field experiment in which facilitators and inhibitors to the formation of place attachment can be identified during the whole process. As part of the British Facilities Management, Thames Valley Network, given the opportunity to study several work groups that will experience office renovation within the same facility in Nationwide Headquarter, Swindon.

The study involved a three phase-longitudinal approach conducted over an eighteen month period to monitor the process of place attachment (and detachment) starting two months before the relocation and ending sixteen months post relocation. Data was gathered primarily from in-depth interviews. However a survey instrument was also used to measure attitudes.

The case study relocation scheme was announced and accepted in July 2003 and the first interviews in phase 1 of the study, took place in March 2004, one month before relocation. The relocation followed in April 2004. The second set of interviews, I2 were undertaken in June 2004 as well as questionnaires.The timing for data collecting phases (periods) were determined by theoretical and practical considerations. After the move, the two month period was considered to be long enough for people to gain a sense of permanence and not be caught up in the frustration of practical tasks regarding the move. Seven month post-relocation was thought to allow enough time for people to evaluate the new situation about their attachments in the final phase of data collection.

A longitudinal approach was important to understand the dynamics of place attachment. It was intended to show the nature of the growth and trace patterns of change in an individual [27]. The rich data provided by repeated in-depth interviews with employees over a one year period provided an essential resource for exploring the process of change.

Several problem points can be derived from analytical approaches in previous place attachment studies:

- In place attachment studies a variety of approaches exist (either theory building or theory testing) which lack coherence
- Place attachment can be thought of as both a product and outcome (i.e. feeling attached) and a process (i.e. reasons for attachment) [24] [28]
- The existing theory on "place attachment" is incomplete and may not be applicable in all types of work environment.

The proposed model is adopted from Passini's (1992) model of cognitive mapping. Passini suggested that people cycle through a set of decisions using a process of 'matchmaking' to evaluate a decision and determine behaviour [29] [30]. As place attachment is a cognitive process, matched feedback process well explains how this mechanism works in a changing environment; people cycle through within move (before move, on the move and after move). Our expectation of a future setting is the product of our past experiences. In a familiar environment, a person recalls what should be sensed at a location and this is checked against what is actually sensed. If there is a match, then a planned behaviour is executed, as establishing new attachments. If the two do not match, it is problematic; he shows resistance to change. New approaches are needed to manage the expectations and attitudes. It is suggested that once precursors of his previous attachment are identified, they can be used as a mechanism to adapt to new situations and find the match to continue the process (Figure 3).

While defining the attachment, one should consider not only cognitive bonds which explain the operational aspect, but also the emotional and symbolic content of the bond which covers the precursor of attachments; individual characteristics influencing attachments; and characteristics of places which influence whether people attach to them. Place attachment is the pattern of reactions that a setting stimulates for a person. These reactions are a product of both cognitive and emotional/symbolic aspects of the bond (Figure 1).

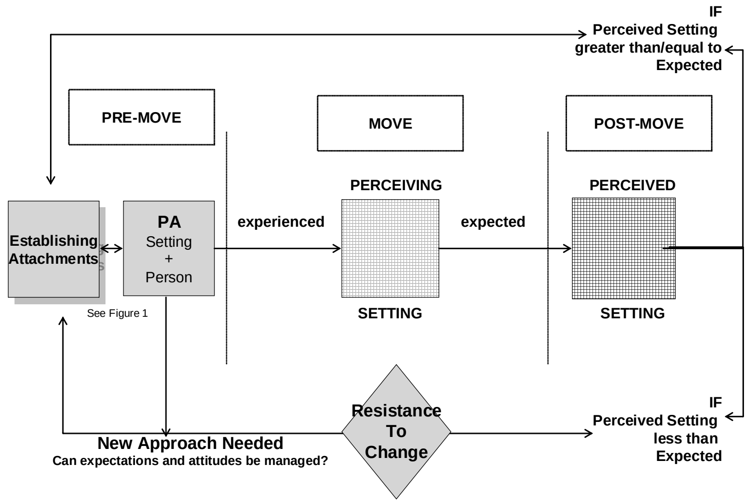

Figure 3: The proposed model-matchmaking process (adapted from Passini's (1992) model of cognitive mapping)

There have been many attempts to conceptualise the process of interacting with an environment and the role of place attachment in determining spatial behaviours. While the previous models reflect on the complexity of place attachment, they go no further in providing testable hypotheses that would stimulate research. The proposed model in this study, offers some integration of the processes, concepts, and relationships involved.

It would be wrong to suggest that previous models explaining place attachment are mutually exclusive. They place different emphasis on the importance of stability and, therefore, on the consequences of leaving a place. The proposed model takes account of this issue. While the emphasis of the research is on the emotional and symbolic bonds, a quantitative survey explaining the cognitive process of attachment would provide numerical support for the links.

4. Conclusions

The analysis confirms the presence of "place attachment" issues in the cases studied. Employees and themanagement of the department expressed concerns about this. The question raised is 'what conflicts arise between user expectations and the eventual characteristics of the new work environment?' Moreover, 'what practices should organisations undertake to minimise change resistance and to maximise the benefits of organisations connecting people through their beliefs and feelings?' The conceptual framework of the study aims to answer such questions.

It has been shown that place disruptions (move experiences) interrupt the processes that bind people to their socio-environments. In order to understand the impact of this disruption, one must examine: (1) pre-existing conditions that influence the experience of attachments, as well as (2) post disruption conditions that influence how individuals can cope with their losses and begin rebuilding ties to places and people [18]. The difficulty of coping with loss and re-constructing place attachment is that organisations rarely appreciate the depth and extent of these attachments and yet these emotional connections remain unmanaged.

Change is necessary. Without it, organisations and individuals become complacent and stale. However in managing change, the critical task is to understand how changing one element changes the rest; how sequencing and pace affect the whole structure. Achieving this critical balance means balancing new strategies whilst preserving the sense of continuity. This is achieved by managing the organisational context in which change occur and creating connections with employees. The question of place attachment has a role to play in managing the emotional connections with new workplaces. Facilities managers, designers and planners need to be aware that people become attached to place and that they are likely to encounter resistance from them. In the knowledge that place attachment is a significant part of human well-being and psycho-cultural adaptation to an environment, designers may be able to solve problems of work space design. Design elements can be introduced that nurture a sense of belonging in an organisation.

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Living environment – relation between sociopsychological and real estate aspects

Alenka I. Temeljtov Salaj,
Joint Services of the Government, Slovenia (email: Alenka.Temeljotov@gov.si)
Tina Škrinjar,
University of Maribor, Slovenia
Maja Meško,
Mira Bandelj,
University of Ljubljana, Slovenia

Abstract

Real estate is one of the most important elements of the infrastructure, connected with place of living and its environment. Very important parts of the living environment are the public buildings and other infrastructure, above all traffic. There are different interrelated aspects, from which real estate could be elaborated: technical, functional - physical, economic, marketing, urban, normative (ownership), ecological–ergonomic.

The main problem generally refers to the relationship between sociopsychological and real estate aspects. We were interested in: the structure of perceptions connected with different aspects of real estate in the living place and in its environment, types of public buildings and sectors of traffic infrastructure which are perceived as most worthy of financial investments; and the difference between the groups of participants regarding perception of environment and real estate aspects and regarding the perceived needs of investments into different infrastructure areas. We verified hypotheses, that perceived needs for investment differ regarding area of investment and regarding group of respondents. We expected, that evaluations of proper living environment discriminate between different evaluation of its offer.

Four groups of participants were embraced in the research: students of psychology, employees or owners of real estate agencies, people, employed in important public institutions and people with academic education from the field of building construction.

The following variables were identified in the framework of the actual research: demographic characteristics; objective characteristics of living place and its environment, connected with real estate; subjective variables, connected with living place and its environment, like evaluation of living place, its environment, the people living in the environment, the different offers located in the environment, but also the evaluation of proper working place; perceived need for the financial investments into different areas of infrastructure.

Factor analysis reduced evaluative variables, measuring perceptions connected with living place and environment. Treating the evaluations as predictors we discovered significant discrimination between two groups of respondents who evaluated the offer in their living environment: evaluation of the people, together with some evaluations of environment have the highest correlation. Friedman's nonparametric test for the repeated measures revealed the perception of investment priority, connected with traffic infrastructure, into new apartments, geriatric buildings, hospitals and youth clubs. We discovered with the Kruskal – Wallis test that public groups more than others prefer investments in apartments and engineers more than others prefer investments in swimming pools.

Keywords: environment, infrastructure, perceptions of real estates, public buildings, investments

1. Sociopsychological aspects of real estate

Different responses on environment depending on climate, self-evaluation, values, lifestyle, culture, identity and efficiency of individual could be expected by particular target samples. That can be reflected in the relation toward real estate status of the family, living place, organisation, evaluation of inheritance and nation. The life cycle of real estate has not only the nature of technical, technological and economic aspects but also is the result of different perceptions of individuals between the real estate processing. The relation is detached through the functional, living, ecological and other qualities.

The real estate market is a process of social interaction and communication which is indicated in the process of offer and demand. Real estate market research is dealing with urban experts, investors, financial experts, agents, marketing researchers, sociologists, psychologists. It contains few phases: defining market sphere, analysing economic base (sources, employment, income, population, economic trends), analysing market condition (offer and demand), projections and conclusions (intensity of demands, sort, price, market share) and analysing potential profit (regarding legally, location, physical, market, social, psychosocial, financial facts). The multidiscipline is important for people concerned with real estate, in the sense of versatility, following the legal, economic, social, cultural, architectural trends and rules. Experts should be educated at the schools (Thompson, 2002) equally on the cultural and technical level because the importance of natural and humanistic sciences is on the same level for the integral personal growth.

The main questions in environmental research are connected with interaction between environment and social behaviour, and their assimilation to changes which are caused. The interaction models between individual and environment are gathering on analyses of social variables (individual and group, personality, culture, part, organisation, social-economic characteristics) considering the influence of physical facts and variable's analyses of nature and shaped environment (characteristics of architecture and landscape, characteristics of environmental processing, sphere and frequencies of the processes). From the marketing point of view real estate could be interesting on every level of the market network, and it can have ergonomic and its ecological part (Stockols&Altman, 1991).

Macro-environment is decided with two elements of space's comprehension (Kovič, 1992): A) Space is measured in four dimensions (co-ordinates of space and time), is objective real and present. It is conditioned by the combination of elementary climate and geo-morphological components of nature and built environment. B) Space is represented in un-measurable dimensions, is subjective real. It is conditioned by the perception and spiritual field of global space with interactive influence. The built environment is exactly defined and suited for the given or perceived circumstances at a particular moment. Components of global space, which define the quality of un-measurable space, are always changing and influencing the human perception of living environment.

The town is a place in which three basic components of spatial ingredients are connected: nature space – it gives the basic shape of land, it's structure and characteristics, with water, vegetation, fawn and clime; social setting – it includes individual and community, activities, institutions, culture with customs and manners; and material products – which form the culture of the society with buildings, installations and recourses. All together are expressing the entireness of occurring and collaborating nature, beings and things in dynamic process of changing and revitalising, from which neither past, nor in development focused future is not excluded.

One of the important questions of psychological research of the environment is the interaction between the individual and environment. This concept has significance in the sense of interaction of the individual with his immediate physical environment. The word interaction means reciprocal activity or influence: environment on individual and individual on environment. An individuals influence is possible on its immediate environment, especially if we talk about two-way influence. This interactive relation was shown by Piaget (1971) with processes of assimilation (adaptation of something to oneself) and accommodation (adaptation of somebody to environment). Assimilation and accommodation are basic processes of interaction with environment. Biological views of the mentioned processes, Piaget "transferred" on the level of psychological functioning. Assimilation and accommodation have become basic processes of interaction with physical and social environment. From the view of individual psychological processes are the base for the analysis of cognitive development of individual.

Cognitive models of interaction between human and environment are dealing with questions: about the relation between characteristics of the environment and individual characteristics; about the differences in cognitive perceptions and categorisations of the physical environment, from the point of view of various social and cultural groups and their social and spatial behaviour, standpoints and stereotypes toward physical environment; and about social representations of different macro-objects and macro-events (Rus, 1997).

The integration of global and local views is significant for urban analyses nowadays. The new urban concepts are related with social changes in line of globalisation, development of informative and communicative technology, democratisation of society, ecological consciousness, energy economising and changes of life style and patterns. Slovenian towns, where the consciousness about preserving the culture in the meaning of architectural heritage exists, are uniformed under the influence of investment capital and modern designing access. Some of the objects or complexes escape from the uniformity by changing the content, the open spaces are becoming scenes for social interactions and collective identity (Dimitrovska, 2001). Rem Koolhaas (1995) has the theses of fluid and an-rational space, in which particular objects are only artefacts or substrates of urban ingredients. The final result could be only autistic in dis-functionally space. Open interactive spaces are removed from the uncommunicative and aggressive environment of streets, squares and parks to the supervised world of internet, as well as the enclosed and safe space of market centres and terminals.

2. Research problem

The problem generally refers to the relation between sociopsychological and real estate aspects. More concretely, it could be explained as the following questions: Which is the structure of perceptions connected with different aspects of real estate in the living place and in its environment? How do these perceptions discriminate between two groups of respondents, who 1/ more positive or 2/ less positive evaluate different offers, connected with the quality of life of their living environment? Which types of public buildings and sectors of traffic infrastructure are perceived as most worthy of financial investments? Do the target groups of respondents differ regarding the perceived needs of investments into different infrastructure areas?

The following hypotheses are formulated:

- There are significant differences unperceived need for investment into different areas of real estate (for example: schools, hospitals, sport halls, etc.).
- There are significant differences between four groups of respondents in perceived need for investment into particular category of real estates (for example: schools, hospitals, sport halls, etc.).

- Evaluation of the living place, its environment and of people living there (as set of predictors) significantly discriminate between two levels of criteria (perceived offer in the place of living: above and under median level).
- Perceived investments into different areas are mutually dependent, forming also independent groups (criteria of perceptions).

The research comprised four groups of participants:

- students of psychology from the Ljubljana University, Slovenia (n=25, mean age=25.80, SD=5.8, 0,9 women, 0,10 men);
- owners or employees of real estate agencies in Slovenia (n=31, mean age=43.55, SD=12.66, 0,4 women, 0,6 men);
- employees in the public sector and state institutions from Slovenia (n=24, mean age=39.20, SD=14.00, 0,6 women, 0,4 men);
- employees in the field of construction business in Maribor, Slovenia (n=28, mean age=37.36, SD=10.82, 0,6 women, 0,4 men).

Applied instruments are only a part of a comprehensive questionnaire, connecting questions about objective characteristics of real estate and correspondent perceptions (evaluations). The following variables were identified in the framework of the actual research:

a/ particular demographic characteristics;

b/ particular objective characteristics of living place and its environment, connected with real estate;

c/ subjective variables, connected with living place and its environment. All evaluations were obtained as summative scores, using the semantic differential with seven point bipolar continuums (example of one bipolar continuum: warm 1 2 3 4 5 6 7 cold).

The following bipolar attributes for evaluation of the living place, place for leisure time and work place were embraced in differential: space enough/ not space enough, dark/ shine, satisfying/ not satisfying, dirty/ clean, settled/ not settled, poor/ rich, pleasant/ unpleasant, full/ empty, equipped/ not equipped, cold/ warm, dry/ wet.

The following bipolar attributes for evaluation of the environment 1 were embraced in differential: clean/ dirty, supplied/ not supplied, cultural interesting/ not interesting, quiet/ noisy, entertaining/ boring, peaceful/ violent, friendly/ hostile, pleasant/ unpleasant, social/ not social, open/ closed, lives with tourism/ doesn't live with tourism, expanding/ collapsing, with good management/ with bad management, with good offer/ with bad offer, dynamic/ rigid, cooperates with people/ doesn't cooperate with people.

The following bipolar attributes for evaluation of the environment 2 were embraced in differential: adapted to the people with different needs/ not adapted, with enough space for everyday living/ not enough space, with efficient traffic infrastructure/ not efficient, without traffic locks/ with traffic locks, with secure traffic/ without secure traffic, with regulated parking places/ without regulated parking places.

The following bipolar attributes for evaluation of the offer in the place of living were embraced in differential: enough kindergartens/ not enough, enough shops/ not enough, sports buildings/ not enough, enough health centres/ not enough, enough cultural institutes/ not enough, enough green parks/ not enough, enough open spaces/ not enough, enough children's playgrounds/ not enough, enough leisure activities/ not enough.

The following bipolar attributes for evaluation of the people were embraced in differential: optimistic/ pessimistic, active/ passive, independent of others/ dependent, worth imitating/ not worth, exciting/ not exciting, oriented on future/ oriented on past, interesting/ uniform, not oriented on commonness / oriented on commonness, in harmony with oneself/ not in harmony, successful/ not successful, opened/ reserved, considerate/ not considerate, convinced worth of own aims/ not convinced, oriented inside/ oriented outside.

d/ perceived need for the financial investments into different areas of infrastructure: educational institutes (primary schools, high schools, university buildings), health infrastructure (into health centres, hospitals, other, geriatric centres), sport (swimming pools, skating halls, athletic stadiums), traffic(highways, railways, local roads), apartments (new apartments), culture (opera halls, theatres, museums, youth centres). Perceived need was measured on the 5 point scale (1=not needed, …, 5=needed very much).

Internal consistency for the instrument was identified for each of the four compared groups. Cronbach's alpha for each summative instrument in each group was higher than 0.80.

3. Results and discussion

Table 1: Mean ranks of Friedman's nonparametric repeated measures test: perceived need of investment into particular objects for all subjects together

	Mean Rank		Mean Rank
primary schools	**8.04**	**highways**	**10.98**
high schools	**8.85**	**railways**	**11.08**
university buildings	**8.86**	**local roads**	**11.13**
into health centres	**8.82**	**new apartments**	**12.08**
hospitals	**10.46**	**opera halls**	**5.95**
geriatric centres	**10.34**	**theatres**	**7.38**
swimming pools	**8.79**	**museums**	**6.86**
skating halls	**5.51**	**youth centres**	**10.49**
athletic stadiums	**7.38**		

Note. N = 89; Chi-square (16) = 275.56, p = .000.

Friedman's nonparametric test for the repeated measures revealed the perception of investment priority. The highest priority is connected with new apartments, traffic infrastructure, youth centers, hospitals and geriatric buildings. The lowest preference was discovered in the case of all infrastructure connected with culture (opera, museums, theaters).

Dwelling problem is one of the most burning problems in our country. Prices for the new apartments are very high (these can be compared with the prices in highly developed countries in Europe), supporting the financial loan system is not attractive enough for young families, on the other hand there is not enough real estate for renting which causes very high rents. So, following analyses of development prospects offered by trends in supra-regional material and immaterial communication, recollection about issues in renewal of the Slovene housing stock is becoming a very dynamic dimension (Zupančič Strojan, 2004). Conscious balancing of extreme trends and respect for multiple, not necessarily economical or natural conservation dimensions of sustainability, but also wider cultural ones in any physical scale, can help in establishing dynamic balance.

It is very interesting that perceived need of investments in new apartments, railways and local roads have the highest values. The main problem in Slovenia is the lack of an efficient public transport system in spite of the fact that new residential building are built on the peripheries of towns. Polycentric strategy of decentralisation activities, besides connecting knowledge and business innovations, includes spatial integration in the mean of urban designing and improving traffic accessibility between the towns and other countries (Pogačnik, 2000). The investments intensity is oriented in highways corridors, for which the special state programs and legislation are accepted, meanwhile the view of connecting the suburbs and other settlements near big urban centres with the efficient, attractive public transport is neglected in spite of very strong dependency of personal transports, problems with park places and pollution.

Table 2: Kruskal-Wallis nonparametric test for four independent groups and perceived need for investments as independent

areas of investment	Mean Ranks group1 group2 group3 group4				Chi square (df =3)
primary schools	51.1	43.1	47.3	51.2	1.64
high schools	57.3	37.9	48.9	50.8	6.84 #
university buildings	55.5	39.5	51.3	48.7	4.71
into health centres	53.4	38.4	48.5	47.7	4.23
hospitals	50.6	45.8	51.7	44.1	1.45
geriatric centres	44.0	53.9	52.9	41.4	0.63
swimming pools	44.3	39.2	45.4	58.9	4.34 *
skating halls	48.1	37.9	47.3	54.5	8.40
athletic stadions	53.2	35.9	52.9	48.8	5.60 #
highways	42.2	48.7	44.5	52.3	2.22
railways	47.8	47.9	42.2	50.9	1.40
local roads	46.1	49.1	50.1	46.6	0.37
new apartments	48.8	48.1	57.1	37.2	8.15 *
opera halls	46.1	44.5	48.9	47.0	0.35
theatres	51.6	39.9	49.0	47.5	2.86
museums	49.1	41.0	48.7	50.2	2.16
youth centres:	55.6	43.8	42.7	47.2	3.14

Note. N1 (students) = 18, N2 (agencies) = 24, N3 (public)= 19, N4 (engineers)= 28.
** $p < .05$. # $.67 < p < .78$.*

Almost no significant differences were discovered with Kruskal – Wallis test between the groups of respondents, two variables were discovered as important (p<0.05): investment in swimming pools and new apartments. Public group more than students, real estate agents and engineers prefers investments in apartments and engineers more than others prefer investments into swimming pools. Slovenians like sports, so it is also a country of sports champions in team or individual competitions in spite of some bad real estate conditions for training: there is not a football stadium, olympic swimming pool, or athletic stadium in our capital Investments in sports objects are needed and would also be great challenges for engineers.

Table 3/1: Structure matrix: correlation between measured variables and canonical discriminant function

	Function 1
Evaluation of the people	.67
Evaluation of the environment1	.66
Evaluation of the environment2	.58
Evaluation of the working place	.45
Evaluation of the living place	.36
Evaluation of the leisure time	.13

Note: Measured variables are summative scores.
Wilks' lambda = 0.62, Chi – square (16) = 32.14, P = 0.00.

Table 3/2: Functions at group centroids

Perceived offer	Function 1
Under Mdn	-.67
Above Mdn	.89

Note: Perceived offer is dichotomised regarding Median value.

Table 3/3: Means and standard deviations for independents – predictors for criterion »higher - lower« evaluation of the offer in the living environment

	Under Mdn		Above Mdn	
	M	SD	M	SD
Evaluation of the **people**	**50.90**	**12.16**	**62.32**	**9.08**
Evaluation of the **environment1**	**64.88**	**15.35**	**78.00**	**12.87**
Evaluation of the **environment2**	**21.39**	**7.21**	**28.93**	**7.38**
Evaluation of the **working place**	**53.76**	**11.98**	**61.22**	**8.77**
Evaluation of the **living place**	**56.10**	**12.89**	**62.35**	**8.20**
Evaluation of the **leisure time**	**60.07**	**11.83**	**62.19**	**8.22**

Note. All evaluations are summative scores, measured with semantic differential.

Particular summative evaluations, measured with the questionnaire, were treated also as predictors in discriminative analyses with perceived offer as two level criterion. We discovered, that they significantly ($p < 0.05$; $p = 0.06$) discriminate between two groups of respondents, who represent criterion variable, dichotomized regarding the median value into those, who more (above median) or less (under the median) evaluate the offer in their living environment. Evaluations of proper living place, of leisure time place have the lowest discrimination, and evaluation of the people, together with some evaluations of environment have the highest mentioned correlation. It seems, that evaluation of the offers is closely connected with evaluation of people, which may mean that investments in environment's real estate must not "forget" aspects, which facilitate the satisfying of some other social–emotional needs. The environment is laying on one side of the field of physical perception (Trstenjak, 1987). On other side exists the subjective picture of it, arising in the interactive process between the observer and the environment as a product of different experiences and sensitive perceptions

Table 4.1: Statistics of Factor Analysis

Variable	Commu-nality	Factor	Eigen value	Percent of explained variance	Cumulative %
Living place	1	1	3.56	50.9	50.9
Leisure time place	1	2	1.19	17.0	67.9
Evaluation of the environ.1	1		0.78	11.2	79.0
Evaluation of the environ.2	1		0.50	7.1	86.1
Evaluation of the offer	1		0.45	6.4	92.5
Evaluation of the people	1		0.33	4.7	97.2
Working place	1		0.20	2.8	100.0

Note. There are two components with eigenvalue equal or > 1;

Table 4.2: Rotated component matrix (varimax) for studied variables: evaluations of the living place, its environment and of people living there

Variable	Factor 1	Factor 2
Living place (accommodation)	.27	**.80**
Leisure time place	.15	**.86**
Evaluation of the environment1	**.80**	.40
Evaluation of the environment2	**.84**	.07
Evaluation of the offer	**.75**	.10
Evaluation of the people	**.76**	.36
Working place	.13	**.69**

Note: Variables are represented as summative scores, measured with semantic differential

Factor analysis reduced evaluative variables, measuring perceptions connected with living place and environment (with evaluation of working place added) into two factors, both together explaining about 70 % of variance. The first factor of the varimax rotated matrices correlates exclusively with different evaluations of the environment, including the evaluation of the people, living there and the second factor correlates exclusively with the evaluation of the living place, of the place, where somebody spends his free (leisure) time and with the evaluation of the working place. This factor may be specific for tested group(s), whose social status is characterized with shared quality of living place and working conditions.

4. Conclusions

The intention of this research was to explore the relation between the individual and real estate, and vice versa, with the aim that an investor, financial expert, urban designer would know what kind of investment are perceived as most worthy or needed, all seen from the aspects of future invests, building companies and living environment.

We can stress on the results of the research, that in Slovenia:

- The highest priority for the perceived need of investment (table 1), which is good information for investors, financial experts and building companies, is connected with: new apartments, traffic infrastructure (local roads, railways, highways), youth centers, hospitals and geriatric buildings. Perceived need of investment in educational buildings (university buildings, high schools, primary schools), into health centers and investment connected with sport (swimming pools, athletic stadiums) is in the middle. The lowest one was discovered for cultural objects (theatres, museums, opera halls) and skating halls.

- Public group more than students, real estate agents and engineers prefers investments in new apartments and engineers more than others prefer investments into swimming pools (table 2), what could be seen as challenge for engineers and designers.
- The evaluation of the offers (table 3.3) is closely connected with evaluation of people. It means that investors, social experts and designers should consider aspects, which facilitate the satisfying of social-emotional needs, while accessing the investments in environment's real estate.
- Participants separated perceptions connected with living place and environment into two factors (table 4.2). The first factor correlates with different evaluations of the environment including the evaluation of the people living there and the second factor correlates with the evaluation of the place for living, leisure time and working.

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Facilitation of Urban Renewal with Building Safety and Conditions Index

Daniel Chi-wing Ho,
Department of Real Estate of Construction, The University of Hong Kong
Danny Shiem-shin Then,
Department of Building Services Engineering, The Hong Kong Polytechnic University
Yung Yau,
Department of Real Estate of Construction, The University of Hong Kong

Abstract

High-density high-rise building development is the most spectacular feature of Hong Kong's urban areas. However, fire safety and conditions of these buildings become major concern of occupants and the government as the majority of the territory's population live in high-rise apartment buildings. There is increasing pressure on maintaining the level of safety performance in buildings. The recent occasional accidents of falling concrete pieces and windows in Hong Kong have aroused public concern over the possible dire consequences of building neglect. In view of Hong Kong's growing problem of urban decay and building dilapidation, urban renewal has become a matter of great urgency.

In the current economic climate, however, budgets for urban renewal are unlikely to meet the ever-increasing needs. Although it is unlikely that this problem can be overcome completely within an injection of further resources, it is possible for the government to improve the situation by ensuring that the best solution in terms of 'value for money' is achieved in the urban renewal programme. The Building Safety and Conditions Index (BSCI), developed by the Faculty of Architecture of the University of Hong Kong, can indeed help to solve the contemporary building problems.

The BSCI is a benchmarking tool for classifying buildings in respect of safety and physical conditions of buildings. Objectiveness can be achieved in the formulation of the BSCI by adopting rigorous multi-attribute decision-making techniques such as the Analytical Hierarchy Process. Through the BSCI, occupants and the public will be informed of the safety risk associated with their living environments. In view of the monetary benefits, the building owners will upkeep their properties in serviceable conditions. For the government, the BSCI can serve as a priority setting tool to facilitate resource allocation to repair or upgrade buildings with the most urgent needs. Also, with reference to the results of the BSCI assessment, an alternative strategic solution can be achieved.

Keywords: Benchmarking; building labeling; building classification; poli; safety and conditions

1. Background

High-density high-rise building development is the most spectacular feature of Hong Kong's urban areas (Choy, 1998). In Hong Kong, there are now around 42,000 private buildings territory-wide (Housing, Planning and Lands Bureau, 2004). About one quarter of these buildings are 20 to 40 years old and are more susceptible to maintenance problems, particularly those without proper management. This accounts for about half of the residential building stock in Hong Kong. As a matter of fact, the problems of building disrepair and unauthorized building works (UBW) have long been the eyesores of the cityscape in Hong Kong, like many other developed cities. From 1990 to 2002, accidents related to UBW resulted in at least 21 deaths and 135 injuries (Leung and Yiu 2004). In addition, as the majority of population in the territory live in high-rise apartment buildings, the occupants are highly prone to hazards like fire and structural stability. Several tragic fires in recent years have illustrated the gravity of the situation. Requests for addressing the prolonged problems of inadequate building management and maintenance in Hong Kong have become more frequent than ever and any further delay to solve the problem of building neglect cannot be tolerated in any means.

In view of Hong Kong's growing problem of urban decay and building dilapidation, urban renewal has become a matter of great urgency. Urban renewal includes processes ranging from rehabilitation to comprehensive redevelopment. As advocated by Government of Hong Kong Special Administrative Region (2005), enhancing the distinctive characteristics of our territory through urban renewal, which is conducive to the development of local community economy, should be put at the top of agenda. However, upholding the public safety in respect of building conditions is costly. This can be exemplified by the recurrent expenditure of Buildings Department, which is the local authority controlling new development and existing building stocks. As shown in Figure 1, the expenditure has risen from HK$470 million in 1999/2000 to HK$743 million in 2003/2004 (Audit Commission, 2003).

In expectation, budgets for urban renewal cannot meet the ever-increasing societal needs. The problem of deferred actions for achieving better living environment which is common in many countries is resulted eventually. It is clear that increasing pressure is being brought to bear on the government resources available for urban renewal and the process of setting priorities has always been a problem for policy-makers. Although they are aware of the benefits of setting priorities, little effort has been put into the development of a systematic approach for prioritizing works.

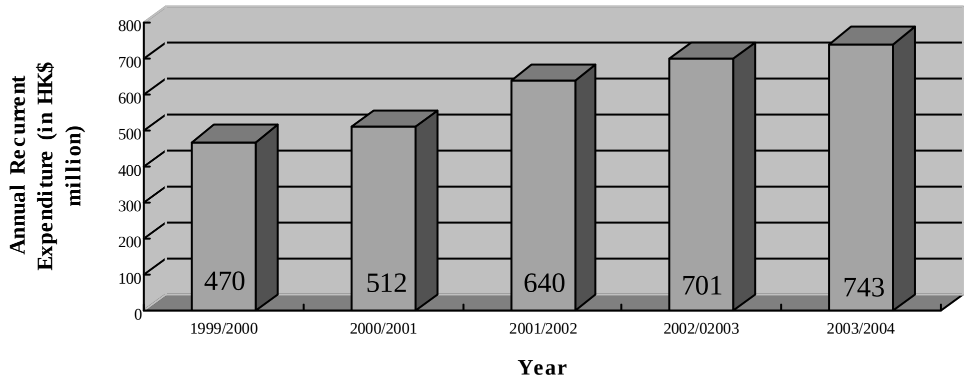

Figure 1: Annual recurrent expenditure by the Buildings Department in the past five years (Source: Audit Commission, 2003)

Therefore, there is an outcry for policy-making tool for better resource allocation for arresting the problems of building neglect in Hong Kong. Indeed, the Building introduced by Ho and Yau (2004) as a benchmarking tool for maintenance managers can help to bridge the gap. Not only can the BSCI assessment framework and the index itself promote private incentives in the upkeep of building conditions by market force, but also serves as a decision-making tool for the government. This paper studies the applicability of the BSCI for facilitation of urban renewal in Hong Kong.

2. The Building Safety and Conditions Index (BSCI)

The BSCI is a benchmarking tool, developed by the Faculty of Architecture of the University of Hong Kong, for classifying apartment buildings in respect of their safety and physical conditions in view of the need to enhance the living environment of our city. It serves to indicate the level of achievement of individual buildings in enhancing the safety of both occupants and the general public. The assessment scheme of the BSCI is backed up by rigorous and sound theoretical foundation so its creditability and practicality can be achieved. Besides, what makes the BSCI distinguishable is that its assessment framework is bespoke for the mass assessment of buildings.

2.1 Features of the BSCI

The BSCI assessment framework is intended for first-tier screening of building safety and physical conditions. Thus, a wide coverage of buildings within a short period of time at a reasonable low cost is a must. Accordingly, the assessment framework should be applicable to most apartment buildings, be they low-rise or high-rise. In addition, the factors to be considered should be directly related to building safety and conditions that pose hazards to occupants and the public. These factors should also be measurable and verifiable so objectiveness can be maintained. However, subjective judgments are unavoidable in most cases of condition assessment. In this regards, validation with documentary evidence such as record photos is necessary.

Moreover, the assessment methods should be practicable and simple, and only characteristics of buildings easily assessable by the public are acquired, measured, and assessed. Whenever possible, a building is assessed with reference to its basic configurations and conditions. On-site assessment is generally confined to common areas and the external environment only so no inspection to individual flats is required. Last but not least, the BSCI is the aggregation of the performance of individual building factors into a simple and user-friendly index for each building. For the easy consumption of ordinary people, the index can be presented in various forms such as numeric index or grades A, B, and C. Based on the index or grade, the general public can be better informed of the performance of buildings in respect of safety and physical conditions.

2.2 Construction of the BSCI

From above, the BSCI is defined and it is essentially an aggregate figure of ratings and weightings of all building factors directly related to safety and conditions of a particular building. Mathematically,

$$BSCI = g\,(w_1, w_2, \ldots, w_n; F_1, F_2, \ldots, F_n) \tag{1}$$

where w_i (i=1, 2, …, n) denotes the relative importance (weighting) of the i^{th} building factor in affecting the safety and conditions of that building; F_i denotes the rating of the i^{th} building factor collected using the above assessment framework; n is the total number of building factors; and g is a function that combines all w_i's and F_i's. The simplest form is the weighted arithmetic mean, with all w_i's summed to unity:

$$BSCI = \sum_{i=1}^{n} w_i F_i \tag{2}$$

2.3 Hierarchy of Building Factors

The building factors, F_i, in equations (2) have been identified through literature reviews and workshops with relevant professionals and experts. For the purposes of the BSCI, a number of safety attributes have been first made out. Fire hazard should take a place because it has long been regarded as one of the most threatening hazards to the building occupants (Chow et al., 1999 and Lo, 1999). The fire safety ranking system developed by Lo (1999) is apt for Hong Kong's situation and provides valuable guidance for identifying fire safety attributes. Yet, building safety embraces not only fire safety, but also many other factors such as structural integrity and falling objects (Buildings Department, 1997 and Choy, 1998).

Finally, eight key safety attributes, namely fire resistant construction, means of escape, means of access for fire-fighting, fire services installations, internal conditions, external conditions, density, and special hazards are identified. To come up with a practical assessment scheme for building classification, the safety attributes are decomposed into a list of building factors that can be, as far as possible, objectively measured. The building factors relevant to the safety attributes are shown in Table 1 for illustration.

Table 1: List of building factors that affect safety attributes

1. Fire Resisting Construction	5. Hazards
l compartment volume l staircase opening l fire-resisting doors	l incompatible uses l electrical installations gas installations
2. Means of Escape	**6. Density**
l travel distance l direct distance l discharge value l obstacles l exit and directional signs	l population per floor l number of flat per floor
3. Means of Access for Fire-fighting	**7. External Conditions**
l emergency vehicular access l fireman's lifts l distance between fire services access point and fireman's lift	l conditions of canopies l unauthorized building works protruding from the external walls l finishes l falling objects
4. Fire Services Installations	**8. Internal Conditions**
l fire extinguishers l hose reels and fire hydrants l emergency lighting	l debonded tiles l cracks l spalled concrete

The list is not exhaustive. Some strategic building management factors which apply to all safety attributes, namely management organization (e.g. deeds governing common areas, owner's corporations, and property management companies), documentation (e.g. the keeping of building records), emergency preparedness (e.g. plans for emergency situations, the provision of contingency funds), and post-occupancy evaluation systems (e.g. occupant survey), are not included. These factors should not be ignored because building safety is inseparable from building management (Choy, 1998).

For facilitating the determination of weightings of different building factors, the relationship between the safety attributes and various aspects of building factors is then mapped together to develop a hierarchy of building factors. Intuitively, poor conditions of building are attributed to misuse and the lack of maintenance. However, much literature (for example, Van Erdewijk, 1988; Heimplaetzer and Goossens, 1991 and Al-Homoud and Khan, 2004) pointed out poor design is one of the causes of building-related accidents. Therefore, building design should play an important role in building safety. In this regard, building factors are grouped into two main categories, namely *Design* and *Management* at the top level, as shown in Figure 2. Each of the building factors at the bottom level will be assessed in accordance with a scoring table, which was designed after a thorough consultation with experts in the relevant fields.

With reference to the hierarchy, *Design* factors include three categories, namely *Architecture*, *Building Services*, and *External Environment*). *Architecture* mainly deals with the provision of passive systems like means of escape and means of access for fire-fighting and rescue to protect the occupants in case of fire. Also, this category is assessed on the measures against falling objects such as the provision of utility platforms. Similar to *Architecture, Building Services*, such as fire services, electrical installations, and fuel supply, are included because their designs also have a direct influence on the safety of building occupants. As for the *External Environment*, hazards like the presence of a petrol filling station in the neighbourhood are considered. With regard to these design aspects, the safety issues of buildings can be addressed at the outset of a development project.

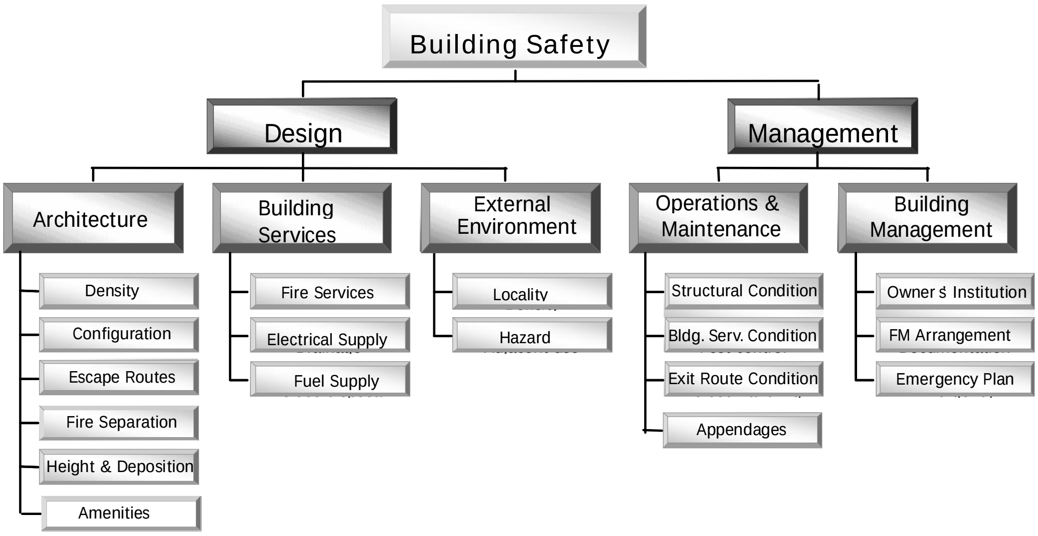

Figure 2: Hierarchy of building factors for safety and conditions assessment

Likewise, building factors under *Management* are grouped into two categories, namely *Operations & Maintenance* and *Building Management*. *Maintenance* is the inspection and upkeep of various building fabrics and services while *Operations* refers to the tidiness and integrity of the exit routes and presence of UBW in the building. *Building Management*, regarded as the software for improving the safety and condition of buildings, embraces strategic issues such as owner's institution, arrangements of facilities management, emergency preparedness, and post-occupancy evaluation.

2.4 Determination of Weightings

Step 1	The interviewee completes the questionnaire in a laptop computer.
Step 2	The ranking, weighting and internal consistency ratios are calculated using the computer package *Expert Choice 2000 2nd Edition*.
Step 3	The analyzed results, i.e. the weighting and ranking of each building factor are reported to the interviewee.
Step 4	If the internal consistency ratio in any category level is not lower than 0.1 which is the accepted level of internal consistency as suggested by Saaty (1982), the computer package will locate the likely source of inconsistency. Without influencing the interviewee's decision, the interviewee is allowed to revise their response either following the suggestion of the computer package or filling in the questionnaire again.
Step 5	After the interviewee completes the revision in the laptop, an instantaneous feedback on the internal consistency ratio is shown to the interviewee on the computer.
Step 6	If the internal consistency ratio is still not lower than 0.1, the interviewee can follow Steps 4 and 5 again for further revision. The process will continue until the interviewee does not wish to make any further changes.

Figure 3: Procedures of the AHP interview

Turning to the determination of the relative importance of the building factors in equation (2), multiple decision criteria systems, such as the Analytical Hierarchy Process (AHP) developed by Saaty (1982), will be adopted to calculate the weighting w_i. The hierarchal representation facilitates the assessment of the relative importance of the building factors using the AHP. Workshops are organized to interview representatives from relevant professional bodies and universities to determine the weightings of building factors perceived by these interviewees. Through a pairwise comparison of the relative importance of all factors at the same level of the hierarchy, the building factors can be prioritized. The detailed procedures of the interview are shown in Figure 3. With the use of AHP, more reliable weightings can be achieved, which is one of the most crucial aspects of the BSCI assessment framework. When all w_is and F_is are found, the overall index BSCI, which is a single measure of the performance of building safety, can be computed.

3. Applications of the BSCI

Ho and Yau (2004) stated that safety is an abstract concept which attracts diverse perceptions to different people. With the integration of people's perception with different background in a scientific manner, the BSCI provides a means of objective and widely accepted *inter*-building comparison for distinguishing the good from the bad. It serves as a benchmarking tool to measure and compare building performance in terms of safety and conditions. It is believed that a well-publicized and well-received BSCI can facilitate the urban renewal in Hong Kong. On one hand, it promotes the private sectors to voluntarily maintain the buildings by market force. On the other hand, the government can make use of the BSCI for its decision-making process.

3.1 Promotion of building care by market force

A safe home is a good one. Buildings with better safety performance should be valued higher. Other than the longevity of assets, it is because less risk premium will be paid by the potential buyers for the unforeseen problems brought about by the disrepair of the purchased properties. These buyers may risk paying a large amount of damages, ranging from approximately HK$60,000 to HK$350,000 per unit, as compensations for the victims in future building-related accidents (Leung, 2003). This amount constitutes quite a substantial portion of the average value of the units. Furthermore, well-maintained buildings may attract more favourable mortgage terms, insurance premium and rental income. However, there is asymmetric information regarding the building safety performance during property transactions. Therefore, the public places a high emphasis on the building age which is taken as a proxy for the safety performance of a building.

The BSCI now provides a useful tool for evaluating safety aspects of a building that are not easily observable. According to such previously hidden information provided by the index on how each building performs in terms of safety, the public can distinguish buildings of similar ages with different safety performances. The BSCI creates labelling effects on those better-performed buildings and these will be translated into higher property values. With a view to the prospective monetary benefits, most property owners would voluntarily exercise their management and maintenance responsibilities. With a reassessment mechanism, property owners of buildings with lower grades could implement improvement projects to their buildings in consideration of the potential monetary benefits. As empirically shown by Chau, *et al.* (2003 and 2004), improvement works brought about a substantial increase in property value which far exceeded the cost of upgrading.

At the same time, the BSCI can serve as a useful performance evaluation tool for the maintenance managers so that the continual maintenance performance can be evaluated by tracking the BSCI of the relevant buildings periodically. In other words, the BSCI can be used as a key performance indicator for maintenance services providers (Ho and Yau, 2004). The same is applicable to the developers and designers, with the incorporation of design factors in the BSCI assessment scheme. This is because higher grades obtained for their housing products or managed buildings can be a powerful marketing tool, especially when concerns over the quality of our living environment continue to surge. More importantly, the BSCI offers information on good design, maintenance and management practices. Designers and maintenance services providers can cross-check their practices with the criteria set for the scheme, and follow the practices to improve their services.

Eventually, positive recognition is awarded to well-designed, managed and maintained buildings through the BSCI. The desire of owners, developers, designers and maintenance services providers for more benefits, be in monetary terms or not, will bring market forces into play to foster a culture of building care. This would attract more resources from private sectors to be invested in the upkeep of private apartment buildings.

3.2 Decision-making tools for government

It is not uncommon for government budgets to hardly meet the ever-increasing societal needs of urban renewal. Hence, it is essential to ensure that the best solution in terms of 'value for money' is achieved in an urban renewal programme. The BSCI can be used as a priority setting tool for decision making and budget planning, providing a basis for allocating and directing funding to specific building-related problems. The value of the BSCI becomes more apparent when the number of problematic buildings in Hong Kong is so large and fiscal resources for urban renewal are limited and must be spread out over extended periods.

Needless to say, the grade or numeric figure of the BSCI can tell how a building performs on safety aspects. This priority setting function of the BSCI can help the government efficiently allocate resources to the areas where action is most needed. Apart from simply classifying buildings into grades A, B, and C, the government can make the full advantage of the assessment framework for decision making. Using the rates obtained from actual assessment and the hierarchy in Figure 2, scores can be for the *Operation and Maintenance* and the *Building Management*. The former reflects the existing conditions of buildings while the latter measures the potential for good safety performance to be achieved. The pair of scores of all buildings in Hong Kong can be mapped in a 2-dimensional matrix, as illustrated in Figure 4.

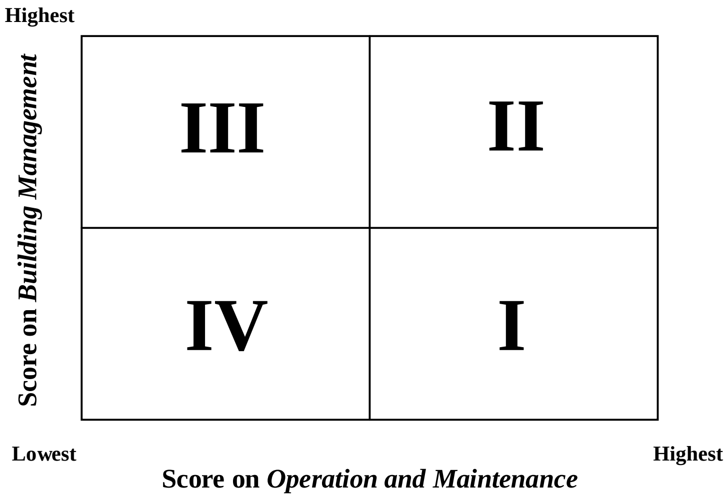

Figure 4: Connection between Operation and Maintenance and Building Management

Owners of apartment buildings with poor existing conditions but with high potential to achieve good safety performance (i.e. buildings in Quadrant III) will be encouraged to undertake improvement works to their buildings in return for higher rental or value of their properties. For buildings with good existing conditions but lacking potential for future safety performance (i.e. buildings in Quadrant I), the government should put more resources to educate the owners on the importance of building care. For instance, assistance should be given to these owners in forming owner's corporations.

Because of the lack of potential to achieve good safety performance, improvement to buildings with poor existing conditions (i.e. buildings in Quadrant IV) may not be practical. Resorts like government loan for improvement works and government-led improvement works should be opted for these buildings although the money will come from the public purse. Redevelopment may be also considered for buildings of this end. To the other extreme, the public resources to be allocated to well-conditioned buildings with potential for future safety performance (i.e. buildings in Quadrant II) should be minimal.

4. Concluding Remarks

The purpose of creating a building is to provide an improved environment for individuals, organizations, and communities (Halliday 1997). It is a common belief of ours. Paradoxically, the problems associated with building safety do not only affect property occupants or users, but also problematic results and their costs are spread across the society. Failure of the general public to undertake systematic and planed preventative maintenance to privately owned buildings has led to a substantial maintenance backlog and provided a contributing factor to the continued proliferation of unauthorized building works, incidence of canopy collapses and fatalities from fire (Choy, 1998).

Undoubtedly, these problems should be properly addressed without further delay but incremental remedies have been criticized for the lack of forethought. A long-term view and sustainable solutions should be taken. The BSCI developed by the Faculty of Architecture of the University of Hong Kong can serves these purposes. The implementation of the BSCI is beneficial to all parties. For the general public, the assessment scheme provides a useful tool for building performance evaluation. For developers, designers, building owners, and maintenance and management services providers, the information provided by the assessment scheme encourages better design, construction and maintenance of their buildings. As a result, the BSCI assessment scheme will serve to foster a culture of constructing and maintaining good quality buildings. Resources from private sectors are pumped into urban renewal. For the government, the results of the BSCI can be used as a policy tool. Such benefits become more noticeable especially during the time of government's financial stringency.

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Client's Tool For Leading Edge Construction And Design Briefing

Nina Ryd,
Facilities Management Consultants (email: nina.ryd@fmkonsulterna.com)
Inga Malmqvist,
Chalmers University of Technology - Facilities Management (email: imalm@arch.chalmers.se)

Abstract

This ongoing research and development project seeks an innovative and planned approach to capture requirements in construction projects, with the purpose of overcoming the restrictions of the conventional briefing process. It aims to develop practical tools that support and facilitate understanding and implementation of client's requirements, effective collaboration between stakeholders and create an innovative, groundbreaking briefing process. Such tools help reducing uncertainties and future problems by early consideration of issues affecting the lifecycle of a facility. Comprehensive development trends in Sweden effecting the improvement of briefing tools are described. Emphasis is on strategic briefing. Processes that converts corporate strategy into property investment or corporate real estate decisions. Processes that capture the organisation's mission, vision and values, as well as guide the process of considering alternatives that satisfy the corporate strategic direction. The project will be based on a number of empirical investigations, case studies and interview surveys among client organizations as well as development of a prototype. The results provide insight contributing to the construction client's as well as the facilities manager's development of competence with regard to the consequences of their selected strategy for facilitating briefing and provision of facilities.

Keywords: briefing/programming*, client, facilities management, corporate real estate, end users, stakeholders, process.

*The British concept construction and design briefing is used as a synonym to the American concept architectural programming throughout this paper.

1. The Client Briefing Tools Project

1.1 Overview

This paper reports preliminary findings of an ongoing research and development project founded by FORMAS (www.formas.se), the Swedish Research Council for Environment, Agricultural

Sciences and Spatial Planning. The project seeks an innovative and planned approach to the founding of client requirements in design and construction projects. The overall aim is to develop practical tools that support and facilitate understanding and implementation of client requirements. Furthermore, the project considers the foundation for successful management of requirements throughout the construction process and the lifecycle of the facility. The development of this briefing tools are assumed of particular interest for client representatives, project managers, development managers, developers and design managers in the real estate and construction sector.

1.2 Industrial Relevance

This R&D project is forming an organised community of people belonging to the industry, real-estate companies, and the real estate division of the county council as well as from universities [1] where the new ideas can more easily reach industry's expectations and where client’s needs can be better faced, and where business problems can be thoroughly discussed.

The practical value of the project is expected as following:

- It contributes to innovative development, satisfaction and support of the client's objectives, demands and requirements of the construction sector
- It contributes to the development of the client’s knowledge about the character of innovative construction briefing processes.
- It provides insight for construction clients with regard to the consequences of their selected methodology for capturing requirements and provision of facilities.
- It provides insight contributing to the construction client’s development of competence
- Implementation and use of the tools in selected client organisations will be one major long term value.

2. The Briefing Process

Rezgui et al. [2] defines the briefing process as ”a process running throughout a construction project by which the requirements of the client and other relevant stakeholders are progressively captured, interpreted, confirmed, and then communicated to the design and construction ”team”. This definition broadens the customer perspective [3]; [4], emphasizes cyclic aspects [5] and clarifies the briefing activities [6]; [7]. However, there always needs to be an avenue for stakeholders to identify, clarify, analyze, formulate, and confirm their perspectives [8] - a process with the overall aim of continually co-coordinating the client's business and facility planning.

2.1 A Strategic, Tactical, and Operative Briefing Process

Strategic briefing is a concept that has still not been completely accepted in Sweden. This basically British concept was introduced at the beginning of the 1990s to reduce the limitations experienced in traditional specification development when both public and private operations were in a state of constant change [9]. The more conventional, needs-initiated briefing process was based on the assumption that the requirements a structure must meet can be described with the help of studies of existing work processes, interviews with employees, and management.

Strategic briefing springs from the current operational needs, but also takes a longer perspective and focuses on the operation’s strategic development plans, its prospects, and the building’s potential for adaptation for other uses. It is a matter of identifying the activity that is to be housed in the building, how it might change, and the factors that affect these changes. Bertelsen et al, for example, found that the identification of the strategic themes is of fundamental importance for the client's possibilities to manage the construction process [3].

The tactical briefing process helps define the course of action. An operative brief considers those aspects that can be adapted and changed as the operation changes. It includes operational and building-related performance specifications, guidelines for layout, and interior design concepts that together form the foundation for the individual organisation’s use of the premises.

3. Comprehensive Development Trends in Sweden - Effecting the Improvement of Briefing Tools

In 2003, twenty three in-depth semi-structured interviews were carried out with representatives from the following organisations: Swedish Cabinet Office and Ministries, the Swedish Board of Civil Aviation, Akademiska Hus AB (2), The National Swedish Property Board, the National Fortifications Administration, Specialfastigheter, County Council Property in Uppsala, Locum AB (2), the Swedish Church, SAR competition office, property consultants Jones Lang LaSalle, White Strategi architects, BSK-architects, Forum for Health Care Building, Gotland’s, Malmö’s, and Härryda’s municipal property offices, The Swedish Pharmacy, Denmark’s Radio, Swedish Posten, The Directorate of Public Construction, and Property in Norway [10]. Those chosen for the interviews had good knowledge of and experience in the sector, regularly carry out briefings, and represent different types of organisations and operations.

Each interview was recorded on tape and transcribed. The respondents were sent transcripts, which gave them the opportunity to make corrections and additions or change the content if necessary. Some of the respondents reacted with annoyance to these transcripts as they exposed the interview dialogue as it actually was. Due to this, several respondents received applicable narrative summaries of the interviews instead of transcripts from tape. In addition, some respondents had a second opportunity to react on descriptions of their experience due to balance experience and reflections over the time of approximate one year. Relevant documents supplied by interviewees were also reviewed.

The semi-structured interviews centred on descriptions of how briefing is carried out today and on what the respondents wanted to improve. A number of specific areas were covered: methods, roles, responsibilities, decision-making processes, scope, formulation of needs, and suggestions for improvements. The results that are of importance when developing briefing tools are described in the following section.

3.1 Increased Client focus, Higher Pace of Change, and Sell-off of Properties

Several factors affecting the conditions for Swedish briefing have changed in the last decade. One of these is an increased customer focus resulting in discussions on how briefs are carried out in individual projects. This was discussed on a broader perspective in terms of which building and project planning policy companies and organisations in the consulting, building, and real estate industries should follow.

Project manager at a county council-owned property company: *"As a result of the introduction of market rents, we have been forced to become more client-oriented… We have begun working on a handbook on how we can carry out a more professional strategic facility planning process."*

Project manager for a state property company: *"Our operations have been streamlined since so many project manager functions are now being bought in the market, while our briefing work has grown and has been forced to become more customer-oriented."*

Project manager for a public property company: "*The problem with our earlier briefing is that we had too little contact with the customer. The people who developed the briefs did not really know very much about the actual needs of the organisation that would use the building."*

Development manager in a property business: "*In connection with extensive sell-offs of our properties, we have had an intense discussion on the actual needs of the organisation, which resulted in more interest in analyses of the connection between the organisation and its buildings"*.

Within the private sector, an increased focus on core activities means that it is more unusual for a company to own its own premises. The briefing process is now based on a more refined user perspective rather than the owner perspective, which was used previously. The pace of change within the organisations has also increased, which means more frequent moving and shorter planning horizons. At the same time, the client is being given more formal responsibility for the management of building projects. The Swedish Planning and Building Act [11] require that the clients ensure that the work is carried out according to the provisions indicated in the law and regulations. This responsibility applies to the function, design, technical solutions, and control of the work. At the same time, many state client functions were affected by cutbacks resulting from more and more services being bought from architectural and technical consultancies. Thus, a representative for the client carries out the briefing process.

On the other hand, the interviews demonstrated that some competencies in the briefing area are often judged to be far too strategic and difficult to purchase and are therefore kept within own organisation in private as well as public sector. In addition, some respondents have expanded the strategic briefing work within their organisations. In this way, the market has contributed to a refinement of the briefing process and caused its main focus to shift.

3.2 More Inexperienced Players in the Early Stages

Several respondents pointed out that the building market has been solid in recent years, something that has also meant more building orders for one-time buyers, primarily from business and industry. As these two groups do not have much experience in the building sector, they are glad to call on consulting services for their briefing needs, which helps explain the increased demand for these firms' services. This puts even more focus on how briefing is conducted.

Some of the respondents emphasised their belief that briefing should be viewed as a strategic assignment and, for this reason, it is not part of traditional, operative project management or design work. This has also contributed to the creation of new consulting services that focus on the briefing process.

Several contractors have invested in their project development programmes to increase their expertise in managing the early stages of the construction process directly with the user as a way to provide more value for the customer as well as to make better business. Since keeping the process under control is of importance for their profitability. When the contractor takes the initiative for a project and propels it from the idea stage to operations and management, the process changes all roles of those involved. This means that the contractor must be able to inspire confidence, be sensitive to the wishes of others, and be able to identify and analyse the clients' needs.

3.3 The Need for Clear and Precise Concepts in the Briefing Phase

The absence of concepts and an established language for the briefing phase was identified as a problem by the majority of respondents. Several apply designations that the KBS (The Swedish National Board of Public Building) formulated in its time during the 1970:ies and 1980:ies, although, in practice, the designations are individually interpreted and used in various ways, while others have developed their own concepts. When the concepts for and within the briefing process are vague, communicating with users and the organisation's representatives can be a significant problem.

Developer: *"There is no common language. During the design phase, we have a lot of technical terms. When we talk about detail design, everyone knows what that is. When we're in the design process, everyone knows what the various phases demand and when the deadlines are. But there is no common language for the briefing phase. It has not been defined?'*

Some of the property owners and their representatives who were interviewed solve the problem by doing much of the work that the client or tenant, who was intimately involved in the implementation, should have been responsible for, while others solve the problem by hiring special project secretaries within the property development company. They have knowledge of the industry and the technical terms that are used in the building project.

3.4 Different Types of Briefing Processes

The respondents work with different types of briefing processes to which they also assign different names. In addition to using designations from the National Board of Public Building, they also use the definitions that are sometimes found in urban planning, and company and operations-specific guidelines. At times, the same briefing data are used for other purposes in a reworked format. Several of the respondents voiced concern over the fact that there are no applicable guidelines or a concordant vocabulary for the different kinds of briefings and for what the different categories of briefings should include, even if most of them say that they know what the different types of briefings can be expected to include.

3.5 Unclear Areas of Responsibility for the Brief

A good number of the respondents would like to have a clear definition of roles and the division of responsibility in the building sector in general. Several respondents felt that it is more important than previously to clearly define the role of the different parties involved during the briefing phase.

Administrator: *"Off and on during the goal discussions, areas of responsibility are created that are supposed to determine who is responsible for what, but they can hardly cover all situations"*.

There was consensus that an unclear, decentralized division of responsibility runs the risk that responsibility for the briefing process will fall between the cracks and that this ambiguity can diminish competency in the area in the long run.

The majority of the respondents have experienced difficulties when they ask their tenants for descriptions of the operations and needs and other information that serves as the foundation for the briefing process.

Briefing architect: *"One can hardly expect the people who represent buildings and furnish operational-compliant buildings to know everything about their tenants' businesses. Just as the business representatives cannot be expected to know the types of information required for a briefing process".*

Property owner: *"We try to make it clear that this is the tenants' facility planning programme. This information serves as input for our design work, our orders. The tenant is responsible for working out a plan for his facilities. We try to be a little 'overly' clear here. I think this is good and necessary, so we know who is responsible. Tenants have to understand that if what they say is wrong, then things wont turn out as they want".*

In those cases in which the information on the business was reported, some of the respondents expressed concern over uncertainty regarding the agreement between the various people who submit information. It was indicated that the consultants hired to carry out the briefing process were sometimes far too dependent on the view of the operations presented by those submitting the information.

Several respondents also expressed concern over a lack of understanding in user groups of the briefing process's requirements in general and the time required for its execution in particular. There was very little understanding regarding the fact that the briefing requirements must often be discussed for sometimes even several years before a satisfactory result is achieved.

All the respondents believe that a well-executed operations description is the basis for a successful briefing needed for an integrated business development and strategic facility planning process.

3.6 Applied Briefing Process Methods

Briefing processes have been part of the organisations used in this study for a long time, and several of those interviewed have had a good deal of experience with this type of work. Many also worked with similar assignments at the former National Board of Public Building. Work methods that were applied on the board are still used to a great extent within private consulting firms, tenant organisations, municipalities, county councils and governmental departments. Methods have been adapted to current operations and it was felt that they worked well during a period of transition.

However, trends and developments within the respondents' own organisations call for clarification and articulation of the briefing's function.

Reasons for change is the increased demand for briefing formulation, including a move to greater client focus with clearer responsibility for long-term profitability from investments. Other trends mentioned include new formats for the briefing process—with more influence from private sector clients and developers—that have already been tried in a number of municipalities. Other types of agreed-upon briefing plans, such as supplements to land use agreements, are also being used. In this manner, the interface between the municipal detail planning regulations and the individual client's briefing process is changing. Increased understanding of the briefing process's strategic importance, the need for an accountable quality system, an aging staff heading toward retirement, and the need to transfer knowledge before the older members of the staff retire were also given as factors on how and to what end briefing processes should be conducted in the future.

On the whole, the respondents believe this development is a positive one. Many feel that the previous routines were often undeveloped, poorly adapted to customers, and far too often based on personal experience. Other disadvantages include lack of comprehensive overview and difficulties in making use of positive experiences.

Project manager in the early stages: *"We knew that our colleagues were collecting a lot of useful briefing documents - good examples. On the other hand, there was no survey or knowledge of how the documents were related to one another, which explains why we have recently begun work aimed at describing the entire briefing process"*.

Some property owners also expressed a self-critical attitude and admitted that, as of now, they have not actually worked out any briefing process methods. However, other managers have already begun to renew their methods for the early stages in the building process from a business-like and client-focused strategic facility planning perspective.

3.7 The Need for New Ways of Working that Generate Constructive Thinking

Several respondents emphasised the importance of creative and constructive thinking as the basis for a successful briefing process. Some went so far as to maintain that it is absolutely decisive and that they are looking for ideas and suggestions on how to implement this mode of thinking.

Client: *"We are looking for good examples of how to get an early dialogue started, tricks of the trade and other methods for taking the initiative. We want to find out how to capture the good ideas, make contact in the right way, how to initiate a process so that, when time is of the essence, we are not forced to do something that everyone can see will be bad"*.

The interviews are replete with observations from those responsible for the briefing process on the difficulties of balancing a favourable work method with daring to critically examine the operations with the purpose of elucidating priorities and actual needs. This was viewed as a sensitive balancing act that is difficult to manage, both for those who manage the briefing process and those who are part of the business or organisation that will use the facilities.

Property owner: *"If the process is experienced as being wrong, then it stays in a tenant's memory for a long time. That is not good, either for us or for them, and particularly not on the threshold of a long-term rental relationship"*.

Several of the respondents imply that it is good for individual projects to have as thorough and detailed a briefing process as possible, but when the organisation is questioned in an attempt to attaining this detailed description, this can be experienced as a potential threat to social relationships and the desire for continued, open discussions. The more clarifications and questions with the intent of achieving a better brief, the more situations arise that can lead to disagreements that, in turn, lead to difficult decisions.

The formulation of goals and needs that arise in consensus are experienced as easier to carry out than those that arise because someone was forced to compromise. It was stressed that more general goal descriptions can act as the instruments that hold a briefing process together over time, even if the goals are difficult to objectify in the actual project.

Everyone agreed that trust is a prerequisite for a constructive specification development process. It is required in order to access the right specification information. There also has to be trust that the individuals conducting the briefing process are competent and have the experience and authority to carry out the assignment. In addition, trust is needed so that people are able to vent their disagreements and priorities in periods of uncertainty without running the risk of a deadlock.

Client: *"The briefing process should take place in a safe environment so that people can communicate, and this has to do with trust. People shouldn't be afraid of making fools or themselves or saying something that's wrong. Not drawing quick or drastic conclusions from something someone has said. These are a few of the personal qualities that are extremely important for making this process work. If there is no trust, then there will be 'attitude' and people 'taking stands'. People notice this kind of behaviour immediately"*.

According to the respondents, the need for a creative and constructive briefing process is both fundamental and complicated. Points of departure focus on relationships, balance between comprehensive and more detailed attitudes, management of insecurity, and different types of trust.

4. Discussion and Future outlook of the R&D project

The findings from the interview study regarding the standing of the construction client and the tools he/she utilises will be combined with the results of an ongoing questionnaire (mars - april 2005) in order to provide a deeper understanding of the mechanisms that are fundamental for the clients' innovative management of projects for the provision of facilities. A presumption is that methodologies and tools could be for example quality function development, problem structuring methods, group decision-making techniques or computer based tools such as database applications and spreadsheet packages. A basic assumption for this study is also that the client today is forced to utilise too production-oriented/process-oriented tools during a project involving the provision of facilities. To focus on the perspective and activity of the construction client, instead of the internal interests of the construction sector, means that attention is shifted from discussions about misinterpreted demand formulations and shortages regarding quality of the building as a project to the prerequisites for developing the clients' competence and management methods. This is in order to allow the client, in the best possible manner, to be able to influence that the outcome of a project is in agreement with its strategic intentions. A perspective that not only focuses on the design and content of specific demands or documents, but that also aims for deeper change with regard to the praxis of the construction industry.

A questionnaire based method will be applied with the purpose of accounting for the following:

- What the client’s tools are, as well as the choice of established tools in relationship to new concepts.
- Verification of factors that a tool has to support or/and if there are other factors that are more relevant?
- The client’s decisive choices before and during a project involving the provision of facilities.
- What administrative and organisational processes influence the construction client’s possibilities regarding the management of a project involving the provision of facilities?

The gathering of information is primarily via a larger number of questionnaires (approx. 100) with a systematic choice of representatives from Swedish construction client organisations. The forum for cooperation between state-owned property boards and real estate management (Samverkansforum för statliga byggherrar och förvaltare), as well as the Swedish association of construction clients’ (www.byggherreforum.se) network and membership register is utilised for the choice of respondents. In addition to this, the relevant documentation and other written sources will constitute the empirical basis for the following of this R&D project.

5. Conclusions

Even if one should be cautious about simplifying the results from the interviews, there are some basic points that are vital for support of the client's briefing:

Briefing tools should:

- facilitate communication and shared understanding of the client's targets with regard to a facility-provision project, but also act as an engine for capturing, preparing and identifying strategic, tactical and operative information and requirements.
- include systems for regularly following up agreed brief assignments and not just final targets. This creates a better possibility of early capture and rectification of things that are unclear.
- be user-friendly and contribute to more active and creative participation on the part of everyone – not least the client as well as less experienced players

- facilitate structuring and prioritisation of the client's requirements.
- support discussions about alternative conceptual and possible solutions.
- support a translation of the client's picture of requirements into measurable requirement formulations.
- simplify verification that the brief's (detailed design brief) requirements are satisfied in the planned solutions as well as deal whit responsibilities.
- deal whit change management
- support both solution-neutral functional descriptions and technical specifications of the client's wishes with the aim of establishing creative conditions for planners to generate physical conditions that best support the client's business targets.
- support different kinds of briefing processes, such as strategic, tactical and operative briefing.

It is advantageous if briefing tools contribute towards better understanding and integration of the client's requirements on the basis of a customer-oriented approach. The tools should contribute towards more explicit definitions and improved communication of the client's requirements and expectations with regard to a facility planning project, so that connections with overall business targets are strengthened.

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[1] A reference group attached to this project includes following contributors: Sven Fristedt, professor in briefing processes, School of Architecture, Chalmers. Bo Törnkvist from Vasa-kronan, a real-estate company specializes in commercial premises, owned by the Swedish state. Harald Pleijel, from The Church of Sweden, Real Estate department in Gothenburg, that supports and maintains the national Swedish church with suitable planned facilities. Klas Lindgren, from The Real Estate division of The County Council of Östergötland (LFÖ). Their mission is to manage the public sector estate and facilities management (efm) services - from strategic estate strategies and the planning of buildings to meet the modernisation of clinical services, through to the concept of the well-serviced hospital - creating an environment that provides front line support to patient needs. Hans-Åke Ivarsson, from Lokalförsörjningsförvaltningens (LFF). LFF's principal mission is to supply Sweden´s second largest city, Gothenburg with the necessary premises for child care and education.

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Valuing Productivity Loss due to Thermal Discomfort

Kwok C. Wong,
Department of Real Estate & Construction, University of Hong Kong
(email: wongkc@hkusua.hku.hk)
Brian W.L.Tse,
Department of Building & Construction, City University of Hong Kong
(email: bcwltse@cityu.edu.hk)
Albert T.P So,
Department of Building & Construction, City University of Hong Kong
(email:bcalbstp@cityu.edu.hk)

Abstract

Thermal discomfort may decrease productivities. This paper derives the economic principle of assessing the market value of such productivity loss based on standard economic principles of the Marginal Productivity Theory. These losses are expressed in terms of proportional losses in economic rents and profits. This paper aims to provide a basis for systematic market valuations of losses due to thermal discomfort, and hence varying strategies under varying circumstances.

Keywords: Productivity loss, thermal comfort, predicted mean vote (PMV), marginal productivity theory.

1. Introduction

Adbou and Lorch [1994] verified that the productivity of occupants is greatly affected by the thermal comfort. Wyon [1996] and Kosonen and Tan [2004] make significant contributions to human thermal comfort. Quantitative relationship between the productivity level and Predicted Mean Vote (PMV) is now defined for some activities. This finding has a great impact on air-conditioning control. Market data and Simulations of PMV changes under varying air-conditioning control systems of buildings at different locations will be investigated.

2. Marginal Productivity Theory

Thermal comfort affects the productivities of staff working in an office.

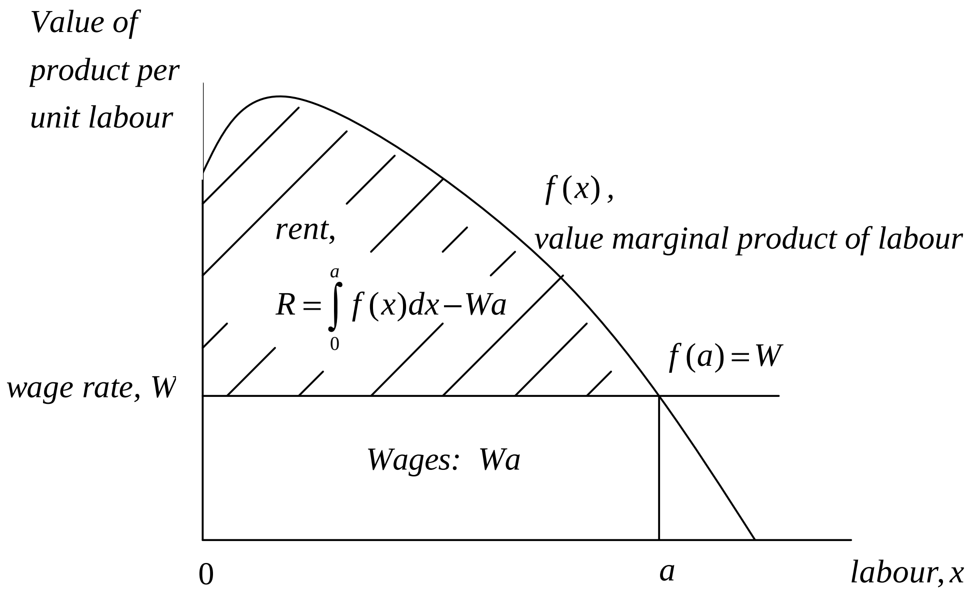
Suppose the value marginal product of labour is a function f of the quantity of labour input x. This function f is a decreasing function of x according to the Law of Diminishing Marginal

Productivity (see, for instance, Stigler [1966]). Standard economics would illustrate that maximum economic rent, *R*, could be receivable at *a* units of labour input into production, where *f(a)=W* , the competitive wage rate. And the maximum economic rent:

$$R = \int_0^a f(x)dx - Wa \qquad (1)$$

Graphically, rent is the area under *f(x)* from *x=o* to *x=a*, less wages *Wa* :

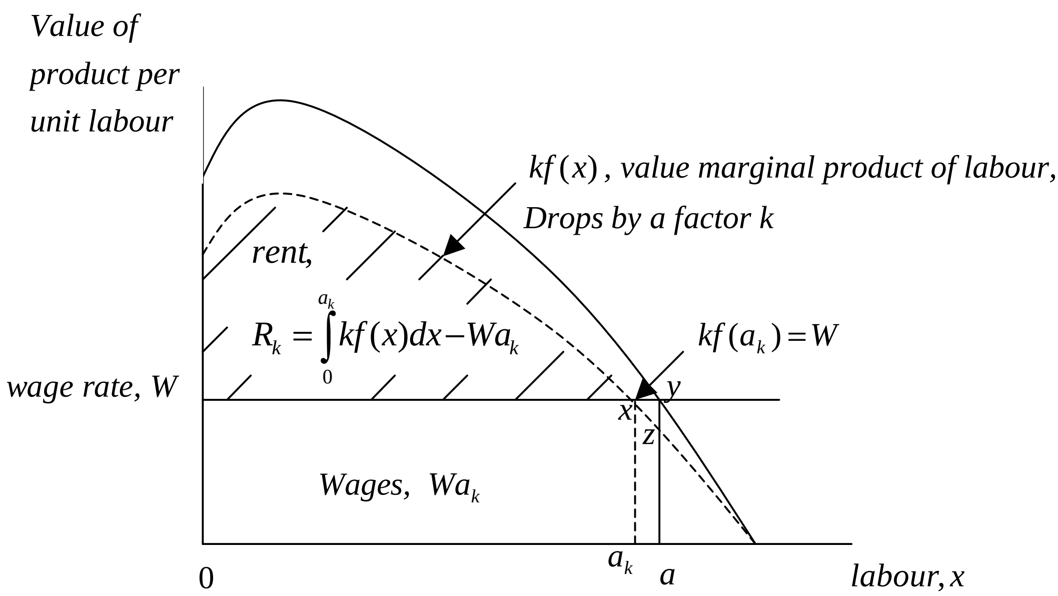
Graph 1: value marginal product and rent



3. Productivity Drop

Now suppose a change in temperature has resulted in a reduced productivity, say *k* times the original value marginal product *f(x)*. For instance, *k= 0.9* means a 10% drop in the output product *f(x),* at any quantity of the labour input, x. Then graphically, *f(x)* becomes a “10% lower” curve at every point labour input:

Graph 2: A drop in productivity



A smaller productivity would imply smaller profits, and therefore, economic rent: $R_k < R$, and

$$R_k = \int_0^{a_k} kf(x)dx - Wa_k \qquad (2)$$

Since k and R are readily available data, we may estimate R_k *using* k and R.

Firstly, from Equation (1), we may re-write kR as:

$$\begin{aligned} kR &= k[\int_0^{a} f(x)dx - Wa] \\ &= \int_0^{a} kf(x)dx - kWa \\ &= \int_0^{a_k} kf(x)dx + \int_{a_k}^{a} kf(x)dx - kWa \end{aligned} \qquad (3)$$

Comparing this to R_k in Equation (2), and adding terms -Wa_k and +Wa_k to this Equation (3), in order to allow sufficient components for R_k, we have:

$$kR = \int_0^{a_k} kf(x)dx - Wa_k + \int_{a_k}^{a} kf(x)dx + wa_k - kWa$$

$$= R_k + \int_{a_k}^{a} kf(x)dx + Wa_k - kWa \qquad (4)$$

Graphically, the term $\int_{a_k}^{a} kf(x)dx$ is the area $a\ a_k\ x\ z$. Assuming the line segment $x\ z$ is reasonably close to a straight line, then this area is reasonably close to:

$$\int_{a_k}^{a} kf(x)dx \cong W(a - a_k) - \frac{1}{2}(a - a_k)(1-k)W$$
$$= W(a - a_k)(\frac{1+k}{2}) \qquad (5)$$

Putting this into (4):

$$kR = R_k + W(a - a_k)(\frac{1+k}{2}) + Wa_k - kWa \qquad (5)$$

After rearranging,

$$\frac{R_k}{R} = k - \frac{(1-k)(a + a_k)}{2} \cdot \frac{W}{R} \qquad (6)$$

When the reduction of labour input due to a drop in productivity is negligible, i.e. $a \cong a_k$ (or, in other words, the employer finds that the drop in productivity does not justify a labour cutting exercise), then

$$\frac{R_k}{R} \cong k - \frac{Wa}{R}(1-k) \tag{7}$$

This means the ratio of reduced profits (or more accurately economic rent) to the original, R_k/R, could be approximated by the ratio of reduced productivity to the original, k, less the corresponding drop, by the factor (1-k), on the wages-to-rent ratio (Wa/R).

Equations (7) could therefore be used to estimate the loss in profits, given data of rent, wages, labour employed, and reduction of productivity loss due to thermal discomfort. If the loss in productivity is so significant that the employers have to cut staff, due to significant reduction in income, then Equation (6) should be used instead.

This implies that if wages is large compared to economic rent, i.e. Wa/R ratio, economic rent (profits) would reduce at a ratio greater than that in productivity loss: R_k/R much smaller than k. In simple words, the larger the labour costs, comparing to business profits, the greater the effects (of productivity drops) on profits.

4. A Numerical Example

Suppose there are two small offices, one a stocks broker at the Central Business District of Hong Kong; and the other, an engineering consultant in the sub-urban area. Both offices occupy 1,000 square meters of usable floor area. The CBD one costs $12,000/m2 yearly to rent; and the sub-urban one, ten times less: at $1,200 /m2. The stocks broker pays higher wages to its staff, around $5 million a year; and the engineering consultant, $3 million. Gross profits for the stocks broker, before wages and office rental, is $7.5 million; and the engineering consultant, $3.5.

Table 1. The stocks broker vs. The engineering consultant

	Symbol	Stocks broker in the CBD	Engineering consultant in the sub -urban area
Office size	s	100 m^2	100 m^2
Yearly rent /m^2	y	\$12,000/m^2	1,200/m^2
Yearly rent payable to the landlord	$y\ s$	\$1,200,000	\$120,000
Gross profits (before wages and office rental)	$G = \int_0^a f(x)dx$	\$7,500,000	\$3,500,000
Yearly wages	Wa	\$5,000,000	\$3,000,000
Economic rent (after wages but before office rental)	$R = G - Wa$	\$2,500,000	\$500,000
Net profit	$\Pi = R - ys$	\$1,300,000	\$380,000
Wages–to-Economic Rent Ratio	Wa/R	2	6
Ratio of reduced economic rent to original, if *k=0.9*	$\frac{R_k}{R} \cong k - \frac{Wa}{R}(1-k)$ from equation (7)	0.7	0.30
% Loss in economic rent	$l = (1 - \frac{R_k}{R}) \cdot 100\%$	30 %	70%
Reduced Economic Rent	R_k	\$1,750,000	\$150,000
Net profit after productivity drop	$\Pi_k = R_k - ys$	\$550,000	\$30,000
Loss in net profits	$\Pi - \Pi_k$	\$750,000	\$350,000
% Loss in net profit	$(\frac{\Pi - \Pi_k}{\Pi}) \cdot 100\%$	58%	92%

Table 1 shows that the net profits, after all wages and office rentals, are \$1.3 and \$0.38 million respectively. Now suppose that productivity drops by 10% due to thermal discomfort. Equation (7) allows us the estimate the profit loss due to such drop in productivity. The results in Table 1 show that the engineering consultant suffers from a much bigger % loss in net profit, 92% vs. 58%. The stocks broker's absolute loss in profit is, however, larger: \$0.75 vs. \$0.35 million.

Absolute loss in profit depends on the base, of the original profit, and the office rental due to location. Such conclusion cannot be easily generalized to all other examples. However, Equation (7) shows that the ratio of the reduced economic rent to the original, R_k/R, is always a negative function of Wa/R: the wages to economic rent ratio. Systematically plotting k, the proportion of the reduced productivity to the original, against Wa/R, we have the following Table 2.

Table 2. The Sensitivity of R_k/R to k and Wa/R. (the stocks broker; and # the engineering consultant)*

	k **: the proportion of reduced productivity to the original**									
***wa/R*:**	**0.95**	**0.90**	**0.85**	**0.80**	**0.75**	**0.70**	**0.65**	**0.60**	**0.55**	**0.50**
wages–to -economic rent ratio	***Rk/R:*** **the proportion of reduced economic rent to the original**									
0.500	0.93	0.85	0.78	0.70	0.63	0.55	0.48	0.40	0.33	0.25
1.000	0.90	0.80	0.70	0.60	0.50	0.40	0.30	0.20	0.10	0.00
1.500	0.88	0.75	0.63	0.50	0.38	0.25	0.13	0.00	*(0.12)*	*(0.25)*
2.000	0.85	**0.70***	0.55	0.40	0.25	0.10	*(0.05)*	*(0.20)*	*(0.35)*	*(0.50)*
2.500	0.83	0.65	0.48	0.30	0.13	*(0.05)*	*(0.23)*	*(0.40)*	*(0.57)*	*(0.75)*
3.000	0.80	0.60	0.40	0.20	0.00	*(0.20)*	*(0.40)*	*(0.60)*	*(0.80)*	*(1.00)*
3.500	0.78	0.55	0.33	0.10	*(0.13)*	*(0.35)*	*(0.58)*	*(0.80)*	*(1.03)*	*(1.25)*
4.000	0.75	0.50	0.25	0.00	*(0.25)*	*(0.50)*	*(0.75)*	*(1.00)*	*(1.25)*	*(1.50)*
4.500	0.73	0.45	0.18	*(0.10)*	*(0.38)*	*(0.65)*	*(0.93)*	*(1.20)*	*(1.47)*	*(1.75)*
5.000	0.70	0.40	0.10	*(0.20)*	*(0.50)*	*(0.80)*	*(1.10)*	*(1.40)*	*(1.70)*	*(2.00)*
5.500	0.68	0.35	0.02	*(0.30)*	*(0.63)*	*(0.95)*	*(1.28)*	*(1.60)*	*(1.92)*	*(2.25)*
6.000	0.65	**0.30#**	*(0.05)*	*(0.40)*	*(0.75)*	*(1.10)*	*(1.45)*	*(1.80)*	*(2.15)*	*(2.50)*

Negative figures (in brackets and *italics*) in this table show cases of negative economic rents, due to substantial reduction in productivity. These are cases in which reduction of profits are so high that such profits could not even to cover operating costs and wages, not even before paying the landlords the office rentals.

We may also see from Table 2 that for any reduction of productivity due to thermal discomfort, *Rk/R* is monotonically decreasing for increasing values of *Wa/R*: the wages-to-economic rent ratio. *In other words, ignoring office rentals payable to the landlord, profits decrease more rapidly for offices where ratios of wages to profits are high*.

5. Conclusions

We started off by deducing the relationship between reduced economic rents to productivity drop due to thermal discomfort, based on the standard marginal productivity theory. We then deduced that the ratio of the reduced economic rent to the original, *Rk/R*, is a function of the proportion of reduced productivity, *k*, and the wages-to-economic rent ratio *Wa/R*: as stated in Equation (7).

This relationship allows us to estimate the reduction in profits due to productivity loss, using data of wages and gross operating profits, which are readily available in a normal office. Numerical and sensitivity analysis concludes that the profits before rental payments (i.e. economic rents) decrease sharply for cases where the ratios of wages to such profits are high.

Such rules of thumb allow the decision maker to (a) to estimate the potential profit loss when a drop of productivity due to thermal discomfort is causing alarm; and (b) whether or not to rectify the problem, given the costs of the rectification. This could be done by simply comparing the potential profit loss to the potential cost of installing sophisticated equipment to monitor and control the indoor environment. Further development along these lines, to develop practical tools of implementation, is expected of the next stage of this research.

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Section V

Sustainability in facilities management

The Valuation and Appraisal of Sustainable Development

Jon Robinson,
The University of Melbourne. Melbourne, Australia, (email: jrwr@unimelb.edu.au)
Peter Lawther,
RMIT University. Melbourne, Australia, (email: peter.lawther@rmit.edu.au)

Abstract

The property market continues to be unsure about the benefits of environmentally sustainable development and accordingly it is not usually reflected in the property valuation and analysis process. Using the concepts of price and worth, an outline valuation process is developed to assist the valuer to take environmentally sustainable development into account through rent, capital growth and psychic income. Research has shown that lessees are prepared to pay a higher rent for improved comfort and control of the environment. Analysis of market evidence has shown that a psychic element of income can increase prices paid for properties by reducing the initial yield. Taking elements of return including higher rental rates payable by tenants and firmer capitalisation rates acceptable to landlords into account together, it is shown that a property exhibiting the highest environmental design and management principles can achieve a substantially improved property investment worth. These remain to be reflected in the general approach to estimates of market price.

Keywords: price and worth, psychic income, income approach, market sentiment, sustainable development

1. Introduction

The principle of environmental sustainability "implies using natural resources in a way which does not eliminate or degrade them or otherwise decrease their usefulness to future generations, and implies using non-renewable natural resources at a rate slow enough as to ensure a high probability of an orderly societal transition to new alternatives" [1]. The World Bank has used the phrase "development that lasts" in this context [2].

The process of sustainable built asset management is continuous throughout the life cycle of the property. The life cycle comprises "consecutive and interlinked stages of a product system, from raw material acquisition or generation of natural resources to the final disposal" [3]. In the context of property and construction, it is a time horizon which commences with the acquisition of land, includes the design and construction of buildings, and continues with the ongoing operation of the property and ceases with the ultimate demolition or deconstruction and recycling of the property.

In Australia, buildings are responsible for 30% of all raw materials used by society and they consume more than 40% of all energy produced causing more than 40% of all air emissions [4]. Development will not be sustainable if the economic constraints under which the property development process operates are not considered. There is a common perception that there is no demand or support for sustainable development. However, the impact of buildings on the environment requires that the property and construction industry contributes to the ESD culture.

The relationship between benefits and costs is commonly assumed to be an impediment to the uptake of sustainable development. The property and construction industry and its clients tend to focus on short-term gains rather than long-term savings or investment opportunities. Perceived higher initial construction costs and maintenance costs are major obstacles, as they reduce profitability. The anticipated additional cost of ESD features is a reason for the perceived indifference of clients to environmental issues.

In Australia, concern for initial costs is reinforced by the involvement of a number of actors in different phases of building delivery, from development, ownership to occupation of structure. Energy efficiency, for example, is not considered a high priority for potential tenants and the emphasis industry puts on initial costs versus life cycle costs militates against ESD considerations.

Inappropriate financing models or lack of access to capital discourages investment in sustainable buildings. There is also no incentive to act, when often the investor is not the ultimate user who is responsible for energy bills. In addition, energy, like other business related expenses, is tax deductible and the plant and equipment that uses energy is can be depreciated against taxable income. Lenders of capital neglect environmental costs in their assessment frameworks.

The property market continues to be unsure about the benefits of environmentally sustainable development (ESD) and accordingly ESD is not usually reflected in the property valuation and analysis process. Using the concepts of price and worth, an outline valuation process is developed to assist the valuer to take ESD into account through rent, capital growth and psychic income. Research has shown that lessees are prepared to pay 5% to 10% higher rent for improved comfort and control of the environment [5]. Analysis of market evidence has shown that a psychic element of income can increase prices paid for properties by reducing the initial yield [6]. Taking all of these elements of return together, a property exhibiting the highest environmental design and management principles can achieve a substantially improved property investment worth. These remain to be reflected in the general approach to estimates of market price.

It is common for investment valuations to be prepared in association with market valuations the former by DCF and the latter by capitalisation. It has been common to adjust the investment variables in the DCF so that both methodologies provide the same result. This tends to suggest that price and worth are identical (which would be so in a fully informed market in equilibrium and is certainly so for a buyer in that market). But reference to any of the financial markets dispels this notion; transactions occur as a result of differing opinions about price and worth and this is of significant relevance to property.

Sales evidence may be analysed and its results used to value a comparable property in the normal way. But this reflects what the market has been paying for comparable properties; it does not necessarily reflect the normative solution, i.e., what it should have been paying.

First, the paper briefly reviews the findings of a sample of the empirical research in which the costs and benefits of ESD are detailed. Second, the residual analysis methodology adopted for the purposes of this paper is briefly described. Third, the data used in this paper are recorded including current market data. Fourth, the calculations are illustrated using the conventional residual model. Finally, some concluding comments are offered together with some suggestions for further research.

2. Background

Conventional business case decision making tools can be used to evaluate ESD buildings, but they have generally not been used, or used inappropriately. ESD buildings by their nature must be considered over the entire life span of the development, not simply the design and construction stage. Therefore, a whole of life or life cycle cost approach to the evaluation of ESD buildings is appropriate. In simple terms, this is because increased investment in sustainability features of building design can be offset by reduced running costs and potential productivity gains during the occupation of the building. Concentration predominantly on increased capital costs of development for ESD buildings, and use of static business case analysis tools which support this view, leads to inappropriate or inadequate consideration of the total development.

The presumption that ESD buildings “cost more” needs to be considered further. The perception that sustainable design and construction inherently contains a substantial cost premium is considered one of the main barriers to ESD [7]. Due to the fact that the construction industry and its clients generally tend to concentrate on short-term gains rather than long-term savings or investment opportunities, this perception that ESD buildings require higher initial construction costs and maintenance costs, is a major obstacle as this reduces the profitability of the project. Indeed, six Californian property developers interviewed in 2001 estimated that green buildings cost 10 to 15% more than conventional buildings [8]. In terms of capital development cost, there is a dearth of published information as regards the cost premium of ESD buildings. Information currently available tends to support the contention that ESD buildings require additional capital expenditure. Exactly how much extra depends upon the level of sustainability measures introduced, although there are some broad guidelines that can be deduced from the little available information.

The International Netherlands Group (ING) Bank in Amsterdam completed in 1987 is perhaps a pioneer in this field, with passive solar heating and ventilation, cogeneration and waste heat capture, day lit office space and interior cores, rainwater usage etc. The additional cost of these features is estimated at approximately 2% of the development cost [9]. The more recently completed 60L building in Melbourne, touted as "the premier green building in Australia" [10], is believed to have carried a capital cost premium in the order of 5%. An analysis of 33 projects certified as "green" by the United States Green Building Council (USGBC) found on average the capital cost premium is about 2%, although this premium varied from 0.66% level 1 certified buildings, up to 6.5% for level 4 (highest) certified buildings [11]. A further study conducted in the United States by Davis Langdon compared the cost of 45 USGBC certified green buildings with 93 conventional buildings. This study found that that there was no significant difference in the construction costs between the two categories of buildings [12]. This is not to say that ESD buildings will not cost more. The Colorado Court energy and resource efficient affordable housing project in California, estimated that the projects special energy measures cost in the order of 12% of the total construction cost [13]. The proposed Council House 2 building in Melbourne includes $11.3million of ESD features in a total building cost of $51.045 million, a premium of around 20% [14].

Yet there is a large body of evidence which suggests that ESD buildings, whilst having an initial capital investment surcharge, will repay this investment many time over in terms of lower energy and operational costs. The ING bank cost premium payback period was just three months and the annual savings of US $2.9M continue. The building uses a tenth of the energy of it predecessor, and a fifth of that of a conventional new office building in Amsterdam. [9] The Four Times Square development in New York was completed in 2000 and considered "the first skyscraper to embrace standards of energy efficiency, indoor air quality, and sustainable materials use.." is expected to have operational costs of 10-15% lower than a comparable project. The energy efficiency measures are estimated to have a payback period of three years [15]. A report to California's sustainable Building Task Force, touted as "the most definitive cost benefit analysis of green building ever conducted" concluded that that minimal increase of capital investment of approximately 2% to support green technologies in buildings would, on average over a 20 year period, result in life cycle savings of 20% of total construction costs. Of these savings, approximately 30% (6% of total saving) emanated from reduced energy and resource usage, and 70% (14%) from increased production productivity and health values [11].

The issue of productivity and ESD buildings is an interesting one. Whilst the original thrust of ESD buildings focused predominantly around greenhouse gas emission reduction and associated energy cost savings, more recently the relationship between the internal building environment and production productivity has commanded attention. Clearly there are difficulties in relation to measuring the value of productivity as a function of building environment, due to the complexity of the many factors which contribute to the way human beings function. Whilst energy efficiencies can be measured fairly precisely, productivity of building inhabitants tends to be less certain [11]. Nevertheless, there is a strong band of case-study evidence to suggest that improved building environments support increased productivity.

The renovation of the Reno Post Office in Nevada, undertaken with objective of reducing energy costs, also heralded a 6% increase in worker productivity [16]. The Pennsylvania Power and Light Company incorporated task lighting for their drafting staff. The effect was to reduce energy bills by 73% which in itself produced a return on investment of 24%. But quicker drawing production times, coupled with increased quality and accuracy of work, reduced sick leave and improved worker morale, combined to produce a return on investment of over 1000%. [16]. After PNC Realty Services operated from a new “green” certified building in Pittsburgh, one of the Directors described the benefit of the new facility in terms of productivity and staff – “people want to work here, even to the point of seeking employment just to work in our building. Absenteeism has decreased, productivity has increased, recruitment is better and turnover less” [17]. Closer to home, the new administration building for Melbourne City Council is expected to save $1.12 million pa (approximately $120 per m2 pa) as a result of an increase in staff effectiveness estimated at 4.9% [14]. These benefits are considerable. Unpublished research conducted by Advanced Environmental Concepts found that the cost of sick leave remuneration in Australia in 2000 (excluding cost of replacement staff, disruption of production etc) was estimated to be $1550 per employee, whilst the cost of replacing employees, or staff churn, is estimated to be anywhere from 29 to 130 percent on an employee’s annual salary.

But these benefits do not necessarily end with increased productivity and a happier workforce. The ING Bank credits its rise from No.4 to No.2 bank in the Netherlands with the new image the building has presented to the public [9] thereby giving rise to an opportunity to include psychic income. This is an element of return brought about by the benefits of owning and operating a socially desirable asset. This is similar to the benefit of owning a “trophy” property, a sentiment that is recognised by the market usually by the medium of a firmer capitalisation rate. It follows that the benefits of ESD should be recognized by the market and reflected in appraisal methodologies as the ESD culture becomes more widely adopted.

So the issue of productivity and performance in ESD buildings can include many dimensions including reduced staff absenteeism and turnover, increased production output and quality through employee comfort and enthusiasm, to improved organizational branding and public perception. Whilst these clearly have a financial benefit which, although perhaps difficult to measure precisely, is nevertheless very significant, it is becoming clearer that these benefits represent a watershed for ESD buildings. Suddenly a building becomes an organizational benefit, and the people within them are considered to matter, rather than simply a way of housing an organization [18]. ESD buildings are no longer just about reduced emissions or increased productivity, but the people who live and work within them are identified and acknowledged as a fundamental and worthy resource in their own right. And this has another financial benefit – reduced risk to occupiers of the building due to the adverse affects of poor indoor air quality. Clearly this has beneficial implications for the insurance of occupants within ESD buildings and the designers of such buildings. In one notable example, designers of ESD buildings who undertook appropriate training were offered a 10% insurance premium rebate as a reflection of the relationship between design and physical ailments, predominantly due to poor indoor air quality [19].

And thus ESD buildings take on a social dimension, in addition to the financial and environmental perspectives. Such an approach is in line with current trends toward "triple bottom line" reporting procedures. Indeed, such a model serves as apt business case decision making model, and a project deemed feasible under such criteria would no doubt embody the ethos of environmentally sustainable development.

3. Methodology

Residual valuation is adopted to illustrate the effect of considering ESD components of return to establish their worth. Owner-occupiers should see immediate benefits provided by this methodology in promoting their accommodation requirements to shareholders and the community. It is obviously less apparent to investors for the reasons outlined above and market recognition is required in these circumstances. Residual analysis is dependent upon a rearrangement of the developer's equation. The developer's equation may be more fully stated as follows:

Value = (Gross Income – Outgoings) / Capitalisation Rate

Costs = Land + Building + Finance + Marketing + Profit

The developer's equation is often rearranged in order to calculate land value. This is known as residual analysis or residual valuation as the case may be. It ties in with the concept that the return to land, economic rent, is a surplus return. In practice, economic rent cannot be separated from the worth of the land in unimproved terms. Thus the residual value is found as follows:

$$L= V-(B+F+M+P).$$

A hypothetical study using residual analysis is used to compare a conventional office property with an ESD property (see below).

Income occurs in many forms, the major classifications in the property context being:

- rental income e.g. rents for offices, retail space in shopping centres and industrial buildings
- sales income e.g. sales of residential lots or units (flats, apartments, detached homes), subdivided floors in office buildings or units on industrial estates.
- business income where the building is the business e.g. hotels in which income is derived from 'room-nights', food and beverage, dining and conference facilities and so on.

In the context of this paper, value may also be generated by increased productivity and the improved well-being of building occupants.

The establishment of net income for evaluation purposes is stressed. All costs of owning and operating buildings must be deducted to achieve net income and this should include allowances for repairs, preventive and corrective maintenance and programmed replacement of building components. Given that building occupants make accommodation decisions based on total accommodation costs (gross rentals), reduced outgoings should lead to increased net operating income.

The price of land is very much a function of market supply and demand. The residual study also allows for land purchase expenses as well as legal fees for conveyancing and for other associated fees and charges. Land holding costs are also included such as State Land Tax and municipal and water rates.

Feasibility studies are usually prepared in the first instance prior to any building documentation being prepared and it is at this stage that decisions are made about whether or not to pursue particular proposals. Accordingly building cost estimates must be "right" early on despite the lack of detail. All building costs must be allocated here including professional fees (usually around 8% to 12% of building cost).

Whether debt or equity, capital required for building development is all treated as a factor input accruing interest for the time that it is involved in the project. In the early stages of feasibility analysis, capital is considered in two tranches:

- Capital expended on the development from the outset, e.g., land costs and expenses. Interest is charged on the amount for the full development period.
- Capital expended during the development process, e.g., progress payments for building. Here, interest is charged on the amount for half the development period (assuming constant expenditure). Thus the whole of the required capital is not set aside at the commencement of the development process.

Sundry allowances, for either or both sales and leasing, often referred to as ripening costs, are also usually included in feasibility studies. Allowances for agents' commissions will be required (10% to 15% of the first years' rent for a leasing commission and 1% to 2% of the sale price for a sale commission) in addition the costs of advertising and promotion.

An allowance may also be made under this heading for the letting up process. It is rare that a building is fully precommitted so that the full rental is paid from the date of completion. Usually an allowance is made for vacancies or the business starting up process. Any leasing inducement required could also be accounted for here.

The profit motive is of course the main driver to building project development. Profit constitutes the developers allowance for risk and return and it is treated as a development costs in residual analysis. Feasibility studies are often computed in order to establish potential profitability.

4. Data

A comparative study of two hypothetical properties, one a conventional office building and the other having ESD features, is provided to illustrate the point of this paper. It is accepted in this paper that the ESD building provides an improved internal environment leading to the benefits reviewed above. The data used in the study are described below.

Market rental values for office buildings are currently around $300 per m2 gross effective after allowing for lease incentives. Property economists currently predict a substantial rise in rents (50% or more) over the next year or two [20]. This will be brought about by the removal of the lease incentives to achieve the levels of current face rentals. A gross rental value of $400 per m2 has been adopted for the conventional building in this study. A 5% rental premium is allocated for the ESD building to reflect the improved internal environment.

An allowance is also made for improved productivity. Referring to the CH2 building in Melbourne, salary savings of $1.12 million pa are estimated and this amounts to $120 per m2. A saving of $100 per m2 is allowed for the hypothetical ESD building in this study.

The outgoings for the ESD building have been reduced from $80 per m2 to $70 per m2 in line with the findings discussed above.

The net operating income is capitalized at 8% for the conventional building. An indicative allowance for psychic income is made by firming the capitalisation rate to 7.75%. It is assumed that both buildings are fully precommitted.

The building costs are estimated at $30 million for the conventional building and $35 million for the ESD building to allow for the additional costs of ESD features as outlined above. The same development period is used for both buildings.

An interest rate of 8% is adopted for both buildings.

Developer's profit is included at 10% for the conventional building and 15% for the ESD building. This reflects an additional risk for the latter despite the improved returns listed above.

5. Results and Conclusions

The residual studies are illustrated in table 1. As can be seen, the land value for the conventional building is $2.2 million and that for the ESD building is $8.8 million. This hypothetical study indicates that the worth of the ESD building ($58 million) is substantially greater than its estimate of price ($40 million) as suggested by the conventional building.

The study shows that in the current market where ESD buildings are valued as though they are conventional buildings, the application of the concept of worth demonstrates that ESD buildings can generate higher values/benefits. As stated above, this concept can be readily accepted by owner-occupiers, but acceptance in the investment market requires further research and analysis including:

- Psychic income
- Improved rental values
- Better technical performance of ESD buildings
- Improvements in productivity and other building occupant advantages.

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Table 1: Residual Analysis (on following page)

DEVELOPMENT RETURNS		Conventional Building				Environmental Building		
		Floor area	Rent/sqm	Net Rental		Rent/sqm	Net Rental	
Gross rental value			$400			$420		
Staff savings			$0			$100		
			$400			$520		
Outgoings			$80			$70		
Net rental value		10,000	$320	$3,200,000		$450	$4,500,000	
Net Income					$3,200,000			$4,500,000
Capitalisation Rate					8.00%			7.75%
					$40,000,000			$58,064,516
Less sales commissions and costs			1.50%		$600,000	1.50%		$870,968
					$39,400,000			$57,193,548
Less letting commissions and costs			15.00%		$480,000	15.00%		$675,000
NET RETURNS					$38,920,000			$56,518,548
DEVELOPMENT COSTS								
Developer's Allowance for Profit and Risk				10.00%	$3,538,182		15.00%	$7,371,985
					$35,381,818			$49,146,564
Building costs				$30,000,000			$35,000,000	
Construction Finance	interest		8.00%			8.00%		
	construction period		24		$2,400,000	24		$2,800,000
GROSS RESIDUAL LAND VALUE					$32,981,818			$46,346,564
Less rates and taxes					$100,000			$100,000
					$32,881,818			$46,246,564
Less holding costs	interest		8.00%			8.00%		
	preconstruction period		6			6		
					$5,480,303			$7,707,761
					$27,401,515			$38,538,803
Less land purchase expenses			6.00%		$1,551,029	6.00%		$2,181,442
NET RESIDUAL LAND VALUE					$25,850,486			$36,357,361

Parameters of accessibility for sustainable design

D.Eric Pollock,
architect SAFA, reg. arch. California USA no.27090
head, sustainable development, Helsinki Polytechnic, Finland (email: eric.pollock@stadia.fi)

Abstract

Sustainability in the built environment includes taking the basic questions of accessibility into account in the pre-planning stages. Accessibility in the built environment includes physical access, visual access and audio access. Well-planned, accessible buildings and urban environments require less retrofitting and modifications during the building life cycle, and are therefor more sustainable. Institutions that produce planning guidelines are essential tools for planning the built environment.

Keywords: sustainability, physical access, accessibility, design, programming

1. Overview

1.1 Background

In 1992 the United Nations assembled the UN Conference on Environment and Development in Rio de Janeiro, which was based on the Brundtland report (WCED World Commission on Environment and Development 1987. It adopted a number of documents, in particular the Rio Declaration and Agenda 21, the Climate and the Biodiversity Conventions (United Nations 1993) pointing out pathways towards sustainable development. This includes how to reconcile social development and environmental protection in a vibrant but resource-efficient economy. In 1995, the Commission on sustainable development CSD has included the institutional dimension of sustainability to the environmental, economic and social ones, resulting in a four-dimensional concept of sustainability.

The concept used is based upon a balanced approach, aiming to avoid irreversible damage in either dimension with equal emphasis. This is equivalent to not overburdening the carrying capacities of the subsystems underlying the different dimensions. Irreversible damage or exploitation must not take place concerning humans (i.e. secure health and self-realisation), the environment (i.e. safeguard viability), the economy (i.e. guaranty competitiveness and satisfaction of material needs) and the institutional system (i.e. make it reliable, trustworthy but open to evolve). The WSSD (World Summit for Sustainable Development in Johannesburg, 2000) further adopted policies for Participatory openness to major groups, gender and minority equality and the decentralisation of power as prominent examples from Agenda 21. [1]

The UN Decade of Education for Sustainable Development (DESD) was launched at UN Headquarters on 1st March 2005. The UN Secretary-General Kofi Annan noted that, in addition to the international launch, a series of regional and national launches of the Decade will take place during the course of 2005. See http://www.un-ngls.org/decade-education.htm for details.

1.2 Accessibility

Accessibility in the built environment includes physical access such as ramps and elevators, visual access such as comprehensible colours and shapes, and hearing access, such inductive amplifiers for meeting rooms and auditoriums.

When such requirements are understood in the programming stage of building projects, then their actualization through the bidding process into realization is clear. Building Information sheet requirements and standards exist, but their application in a later phase is virtually impossible, without forfeiting architectural quality or needless, costly changes in the working drawing stage. Enlightened owners and developers understand the attractivity of buildings that are accessible to all possible users. The concept of seniors living at home for as long as possible also supportws the idea of accessible housing on the general market.

1.3 Objectives

What steps must the designer take to ensure that a building project contains all necessary parameters for accessibility in the conceptual phase? The requirements of accessibility that are observed at the implementation stage are time consuming and costly. Awareness of standards, guidelines at the municipal, national and European level are absolutely necessary to serve the client with building solutions that have a long life cycle and low retrofit need.

2. Requirements

Existing standards for physical, visual and audial accessibility exist at the local, national (Finnish) levels and the EU level. The Finnish Building regulations RakMK section F1 barrier-free building, and the Dwelling design regulations G1 require that all persons are allowed access to all public, service and business buildings and sites. The RT Standard sheet Accessible mobility and environment RT 09-10692, Nov 2002 and (new version 2005) covers the requirements for access routes, parking spaces, ramps, stairs, lifts, entrances, doors, toilets, saunas, meeting rooms, hotels and dwelling spaces. [2]

EU building standards for accessibility are given as recommendations, such as The European Design for All **e-Accessibility** Network (EDeAN), established in July 2002, in accordance with one of the specific goals of the **eEurope 2002 Action Plan.** The Action Plan was agreed on and committed to by the European Commission and all the member states**.** One of the action points included in the plan was to "ensure the establishment and networking of national centers of excellence in design-for-all and create recommendations for a European curriculum for designers and engineers".

EDeAN was primarily created to provideinput for European Curricula in Design for All, a forum for Design for All issues, idea sharing through joint activities such as conferences, symposia and exchanges of students and scholars. EDeAN is also charged with fostering awareness and promoting changes of culture in the public and private sectors. It will also establish links with appropriate education channels to embed Design for All best practices in new curricula. Through a series of common activities and proposals, it is hoped that the network will become a cohesive group that can effectively work toward the advancement and excellence of Design for All.

The eEurope action Plan section 2c. states "Participation for all in the knowledge-based economy states that as the knowledge-based economy advances, the exclusion from ICT becomes more and more a barrier to economic, employment and social opportunities and to using public services. Disadvantaged areas and groups are at higher risk of lagging for various reasons including low-income and poverty, lack of ICT infrastructures, awareness and training opportunities, or difficulties of access because of disabilities. On the other hand, ICT can overcome barriers of distance, distribute more equally knowledge resources and generate new services for citizens with special needs. . . Thus, the risks of the digital divide need to be transformed to digital opportunities by actions focussed at disadvantaged groups and areas. Accessibility to ICT and on-line information and services, taking particularly into account the needs of people with disabilities, is a precondition for ensuring an Information Society open to all. In this respect, governments have to take a lead to ensure equal opportunities of access". [3]

3. Accessible projects

Two Projects which have observed the standards of accessibility in the pre-planning stages are Helsinki Polytechnic Art and Media building TAVI and the IIRIS center for the Visually impaired.

The Helsinki Polytechnic Art and Media building TAVI extension at Hämeentie 161 in Helsinki is a 1625 m2 three-storey extension to an existing building. The students are very creative, and can often be found on evenings and weekends studying. Both the owner and the architect understood the parameters of accessibility, which made the design process from schematics to working drawings without major changes for accessibility reasons. However, the building review board required that the floor levels of the building be lower than the existing ones, to avoid excess height. This caused the need for ramps, but were made at the maximum slope of 1:12.5. The building has an accessible lift and WC.

The Finnish Federation of the Visually Impaired (FFVI) service center IIRIS is a special service provider with a social element as well as an advocacy organization for the blind and the partially sighted. The aim of the Federation is to secure the blind and visually impaired an equal status with other Finnish citizens. To achieve this the Federation seeks to improve the capabilities and skills of the visually impaired, while also trying to influence the society at large. Particular attention for problems of glare, lack of contrast and orientation have been adapted into the building design. Other physical accessibility questions such as ramps, accessible toilets, and services for the blind are also an integral part of the building. [4]

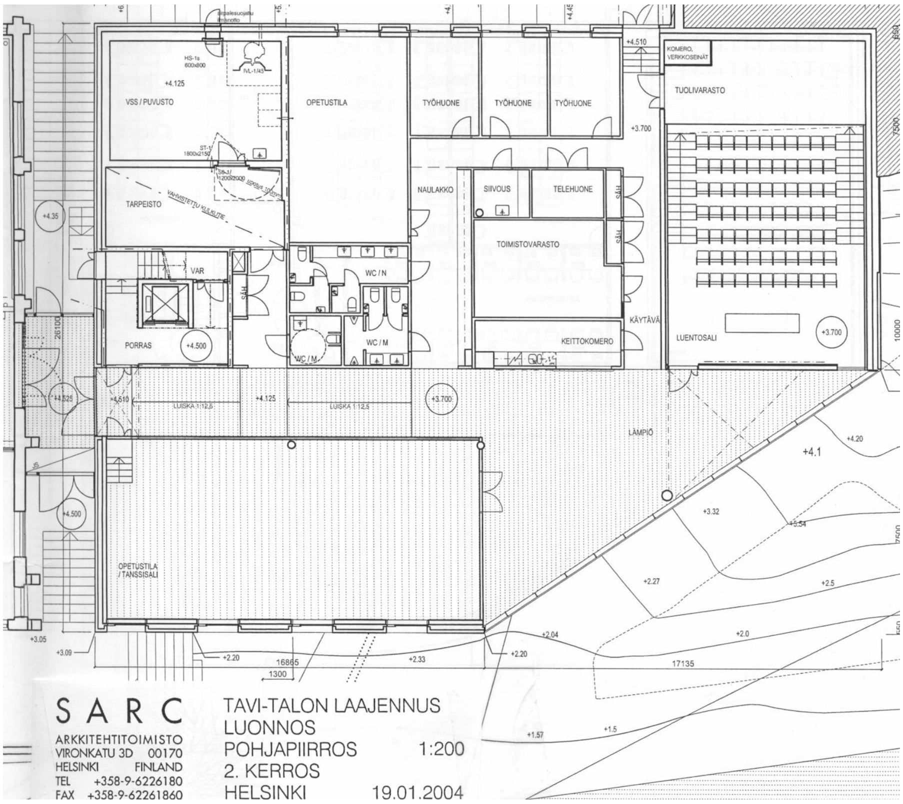

Figure 1: Floor plan of the Art and Media extension, Helsinki Polytechnic

Figure 2: Finnish Federation of the Visually Impaired, Iiris building

4. Results

In the two projects shown, the owners strategy and the designers professional ability to understand the needs of physical and digital (internet) accessibility were incorporated into the design project brief. Space requirements, budgets and services were designed with accessibility in mind as part of the design process, not as an extra permit phase hindrance. The finished buildings will have a longer life cycle with less costly retrofitting, because the design process included all needs of present and future users.

5. Conclusions

Owners and designers that understand both the law and the reality of accessibility in the workplace, schools and dwellings can include accessibility into their projects in the schematic phase, rather than repair buildings later for special users. Designers can refer to the accessibility parameters given, and refer to standards and recommendations to check their projects for their level of accessibility.

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Life-Cycle Values

Sakari Pulakka,
VTT – Technical Research Centre of Finland (email: Sakari.Pulakka@vtt.fi)

Abstract

Life-cycle values are mainly caused by combination of location and most significant characteristics of the facility. Life-cycle economical, energy-saving, ecoefficient, healthy and social facilities are quite similar: durable enough and desirable with functional, change-flexible and unrestricted spaces as well as reliable, advantageous and undamaged systems and other products and materials.

Life-cycle value analysis will be utilized by different kind of organisations in building and facility trades when comparing concurrent technical solutions with each other and making cost-effectiviness, profit and cash flow analysises. The life-cycle economical comparisons should be focused on those characteristics and products with real importance.

Advicing shall be organized through many kind of channels and training programmes.

Keywords: Life-cycle cost, life-cycle economy, values

1. Introduction

The Life-Cycle Value model presented is based on results in networking projects (Table 1) most important of which LCC for building trade (www.LCC-bygg.com) and LIFETIME (www.ril.fi/Resource.phx/tietop/lifetime.htx) as well as working in ISO (15686-5) and CEN (TC348) - standardisation expert groups and developing so many kind of LC-tools.

Life-cycle valueing will be utilized by different kind of organisations in building and facility trades when comparing concurrent technical solutions with each other and making cost-effectiviness, profit and cash flow analysises.

Table 1: Networking (references)

Network	State	Web-adress	Contactperson in Finland	Goals
ISO 15686-5	**Has been approved as DIS**	www.iso.org/iso	Sakari.Pulakka@vtt.fi & Pekka.Vuorinen@rakennusteollisuus.fi	**Has as expert-work developed a standard draft called Whole Life Costing**
LCC for building trade	**Finished 12/2004**	**www. lcc-bygg.com**	Sakari.Pulakka@vtt.fi	**Has developed a Nordic LCC –model included also in ISO15686-5**
REM	**Finished 3/2005**	**www. rakennusteollisuusrt.fi**	Arto.Suikka@rakennusteollisuus.fi	**Has collected LC-based criterias for build up and building design**
LifePlan	**Finished 6/2004**	**www.pim.vtt.fi/ lifeplan/view**	Tarja.Hakkinen@VTT.fi	**Has collected LC-information of building products**
EcoCost	**Ongoing**	**www.ymparisto.fi/default.asp?contentid=64193&lan=FI**	Sakari.Pulakka@VTT.fi	**Developes a LC-model and a collection of eco-efficient solutions**
Lifetime	**Ongoing**	**www.ril.fi/ Resource.phx/tietop/lifetime.htx**	Asko.Sarja@VTT.fi	**Has collected global information about LC-based methods and tools**
LIFECON	**Finished 4/2004**	**www.vtt.fi/rte/strat/projects/lifecon/**	Asko.Sarja@VTT.fi	**Has developed LC-based tools for planning**
EURO-LIFEFORM	**Finished 12/2004**	**www.eurolifeform.com**	Olavi.Tupamaki@villareal.fi	**Aims to develop methods for Life-Cycle Economy**
Life-cycle models of construction	**Ongoing**	**www. rakennusteollisuusrt.fi**	Ilkka.Romo@rakennusteollisuus.fi	**Aims to show LC based methods for construction production and contracting.**
CUBENET - Energy Services	**In prepatation**	**www.akseli.tekes.fi/ Resource.phx/rapu/ talotekniikka/cubenet**	Pekka.Tuomaala@VTT.fi	**Aims to increase companyactivities concerning energy saving solutions**
SUNTOOL	**Ongoing**	**www.managenergy.net /download/nr134.pdf**	Jyri.Nieminen@vtt.fi	**Developes life-cycle economical and ecoefficient solutions to small house areas**
SARA –Value-networked construction	**Ongoing**	www.akseli.tekes.fi	Mika.Lautanala@tekes.fi	**Aims to develop information-technology based planning and evaluative methods.**
OPET-Building	**Ongoing**	**www. motivaenterprises.com**	Ilari.Aho@motiva.fi	**Network of LCC -experts for builders**
Rembrand – facility management	**Finished 9/2004**	www.akseli.tekes.fi	Juhani.Reen@rakli.fi	**Has produced methods and tools for facility management**
PeBBu-thematic network	**Ongoing**	www.pebbu.nl	christer.Finne@rts.fi	**Aims for the inter-national implementation of the principles of Performance Based Building**

2. Objects of Life-Cycle Valueing

Life-Cycle Valueing is a tool for value-managing of facility-based human terms, quality, culture and economy (Figure 1).

The figure 2 outline examples of objects for life-cycle based decision making within the area of facility maintenance. The life-cycle economical comparisons should be focused on those characteristics and products with real importance.

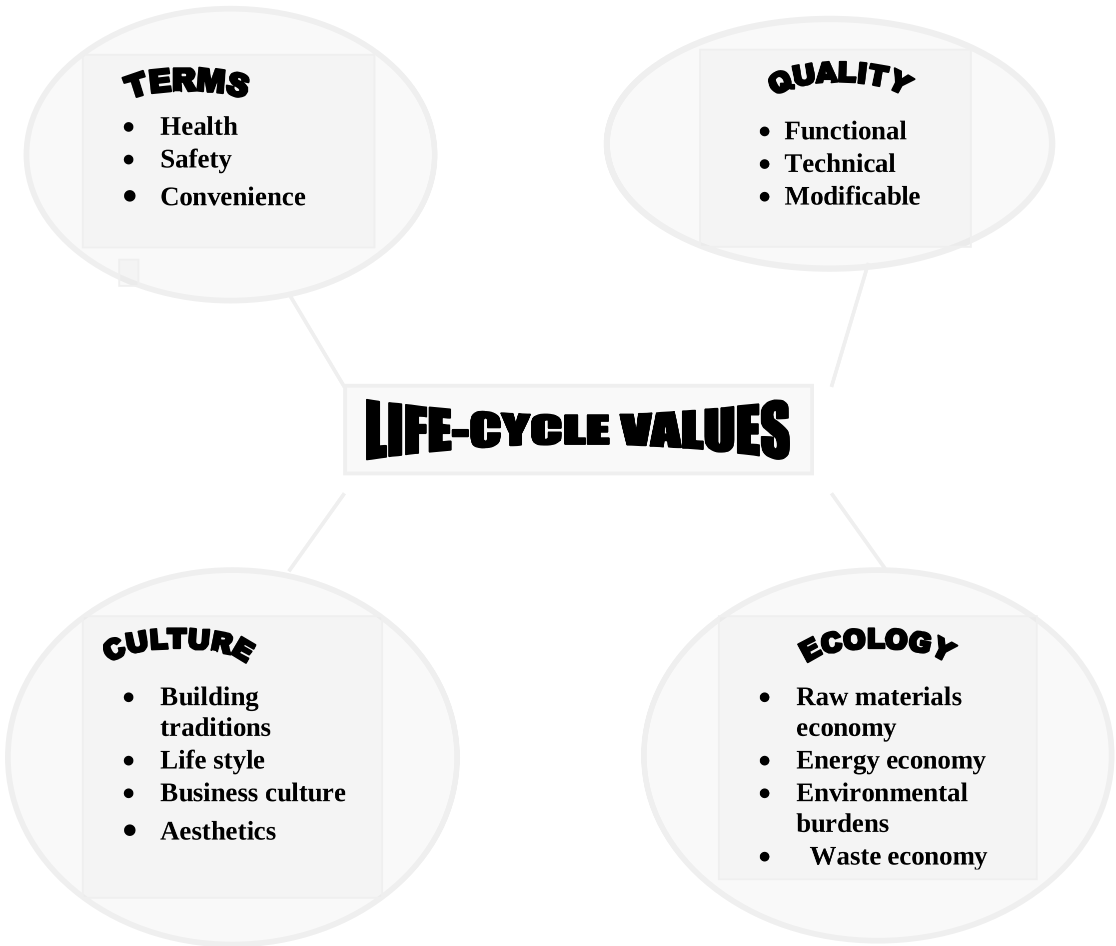

Figure 1: Value factors

In *facility investment* and space acquisition the main interest is concentrated on location, use of spaces and the most essential characteristics (Figure 3). The calculations will also be utilized by comparing possible life-cycle tenders.

Product selection shall be concentrated with facades and windows, base floors and roofs, separation walls, coatings, furniture, ventilation, heating and electrical systems and routings as well as information systems.

By *use and maintenance* the important life-cycle areas are planning, use directions of ventilation and information technology and applying right maintenance methods.

Facility development shall be based on *condition determination*, suitable new construction practises and definition of wanted functionality. The solutions are mainly based on original state of the building: appearance, space complexes, level of energy consumption, modification rate and other technical settings. The life-cycle advantageousness shall be compared with corresponding new house.

Site choice

Performance: location, services

Economy: acquisition cost, life-cycle cost, life-cycle benefits

Demand definition

Functionality: time of use, spatial solutions, energy economy, indoor conditions, modifiability, space services

Economy: acquisition cost, life-cycle cost, life-cycle economy, life-cycle benefits

Building planning

Specifies solutions: time of use, maintainability, recyclebility
Economy: acquisition cost, life-cycle cost, life-cycle benefits

Use and maintenance

Use and maintenance: follow-up, planned maintenance
Facility development: technical and functional renewing

Economy: acquisition cost, life-cycle cost, life-cycle benefits

Figure 2: Focusing of life-cycle based decision making

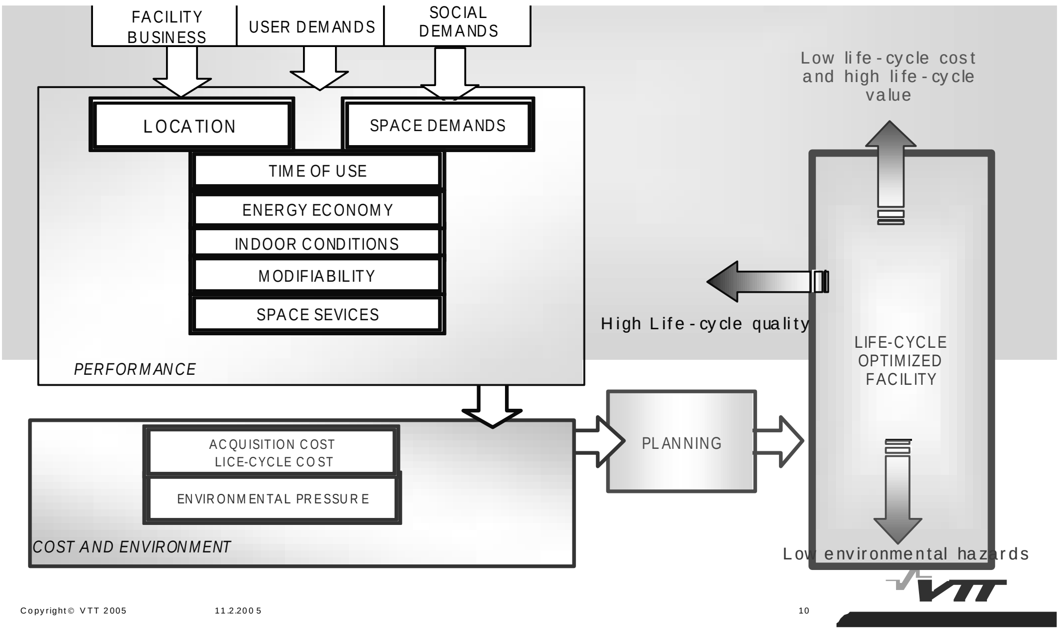

Figure 3: Methods of Life-Cycle Valueing

3. Methods of Life-Cycle Valueing

The LC- method is primary based on CEN/TC 348 (Facility Management) and ISO15686-5 (Whole Life Costing), other manysided international co'operation as well as numerous national development, networking and tooling activities. It includes following definitions:

- **Life-Cycle Costs** (total cost over a technical, economic or functional life-cycle) or Whole-Life Costs (total cost over the whole life of facility, building or component) are usually caused by acquisition, operation, maintenance, modification, renewals and environmental needs for building, system or product (Table 2) as well as possible disposal. The same classification may be applied also in case of facility development as well as individual acquisitions. Present value calculation (all costs accuring within a chosen period of time discounted to a current cost level using a relevant discount rate) is the primary method for life-cycle costing. And, annual costing is fair for cash flowing.

Table 2: Classification of life-cycle cost

Type of life-cycle cost	**Description**
Acquisition cost	Investment including all material, labour and sub costs caused by acquisition of facility, product or material. If the length of life cycle is lower than lifetime, the acquisition cost include only the repayd share.
Funding cost	Price of money within chosen life-cycle.
Facility management	Salaries, rents, taxes, insurances.
Operating cost	Continual cost caused by the use of building including energy, water, waste, cleaning, other space services etc.
Maintenance cost	Time-planned maintenance and renewing of components.
Modification cost	Cost of spatial modifications.
Development cost	Improvement of technical systems, building parts and/or environment through demand management and building condition charting.
Risk cost	Unexpected cost caused by moisture, fire, storms, breakings of systems etc.
Environmental costs.	Possible needs for soil refreshment and sheltering, use of raw material, cost of demolition and recycling etc.

- **The length of life-cycle** is typically 10 or 25 years. Functional life-cycle may be short, many social analysises mean very long life-cycles. The choice of life-cycle will be based on real needs of decision making: Budgeting time, Loan time, Permanence of actions, Period of facility development, Time for life-cycle planning,…. The life-cycle has a remarkable influence on cost distribution (Figure 4).

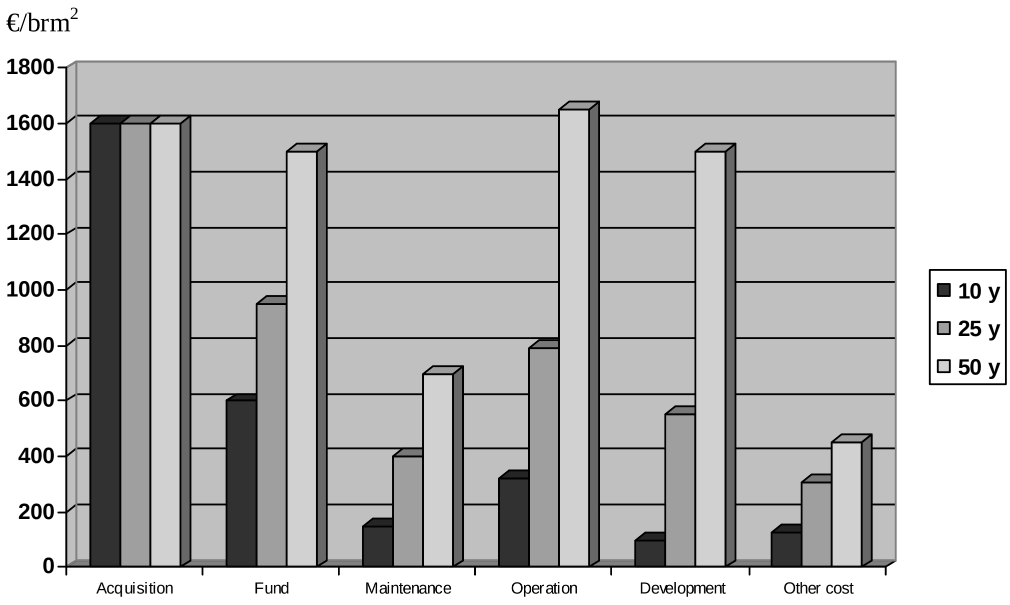

Figure 4: Division of life-cycle costs in different life-cycles

- **Real rate** (nominal rate – inflation) is based on real need and price of money**.**
- **Life-Cycle Economics (LCE)** may be calculated as difference between Life-Cycle Income (LCI) and Life-Cycle Cost or directly as difference in life-cycle costs

$$\mathbf{LCE = LCI - LCC} \text{ tai } \mathbf{LCE = LCC_{diff}}$$

- **If the Resale Value (RV)** is taken in account (for example based on differences in functionality characteristics, remaining life time and possible space service value), **Life-Cycle Profit (LCP)** is the sum of life-cycle economics and difference in resale value:

$$\mathbf{LCP = LCE + RV_{diff}}$$

- By means of profit calculation may be defined **Profit rate** and **Payback time**.
- **Life-Cycle Benefit** is the best relation between performance characteristics, acquisition and life cycle cost, possible life cycle incomes and effects on resale and Environmental Hazards (EH). It may be calculated by means of equation

$$\mathbf{(LCI_i \times RV_i)/(Aq_i \times LCC_i \times EH_i)}$$

- The **sensitivity analysis** may be based on: optimistic ***–probable–*** pessimistic

Possible economical **risks** on different levels

- Advancement of resale value, permanence of characteristics, maintainability and chances of valuation and combatibility of systems with further needs for facility management.
- Mistakes concerning building planning, accessibility of building products, operative experiences, damage riskability and way of use.
- In production process insufficiency of professionals, problems with acquisitions, actions and transfer of project start towards winter time.
- In use and maintainance underprizing in planning phase, defaults of use and maintenance directions, unexpected rises of prises, larger and careles use of systems, unexpected damages and problems with usability in case of user changes and faults and lacks of maintenance actions.
- In case of facility management a failed consolidation of actions, unexpected damages revealed by demolition and disturbances caused to users.

Life-cycle values are mainly a consequence of the combination of location and most significant performance characteristics of the facility (Table 3).

Table 3: The effects of alternative life-cycle characteristics to the costs compared with ordinary parameters (examples)

Location: Southern Finland Life cycle: 25 y Real rate: 2 % Cost level: 6/2005	Acquisition cost **€/m²**	Life-Cycle Cost **€/m²**
Choice of life-cycle characteristics		
*Heating energy economy		
- low-energy level	+20	-30
- minimum energy level	+50	-20
* Inner climate		
- quality class S3	-50	-75
- quality class S1	+80	-120
* Modification rate		
- spacially modifical	+90	-25
- very modificable	+150	+10
* Levels of inner quality		
- high class	+150	+250
- representational	+500	+750
Choise of products		
* Facades		
- highclass facades	+100	+ 130
* Windows		
- energy saving windows	+15	-20
* Effectiviness of heat recovery		
- effectivity 40 %	+5	-8

As an **application example** of life-cycle optimization (acquisition cost, price of money, life-cycle cost, life-cycle economy, profit rate) has been compared a typical office building to a house with better functionality (Table 4). That has been reached by means of life-cycle optimized technical solutions including effects on user activities. For example better inner climate and lower energy consumption is based on interactive ventilation system with excellent automatic control engineering, good insulation ofbase floor, walls, roof and windows as well as effective heatrecovery of ventilation. The inner temperatures are adjusted to stay stable. And longer time of use is based on sufficient structural durability, higher rate of modifications and low riskability of any kind of damages.

As *economical parameters* are calculated

- real and relative effects on acquisition cost and life-cycle cost
- relation to the multiplication of acquisition cost, environmental hazards and life-cycle cost

As conclusions may be generalized that a life-cycle optimized office building compared with a traditional office building

- is 10...40 % more expensive as acquisition
- means 0...20 % higher life-cycle cost
- makes it possible to have 10…30 % higher life-cycle incomes
- has 15...50 % higher resale value
- is very advantageous as investment
- is very cost-effective when observing also environmental hazards
- means as copied remarkable benefits to society

More over it has been noticed that the officeworkers have less symptons and a little better productivity because of better inner climate, high level of information technology, maynsided space services and better work satisfaction.

As an ordinary building falls into decay and goes out of date, a life-cycle optimized building ages worthly and and intelligently.

Table 4: Example of calculating life-cycle economy of life-cycle optimized office building compared with an ordinary

		Traditional building	Life-cycle optimized building
Location	Southern Finland (Vantaa)		
Building type	Office building with steel frame		
Area	2 000 brm²		
Life cycle	20 y		
Realrate	5 %		
Portion to be financed	70 %		
Cost level	6/2005		
FUNCTIONALITY			
Time of use		50 years	80 years
Modification		modular	free
Relational energy consumption		100 %	75 %
Inner climate		ordinary	excellent
Space services		ordinary	manysided
RELATIONAL ENVIRONMENTAL EFFECTS			
Emissions CO_2 eq.		0,60	0,45
Unrenewable energy resources		0,20	0,15
Wastes		0,10	0,07
Other use of natural resources		0,05	0,04
Environmental risks		0,05	0,03
Environmental **H**azard index (**EH$_i$**)		**1,00**	**0,74**
ECONOMICAL EFFECTS		€/a/m²	€/a/m²
Acquisition cost **Aq**		**85**	**110**
Funding cost		36	46
Facility administration cost		5	7
Maintenance cost		14	12
Operating cost			
Heating energy		5	3
Electrical energy		10	12
Other operation cost		8	10
Modification cost		25	3
Environment cots		3	2
Lif**e**-**C**ycle **C**ost	**LCC**	**191**	**205**
Life-**C**ycle **I**ncomes	**LCI**	208	240
Life-**C**ycle **E**conomy	**LCE = LCC$_{dif}$**	**+17**	**+35**
RELATIONAL DIFFERENCES			
Acquisition cost index	Aq_i	1,00	1,29
Life-Cycle Cost index	LCC_i	1,00	1,08
Life-Cycle Income index	LCI_i	1,00	1,16
Resale Value index	RV_i	1,00	1,45
Life-Cycle Benefits	**(LCI_i x RV_i)/(Aq_i x LCC_i x EH_i)**	1,00	**1,63**

4. Conclusions and suggestions

There are different needs for life-cycle based decision-making on different levels of activities to be utilized in different kind of organisations. LC-systematics should be based on ISO15686-5 and CEN/TC 348 when applicable.

As the starting point of generalizing life-cycle based decision making is to specify concepts and calculation model as far as focusing the most essential life-cycle characteristics on different levels of facility business. They also cover the most important objects of technology development. Generalizing of life-cycle contracts shall happen at the same time both in producing companies and in client organisations.

Town planning and realistic population forecasting have the most remarkable importance on time of use of building stock. Also compact and complimental society structures are the way to save several thousand euros per habitant during 30...50 years. So areal life-cycle optimization is necessary next to individual building planning. For example the transfer towards ecoeffective society takes at least 25 years. Generalizing of life-cycle optimized facility concepts should mean

- Reduction of heating and electricity energy making it easier to optimize energy management and increase importance of renewable energy resources.
- Increase of both GNP and employment and transferring labour inputs from energyproducing countries to homelabd and from wasting to recycling services.
- New kind of business possibilities (for example building concepts, coating structures, recycling products).

Life-cycle economical, energy economical, ecoefficient, healthy and social facilities are quite similar: durable, energy-saving and desirable with functional, change-flexible and unrestricted spaces and reliable, advantageous, undamaged recyclable systems, other products and materials. There shall be combined the most economic and ecoefficient performance characteristics to the life-cycle optimized technical solutions in the bestpractise (or nextpractise) building concepts.

The public sector has a central role in promoting life cycle advantageous solutions through its own production and giving directions and building codes. This requires commonly approved technology foresight systematics. The private sectors are applying directions and codes in life-cycle optimized ways and seeking new areas of business which aim at high profits through intensive innovation processes. This means growing international value networking.

Advicing towards life-cycle valuable solutions shall advanced through multisided channels and training programmes. The role of innovation technology is also increasing:

- Product information databases (for example LifePlan)
- Web –based costing tools (for example BeCost)

- Product modelling (for example RYHTI –HVAC –Costing tool)
- Mapinfo based space-costing (for example TILASUKU –tool)
- Simulation tools (for example VTTHouse -tool)
- Client-Demand management (for example EcoProp -tool)

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A review of sustainability in construction and its dimensions

Amr Sourani,
Research Scholar, Dept. of Civil and Building Engineering, Loughborough University, Leicestershire, LE11 3TU, UK (e-mail: A.I.Sourani@lboro.ac.uk)
Dr. M. Sohail,
Senior Research Manager, Dept. of Civil and Building Engineering, Loughborough University, Leicestershire, LE11 3TU, UK (e-mail: M.Sohail@lboro.ac.uk)

Abstract

Sustainability is becoming an increasingly important topic for construction research. It is a multi-dimensional topic involving social, economic, and environmental aspects. Sustainable construction generally refers to the application of the principles of sustainable development in the construction industry. Its definitions, interpretations and priorities will be largely dependent on the context of study. Despite the many claims to benefits that sustainable construction can bring, sustainability still seems not mainstreamed in the construction industry. Focusing on context of the UK construction industry, this paper provides an overview on the subject of sustainable construction and introduces some key knowledge gaps around the issues of conceptualisation, linkages to project life cycle, linkages to project management, implementation mechanisms and tools, and construction procurement. It is hoped that if the gaps are filled, there might be a better chance for sustainability to gain its due place in construction. Through a synthesis of the relevant literature, the paper reviews the criteria representing the social, the economic and the environmental dimensions of sustainable construction. Further research suggests the use of the Delphi Technique as a means of developing a common understanding and consensus among experts regarding sustainability criteria that public clients should address in developing a procurement strategy.

Keywords: sustainable construction, review, social, economic, environmental

1. Introduction

Sustainable development has gained an increasing importance in the construction industry. The application of its principles in this industry is generally described as sustainable construction. With the increasing recognition of the importance of the concept, huge number of definitions have emerged. One of the most common definitions of sustainable development is the one introduced by The World Commission on Environment and Development [1] "*Humanity has the ability to make development sustainable – to ensure that it meets the needs of the present* *without compromising the ability of future generations to meet their own needs"*. Focusing on the UK context, this paper provides an overview on the subject of sustainable construction, explores some of the knowledge gaps related to the subject, and presents the criteria underpinning the social, the economic and the environmental dimensions of sustainable construction. Further research is suggested to obtain a consensus regarding sustainability criteria that should be addressed by public clients in developing procurement strategy.

2. Sustainable construction – an overview

In general, sustainable construction is about the application of sustainable development in the construction industry. Raynsford provides a detailed definition for sustainable construction [2] *"Sustainable construction is the set of processes by which a profitable and competitive industry delivers built assets (buildings, structures, supporting infrastructure and their immediate surroundings) which*

- § *enhance quality of life and offer customer satisfaction*
- § *offer flexibility and the potential to cater for user changes in the future*
- § *provide and support desirable natural and social environments*
- § *maximize the efficient use of resources."*

The definition offered by Raynsford puts emphasis on both the process and the product and introduces some aspects of social, economic and environmental sustainability. However, the definition does not fully capture all the aspects implied by the term. A more comprehensive definition is offered by Constructing Excellence [3] which introduces sustainable construction as the application of sustainable development in the construction industry and suggests that sustainable development is *"all about ensuring a better quality of life for everyone, now and for generations to come, through:*

- § *social progress which recognises the needs of everyone*
- § *maintenance of high and stable levels of economic growth and employment, whilst*
- § *protecting, and if possible enhancing, the environment, and*
- § *using natural resources prudently*

Sustainable development embraces the three broad themes of environmental, social and economic accountability, often known as the 'triple bottom line'." [3]

Regardless of the context, sustainable construction always integrates different dimensions, including social, economic and environmental dimensions. However, the interpretation and the priorities of sustainable construction could be largely dependent on the context as the needs and the conditions of the developed countries are widely different from those of the developing world [4]. For example, the principles highlighted by Gibberd [5] have been developed to support sustainable construction in developing countries and in particular South Africa. Another example could be found in the comment offered by Ofori [6] on the paper of Hill and Bowen [7]. Ofori argued that the paper of Hill and Bowen was written to reflect, at large, the point of view of developed countries in spite of mentioning some issues that were relevant to the context of South Africa. Realizing the differences between developed and developing countries, CIB and other organizations published “Agenda 21 for Sustainable Construction in Developing Countries” [8]. According to this Agenda, such differences are related to the problems and their scale, development priorities, capacity of local industry and government, skill levels in addition to cultural and world view issues which influence the understanding and implementation of sustainable development and construction.

However, it seems that there is a lack of awareness about sustainable construction in both the developed and the developing worlds. In the Netherlands, for example, a survey which was carried out in 1998 showed that quarter of architects and half of the building contractors did not know what sustainable construction was [9]. In the US, Landman showed that lack of training and education in sustainable design/construction was one of the primary barriers to more widespread sustainable building practices [10]. Watuka and Aligula, in their study of sustainable construction practices in the Kenyan construction industry, reported that sixty four percent of the respondents on a questionnaire administered to Architects, Engineers, Quantity Surveyors and Contractors indicated lack of awareness about sustainable construction practices [11].

In the context of the UK, promoting awareness and understanding of sustainable construction was declared as one of the objectives of the UK strategy for more sustainable construction [12]. Although awareness within the construction professions and trades was increasing, it was not enough [13]. The need to raise awareness of sustainable development throughout the industry was also highlighted by the publication “Society, Sustainability and Civil Engineering” [14]. Lack of awareness might be attributed to lack of clear conceptualisation of sustainability, lack of clear case for sustainability benefits, lack of integration of sustainability issues in education and training programmes, the traditional perception that limits the understanding of sustainability within the environmental dimension, the dominance of economic drivers in the performance of businesses at the expense of social and economic issues, and lack of long term perspective.

But lack of awareness is not the only barrier to achieving sustainability, which still seems far from reach in an industry considered as “inherently defensive” for change [15]. There is evidence that the construction industry is falling behind other sectors in its attitude towards sustainability [16]. The progress in the field has been hindered by many barriers, such as the industry’s fragmented nature, lack of long term perspective, clients’ unwillingness to share burden, lack of clear concept definition of sustainable construction and its benefits, regulatory constraints and inconsistent government policy, and lack of fiscal incentives [16, 17, 18].

3. Some knowledge gaps

3.1 Conceptualisation

Some of the recently published material in the literature perceives sustainability as an environmental problem. Consequently, the balance that needs to be created between the environmental dimension and other sustainability dimensions is not adequately acknowledged. There is also a noticeable lack of consensus on the issues underpinning sustainability and its dimensions. Hill and Bowen and Ofori point out that sustainability principles are still poorly defined and argue that these principles are subject to much confusion and disagreement [6, 7]. Ofori [6] argue that this could even be extended to the frequently quoted definition of sustainable development offered by The World Commission on Environment and Development. Lack of understanding and fuzziness of the concept present one of the barriers to the implementation of sustainable construction [17]. Further work, therefore, is still needed to better conceptualise sustainable construction.

3.2 Linking to the project life cycle

Sustainable construction could be better understood if it is aligned to the different phases of the project life cycle. From an implementation point of view, it would be more appropriate to provide such alignment [19]. Among the efforts that addressed sustainability within phases of the project life cycle are: Kibert [20], where the different project phases were integrated within a model for sustainable construction; the publication “Sustainability Accounting in the Construction Industry” [21], where a sustainability accounting plan considered the different phases of the project; Ashworth and Langston [22], where whole of life assessment was linked to the measurement of sustainability. However, there still seems lack of understanding regarding how the principles underpinning the different dimensions of sustainability could fit within the different phases of the project life cycle and what impact this issue could have on the different activities carried out within these phases.

3.3 Linking to project management

Project management could provide a suitable framework to implement sustainable construction, and project managers, through their leading role in the project, could be in an ideal position to promote it [19]. However, there is little evidence that sufficient research has been carried out to establish clear linkages between sustainable construction and project management. An examination of a summary of the UK Association of Project Management's Body of Knowledge [23] would indicate that sustainability does not feature as one of the key topics in that body. It is important to mention here that some of the topics addressed there – such as safety, health and environment; and value management are closely related to sustainability. Yet, they do not provide sufficient coverage of all the issues underpinning it. One of the few attempts to link sustainability to project management was carried out by Uher who developed a project management model for achieving sustainable construction and presented the need to integrate sustainable construction into the traditional project delivery strategy, which is constrained by time, cost and quality objectives [19]. The model developed by Uher focused only on the conceptual stage of the project life cycle. Further work linking sustainability and project management and considering the different phases in the project life cycle is still needed.

3.4 Implementation Mechanisms and Tools

A significant part of the literature discussed the principles of sustainability without sufficient consideration of how they could be implemented, an issue that was also raised by Uher [19]. More work is needed to identify implementation mechanisms and tools and to identify how sustainability could be integrated in the decision making process.

Sustainability has different dimensions and criteria which might be in conflict sometimes. An assessment of sustainability needs to take into account the different criteria underpinning it. This could lead to the use of multi-criteria decision making techniques for assessment. Such techniques were used for solving problems in construction management [24] and selecting construction procurement strategy [25]. In some cases, multi-criteria decision making was used with sustainability provided the basis for choosing criteria for decision making, as in developing SWARD [26]. There is potential to use such techniques to make informed decisions that consider sustainability criteria in problems such as selection of contractor or choice of procurement system [4].

3.5 Sustainability and Procurement

The need for introducing sustainability principles to construction procurement has been increasingly acknowledged. Some publications have addressed many useful issues in the context of sustainability and procurement e.g. the Sustainability Action Plan [27] and Addis and Talbot [28]. However, there still seems a need for further research within that area. For example, the framework developed in the Sustainability Action Plan [27] is based on 10 themes for action. Although these themes provide many useful sustainability principles in general, they do not embrace other principles mentioned in the literature, such as those presented in Tables 1, 2, 3. A more comprehensive and up to date list of the criteria representing sustainable construction that should be addressed is therefore needed. In addition, there is a need to examine procurement systems and strategies in terms of the extent of addressing the objectives of sustainability dimensions. Further research regarding the actions through which sustainability can be better addressed in developing procurement strategies and the barriers facing such actions is still needed. The gap was further discussed in Sourani and Sohail [4].

4. Dimensions of sustainable construction

Despite the variance between the different definitions of sustainability, there is a wide acceptance that sustainable development integrates, at least, three dimensions: social, economic and environmental. Some publications in the literature have mentioned other dimensions of sustainability such as technical sustainability [7, 26], cultural sustainability [6, 15], community sustainability [6] and managerial sustainability [6]. However, in the context of the UK construction industry, the concept of the triple bottom line, which focuses on social, economic and environmental sustainability, remains dominant. Some of criteria underpinning such dimensions are presented below. However, they are rather general guidelines to explore the areas of focus within these dimensions. More effort is still needed to reach a common understanding of the issues representing these dimensions, highlighting the relevance of such issues to the different parties, linking them to the project life cycle and defining how they can be addressed within this cycle. Further research is suggested below to contribute to the effort needed to achieve these targets.

Table 1: Criteria representing the social dimension of sustainable construction

Social sustainability criteria	**Sources**
Protecting and promoting human health through a healthy and safe working environment	[7, 17, 26, 27, 29]
Participation of stakeholders – including community involvement	[15, 17, 26, 27, 28, 30]
Improving the quality of human life including poverty alleviation	[7, 15, 31]
Making provision for social self determination/enhancement	[7, 15]
Training and development – including implementing skills training and capacity enhancement of disadvantaged people	[7, 12, 29]
Seeking fair or equitable distribution of the social costs and benefits of construction – including equal opportunities among different ethnic and social groups	[7, 31]
Seeking intergenerational equity and reducing cost for future generations	[7, 31]
Diversity - including making provision for cultural diversity in development planning	[7, 17, 29, 31]
Social inclusion	[15, 26, 28]
Improving image/reputation	[12, 29]
Employment – including equal employment opportunities	[12, 17, 30]
Recruitment and retention	[27, 29]
Equality	[15, 27, 29, 31]
Accessibility	[12, 28, 30]
Work in occupied premises	[17, 29, 32]
Working environment	[18, 27, 29, 32]
Security – including minimising crime	[17, 28, 30]
Satisfaction – including workforce satisfaction and user satisfaction.	[17, 18, 27, 28, 29]

Table 2: Criteria representing the economic dimension of sustainable construction

Economic sustainability criteria	**Sources**
Financial affordability for intended beneficiaries	[7, 26]
Maintaining high and stable levels of economic growth	[3, 12]
Using life cycle costing	[18, 26, 30, 32]
Creating and maintaining high and stable levels of employment	[3, 7, 12, 28, 31]
Support of local economies	[15, 18]
Investment – including investing some of the proceeds of non-renewable resources to meet the needs of future generations. Investment in green products and in the use of renewable resources.	[7, 31]
Use of Key Performance Indicators (KPIs)	[18, 32]
DQI - Functionality and Flexibility	[18, 30]
Viability	[18, 28]
Profitability	[2, 12, 17]
Competitiveness	[2, 12, 7, 17]
Productivity	[17, 18]
Value for money	[17, 18, 30]

Table 3: Criteria representing the environmental dimension of sustainable construction

Environmental sustainability criteria	**Sources**
Conserve energy	[7, 12, 17, 18, 28, 30, 31]
Conserve water	[7, 12, 17, 18, 28, 30]
Conserve land	[7, 12, 17, 18, 28, 30]
Conserve materials – reuse and recycling	[7, 12, 17, 18, 28, 30, 31]
Resource utilisation	[7, 26, 28, 30]
Consider renewable energy	[7, 17, 18, 30]
Minimise pollution – water, land and air pollution (including noise) – at global and local levels	[7, 12, 17, 18, 28, 30]
Preserve and enhance bio-diversity	[7, 12, 17, 18, 30]
Creating a healthy, non-toxic environment – including high indoor air quality	[7, 18, 20, 30, 31]
Protect and enhance sensitive landscapes including scenic, cultural, historical and architectural	[7, 17, 18, 28, 30]
Re-use existing built assets	[12, 18, 30]
Waste minimisation and management	[7, 12, 17, 18, 28, 30, 31]
Environmental Impact (process and product)	[18, 26, 30, 32]
Transport – including provision of public transport	[18, 30]
Visual impact	[17, 28]

5. Further research

Further research will focus on developing a common understanding of the criteria representing the social, the economic and the environmental dimensions of sustainable construction that public clients should address in developing procurement strategy. This will contribute to overcoming some of the knowledge gaps outlined above in terms of consensus and conceptualisation, linking to procurement as one of the stages in the project life cycle, and linking the to public clients as one of the parties concerned. The Delphi Technique will be used to confirm and evaluate criteria obtained from the literature review and the experts' responses and to derive a consensus, among sustainability experts, regarding the most important criteria

6. Conclusion

Sustainable construction describes the application of sustainable development in the construction industry. As the needs and the conditions of the developed countries are widely different from those of the developing world, the interpretation and the priorities of sustainable construction could be largely dependent on the context. However, regardless of the context, sustainable construction always integrates different dimensions, including social, economic and environmental dimensions. The progress in the field has been hindered by many barriers such as the industry's fragmented nature, lack of long term perspective, clients' unwillingness to share burden and lack of awareness, which seems to be problematic in both the developed and the developing worlds. The paper explored some of the knowledge gaps related to the subject including conceptualisation, linkages to project life cycle, linkages to project management, implementation mechanisms and tools, and construction procurement. It reviewed the criteria underpinning the social, the economic and the environmental dimensions of sustainable construction through a synthesis of the relevant literature. More effort is still needed to reach a common understanding of the criteria, to highlight the relevance of the criteria to the different parties, to link them to the project life cycle, and to identify how they can be addressed within this cycle. Finally, to contribute to achieving such targets, the use of the Delphi technique is suggested to obtain a consensus among experts regarding sustainability criteria that should be addressed by public clients in developing a procurement strategy.

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Harnessing the Role of FM in the Design Processes Through Post-occupancy Evaluation Studies

Abbas Elmualim,
ICRC, The University of Reading,UK (email: a.a.elmualim@rdg.ac.uk)
Scott Fernie,
ICRC, The University of Reading, UK (email: s.fernie@rdg.ac.uk)
Stuart D Green,
ICRC, The University of Reading, UK (email: s.d.green@rdg.ac.uk)

Abstract

In delivering value services to buildings' clients/users, it is vital to gauge building occupants' feed back through post occupancy evaluation studies and walk-through at completion of a project. Such studies are rarely taken in the building industry in the UK apparently for cost reason. On the other hand, there is inkling in the facilities management profession that their role is marginalised particularly during the design processes of buildings contrary to the emerging notion of integration of FM in the design processes of projects. Post-occupancy evaluation studies will help to understand the role of facilities managers not only in the running and maintenance of facilities but further harness their role from initial inception of a project as well as establishing new performance indicators. Post-occupancy evaluation studies were carried out for various buildings including building with innovative sustainability design measures such as the application of hybrid natural and mechanical ventilation technologies. Indoor air quality parameters (temperature, humidity and CO_2) and external wind conditions, temperature, humidity and solar radiation were monitored for the investigated buildings. Structured occupants' surveys and informal interviews with occupants, facility managers and building designers were conducted.

The monitoring results for a building employing hybrid natural ventilation and air-conditioning systems showed that the indoor air quality parameters were kept within the design target range. Due to the short-falls in the control strategy for the hybrid system implemented, it was found difficult to quantify and verify the contribution of the natural ventilation to the internal conditions and, hence, energy savings. It was concluded that the value service for client/users was compromised due to the lack of facilities managers and system and software engineers involvement at early stages of the design processes in the buildings studied. System and software engineers for the building services control were consulted to devise the systems after the completion of the project. It was evident there was a lack of communication between designers, facilities managers and system and software engineers. This has lead to the failure of the control strategies and under-achievement of the full potential of the innovative technologies employed in the design of the buildings. Which further calls for a more holistic life cycle design approach for projects with genuine involvement of FM and IT specialist at the early stage of the design processes.

Keywords: Post-occupancy evaluation, hybrid systems, facilities management, building management system, wind catchers and indoor air quality

1 Introduction

Designing for comfortable internal conditions in buildings is a necessary goal for occupants' good health, well-being and high productivity. The application of passive design principles can help to achieve this goal with less energy consumption and at no extra cost to the building. Such passive design principles include the employment of wind catchers for natural ventilation in buildings. Predictive design tools are commonly used during the early design stage for sizing of systems. These prediction tools, such as thermal models and CFD, are based on steady state conditions and cannot accurately establish the performance of ventilation components in building, particularly when the external and internal conditions are transient and occupants' pattern and activities are changing [1]. It is critically important to gauge building occupants' feed back through post occupancy evaluation studies. Such studies are, rarely taken in the building industry in the UK for cost reason. Government's initiative such as the Building Regulations future performance certification of buildings, air pressurisation and thermo-graphic testing promote such studies to develop energy performance indicators for new and existing buildings [2].

The wind catcher/tower system is a passive ventilation system which not only extracts air using passive stack principles but also utilises the concept of a wind tower to supply air to the spaces as well. Traditionally, wind catchers were employed in buildings in the Middle East for many centuries and they are known by different names in different parts of the region. They were constructed, traditionally, from wood-reinforced masonry with openings at height above the building roof ranging from 2 m to 20 m. With taller towers capturing winds at higher speeds and with less dust [3]. Their application in the hot arid region of the Middle East is to provide for natural ventilation/passive cooling and hence thermal comfort. Wind catchers are traditionally used in places of high urban densities where surrounding buildings obstruct free stream air flow. Traditional wind catchers can be beautiful objects, feasible architectural feature additions to buildings and are inherently durable [4, 5].

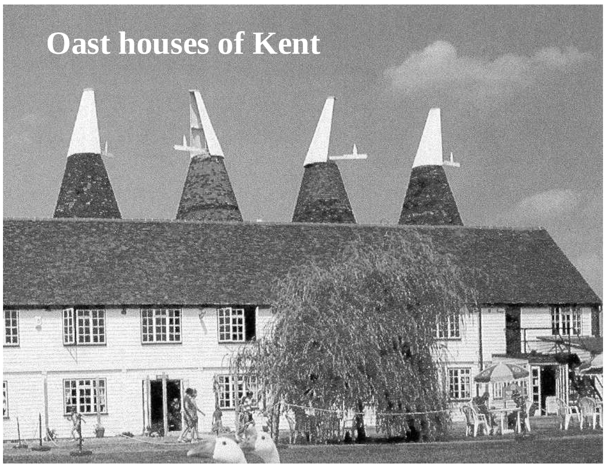
In modern design of wind catchers, the two ventilation principles of wind tower and passive stack are combined in one design around a stack that is divided into two halves or four quadrants with the division running the full length of the stack. As the wind direction changes so do the functions of each of the halves or the quadrants in the wind catcher. This renders the wind catcher as being operational whichever way the wind is blowing. As there are no free parts to the wind catchers, their maintenance is very small. It has the benefit of taking supply air at roof level, which is often cleaner than air supplied at ground level, particularly where the building is adjacent to a road in urban areas [5].

Post-occupancy performance evaluation of indoor environment in buildings where innovative technologies such as wind catchers are installed will assist in validating the systems and test their applicability in buildings for natural ventilation. The subjective assessment of occupants' satisfaction with indoor air quality and their ability to control the operation of wind catcher, hence controlling their environment, is an important criteria in validating the application of the hybrid air-conditioning and wind catchers. Furthermore, such studies will enable the understanding of the success/failures in the design and operation for such systems. This further will provide vital information and knowledge for designer and facilities managers. In this paper, sample quantative results of post-occupancy evaluation studies for two buildings are discussed. The two buildings are the Bluewater Shopping Malls, Kent, and the Seminar Room at the School of Construction Management and Engineering building.

2 Description of Buildings

2.1 Bluewater Shopping Malls

Bluewater Shopping Malls in Kent are newly constructed, out off town, shopping malls. The buildings incorporate wind catchers to ventilate the malls. The wind catcher cowl is inspired by the old form of a Kent oats houses as seen in Figure 1. These forms of oats houses were widely used in the area and became an architectural feature in modern buildings around Kent. The building is an innovative application for wind catchers in the UK and provides the opportunity for validating the application of wind catchers in a temperate climate, such as the UK. The building is managed via an Integrated Building Management System. The wind catchers are automatically controlled in conjunction with mechanical ventilation system.



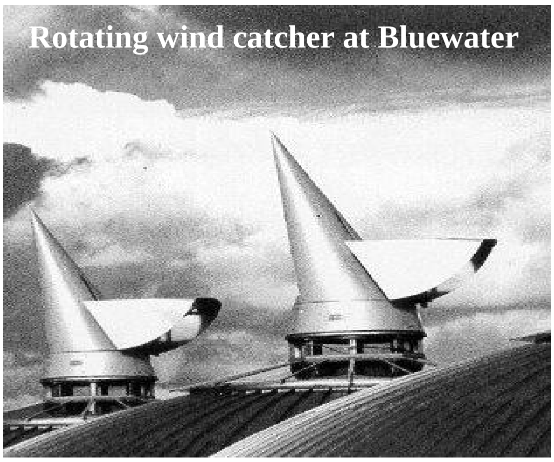


Figure 1: Traditional and modern rotating wind catcher at Bluewater shopping malls, Kent

The Bluewater building consists of three rectilinear form shopping malls with other reception halls and ancinary services (Figure 2). The three malls are forming a triangular shape with south, west and east facing malls and service courtyard in between. Shops were distributed around the three mall streets over two floors. The malls were ventilated using a mixed mode of natural ventilation applying wind catchers and air-conditioning system using the air handling units located on the roof of the buildings. There are 39 rotating wind catcher units distributed along the malls (13 units in each mall street). The performance investigation is carried out by taking the centre of each mall as a monitoring point. Indoor air quality parameters such as temperature, humidity and CO_2 level were controlled by the AHU units.

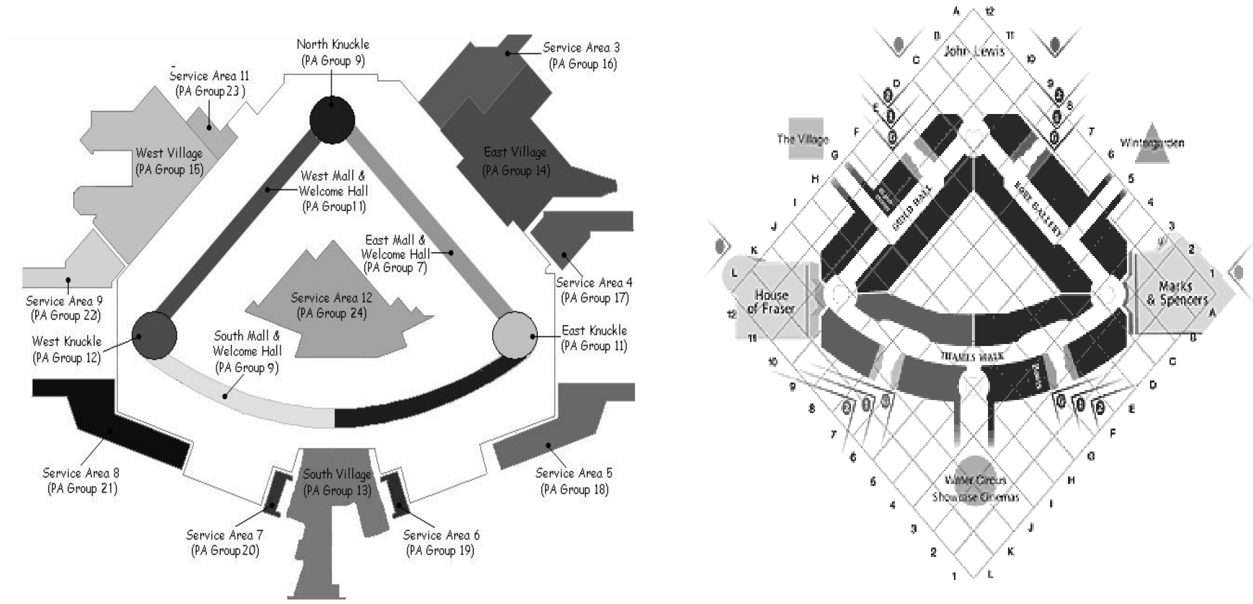


Figure 2: Plans of the shopping malls at Bluewater, Kent

2.2 The Seminar Room 2n09

A combined wind catcher and light pipe (Sun Catcher) was installed in a seminar room at the University of Reading, UK. The 3 storey building was constructed in 1973 and has a split level. It has a rectangular form with two offices running along two corridors, north and south, with atria, service cores and offices in between. The seminar room was newly refurbished and located in the second floor on the North side of the building with a floor area of approximately 61 m^2 and a volume of 211 m^3. The room's external and internal walls are light cream paint blockwork with a pitch roof of 2.5°. The room floor is composed of carpeted concrete with a false ceiling giving a floor to ceiling height of approximately 3.5 m. Two windows are located in the north wall of the seminar room and at adjacent bays each side of the concrete beam in the middle of the room. The windows extend from 1 m above floor level to ceiling providing a glazed area of 1.8x2.5 m. The room's IT area includes 5 computers with intermittent use. Figure 3 shows internal views of the seminar room with the wind catcher segments surrounding the internal light pipe diffuser (Figure 3 a1). The position of the wind catcher in relation to the windows is shown in Figure 3 a2. External view of the wind catcher terminal with the external light pipe translucent dome is shown in Figure 3b. The wind catcher system (1x1x1.5 m) is constructed from glass reinforced plastic with four segments, surrounding the 550 mm diameter light pipe, each with an area of 0.191 m^2 and a total duct area of 0.764 m^2. Each segment was fitted with manual dampers for air flow control operated at ceiling level.

Figure 3: Position of the wind catcher in the seminar room

Indoor air quality parameters were monitored inside the room at two different points. In the centre of the room, internal temperature, humidity and CO_2 concentration were measured using Automatikproducter (AP) and Onset HOBO H08-007-02 indoor air quality logging system. At monitoring point 2 (adjacent to the computer suite) internal temperature and humidity were measured using a complete Davis Vantage Pro weather station, which measure all external conditions including temperature, humidity, wind speed and direction, atmospheric pressure, rain and solar radiations. The weather station is located at the top of the building (2 m above building level, 15 m above ground level and 75 m above sea level). Both the Automatikproducter (AP) and Onset HOBO and the weather station were connected to a PC to facilitate data recording. The Solomat 4100 indoor air quality monitor and data from the weather station at the Metrology Department, the University of Reading, were also used as cross reference with the Davis Vantage Pro weather station data. The measurement of air change rate was carried out using the tracer gas decay method. SF_6 (Sulphur Hexaflouride) was used with CBISS 12 points Intelligent Sampling System (MK2) connected to Brüel and Kjaer (INNOVA) single gas analyser type 3425.

3 Results and Discussions

3.1 Bluewater Shopping Malls

The Integrated Building Management System (IBMS) provided the interface for operating all building equipment and their operations. The system is mainly used to check on the operation of the equipment. Alarms were sent to the IBMS console about any failure and malfunctioning of the equipment such as the air handling units and wind catchers. The IBMS log external weather conditions parameters, AHU status and operation data and internal air quality parameters at an interval of 15 minutes. The IBMS system has been operational for more than three years.

The recorded data is saved into MS Access software. The database is then interrogated via a program in MS Excel developed using MS Visual Basic programming tool. The Excel program provide the data required for any week in the year. The saved database for the year 2001 was interrogated and analysed to investigate the operation of the ventilation system and establish the performance of wind catchers at one central point in each malls street (south, west and east malls). Particularly, their contribution to the indoor air environment and energy savings achieved if any. For investigating the summer operation the database was interrogated for different weeks in the summer period. Figure 4 gives the results for one week in August in the south mall street. The indoor air quality monitors were kept within the design target providing acceptable indoor air environments for the shoppers. The CO_2 never exceeded 1000 ppm, which is an acceptable level according to ASHRAE recommendations [6].

To investigate the co-ordinated operation of the wind catchers with the AHU, fan pressures were plotted across the external wind speed, external temperature and humidity. The results show that the fan pressure was at its highest, approximately 130 Pa, while the recorded external wind speed at its peak with a recorded maximum measurement of 3.7 m/s (Figure 5). It was well established by observation that all the wind catchers units were facing the prevailing wind direction. The results show that in all the malls the fans were at their highest operations at the same time the external wind speed was in the range of 1-3 m/s for the full wind catchers' operation, hence not reducing fan pressure by operation of the wind catchers. This was due to the lack of co-ordination between wind catchers and the AU which is not considered in the IBMS system. This control system failure greatly emphasises the need for the inclusion of facilities managers, software and system engineers at the early stage of the design of the project, i.e. at day one in the inception of the project.

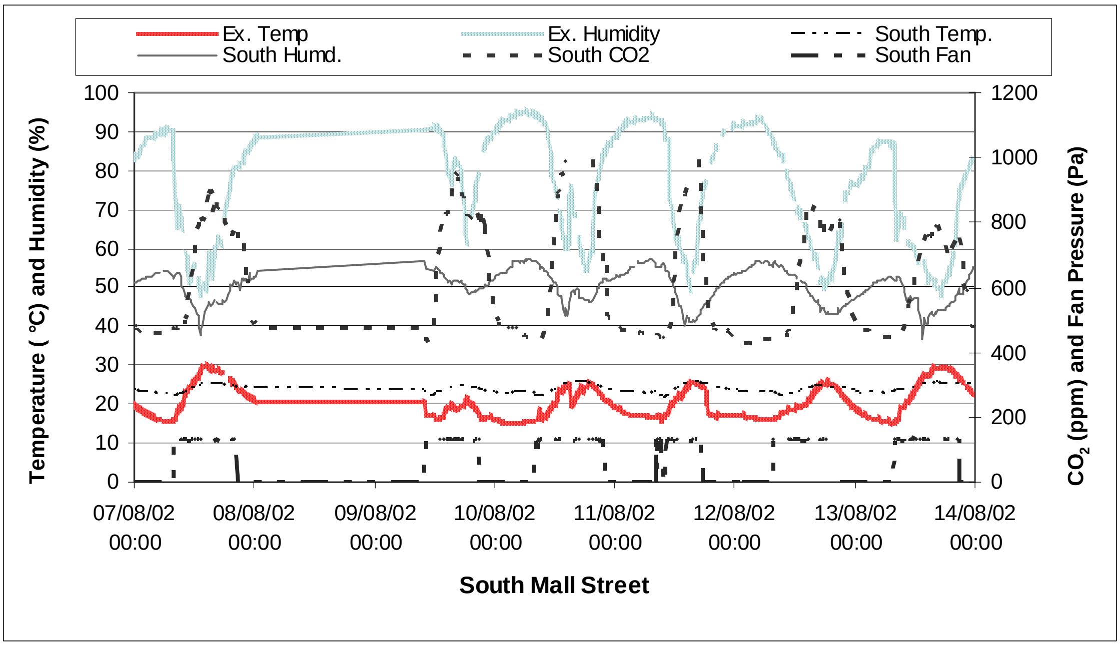


Figure 4: Measured indoor air quality parameters and fan pressure in the centre of the south mall street

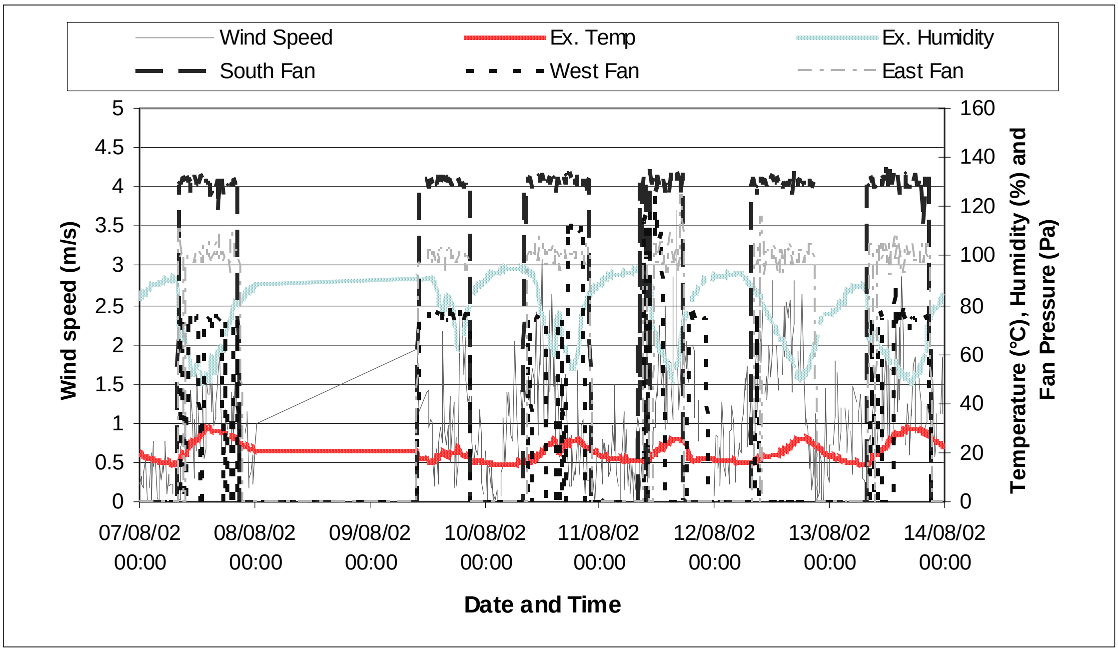


Figure 5: Plotted external wind speed against fan pressure and external temperature and humidity

3.2 The Seminar Room 2n09

3.2.1 Monitoring Results

The wind catcher was tested with dampers fully open and half open while the windows were closed. Tests were also carried out with windows open half the full size (1.8 x 0.212 m) and full size (1.8 x 0.424m) of the wind catcher duct area of 0.762 m^2. The results of two cases are presented in this paper. Case 1: wind catcher dampers fully open/ windows open half duct area during the month of August. Case 2: wind catcher dampers fully open/ windows open full duct area during the month of September.

The combined effect of wind catcher when fully open with open windows was investigated in Case 1 test during the month of August. The size of open windows area was half the size of the duct area of the wind catcher. Figure 6 shows the results for the test in Case 1. While internal humidity and CO_2 levels were maintained at an acceptable level, the internal temperature is higher was higher due to the high external temperature. The combined effect of window/wind catcher operation reduces the internal temperature adjacent to the window. The difference between internal and external temperature was at least 3 °C. The CO_2 level inside the room did not exceed 500 ppm. This is below the ASHRAE recommendations of CO_2 concentration of 1000 ppm [6]. Furthermore, in this case (Case 1), tests were conducted to evaluate the ventilation rate using tracer gas measurement. Further tests for ventilation rate in the afternoon were carried out to establish the validity of tracer decay method in analysing the ventilation rate. Generally speaking the ventilation rate increased during the night and the early hours of the morning and reduced during the warm afternoon as can be seen in Figure 6. This is due to higher temperature difference and relatively high wind speed in the night, thus confirming the suitability of applying wind catchers/towers for night time ventilation in buildings.

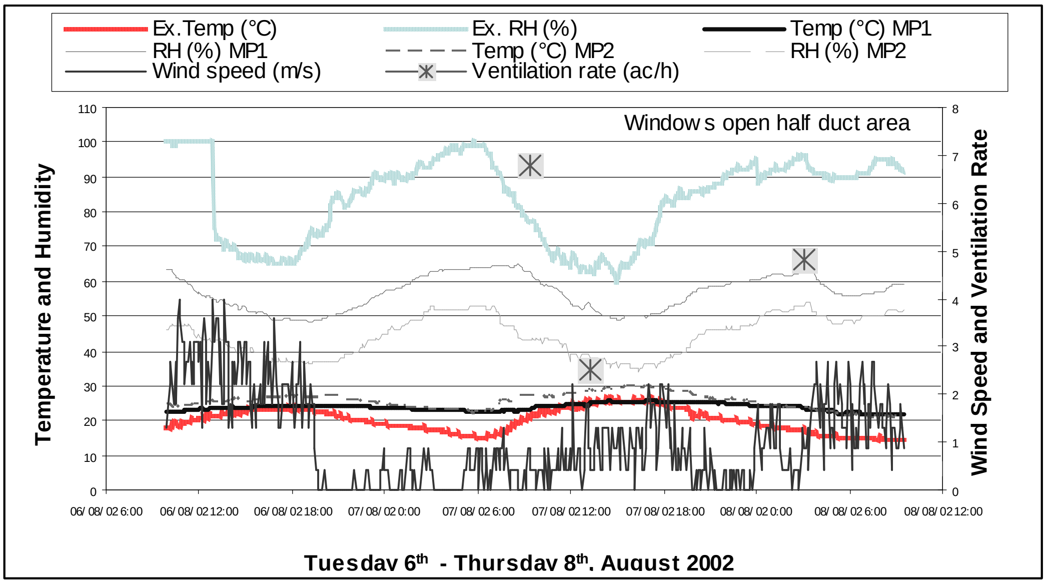


Figure 6: Variation of the measured ventilation rate, wind speed and indoor air quality parameters

The measured local ventilation rates in both conditions of window opening size in this Case show little or no variation when the windows were open the full wind catcher duct area. If the window open area is reduced to half the size of the wind catcher duct area some variation in the localised ventilation rate was observed particularly during the night. The ventilation rate was slightly lower by the window (SP4, 1.6 ac/h). Such a ventilation rate is considered to be insufficient when compared with the CIBSE recommendation of 6-10 ac/h.

Table 1 gives the measured ventilation rate, thermal and indoor air quality parameters in the repeated tests for Case 1. The results showed that the ventilation rate (hence, the performance of the wind catcher) depends on the wind speed and direction. The repeated tests for the ventilation rate in the afternoons gave similar results in a range of 2 – 2.5 ac/h as in the previous tests. The analysis of these results, (taking into consideration the variation of external conditions) showed no discrepancies in air change rate, thus establishing the applicability of tracer gas decay method in measuring air change rate for wind catchers. However, the overall building performance is more complex and depends on other variables, such as the thermal mass of the building, air infiltration through the fabric in addition to windows and the wind catcher opened areas.

Table 1: Averaged measured indoor air quality, thermal and ventilation parameters, repeated Case 1 (windows closed).

Date and time	ventilation rate ac/h (average)	Temp diff	Wind speed m/s	Directio n	Ex.Temp (°C)	Ex. RH (%)	Temp MP1 (°C)	RH MP1 (%)	CO_2 ppm	Solar Rad. (W/m^2
Afternoon 23/07/2002 1 5:52- 18:40	**1.4 (82 l/s)**	**5.3**	**2.8**	**W**	**18.7**	**81.1**	**24.0**	**59.0**	**488. 4**	**143.1**
Night 23/07/2002 20:30:- 23:29	**2.3 (135 l/s)**	**7.1**	**2.0**	**W**	**17.1**	**81.8**	**24.2**	**55.1**	**469. 2**	**2.3**
Morning 24/07/2002 00:08 - 03:08	**3.5 (205 l/s)**	**8.0**	**1.0**	**NNE**	**16.2**	**82.1**	**24.2**	**53.0**	**411. 6**	**0.0**

In Case 2, the size of the opened window area was increased from half to full duct area. Figure 7 shows the measured indoor air quality parameters in Case 2. The monitored indoor air quality parameters were kept within acceptable levels. The measured ventilation rate in the night was lower than in the afternoon despite the higher temperature difference and slightly higher wind speed. This can only be explained by the variation in wind direction. The ventilation rate is dependent on temperature difference, wind speed and wind direction and, hence, the established performance of wind catchers. However, in some cases the ventilation rate was found to be insufficient with values of 2-5 ac/h compare with the calculated ventilation requirement of 11 ac/h.

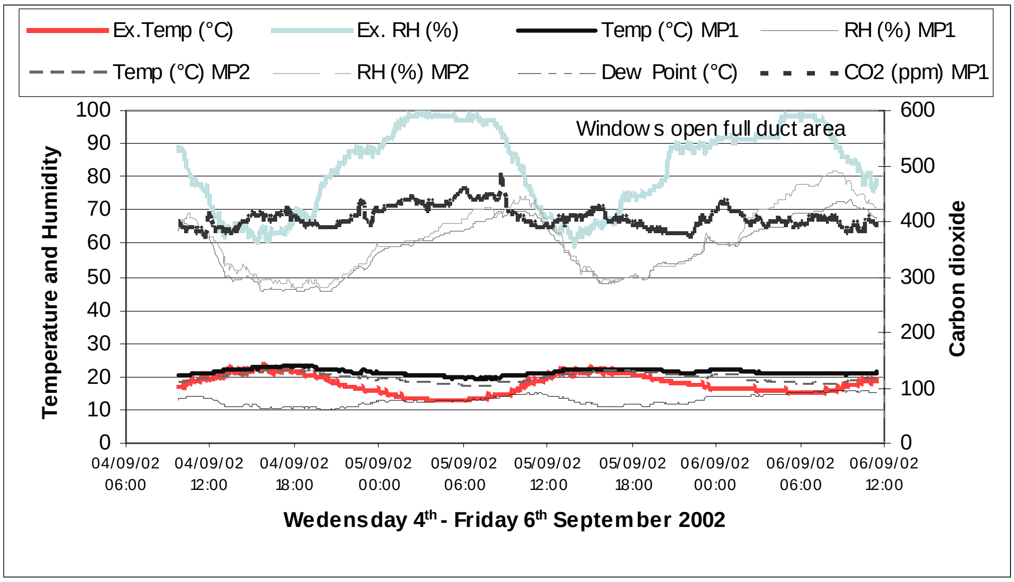


Figure 7: Measured indoor air quality parameters in with windows open full wind catcher duct area, Case 2

3.2.2 Occupants Survey

The study of subjective assessment of the indoor environment in the Seminar Room 2n09 was conducted using structured questionnaire. The questionnaire was structured around four main areas; personal details, thermal environment, visual environment and overall environment in the seminar room. For the data entry, data manipulation and statistical analysis, SPSS software for Windows was used. SPSS is a package developed originally for social scientists using large mainframe computers. Since then it has been refined and redeveloped for different types of computer architecture including Windows [7].

Table 2 gives the nationality versus overall thermal conditions cross tabulation. The majority of the occupants were neutral (41.7%), one third of the occupants felt significantly warm, and 16.7% of the occupants felt only slightly warm. The distribution of overall thermal comfort in conjunction with age is shown in Figure 8. It shows that the majority of occupants in the age range 20 – 40 felt neutral to slightly warm. With regard to the recommendations of the installation of the wind catcher and light pipes systems, 75% of the occupants surveyed welcomed the application of the system for natural ventilation and daylighting in buildings. The same percentage found the air movement inside the room to be acceptable. Interestingly, although 25% of the occupants found the air to be stagnant they still welcomed the installation of wind catchers. This could be due to the environmental awareness of the occupants and their desire to apply renewable energy and low energy architecture systems in buildings. Furthermore, through informal interviews many occupants of the seminar room expressed their satisfaction with the performance of the wind catcher and they changed their sitting area to be under and around the wind catcher in the summer months of 2002.

Table 2: Distribution of nationality with overall thermal conditions

Nationality * Overall thermal conditions Crosstabulation

			Overall thermal conditions				
			warm	slightly warm	neutral	slightly cool	Total
Nationality	British	Count	1		1	1	3
		% within Nationality	33.3%		33.3%	33.3%	100.0%
	Sudanese	Count			1		1
		% within Nationality			100.0%		100.0%
	Chinese	Count	1		1		2
		% within Nationality	50.0%		50.0%		100.0%
	Western Europe	Count			1		1
		% within Nationality			100.0%		100.0%
	Korean	Count		2			2
		% within Nationality		100.0%			100.0%
	Turkish	Count			1		1
		% within Nationality			100.0%		100.0%
	Taiwanese	Count	1				1
		% within Nationality	100.0%				100.0%
	Malaysian	Count	1				1
		% within Nationality	100.0%				100.0%
Total		Count	4	2	5	1	12
		% within Nationality	33.3%	16.7%	41.7%	8.3%	100.0%

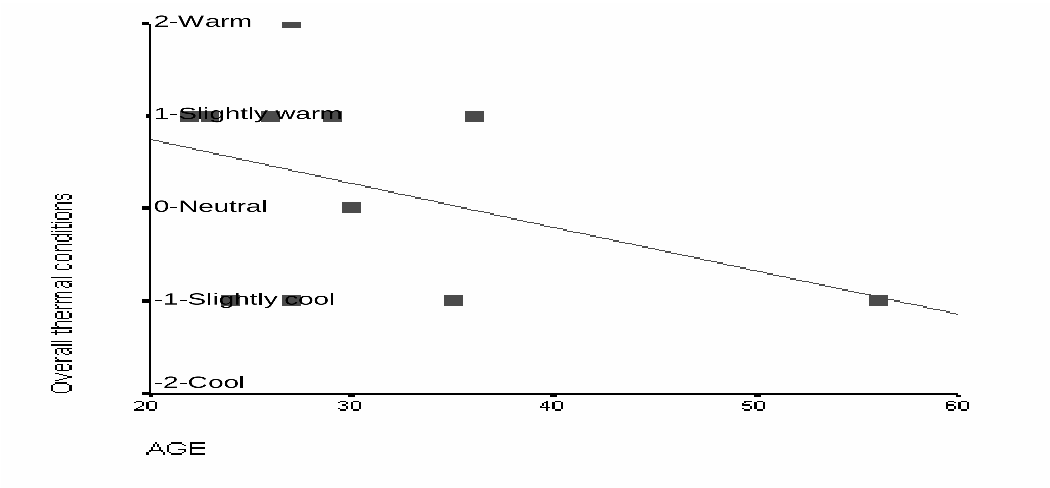


Figure 8: Distribution of overall thermal comfort with age of occupants

4 Conclusions

Post-occupancy evaluation studies enable the validation of building design processes and operation. Such studies will enable emerging concept of learning from use, which facilitate much needed integrative approach for building design and operation. Particularly, integration of FM and software and system engineers at early stage of the design processes. In this paper post-occupancy evaluation studies were carried out into two buildings; Bluewater Shopping Malls in Kent and the Seminar Room 2n09 at the School of Construction Management and Engineering. Monitoring of indoor environment in real weather conditions was conducted to evaluate the indoor air quality within the buildings together with an occupant survey.

The Bluewater Shopping Malls in Kent provided an innovative application of a wind catchers integrated with the mechanical ventilation system (hybrid). The integrated system is controlled via the Integrated Building Management System (IBMS) which recorded all external and internal parameters into a computer database. The summer month operation showed that the indoor air quality parameters were kept within the design target range. It showed that the fans came into operation whenever the CO_2 level was reaching a set-point of 1000 ppm. The operation of the fan increased the ventilation rate and hence reduced the CO_2 concentration to the recommended value. While the wind catchers were operational, no data was recorded regarding their operation, opening time and position. Though the control strategy implemented was working effectively in monitoring the operation of mechanical ventilation systems, i.e. AHU, it did not cover the integration of the natural ventilation system, i.e. wind catchers, with the mechanical ventilation. Controlling the operation of the wind catchers via the AHU led to isolation of these systems in the event of malfunctioning of the AHU, hence the wind catchers will remain shut. Due to the shortcoming of the control strategy implemented in this project, it was found difficult to quantify and verify the contribution of the natural ventilation systems (wind catchers) to the internal conditions and, hence, energy savings.

The monitoring results and occupant survey conducted in a University seminar room showed that indoor air quality parameters were found to be within acceptable level when the wind catcher was operating. The air change rate measured was in the range of 1.5 ac/h to 6.8 ac/h. These results were complemented with occupants' survey analysis where 75% of the occupants welcomed the installation of wind catchers systems.

The results of the monitored buildings emphasised the importance of harnessing the pivotal role of facilities managers and software engineers in the early stage of design. Looking beyond the figures, post-occupancy evaluation studies provide an ideal tool for processes improvements and understanding of behavioural changes through the various stages of the construction cycle of a project. The studies will provide indispensable knowledge and information to be incorporated into new project and thus achieving the goal of client/user centred integrative design and service delivery.

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The Growth of Environmental Requirements in International Facility Management

Mikko Nousiainen,
Helsinki University of Technology (mikko.nousiainen@tkk.fi)
Seppo Junnila,
Jaakko Pöyry Infra Consulting (seppo.junnila@poyry.fi)

Abstract

In the service and light industry (SLI) companies have already realised that the use of facilities causes a large share of their environmental burden. This study presents typical environmental objectives within the largest companies operating in the SLI and investigates whether these companies have specified facilities (facility management) as a high priority issue when minimizing company's environmental impacts. In addition, the study aims to determine whether there has been any increase in environmental requirements for facilities management organizations in recent years. We found that the most typical environmental objectives in SLIs are reduction of electricity consumption, waste recycling/re-use, waste minimisation and reduction of climate change emissions, all of which are closely related to the use of the facilities. At present, one third of the companies studied emphasize the role of facilities in their environmental management. When comparing the results between the years 2003 and 2005, we see that the most typical environmental objectives have changed and that more companies have explicitly stated the environmentally important role of facilities or facility management.

Keywords: environmental management, environmental objective, comparison, facility management, service industry

1. Introduction

Corporate social responsibility (CSR) and sustainability are of growing importance for companies operating in the service and light industries (SLIs). For example, the number of organisations certified according to the ISO 14001 environmental management certificate increased thirty-four per cent in the year 2003 to over 66 000, the highest number ever [1]. Companies also publish significantly more CSR reports than they did some years ago [2] [3], and, for instance, over fifty per cent of companies listed in Fortune Global 500 publish environmental reports [4]. CSR includes several fundamental elements, of which the most important are a company's duty to openly report its environmental performance and to minimise its environmental impacts. Recent studies have disclosed that, in the SLI, a large part of the environmental burden of companies is most likely caused by the facilities themselves [5].

Furthermore, it has been suggested that facility management (FM) should have the key role of environmental management of SLI companies, since facilities represent less than ten per cent of company expenses but cause almost a half of the environmental impact of the SLI organisation [6].

Several studies have been conducted about companies' environmental reporting but on a more detailed level environmental management is less studied [7]. Only a few studies have analysed SLI companies' environmental management from the facilities or FM's point of view. In one such study, SLI companies were found not to explicitly state facilities in their environmental management, but yet their most common environmental objectives related closely to the use of facilities [8]. From society's standpoint, SLI companies, such as banks, are an important group of companies and the potential for reducing the environmental impacts of SLI companies has been found to be significant [5].

This study presents the most typical environmental objectives within the largest companies operating in the SLI and investigates whether these companies have specified facilities (FM) as a high priority issue when minimizing company's environmental impacts. In addition, the study aims to determine whether there has been any increase in environmental requirements for facilities management organizations in recent years.

2. Method, material and selection of companies

The study is based on the case study method and environmental information published by SLI companies. The study was carried out as a multiple-case study and by using a time series design. The study has an exploratory approach and embedded units of analysis. [10] Each company represents a case and each named objective an embedded unit of analysis. The data collected related to both qualitative environmental objectives (i.e. to reduce energy consumption, environmental risks) as well as quantitative ones (i.e. the use of energy [GWh], CO_2 emissions [tons]). The data was entered into a matrix and each environmental objective analysed. Quantitative environmental objectives were separated out from qualitative objectives and then the data was analysed by country and by industry sector, special attention being paid to the recognition of facilities FM. Finally, the results were compared with a similar study conducted in the year 2003 and published in 2004 [8].

Altogether, thirty-one SLI companies were included in the study. The companies were selected as being among the five largest, based on turnover, in their respective area, and as having published environmental information. The largest companies were selected because "they are highly visible to stakeholder groups and are often presented as examples of environmental behaviour of the industry as a whole" [11]. The selected companies were the same as those in a previous similar study to obtain better comparability. However, two companies have changed since 2003 because of corporate fusions, so new companies replaced the old ones (Sonera > TeliaSonera, SCC Scandiaconsult > Ramboll) [12][13].

The companies represent three different geographical and four industrial areas. Of these companies, eleven are Finnish, ten European and ten from the USA, and the industry sectors are represented as follows: banks and insurance (eight); trade (eight); ICT (nine); consulting (six). European and American companies were selected on the basis of the Fortune Global 500 list [14], and Finnish companies on the basis of the Talouselämä 500 list [15] (in Finland Talouselämä is equivalent to Fortune or Business Week). European and American consulting companies, however, were selected on the basis of one consulting company's peer group [16], because typically the turnover of consulting companies is too small to reach the Fortune 500 list. Selected companies are presented in Table 1. by country of origin and industry sector.

The study is based on publicly available environmental information on the Internet pages of the companies. Besides Internet pages, the data used also include other available documents on the Internet, like annual, sustainability or CSR reports. The data were mostly collected in the autumn 2004 and reviewed in February 2005.

Table 1: Companies included in the study.

	Finland	**Europe**	**United States**
Banking and insurances	Sampo	AXA	Citigroup
	Tapiola	Allianz	Bank of America
	Nordea	ING Group	
Trade	Kesko	Kingfisher	Target
	SOK	Pinaul-Printemps	The Home Depot
	Stockmann		Wal-Mart
ICT	TeliaSonera	Deutshe Telekom	Motorola
	Nokia	Vodafone	Verizon
	Elisa	France Télékom	Microsoft
Consulting services	Jaakko Pöyry Group	Amec	SNC-Lavalin Group
	Accenture	Ramboll	Jacobs Engineering Group

3. Results

3.1 The most common environmental objectives

In this results section companies' environmental objectives are analyzed first in general and then by companies' geographical and industrial sector distribution. After that, the change in companies' environmental objectives, and the role of facilities and FM, are analyzed. Environmental objectives of each studied company are presented in Table 2.

Almost every company, about ninety per cent, uses environmental objectives, and, surprisingly, about sixty per cent of companies measure their environmental performance by using quantitative environmental objectives (Table 3.). The use of quantitative environmental objectives, in general, is considered as a sing of better capability to manage environmental

impacts, and therefore declare organisation's commitment to environmental management. Companies who have the most reported qualitative and quantitative environmental objectives are Kesko, AXA, Nokia and Deutsche Telekom.

Table 2: Environmental objectives recognized by a company. An empty box (□) indicates a qualitative objective and a full box (■) a quantitative one. A thin square ( ) around a box indicates a positive change and an X a negative change compared to year 2003.

OBJECTIVE / COMPANY	Sampo	Tapiola	Nordea	Kesko	SOK	Stockmann	TeliaSonera	Nokia	Elisa	Jaakko Pöyry Group	Accenture	AXA	Allianz	ING Group	Kingfisher	Pinault-Printemps	Deutshe Telekom	Vodafone	France Télékom	Amec	Ramboll	Citigroup	Bank of America	The Home Depot	Target	Wal-Mart	Motorola	Verizon	Microsoft	SNC-Lavalin Group	Jacobs Engineering Group
ENVIRONMENTAL IMPACTS																															
climate change				g			g	g				g	g	g	c		[g]	g	[g]	g		g	[c]		[c]		[g]	[g]			
acidification				g			X	[g]																							
summer smog				g	X		X																				g				
ozone depletion substances								g										g				X					[g]				
particles				g			X																								
ENERGY																															
heat	g	g		g	X		X	g				g	g				[g]		c			g									
electricity	g	g	c	g	X	c	c	g				g	g	g	c	g	g	g	g	c	c	g	[g]	c	c	c	g	c			
NATURAL RESOURCES																															
material				g								g					c						c	c			c			c	
water	g	g		g	X		X	g				g	g	g		g	[g]	c				g		c			g	[g]			
paper	g	g											g	[c]		[c]	g	g			c		g								
TRAFFIC																															
commuting / travelling		c	c				c					g	g	[g]			g	g	g			[g]	c								
transportation / distribution		c		g	c	c	c								c	[c]															
WASTE																															
waste (general)	c	g		g	c		X	g				g	g	g	c	[c]	g	g		g		g			c	c	c	c			
packaging				g	g	[c]									c									c			c		[c]		
several waste components	c		X	g	c		X					g					[g]										[g]	[g]			
MISCELLANEOUS																															
facilities, FM, or real estates	c	[c]		c	c							[c]	[c]	[c]			c											[c]	[c]		
waste recycling / re-use	c	g	c	[g]	[c]	c		g					[c]				[g]	[g]		c	c	[g]	[c]	c	[g]		[g]	[c]	[c]		
environmental risks			c		c														c				c	c							
environmental education	c		c						c				c											c						c	
following the legislation	c		c			c			c								c	c	c					c	c		c	c	c	c	
environmental purchasing	[c]	c	c	c			X	c	c			c	c	c	c	[c]	c	c			c	c					c				
visual impacts of masts							c										c	c	c												
other objectives			c			[c]		[g]				[g]	[g]	[c]	c	[c]	c	[g]		c	[c]	[c]	c	c			[c]	[c]			

Table 3: Number of environmentally active companies selected for the study, and the use of environmental objectives in each respective area.

	Number of companies	No objectives	Qualitative objectives	Quantitative objectives
Geographical				
Finland	11	2	11	8
Europe	11	0	11	9
USA	10	1	9	5
Industry sectors				
Bank and insurance	8	0	7	8
Trade	8	0	8	4
ICT	9	0	9	7
Consulting	6	3	2	1

Companies are emphasizing several environmental objectives as a part of their CSR, and the most typical environmental objective in SLI seems to be the reduction of electricity consumption. Almost every company has emphasized it in its environmental management, and over half of the companies also measure their electricity consumption. Other common environmental objectives are waste recycling/re-use and waste minimization. As well, reduction of climate change emissions, environmental requirements in purchasing and minimal water usage are often seen important.

When the results are analyzed in geographically, we see that European companies have recognized more environmental objectives than Finnish and US companies. The difference between European and Finnish companies is, however, quite small if compared with the difference between European and US companies. This is especially true in the use of quantitative environmental objectives. In addition to the most typical environmental objectives, each area also has its own characteristics. Most studied European companies focus on climate change, and in most cases company has a quantitative climate change indicator. In Finland attention is paid to waste recycling/re-use, environmental purchasing and heat energy whereas US companies find recycling/re-use and following the legislation important. The most common environmental objectives in studied geographical areas are presented in Table 4.

Table 4: The most common environmental objectives in Finland, Europe and in the United States.

Finland	Europe	USA
Electricity	Electricity	Electricity
Waste recycling / re-use	Climate Change	Waste recycling / re-use
Heat	Waste	Legislation
Water	Environmental purchasing	Climate Change
Waste	Water	Waste
	Paper	
	Commuting	

Differences exist also between the industry sectors. Banks and insurance companies, ICT companies and trade companies are all almost equally active in their environmental management. The consulting sector is a more passive industry sector, and three consulting companies have no environmental objectives. Excluding consulting, each industry sector has some typical objectives. For instance, banks and insurance companies are interested in commuting, paper use, and environmental requirements in purchasing, while trade companies focus on transportation/distribution and packaging. ICT companies communicate that they follow legislation and are especially interested in minimizing their climate change emissions. It should be noted that all studied ICT are measuring their climate change emissions. The most common environmental objectives in each industry sector are presented in Table 5.

3.2 The change in environmental objectives

Companies' environmental objectives presented in this paper are now compared with the results of similar study, which was published in the year 2004, and which is based on data collected in the year 2003 [8]. We see that SLI companies have now recognized more environmental objectives

Table 5: The most common environmental objectives in each industry sector. The following objectives were equally common in each sector. Banks and insurance: waste, recycling/re-use, water; Trade: transportation/distribution, packaging, recycling/re-use; ICT: climate change, legislation; Consulting: Electricity, recycling/re-use; ALL: climate change, purchasing.

Bank and insurance	**Trade**	**ICT**	**Consulting**	**ALL**
Electricity	Electricity	Electricity	Electricity	Electricity
Environmental Purchasing	Waste	Climate Change	Recycling / re-use	Recycling / re-use
Waste	Transportation / distribution	Legislation		Waste
Recycling / re-use	Packaging	Recycling / re-use		Climate Change
Water	Recycling/re-			Purchasing Water

than in the year earlier. This study evaluated 22 most common environmental objectives, from which fourteen are nowadays used more often than earlier. These are waste recycling/re-use, reduction of climate change emissions and facilities. Facilities is used as a qualitative objective, probably because quantitative measurement is challenging. Some objectives are used less than earlier (Figure 3.).

However, the number of companies, which have recognised environmental objectives, has not changed, so the development has taken place in previously active companies. Companies who have enhanced most the reporting of their environmental objectives are Motorola, Deutche Telekom and Pinault-Printemps Reroute. By contrast, some companies, i.e. TeliaSonera and SOK, share now less environmental information than earlier, mostly because of company fusions.

The total number of environmental objectives emphasized by a company has also risen. Geographically, both European and US companies seem to measure their environmental performance more today than earlier, whereas the studied Finnish companies appear to now use less quantitative environmental indicators (Figure 1.). The trend to use qualitative environmental objectives seems to be mounting in all geographical areas. This trend is also seen when industry sectors are compared; and further it holds true for quantitative environmental objectives. Banks and insurance companies have adapted most new qualitative indicators, and they also seem to measure their environmental performance more than other industry sectors. The consulting sector is an exception since no development can be seen in there. The most remarkable change in environmental objectives has occurred among ICT companies who are emphasizing reduction of climate change emissions and waste recycling/re-use more strongly then earlier (Figure 2.).

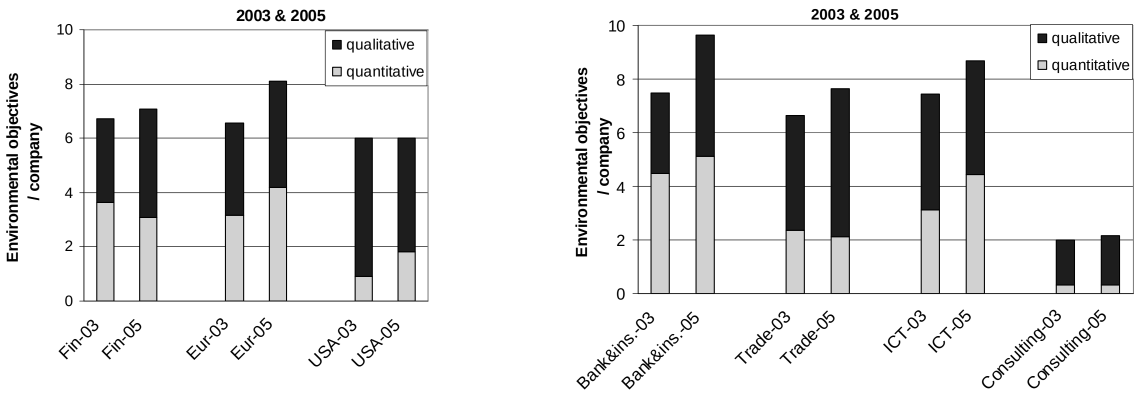

Figure 1. & 2: The number of environmental objectives in Finnish, European and US companies and in different industry sectors in the years 2003 and 2005.

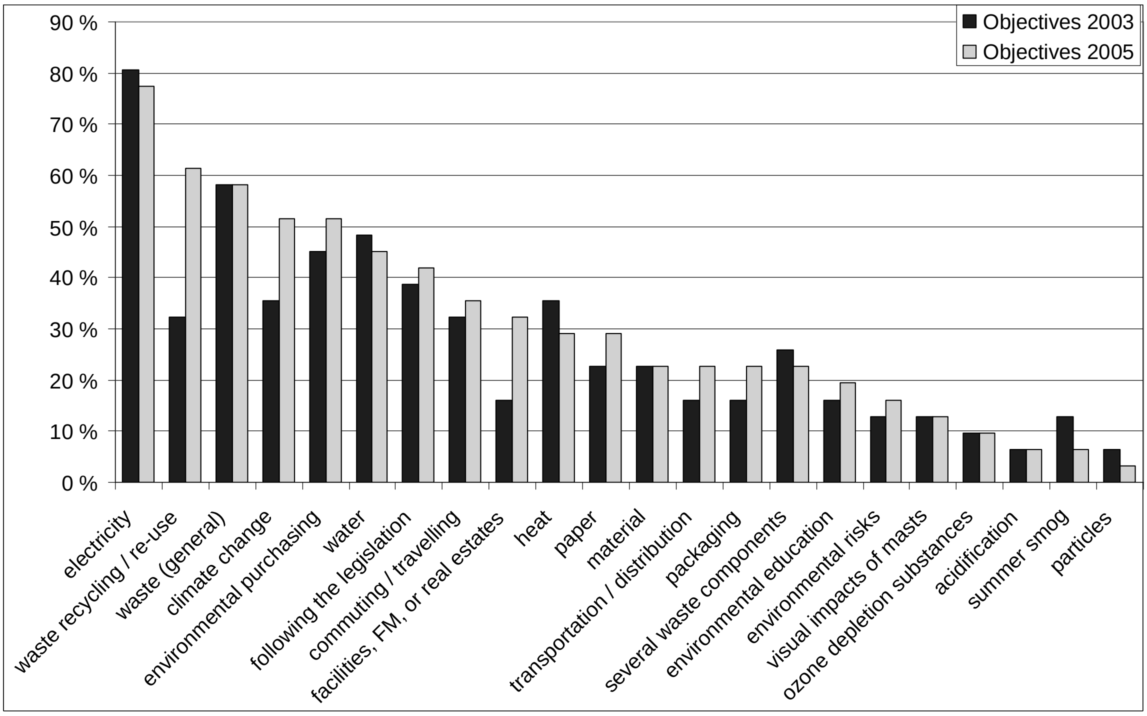

Figure 3: Environmental objectives used by the SLI companies in 2003 and 2005.

Generally speaking, companies have improved their environmental reporting. Most companies, 21 out of 31, have enhanced the available environmental information in their Internet sites. Typically, the companies have improved the availability of quantitative environmental information. Many companies have also activated in their CSR during the last two years, and they are now publishing CSR-reports, using the Global Reporting Initiative (GRI) Guidelines, and striving for a certified environmental management system.

3.3 The role of facilities and facility management

At present, ten out of thirty-one companies have explicitly stated performance of facilities/ facility management as an environmental objective. Four of these companies are Finnish, four

European and two American; five are banks and insurance companies, two are trade companies, and three are ICT companies.

Surprisingly, the greatest growth among all environmental objectives has taken place in facilities/FM. The number of companies who have explicitly stated facilities/FM as an environmental objective doubled since 2003. In contrast, environmental requirements in purchasing, for example, increased very modestly (Figure 4.). The increased focus on facilities, and also on waste management/re-use, indicates that companies aim to improve the environmental performance of concrete and ordinary matters.

Furthermore, some facilities recognized companies are very strongly accentuated facilities or FM in their environmental management. The companies have, for instance, environmental programs and life-cycle objectives especially for facilities, and companies, such as Microsoft and SOK, are using or exploiting building environmental certification systems. Moreover, some companies who have not explicitly stated facilities in their environmental management, are, for example, paying attention to energy usage, implementing building management applications, and even performing energy audits in their buildings. It seems that these companies have indirectly recognised the important role of facilities from the environmental management point of view.

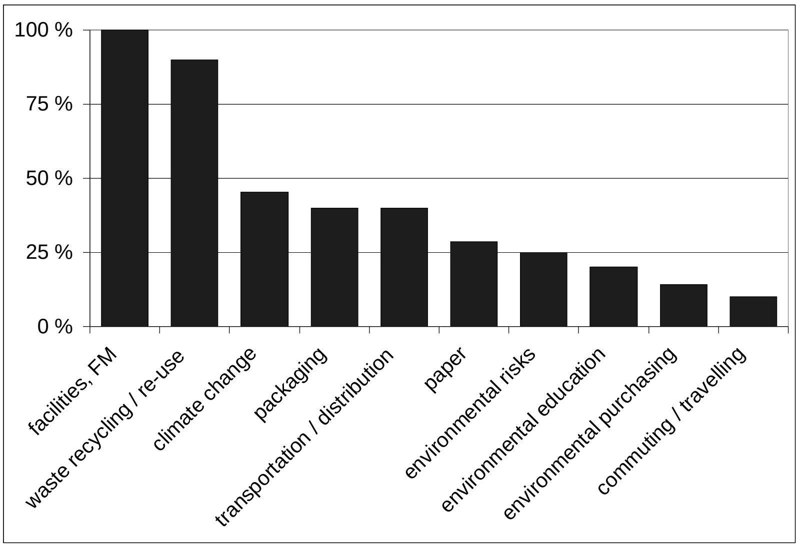

Figure 4: Increase in the use of environmental objectives between 2003 and 2005.

4. Discussion

This study presented the most typical environmental objectives within the largest companies operating in SLI, and investigated whether facilities or facility management have been specified as an environmentally high priority issue in these companies. In addition, the study aimed to determine whether there has been any growth in environmental requirements set for facilities management organization in recent years.

The role of facilities and FM in SLI companies' environmental management is clearly increasing. The number of companies who have explicitly stated facilities in their environmental objectives doubled during the last two years, being now roughly one third of companies. SLI companies are taking a more and more comprehensive viewpoint towards environmental issues, and their most typical environmental objectives are reduction of electricity consumption, recycling/re-use, waste minimization and reduction of climate change emissions. European companies have improved their environmental reporting more than US companies, which in general seem to be less active in their environmental management. However, companies with smaller turnover may not see CRS as important as large companies, and they might be less willing to invest in it. This may be the case also with studied consulting companies.

Buildings sustainability, or environmental performance, is universally becoming a more and more important issue. Interestingly, in the US, the use of the building environmental certification system (LEED) has grown over 30 per cent in 2003 [17], and green buildings are a hot topic in the construction and real estate sector. This study showed a notable increase in the status of facilities in companies' environmental management, which suggests that in the future the importance of facilities and FM will be even more widely accepted, when SLI companies aim to minimize their environmental impacts and emissions. It has already being stated, perhaps commercially, that "senior management will start to see the value of having facility managers who are skilled in green buildings" [17].

Some limitations can be recognised. First, the main limitation relates to the use of only one source of evidence. According to Yin [10], the quality of a case study is always improved when several sources of evidence are used. Second, the selection of companies from each industry sector may have caused distortions because different industrial sector classification is used in Fortune and Talouselämä magazines. The third limitation stems from the very diverse interpretations of the concept "environmental objective". In some companies, environmental objectives are understood as very practical and strict instructions, whereas in others, they are seen as wide-ranging, general statements. Also, companies don't communicate their environmental objectives clearly and unambiguously.

5. Conclusions

Companies' environmental responsibility is becoming an increasingly important issue, and companies are realising the importance of facilities and facility management from the environmental management point of view. This may result in significant changes in the needs and expectations the facility users (e.g. SLI companies) have for facility owners, facility managers and facility service providers.

The practical implications of the results are probably the most substantive for facility and real estate companies. These companies should take advantage of the results when improving their operational practices, planning their future strategies and developing their services.

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Refuse Collection Facilities and Health Concerns in Dense Urban Residential Buildings

Dr. Edwin H W Chan,
Department of Building and Real Estate, The Hong Kong Polytechnic University, Hong Kong China (email: bsedchan@inet.polyu.edu.hk)
Miss Grace Lee,
Department of Building and Real Estate, The Hong Kong Polytechnic University, Hong Kong China (email: 04900969r@polyu.edu.hk)

Abstract

Refuse collection facilities and the related management are of particular importance to dense urban residential buildings because they are normally congested and high-rise with noted difficulties with vertical transportation. The issues in concern include property management, cooperation from and convenience of the residents, technology and cost benefit of the facilities. All the efforts in the refuse collection management aim to provide a pleasant and hygienic environment for the resident. However, there is little in-depth study carried out to examine the relationship between the refuse collection facilities and their impact of the health of the residents. This topic was brought to focus after the recent outbreak of the atypical pneumonia, known as SARS in Asia in 2003. Peoples in the region were more concern about their built environment and its impact of their health. This paper present the findings of a study carried out in Hong Kong which compared the popular traditional refuse collection systems and the more advanced automatic refuse collection system. The study was carried out with particular reference to the health issues of the residents. The study found that apart from the consideration of cost, technology and efficiency of the facilities, management of the facilities is the most critical for the success of a refuse collection system.

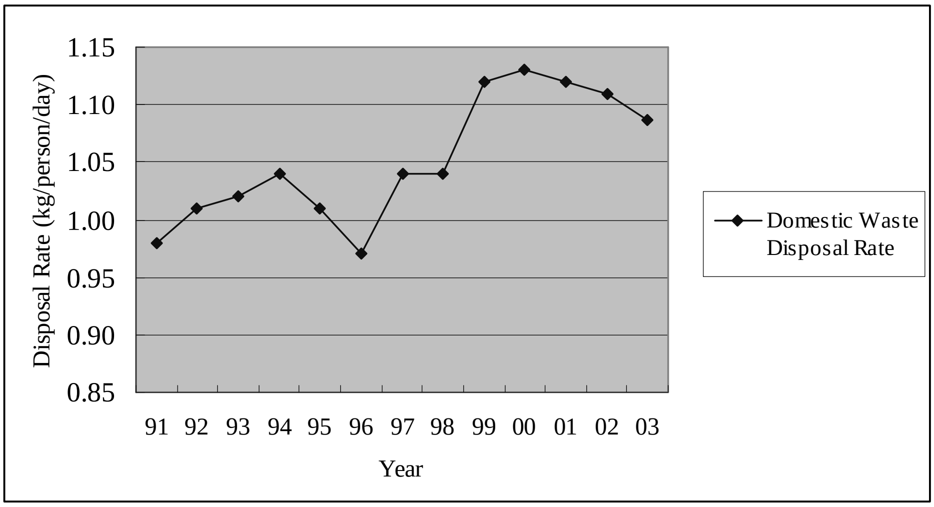
Keywords: Healthy Building, Refuse Collection, Management, Facilities, Residential

1. Background

After recent outbreak of the atypical pneumonia, known as SARS in Asia in 2003, the public concern about protecting human health and preserving the quality of their living environment had been aroused. As refuse collection facilities are widely recognized as hotbeds of bacteria cultivation, it is worth to examine the relationship between the refuse collection facilities and their impact of the health of the residents, and recommend some ways to improve the refuse collection management in order to provide a pleasant and hygienic environment for the residents. Nevertheless, little in-depth studies are carried out to investigate this issue. This paper present the findings of a study carried out in Hong Kong which compared the popular traditional refuse collection systems and the more advanced automatic refuse collection system, identified the social acceptability and financial viability of those systems, and developed guiding solutions for refuse collection management.

1.1 Overview

Everyday, thousand tonnes of refuse from residences (known as domestic wastes) are generated in Hong Kong [3]. Figure 1 has shown the disposal rates of domestic waste per capita in 1991-2003. Obviously, such huge amount of refuse not only affects the living environment of the citizens but also impose health risks on them and the cleansing workers. Numbers of previous researches indicated that health hazard would be generated from the process of refuse collection [6, 7, 10, 12]. Sigsgaard (1994) also reported that Danish refuse collectors were prone to suffer from allergies, infections and respiratory problems. In order to minimize nuisance and health risk to the cleansing workers, the residents and their living environment induced by huge amount of domestic wastes, refuse should be disposed of properly [8].



Source: Environmental Protection Department (2004a)

Figure 1: Per capita disposal rates of domestic waste in 1991-2003

2. Conventional Refuse Collection Systems VS Automated Refuse Collection System

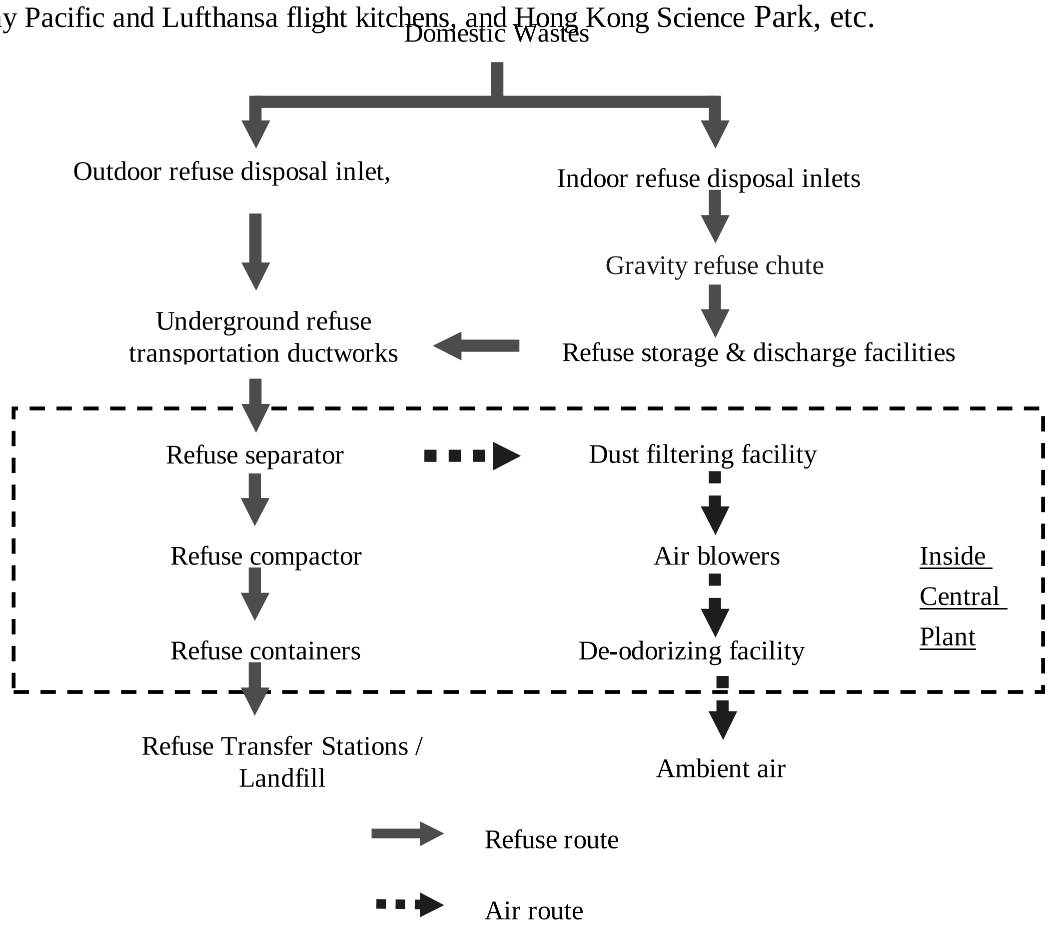
2.1 Conventional Refuse Collection Systems

Conventional Refuse Collection Systems (CRCS) are traditional refuse collection methods commonly adopted in Hong Kong throughout the years. There are two types of CRCS: one with refuse chute and the other without. For the residential developments with the provision of refuse chutes, the occupants either dump their refuse directly to refuse chute or dispose the refuse at designated areas on each floor. The cleansing contractors then collect their refuse to refuse room on each floor and dumped the wastes to the refuse chute through indoor refuse disposal inlets. The refuse collection bin under the chute would store the refuse temporarily. The cleansing workers transport the refuse collection bins inside the refuse chambers located at G/F of different blocks manually to the central refuse collection point where Food and Environmental Hygiene Department (FEHD) collects refuse daily at predetermined time. For the buildings without refuse chute provision, the residents dispose their refuse at specified locations on each floor. The cleansing workers collect the refuse and package them into larger plastic bags or place them into the collection bins. Then, the bags or the bins will be conveyed to the ground floor by passenger or goods lifts.

2.2 Automated Refuse Collection System

Automated Refuse Collection System (ARCS) is a more advanced type of refuse collection system. It is controlled by centralized and computerized programs [5]. The refuse dumped through indoor refuse disposal inlets on different floors to the refuse chute or outdoor refuse disposal inlets is temporarily stored in refuse storage facilities. The sensors will be triggered once the storage facilities are full and refuse released from the refuse discharge valves will then be transported to the central plant room through underground ductworks by suction of air. The refuse enters into the cyclone type refuse separator which separates the air and refuse for further treatment. The exhaust air is discharged to ambient air after treatment by de-odorizing facilities like carbon filter or chemical scrubber while the refuse is compacted and stored in a refuse container ready for disposal (Figure 2).

ARCS is not a new device for refuse collection in Hong Kong property market. In mid-1990s, the Hong Kong Housing Authority (HKHA) had implemented two ARCS pilot schemes at Wah Sum Estate and King Shing Court and at Shek Yam East Estate respectively. As this system was subjected to positive comments and had enhanced the living environment at that time, HKHA had approved the adoption of ARCS as a standard provision for future public housing estates and Home Ownership Scheme (HOS) courts to enhance their sanitary and environmental conditions since 1998 [4]. Besides, this system was also adopted in several private commercial projects in Hong Kong. For examples, ARCS are installed in Hong Kong & Shanghai Bank Headquarters, Cathay Pacific and Lufthansa flight kitchens, and Hong Kong Science Park, etc.



Source: Hong Kong Housing Authority (2003)

Figure 2: R*outing of refuse and air in ARCS*

2.3 Comparison between Two Refuse Collection Methods

2.3.1 Characteristic of CRCS

(1) Low installation, operation and maintenance costs as it does not involve mechanical devices and construction of central plant and underground refuse conveying ductwork.

(2) Nuisances such as spills and odor would be generated probably during movement of refuse from each floor to the central collection point and loading of refuse from the refuse collection bins to the refuse collection vehicles that may pose health risk on the cleansing workers and the residents nearby.

(3) Bags containing refuse dumped into the refuse chute may break before reaching the refuse collection bin underneath or the refuse may throw everywhere in the refuse chamber when total amount of refuse is far beyond the holding capacity of the bin. Thus, the bin or the refuse chamber will be smeared with dirt and sanitary or hygienic problems are resulted.

2.3.2 Characteristic of ARCS

(1) ARCS is perceived as a more healthy operation for refuse treatment as the chances of emission of unpleasant smell and spill of refuse are significantly reduced when the refuse is transported in concealed ductworks and stored in containers for disposal.

(2) Total numbers of cleansing workers required under ARCS for conveying refuse from refuse chambers on G/F of each block to central collection point and loading the refuse to the refuse collection vehicle can be greatly reduced.

(3) Movement of noisy refuse collection vehicles and unpleasant odour generated from the refuse collection bins and vehicles can be eliminated. Hence, the overall image and appearance of our society can be improved.

(4) To connect all refuse chutes from different blocks to the central plant room, extensive underground conveying ductworks have to be provided, which pose difficulties in arrangement of the routings of various types of utility services.

(5) More underground spaces are required for accommodating refuse transportation piping.

(6) Provisions of underground refuse transportation pipe works and the central plant have increased the installation and maintenance costs. The Hong Kong Housing Authority revealed that the installation cost of ARCS is 10 times more than the initial cost of the conventional method.

(7) As the refuse is transported inside the ductworks by suction, and the refuse and exhaust air are treated by mechanical means, high running cost and energy consumption are expected.

(8) The chance of system breakdown due to mechanical failure is high that may affect normal refuse collection. Once the system fails, refuse should be handled manually and nuisance would be created.

Table 1: Results of comparison between characteristics of two systems

	CRCS	ARCS
Cost - ***Installation*** - ***Maintenance & Operation***	Low	High
Spatial Requirement	Moderate	Large (mainly U/G spaces)
Health Risk	High	Low
Nuisance Generated	Probably	Not probably
Labour Required	Intensive	Not intensive
Chance of System Breakdown	Low	High

3. Discussion

Although the comparison supports that ARCS prevails over the traditional method as it improves the living environment of the residents [11] and benefits the society as a whole, its popularity in Hong Kong residential development is still low comparative to CRCS. The major obstruction is due to high initial and running cost of ARCS (Table 2). As mentioned by the Hong Kong Housing Authority, the installation cost of ARCS is 10 times more than the initial cost of the conventional methods. Owing to the financial consideration, the Hong Kong Housing Authority has ceased to install ARCS in public estates recently.

Table 2: Installation, operation and maintenance costs for ARCS

	Installation Cost* **(per flat)**	**Operation & Maintenance Cost*** **(per flat per month)**
Hong Kong Housing Authority	$5,000	$30
ARCS Installer	--	$24
ARCS Supplier	$5,000	$25
Average Cost	**<u>$5,000</u>**	**<u>$26</u>**

* Costs obtained from projects of three parties with more than 3,000 flat units in a single development

Private sector also advised that it was not cost effective to install ARCS in private residential developments especially those in smaller scale after carrying out cost-benefit studies. The installation cost of ARCS could only be justified if there was sufficient numbers of flats in a development, and the operation and maintenance costs could also be reduced when there were certain amounts of residents to share the costs. However, most of the private residential developments nowadays are in small or middle scale; therefore, the installation cost per unit is much higher for private development. The developers have lower incentive to invest in ARCS and they give up this option for refuse management and adopt a cheaper acceptable alternative i.e. CRCS instead.

Apart from the installation cost, high operation and maintenance cost is also a reason making ARCS less attractive. ARCS is an automatic refuse collection device without heavily rely on people to dispose the refuse. It is supposed that the savings in labour cost can partially cover the additional operation and maintenance costs induced by ARCS. Nevertheless, the labour cost for handling refuse could not be reduced after using ARCS. The property management staff pointed out that self disposal was not preferable in Hong Kong especially in public housing estates because some residents would dispose substances that may damage the refuse chutes or cause fire accidents. Thus, cleansing workers were required to be employed to dump the refuse to the chutes for the occupants, and total running cost of ARCS including labour cost was still high.

4. Results of Questionnaire Survey

From late May to July 2004, questionnaire surveys to the residents living in public housing estate, sandwich class housing and private residential development were conducted and 651 numbers of questionnaires were returned. Nearly 80% of replies pinpointed that refuse collection methods would affect their health in large extent. Undoubtedly, many residents supported ARCS as they strongly believed that the system could improve their living environment. However, many of them were not willing to pay additional amounts for operating and maintaining the system. The results were summarized in Figure 3 and 4.

About 40% of respondents living in public housing estate believed that ARCS was the best refuse collection system; however, approx. 30% of them are happy to use CRCS (using refuse chutes) if additional amount of fee should be paid for ARCS. For the residents in sandwich class housing estate, 64% of respondents preferred ARCS and approx. 25% of respondent would like to adopt CRCS (using refuse chutes). About 63% of respondents in private residential development preferred ARCS and 32% of respondents preferred to use refuse chutes while 4% of them would like to use lifts to convey their refuse. The questionnaire survey perceived that the residents generally supported ARCS even though they were living in various types of housings. They believed that this system could minimize the nuisances generated by manual handling of refuse, eliminate negative health impacts on residents and cleansing workers, and enhance overall hygienic and sanitary conditions of their estates.

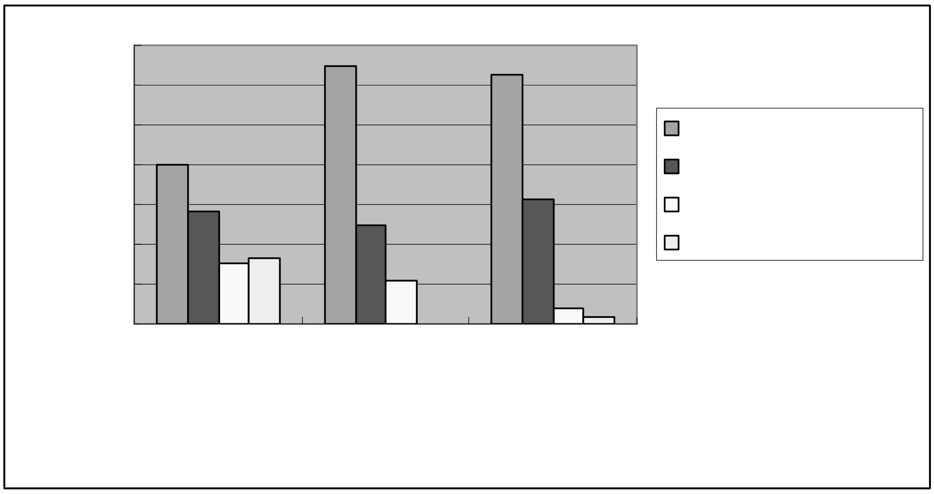


Figure 3: Residents' preference towards the refuse collection systems

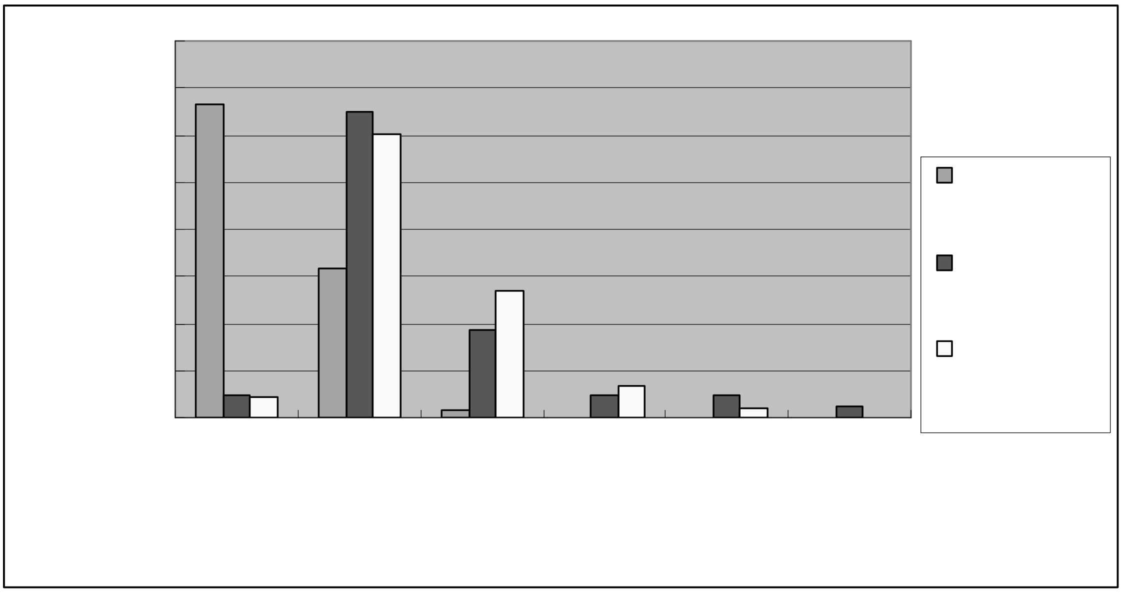


Figure 4: Willingness to pay for supporting ARCS

Nevertheless, majority of the respondents living in public housing estate would NOT like to pay additional amount to support the normal operation of ARCS. Some of them claimed that the Hong Kong Government was responsible to provide a healthy living environment for them and therefore, government should pay for installation, operation and maintenance of the system. If they had to share part of the cost of ARCS, they would prefer conventional system. That explained why there was significant amount (about 44%) of respondents selected conventional refuse collection system in the survey. For the respondents who were living in sandwich class housings and private residential buildings, most of them were willing to bear the cost for operating and maintaining ARCS; however, they only accepted a maximum increase of less than 5% in monthly management fee. With reference to the figure in Table.2, the average operation and maintenance cost per flat per month was about $26 only which could probably be covered by the maximum amount (i.e. 5% of existing amount of monthly management fee or rent) the residents were willing to pay. Hence, the developers have to justify the financial viability of the installation of ARCS solely before selection of the most suitable refuse collection method in their property development.

5. Recommendations

5.1 Importance of Proper Management

As afore said, the popularity of ARCS is low due to its high installation cost even though it is widely recognized that this system can enhance the environment when dealing with refuse. The developers cannot justify the cost to install this advanced refuse collection system and they prefer to adopt traditional system at this moment. To cope with the problems induced by the conventional refuse collection system, proper management of these facilities can help a lot. The nuisances can be minimized through proper building management by frequent cleaning of refuse rooms and chambers; replacement of refuse collection bin before reaching its holding capacity; using refuse collection bins with larger capacity; advance planning of the refuse transportation route in order to minimize the movement of bins and refuse collection vehicles in the estate, etc. In addition, self disposal can be promoted through property management to reduce the workload and health risk imposed on the cleansing workers as they are not required to expose to the refuse removing from the bin to the chute. In order to facilitate the owners or tenants to dispose the refuse through indoor refuse disposal inlets, contactless devices such as infra-red sensor and voice recognition device for opening them can also be installed to avoid disease transmission and possible contamination by direct contact.

Waste separation can also be promoted to reduce the total amount of household wastes generated in an estate. Through proper education by property management staff, most residents would discard general household rubbish directly into refuse chute and put recycled materials like paper, aluminum cans and plastic bottles in designated areas inside the refuse room. The cleansing contractors would collect the recycled materials and dispose other wastes at the bottom of the chutes for them. After implementation of the recycling scheme, it is believed that the cleansing contractors can earn more on top of their basic monthly salaries by selling recycled wastes. With incentives, the cleansing contractors are willing to take up the responsibility to collect those wastes. In this way, both cleansing workers and residents are benefited as the hygienic conditions are sustained and even improved when adopting conventional refuse collection system.

5.2 Other suggestions

(1) For those who would like to install ARCS in their developments, it is desirable to install it to serve several residential projects in the same district at the same time in order to spread the initial cost for installation of this system among estates. Each resident can also bear a smaller amount in operating and maintaining it.

(2) To minimize the risk of infection, refuse collectors should take injections regularly, such as tetanus shots and hepatitis B vaccine. They should wear protective gear like goggles, nose-and-mouth masks and heavy masks. They should also use clean water and towel to scrub themselves during breaks or after works [12]

(3) In-depth study on the impact of refuse collection methods on health and cost-benefit study should be carried out before drawing conclusion on promotion or adoption of ARCS. If it is scientifically proved that ARCS systems are the only way to solve the health problem imposed by the conventional refuse management system, ARCS systems should become essential installations even though their initial cost may be high.

6. Conclusions

The questionnaire survey pinpointed that many Hong Kong citizens concerned about their health and living conditions. As the residents believed that refuse treatment was one of the major factors affecting their health, they would support or prefer a refuse collection system that could treat the refuse in a more hygienic way i.e. ARCS. Nevertheless, they would not like to pay more money to support the operation of the system. Besides, there were other obstructions for promotion of this system. The developers found difficulties in determining break even point and could not justify the cost to install this system. Hence, the publicity of this system is low nowadays. It seems that the local practitioners and researchers still have a long way to go before having a technically feasible, economically viable and high efficiency proposal on refuse collection. This study provides an insight that good building management could address nuisance problems induced by refuse collection system. To enhance the living environment of the residents, more resources should be put on the management of existing refuse collection facilities.

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Section VI

Innovation and development in facilities management

The Nature of Innovation Climate in Facilities Management

Paula Cardellino,
The University of Reading, Reading, UK, (email: p.cardellino@reading.ac.uk)
Edward F. Finch,
The University of Reading, Reading, UK (email: e.f.finch@rdg.ac.uk)

Abstract

Despite the abundance of research on innovation in organisations, very little is known about service innovation as opposed to product innovation. Novel developments in customer care, front-of-house FM and new ways of working share parallels with service innovations in other sectors where a change of process has profound effects. More specifically, little is known about the FM environment most likely to stimulate service innovation. This paper attempts to describe the emerging concept of 'innovation climate' and proposes using a measurement instrument to measure this phenomenon. The approach will enable characterisation of FM organisations in terms of their predisposal to innovate within the prevailing climate.

Keywords: Innovation climate, service innovation, innovation process

1. Background

This paper describes an ongoing study funded by the ICRC (Innovative Construction Research Centre) involving the participation of organisations in the Thames Valley region of the UK. An innovation network (BIFM Thames Valley FM Innovation Network) of around fifteen companies has provided a practical vehicle for the comparison of how FM teams in organisations engage in innovation. The Thames Valley is often described as the 'silicon valley' of the UK with a high preponderance of hi-tech organisations, although the network itself involves other client organisations including building societies, banks and service providers. Rather than simply providing a place for exchanging good ideas, the network sought to ask more fundamental questions about innovation in their organisations. What are the characteristics of a good FM innovation? What are the influencing factors that enable innovation? To answer these questions required a fundamental look at how FM individuals and teams function. Many of the organisations in the network were involved in radical and challenging innovations that often pushed the boundaries of FM activities. What were the features of these organisations that enabled them to achieve this?

2. Innovation in services

A number of recent research papers examining the nature of *service innovation* have highlighted the feasibility of testing such innovations in a scientific and controlled manner. Innovation in services has “emerged from Cinderella status, from being neglected and marginal, to achieving wide recognition as being worthy of serious study” (Miles, 2000). The perception of services as non-innovative activities has progressed to a widespread view that innovation can play a major role. This has resulted in increasing attention being paid to service innovations (Evangelista, 2000; Miles, 2000; Drejer, 2004; Tether, 2004) . The “laggard” classification of the service sector as being solely subject to client “pull” (Howells, 2000) has given way to a much more positive view of the sector in which a huge variety of complex and innovative activities go on (Hertog, 2000; Uchupalanan, 2000; Tether, 2003; Thomke, 2003; Vermeulen, 2004). Some authors have even gone so far as to suggest a unifying of approaches to innovation between the manufacturing and the service sector.

In Thomke’s study, Bank of America has applied the discipline of formal R&D processes to services. They have been running a series of formal experiments seeking to create new service concepts for retail banking. The company has turned a set of their branches into “laboratories” where research teams conduct live experiments during regular business hours. The results of these experiments are compared to those in normal branches, pinpointing attractive innovations for broader rollout. In this case, innovation in services, and services innovation is understood in broader terms, being extended to non-technological innovation.(Hipp, *et al.*, 2000).

3. Process of Innovation

In order to analyse innovation in a meaningful way, it is necessary to distinguish between the numerous stages, each of which have their own time-spans, resource requirements and decision approaches. There are several models in the literature suggesting the sequences of events in the evolution of an innovation (Wilson, 1966; Hage, *et al.*, 1970; Harvey, *et al.*, 1970; Zaltman, *et al.*, 1973; Kimberly, 1981; Rogers, 1983; Tidd, *et al.*, 1997; Van-de-Ven, *et al.*, 1999). As Edison realized, ‘innovation is more than simply coming up with a good idea; it is the process of growing them into practical use’ (Tidd, *et al.*, 1997). Rogers (Rogers, 2003), a leading researcher in innovation processes, proposed a model that consisted of a sequence of five stages (Table 1); the first two of which are concerned with the *initiation* and the latter three with the *implementation*.

Table 1: Roger's (2003) Stages of Innovation

Stage 1. Agenda setting	Initiation (Information Gathering)
Stage 2. Matching	
Adopt or Reject Decision	
Stage 3. Redefining/restructuring	Implementation and diffusion of innovation
Stage 4. Clarifying	
Stage 5. Routinizing	

The first two stages, 'agenda setting' and 'matching' represent the entire information gathering, conceptualizing, and planning effort leading to the adoption of an innovation. The decision to adopt or reject the innovation marks the end of the initiation phase of the model. The last three stages, 'redefining/ restructuring', 'clarifying' and 'routinizing' constitute all of the events, actions, and decisions involved in putting the innovation into use. Rogers does not consider his model to be fixed; the process may occasionally back-track or skip one ore more stages although he suggests "Later stages … cannot be undertaken until earlier stages have been settled, either explicitly or implicitly" (Rogers, 1983).

Field studies demonstrate the difficulties in analysing the process as a linear succession of events. Research led by Van de Ven involved fourteen in-depth case studies of technological innovations in a variety of fields including: industry; education; agriculture; health; and defense (Van-de-Ven, *et al.*, 1999). This study pursued a common theoretical background for the data analysis in the innovation process. Their results showed that ideas develop in different ways, moving from inventions to reinventions. Some ideas are discarded and others are carried one step forwards. In many cases different people are involved in the different stages, adding different perspectives and time horizons to the development of the idea.

At a certain level of abstraction it is possible to see the same basic process common to all of these models. The common elements in the innovation process are: 1) Initiation Period, 2) Development Period, and 3) Implementation / Termination period.

One key and unanswered question that arises from these models is whether the necessary factors for success are the same or different at each stage. More specifically, when looking at the situational context, is it possible to identify an optimal environment for every stage. The study described in this paper will measure the climate of the contributors and stakeholders reflected through the different stages of an innovation. This will enable the comparison between them and analyse what makes some stages "push" for an innovative environment while others hinder this attitude. So, people are to be considered the main actors within "the innovation journey"; they will be responsible for the success and development of the idea. How can we nurture a climate for innovation and creativity in a sector where often good ideas are not recognised?

4. Climate for Creativity

Climate plays a vital role in determining the outlook or likelihood of innovation, creativity, or change taking place in a particular place. The study will focus on the psychological aspects of the work environment commonly referred to as "organisational climate". Organisational climate refers to the recurring patterns of behaviour, attitudes and feelings that characterise the day-to-day life in the organisation as experienced and understood by the individuals. The climate is observable at a surface level within the organisation and it changes in a dynamic way. In this way, it is important to distinguish between organisational climate and culture. The culture refers to a long term characteristic with deeper and enduring values, norms and beliefs of the organisation. The culture is long standing, deeply rooted and usually hard to change.

In the context of the innovation process, organisational climate plays the part of an intervening variable which can affect the results and development of an idea (Figure 1). From our research we wanted to know about the prevailing climates in our case study organizations. From this, it was hoped that we could establish an association between certain climate factors and innovation success in FM.

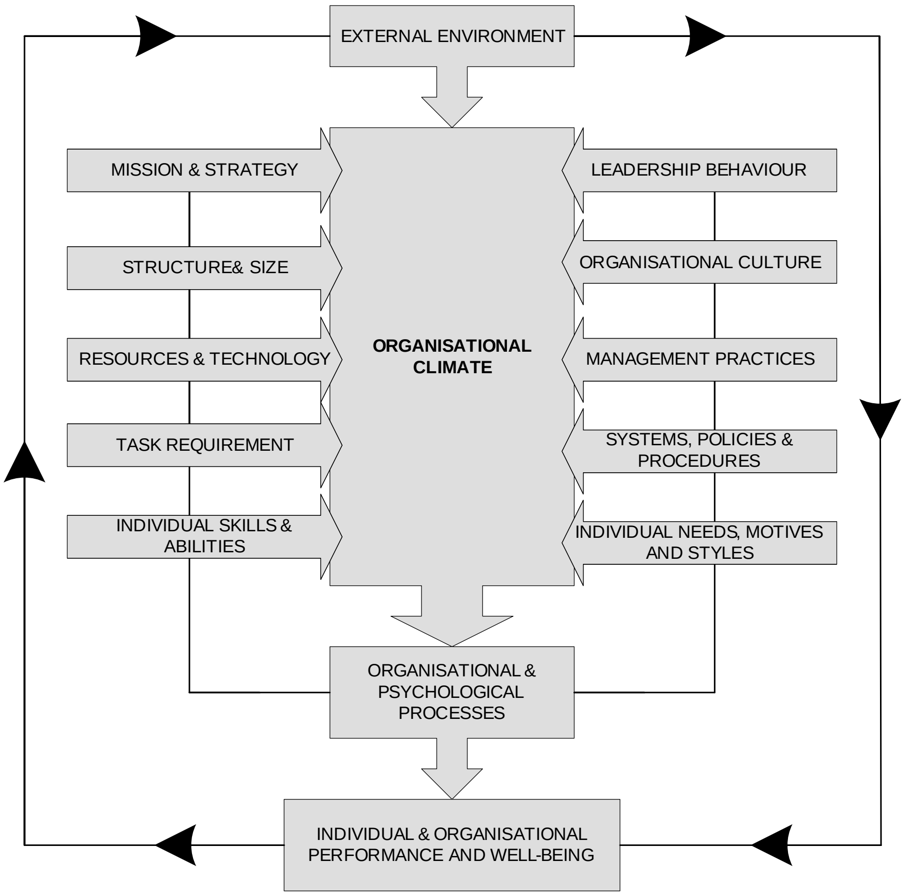

Figure 1 : A Model for Organisational Change (The Creative Problem Solving Group, 2002)

The organisational climate is influenced by many factors within and external to the organisation. The external factors refer to the markets changes, global financial conditions, and legislation that can affect the performance of the organisation. These factors cannot be controlled by the organisation; although it may demand new flexible behaviours within the organisation.

The transformational variables for organisational change are represented by the top four of the model shown above (Figure 1) – that is, 'mission and strategy'; 'leadership behaviour'; 'structure and size' and 'organizational culture'. The mission and strategy define the basic purpose of the business and the way in which it is going to achieve it. Leadership behaviour includes any attitude seeking to transform the organisation. This has been found to have a profound influence on the perception people have of the climate for creativity and change (Ekvall, 1996). Organisational culture represents the roots that provide individuals with a sense of belonging to the organisation. It influences the way people respond to surprise, creativity and change. Structure refers to the way people and functions are arranged. Ekvall (Ekvall, 1996) has shown that the type of structure within departments of an organisation has an impact on employees perceptions of the climate in those departments.

The remaining elements of the model are referred to as transactional variables. They are used to preserve and implement changes taking place in the transformative level of the organisation. For the purposes of our research we applied this model using a standard measurement instrument known as the Situational Outlook Questionnaire.

5. The development of the Measure

The Situational Outlook Questionnaire has been developed looking at people's perceptions of the character of life within a workplace. Its particular focus is on how attitudes, feelings and behaviours support creativity and change. This instrument grew from a research programme in Sweden during the 1980s concerning organisational conditions that stimulate or hamper creativity and innovation (Ekvall, 1996). The questionnaire tool was adopted by the University of Buffalo in the US from the earlier measure developed by Ekvall. As an Industrial psychologist working for Volvo in the 1950's and other large Swedish companies in the 1960's and 70's Ekvall observed differences in how the working atmosphere of different companies affected the degree of participation in idea suggestions schemes.

The Situational Outlook Questionnaire (SOQ) will be used in this study to assess the climate for creativity, innovation and change within the FM sector. This tool enables a better understanding of the perception of the environment in which people work on a day-to-day basis and the impact on their predisposition for creativity and change.

The SOQ consists of fifty questions, with five questions for each of the ten dimensions. Each item is scored from zero to three; zero standing for "not at all applicable" and three for "applicable to a high degree." Thus, results will be reported in a 0 - 3.00 format.

The dimensions of the SOQ include:

- Challenge and Involvement: The emotional involvement of the members of the organisation in its operations and goals. A high challenge climate exists when the people are experiencing joy and meaningfulness in their job, and therefore, they invest much energy. Low challenge means feelings of alienation and indifference; the common sentiment and attitude are apathy and lack of interest for the job and the organization.
- Freedom: The independence in behaviour exerted by the people and tolerated within the organization. In a climate with much of this kind of freedom people are making contacts to give and receive information and discuss problems and alternatives; they plan and take initiatives of different kinds and make decisions. The opposite climate would include people who are passive, rule-fixed, and anxious to stay inside the frames and established boundaries.
- Trust/ Openness: The emotional safety in relationships. When there is a strong level of trust, everyone in the organization dares to put forward ideas and opinions. Initiatives can be taken without fear of reprisals and ridicule in the case of failure. The communication is open and straightforward. Where trust is missing, people are suspicious of each other and take initiative cautiously because of the high price mistakes bring.
- Idea Time: The amount of time people can use for elaborating new ideas. In the high idea time situation, the possibilities exist to discuss and test impulses and fresh suggestions that are not planned or included in the task assignment; and people tend to use these possibilities. In the reverse case, every minute is booked and specified. The time pressure makes thinking outside the instructions and planned routines impossible.
- Playfulness/ Humour: The spontaneity and ease that is displayed. A relaxed atmosphere with jokes and laughter characterizes the organisation that is high in this dimension. The opposite climate is characterized by gravity and seriousness.
- Conflict: The presence of personal and emotional tension in the organisation. When the level of conflict is high, groups and single individuals hate each other. There is gossip and slander present. In the opposite case, people behave in a more mature manner; they have psychological insight and control of their impulses.
- Idea Support: The ways in which new ideas are treated. In the supportive climate, ideas and suggestions are received in an attentive and kind way by managers and co-workers. People listen to each other and encourage initiatives. Possibilities for trying out new ideas are created. The atmosphere is constructive and positive. When idea support is low, the reflexive "no" is prevailing. Every suggestion is immediately refuted by counter-argument. Fault-finding and obstacle-raising are usual styles of responding to ideas.

- Debates: The occurrence of encounters and disagreements between viewpoints, ideas and differing experiences and knowledge. In the debating organisation, many voices are heard and people are keen on putting forward their ideas. Where debates are missing, people follow authoritarian patterns without question.
- Risk-taking: Tolerance of uncertainty and ambiguity evident in the workplace. In the high risk-taking case, decisions and actions are prompt and rapid opportunities are taken. In a risk-avoiding climate there is a cautious, hesitant mentality.

The nine dimensions and three supporting open questions in the questionnaire attempt to describe employee's perception of the atmosphere within the organisation, where higher scores on the nine positive dimensions with a lower score on the negative dimension (conflict) indicate a climate more conducive to creativity.

For FM professionals concerned with the design of the workplace, a surprising feature of the questionnaire is that there is no acknowledgement of the role of the physical environment on innovation. For example, an open plan design may encourage people to be more open about ideas. However, the tool has purposefully been designed with degrees of ambiguity to elicit a variety of views about what we mean regarding 'work environment'. Furthermore, the immediate goal of our research was to examine the broader concept of 'work environment'. However, we hope to develop our analysis in future studies to specifically address the role of the physical workplace in stimulating innovation.

The SOQ tool has been used for over 10 years in organizations around the world having studies (Ekvall, 1987; 1996; Ekvall *et al.*, 1983; Isaksen, *et al.*, 1999) supporting the validity and reliability of the SOQ. It is hoped that the results from the study can be used in a cross-comparison with other professions and other types of organizations drawn from this databank.

6. Methodology

The methodology used in this study measures individuals' perception of the climate dimensions for the three stages in the process of innovation: 1) Initiation Period, 2) Development Period, and 3) Implementation / Termination period. Respondents will complete the SOQ for each of the stages. As an accurate measure of the psychological climate for creativity the SOQ will be sensitive enough to show distinct differences between the three situations.

In this study the SOQ data will enable us to categorise organizations as being creatively innovative, average or stagnated. Since our study will also consider the stages of innovation, it is likely that organizations may exhibit different levels of innovativeness at different stages. In other words, the climate may be more supportive of innovation at the information gathering or implementation stages.

The SOQ is, however, not a direct measure of organizational stagnation or progressiveness. Rather, they act as a barometer gauging the general perception of how these dimensions are perceived within a given climate. The scores on the SOQ are best used as a profile and can help to identify strengths and potential weaknesses within any specific working situation.

The scores in the ‘spider diagram’ below give an example of the variation along the nine climates dimensions for a given organisation (Table 2). People in innovative companies exhibit higher scores for each dimension except for conflict.

Table 2: Comparison of Mean Scores for Three Types of Organisations

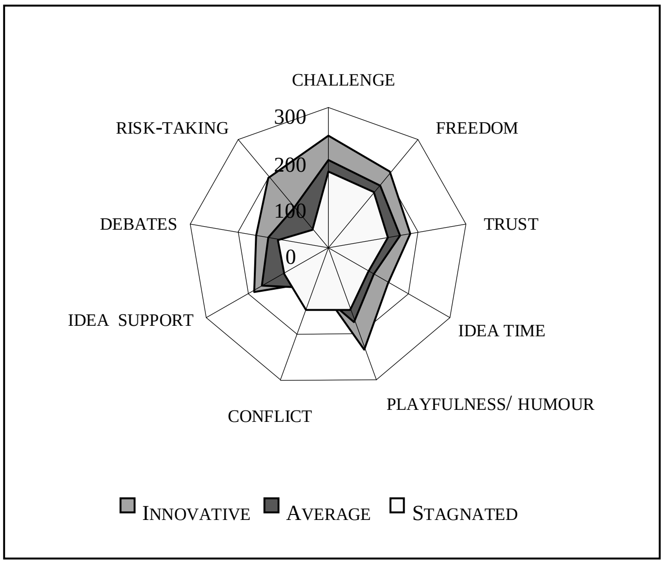

Table 3 Creativity in Stages of Innovation

	INITIATION	**DEVELOPMENT**	**IMPLEMENTATION**
Creatively Productive			
Creatively Average			
Creatively Stagnated			

From these results a comparison between the different stages of the innovation process will be undertaken (Table 3). This will help understand the psychological perception of individuals within an organisation (in this case the FM sector) during the “Innovation Journey”, enabling the development of structures and systems to support organisational innovation in every stage of the process.

Being able to classify the stages of the process (creatively productive, average and stagnated), will benefit the organisation in various levels. On an individual level, the understanding of the climate will make the invisible more visible, prompting individuals to modify the climate within which they work. On a team level, an understanding of the climate will help promote honest communication among the team members. Suitable modification of the innovation climate will promote effective problem solving, enabling a productive group functioning and will shed light on unnoticed strengths upon which the team can build on. This analysis will allow organisations to better structure themselves to enable a more productive workplace; building upon those structures that seem to be working well whilst modifying others (Isaksen *et al.*, 1990).

7. Conclusions

This paper has provided an outline of the proposed study, identifying key unanswered questions for the facilities management community. The fact that FM is a service based industry has tended to marginalize the issue of innovation: a concept which has typically been exclusively associated with manufacture. However, the recent emergence of convincing research on *service innovation* is providing the imperative and analytical tools to further understand this process. The existence of an innovation network provides a unique opportunity to undertake longitudinal studies in innovation. The results from this research will enable the network not just to provide an exchange for good ideas but to acquire a more long-lasting understanding of how to 'do innovation'. From existing research, the evidence points to the fact that good ideas within a bad climate are inclined to fail and seemingly marginal innovations can have a big impact in supportive climates.

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Innovations and transfer processes in building management services. Organizational models, methodologies, procedures and tools

Claudio Molinari,
Department BEST – Polytechnic of Milan, Milan, Italy
Cinzia Talamo,
Department BEST – Polytechnic of Milan, Milan, Italy (email: cinzia.talamo@polimi.it)
Giancarlo Paganin
Department BEST – Polytechnic of Milan, Milan, Italy (email: giancarlo.paganin@polimi.it)

Abstract

The developing market of building management services (e.g. property management or facility management) is now a day characterized by different complexity factors regarding both demand and offer operators. From this situation of complexity some problems arise in managing the services processes and in controlling and assuring quality. At the same time, till now it has not really been developed a specific culture for buildings services, made both of a methodological approach for organizational and operational functions, and of an appropriate system of tools.

On the basis of these considerations, the paper – after a synthetic investigation of complexity factors and their influences and problems on services organization – has the aim to point up a working hypothesis: innovations and improvements for building services can be developed through a process of transfer of methods and tools from different industrial and management fields with an appropriate adaptation to the specific context of building industry. The paper selects and analyses some approaches and their possible applications in buildings management services: first of all it deals with Supply Chain Management, defining different modalities of treatment of this approach inside different building services organization models (aggregation, integration, homogeneous system of services). Besides, about the supply chain management in building services, the paper deals with different actions inside services phases (design, planning, programming, monitoring and verification) and related process supports (procedures, resources and information management systems, tools, check-lists, key performance indicators, audit, etc.). Finally the paper analyses possible applications to building services of customer value approach and knowledge management systems.

Keywords: Buildings services, quality management, supply chain management, knowledge management.

1. The buildings services scenario

1.1 Growing market and complexity factors

In Italy the market of buildings services is constantly growing, as shown by some market analysis and statistical investigations (Table 1). This developing market is now a day characterized by different complexity factors regarding both demand and offer operators, such as:

- the increasing number of specific services regarding different operational areas that should be really integrated in order to pursue effectiveness and efficiency of processes;
- the multiplicity of interacting operators different for skills, know-how and methods due to their origin from different contexts and disciplines (industry, construction, logistic sectors, safety and health, security, economical and financial studies, etc.);
- the difference in organization and contractual models, with problems in defining roles, authorities and responsibilities;
- the large range of functions of buildings and real estate (e.g. residential, health care, industry, etc.), each one dealing with specific requirements for needed services;
- the large number of information regarding the buildings, coming from a multiplicity of sources, that have to be spread between different operators.

Table 1: Scenario of Facility management market in Italy (milions of Euro 2003). From Cresme, Facility management 2003, III Report Market in Italy, Proseg, 2003.

		Real demand					
	Potential demand	**2003**		**2008**		**2012**	
		Min.	**Max**	**Min.**	**Max**	**Min.**	**Max**
Industry	53.472	6.531	9.206	17.218	25.588	27.612	35.334
Retail	18.860	948	1.575	2.829	4.149	6.016	8.262
Hotel-restaurants	5.940	891	1.1.28	1.485	2.198	3.267	4.158
Transportations	7.090	1.1.34	1.347	2.482	3.687	3.889	4.963
Banks, Insurances	15.899	2.385	3.021	5.564	8,267	8.744	11.129
P.A., Schools, sanity,	33.966	5.435	6.793	11.548	19.360	20.379	25.474
Total	**135.227**	**17.324**	**23.070**	**41.126**	**63.249**	**69.917**	**89.320**

1.2 Organization models and services operators

Now a day the scenario of services offer is represented by a large variety of operators - different for dimensions, organizational structures and approaches, origins, financial resources, etc – all active in national – and often also international – market, both in competition and in association, in many possible configurations and in very dynamic manners.

It is possible to summarize as follows the more significant categories of offer operators:

- “great operators”, for instance, operators coming from the industrial Global Service field, firms engaged in utilities management (production and distribution of gas, water, fuel, etc.), firms rising from industrial groups through “spin off”, international firms operating in industrial maintenance and energy areas, real estate consultants, and so on. They are operators very skilled in organizational themes, with significant financial resources and with an easy access to banking establishment, that only now are beginning to deal with buildings characteristics and behaviours;
- construction firms that, inside a general scenario of transformations in construction market (fragmentation of organizations, increase of maintenance and refurbishment demand, new types of contracts, new regulations in public works, etc.), are looking for new business opportunities inside fields in which they can apply their technical knowledge about buildings, their capabilities of relationship with public administrations, their expertises in construction supplier management;
- specialized suppliers of services (such as energy management, cleaning, security, etc ,) that try to profit by their consolidated relationships with their Clients and by their capabilities in designing and managing services, in order to extend their business areas by adding new services;
- very small firms, traditionally occupied in technical works with operational expertises in buildings and equipments maintenance, that now are gathering together in networks in order to collaborate and to act as a “single entity” in service supplying. The aim is to answer in a very flexible and dynamic way to various market requests with different temporary aggregations of services, trying to be more and more adherent to clients requirements. The network may offer activities of design, coordination and control of the assemble of services.

In general the tendency is towards the assembly of many and different services, variable in its configuration, with a single interface for Clients. Clients are changing their tasks: in the past the main tasks were selection and coordination of all the different service suppliers, today the main tasks are the definition of global service requirements, the selection of an unique service provider, the control of service results. Notwithstanding such an evolution, at moment it seems that demand operators, even if quantitatively important, have difficulties in defining the services results in terms of quality requirements (WHAT), and are not still able to drive the ways in which the offer could better organize the services (WHO and HOW).

1.3 A working hypothesis: innovations and improvements through a process of transfer

Considering the actual, complex scenario, it appears that - even if many contributions, expertises, know-how are presents - the real potentialities of this field are not yet completely expressed, since it has not yet be developed a specific culture for buildings services, made both of a methodological approach for organizational and operational functions, and of an appropriate system of tools.

Following this reflection, a working hypothesis can be assumed: innovations and improvements for building services can be developed through a process of transfer of methods and tools from different industrial and management fields with a specific adaptation to the particular context of buildings industry. In particular, considering the above mentioned factors of complexity and the problems of coordination, the attention can be put on some basic aspects and approaches as, for instance: supply chain management, knowledge management, interactions between demand and offer operators.

2. Supply chain management in buildings management services

2.1 Supply chain management approach

"*Supply chain management is a set of approaches utilized to efficiently integrate suppliers, manufactures, warehouse, and stores, so that merchandise is produced and distributed at the right quantities, to the right locations, and at the right time, in order to minimize system wide costs while satisfying service level requirements*" (Simchi-Levi, Kaminski, Simchi-Levi , 2000).

Considering this field of applications, through a process of transfer and adaptation from industry to buildings services, supply chain management can provide interesting contributions in terms of philosophy of approach, network management strategies, coordination modalities, methodologies and tools in the cases of many suppliers working together sharing some basic aims:

- to increase efficiency and effectiveness in complex services processes, where a high level of interactions exists between many decisions makers and operational teams belonging to different organizations, working with different modalities – sometimes synchronically, other times diachronically - on the same object (the building);
- to perform continuity and unique modalities in quality planning and control;
- to deliver a service constantly conform to customer requirements, reducing the period for response to not planned requests and to demand varying over time;
- to recognize and to solve, as soon as possible, possible conflicts between suppliers;
- to share common resources, information and knowledge with the aim of service optimisation.

2.2 Buildings services strategies according to supply chain management approach

Supply chain approach provides some keys useful to interpret actual and potential buildings services strategies. On this basis, at present it is possible to recognize different strategies in the processes and in the procedures that regulate the interaction between services suppliers. In particular, it is possible to identify at least three main strategies that represent different behaviours in supply chain management and that, at the same time, can be considered the steps of a progressive maturation of buildings services organizations, from a “simple addition” of services towards the creation of an organized system:

- *aggregation*. This strategy leads to some essential activities, such as selection of suppliers and control on results. Aggregation is typically the first step in multi-services organization and represent a very simple model of behaviour. It is based upon the definition of requirements for suppliers – and eventually of service delivery guide-lines - on the basis of the criterion coming from the objectives of the service, leaving full organizational and operational autonomy to the different suppliers;
- *integration*. This strategy has the aim to optimise the effectiveness of the processes and the quality of results through the coordination of the different suppliers, that preserve their internal own organization, but share with the supply chain interaction aspects concerning planning and development of activities, information, communication, logistic, etc. This strategy presupposes the individuation of an interface area inside the supply chain; from this area indications of coordination come and are spread to the suppliers that have to adapt their behaviours to needs “of superior order”;
- *homogenizing*. This strategy represents the highest level in suppliers organization and the supply chain can be considered as an original entity. During the service period, the suppliers share not only coordination aspects connected with organizational and operational issues, but also: policies, strategies and goals expressed by the supply chain, collective service such as call centre, sophisticated management methodologies, information systems, purchasing

offices, legal and administrative supports, quality systems and procedures, safety and health management systems, statistical elaborations, data-bases, training and empowerment policies, and so on. Each supplier has to adapt the *modus operandi* to the supply chain directives, taking profit by using high quality services, that couldn't afford if standing alone, and by learning by high level experiences.

The acquisition of one of the different strategies implies that the activities of the supply chain management can cover a wide range of level (from the strategic through the tactical to the operational level), as synthesized in figure 1.

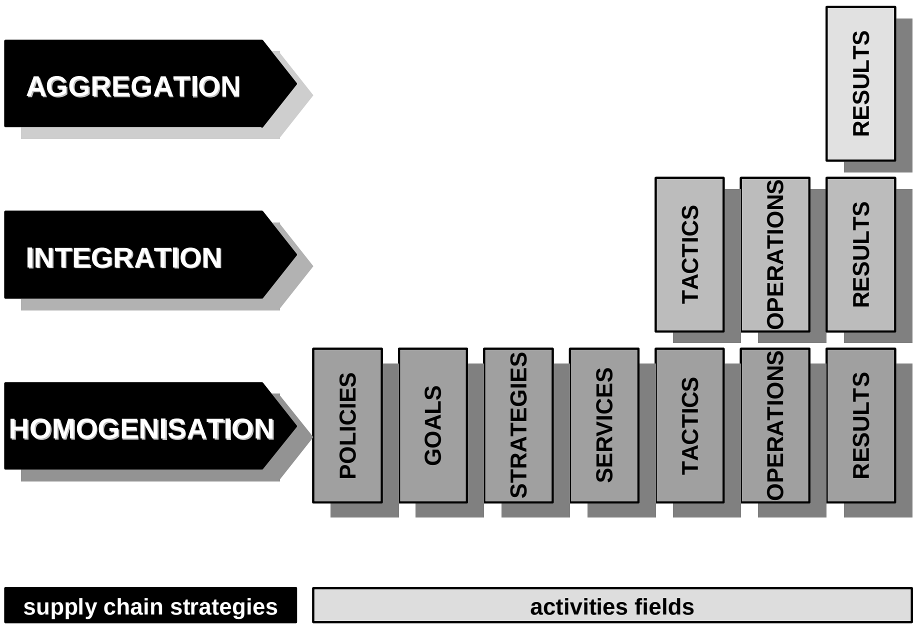
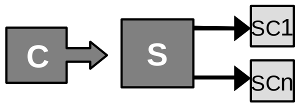
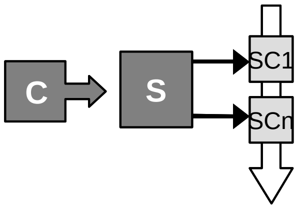
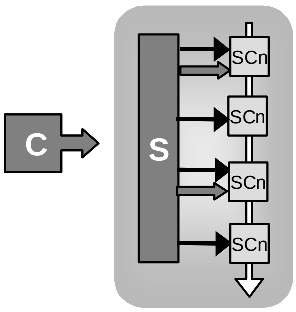
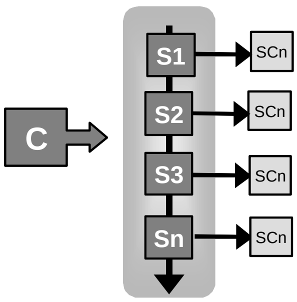
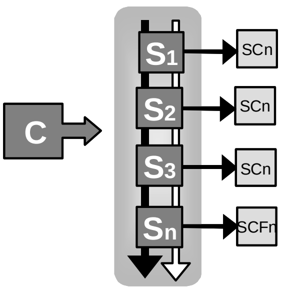


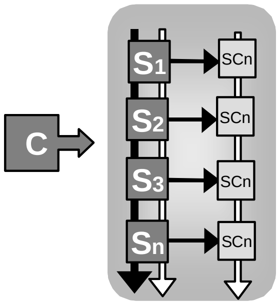
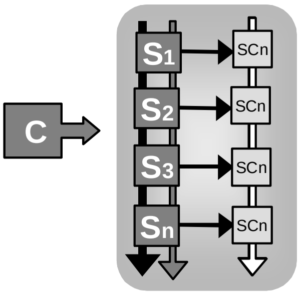
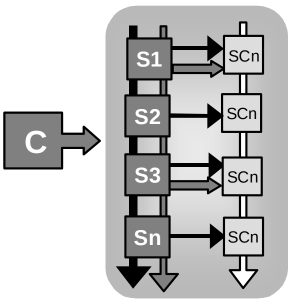
Figure 2: Supply chain strategies and activities fields shared by the services suppliers

2.3 Buildings services models according to supply chain management strategies

According to the above described supply chain strategies, it is possible to define several buildings services models (table 2), representatives of actual behaviours, of relationship with Clients and of modalities of interaction between suppliers.

Table 2: Schemes of the possible models concerning relationships between components of the supply chain

	Models	Description
MODEL 1		*Traditional model of one or several services in which the supplier is the only interlocutor of client. The supplier can select and aggregate sub contractors, that are chosen on the basis of prefixed requirements and controlled on the basis of the results that must be compliant to specifications and contracts.*
MODEL 2		*Evolution on model 1. In this case some aspects regarding coordination between sub-contractors are introduced. These aspects can initially concern operational actions and successively planning activities. It is possible to execute controls not only on final results, but also in process. Sub-contractors operate in autonomy, and may have to modify their plans only in the cases of necessary coordination with other sub-contractors.*
MODEL 3		*Evolution in the relationship Client-single supplier. Here it is the beginning of principles of supply chain management approach. The relationship between supplier and sub-contractors concerns not only the selection, coordination and control, but also involves goals, strategies, tactics. Inside the specific service contract, sub-contractors have to adapt some of their procedures and management methods (Quality systems, safety and health management, information systems, etc.). The links, that can rise, create the conditions for permanent relationships, also for other services contracts, toward the development of more advanced management styles.*
MODEL 4		*Model based on a relationship of the Client with a group of supplier, selected and gathered together in order to satisfy specific service requirements and to be more competitive due to the integration of many expertises and resources. Each supplier, for its competences, can interact with specific sub-contractors, according to the modalities of the previous models.*
MODEL 5		*Evolution of model 4. In this case there is a growing and a consolidation of relationships between suppliers, that are engaged in a permanent action of coordination in order to increase efficiency and effectiveness. This coordination can regard aspects related to planning, communication, information, logistic and criterion for selection and monitoring of sub-contractors.*

MODEL 6		*The evolution of model 5 can lead to actions of extension of general coordination activities to the sub-contractors with effects of increasing efficiency of processes, better quality control actions, general sharing of knowledge and expertises to all the components of supply chain.*
MODEL 7		*Further level of growing of the supply chain management is the realization of an upper structure (the supply chain itself) that represents an entity that can be considered as a single decisional, informative and operational system, where all the suppliers share common policies, strategies, goals, procedure and services. The sharing of these aspect implies for all the supplier the acquisition of innovative management methodologies and tools. The expression of a common policy and goals allows to be much more competitive in the market and to better intercept and satisfy Client needs; besides it gives to the Client the guarantees of coherence and stability, very useful for fidelity and collaborations in relationships.* *Inside this model we can consider that the supply chain can be able to express an "intelligence of system" coming from the interaction between different shared expertises and knowledge of the suppliers, and that processes of auto-learning of the system are possible, amplifying, at level of supply chain, improvements realized at level of single suppliers.*
MODEL 8		*When the model 7 purses in maturation, it is possible to go to further improvements of the global system by involving in the sharing actions also some sub-contractors (for instance, the most significant for dimensions, for characteristics of their mission, for critic functions, for continuity in relationship, and so on).The homogeneous character of the supply chain is extended to lower levels, in order to increase knowledge and circulation of information and expertises, particularly those coming from operative fields. At the same time the sharing of management practices towards sub-contractors improves their competences and their capabilities of interaction with other component of the supply chain.*
Key	C Client S Supplier SC Sub-contractors Supply chain Selection Coordination Sharing	

3. Supply chain management activities and supports

According to the eight proposed models for the supply chain management and on the basis of the key strategies of organization for buildings services (aggregation, integration and homogenisation), it is possible to analyse the different phases of service process (design, planning, delivery, monitoring and control), to underline the characterizing actions (selection, coordination, sharing), and to define main activities and related supports (table 3). In this paper only the most complete situation regarding homogenisation strategy is analysed.

Table 3: Key strategies of organization for buildings services according to supply chain management approach and, for each one, main actions characterising the different stages of a service process

		SERVICE PROCESS STAGES			
STRATEGIES	**ACTIONS**	**DESIGN**	**PLANNING**	**DELIVERY**	**MONITORING AND CONTROL**
aggregation	*selection*				
integration	*selection and coordination*				
homogenizing	*selection, coordination and sharing*				

3.1 Main activities and supports in service design stage according to homogenizing strategy

The main activities and related supports that characterize the design of service performances operating according to a homogenisation strategy regard:

- *design and implementation of the organizational structures*. The supports for this activity can be: organization chart (hierarchical and functional) of the structure; operational structures (call center, purchasing and legal and administrative offices, technical departments, EDP, etc); job description for main roles of the structure; information system;
- *definition of goals, policies, strategies and guide-lines for the management of the service.* The supports for this activity can be: management manuals (technical, administrative, logistic, health and safety, etc.); tools for Customer Relationship Management (CRM); management manual for quality; organizational and operational procedures (for coordination,

communication; interaction with Client, processes control; results control; management of environment, health and safety); procedures for purchasing (sub-contractors selection, structures of the orders, terms of payment, etc.);

- *statement of a knowledge management*. The necessary tools are knowledge management systems;
- *statement of benchmarking processes inside the supply chain.* The supports must be indexes for processes, results and client/customer satisfaction measurement;
- *human resources policies.* It is necessary to adopt training and empowerment procedures and programs;
- *definition of requirement for sub*-contractors selection. It is essential to rely on lists of organizational, economic, technical, logistic requirements. Typically: tools as vendor lists of sub-contractors of previous services and works, and procedures for the quality management of sub-contractors;
- *definition of strategies of customer value.* It ca be useful to collect and analyse previous clients relationships and to operate with case-based knowledge systems.

3.2 Main activities and supports in service planning stage according to homogenizing strategy

The main activities and supports that characterize the planning of service deal with:

- *briefing between suppliers*. The supports for this activity can be: general scheme of constrains, goals and service standards;
- *coordination of activities of documents and data collection and of physical survey*. It is necessary to adopt a common system of classification and coding for buildings and their parts;
- *implementation of the information system for the service*. It is necessary the assumption of an information system and the related procedures for implementation and use;
- *definition of the general plan for the service.* Supports can be: general scheme of the plan; guide-lines and criterion for the definition of priorities in the execution of interventions; guide-lines and criterion for logistic optimisations;
- *definition of the operational program for the service.* It can be useful to adopt methodologies such as linear and reticular programming techniques; besides it is necessary to point out target start and target completion (constraints in beginning and end of activities);
- *assumption of a common logistic support.* The main supports are: centralized purchasing office, a common warehouse management, a general qualified sub-contractors register;
- *implementation of common scheduling*. It is essential to get a centralized system of management (emission, allocation, closing, report) of the work orders;

- *training of workers.* Training activities ca be sustained by actions of tutoring (learning on the job), by procedures and instruction for the specific tasks and by teaching sessions based on themes closely connected with services jobs.

3.3 Main activities and supports in service delivery stage according to homogenizing strategy

If design and planning phases have been well conducted, if all coordination actions have been stated, and the flow of information, decisions and resources is adequately supported, in the development phase the main activities are merely:

- *management of resources*. The required supports can be: procedures and instructions for procurement and management of materials and services; information system with ERP functions (enterprise resources planning); procedures and instructions for warehouse management;
- *global vision and monitoring of current activities inside different suppliers services, with particular attention for safety aspects.* Useful supports can be coordination procedures for activities at high risk OHS (for instance Lock-out/tag-out, work permit, etc.);
- *work orders emission*. It is necessary to use an information system with functions for management of programmed and not programmed interventions;
- *report of completed works*. It is fundamental an information system with functions for implementation of clinical data sheets (feedback data);
- *continuous upgrading of information about building conditions*. It is necessary the presence of a system of technical, diagnostic and clinical data sheets.

3.4 Main activities and supports in service monitoring and control stage according to homogenizing strategy

It is very important to carry out activities regarding both monitoring and controls during services processes and at the moment of completion of works. The results of the services, the performances of suppliers and of sub-contractors that have been checked, fundamental interactions and communications with Client and between suppliers, and eventual problems, non conformity and corrective actions executed must be registered, analysed, elaborated, collected inside knowledge management systems in order to spread between the supply chain components new experiences and to increase the expertises of the chain.

The principal activities regarding monitoring and control functions are:

- *monitoring of sub-contractors performances*. It is useful to adopt: benchmarking indicators; *work-sheets* and *time-sheets;* procedures for supervision on works advancement and for account control; evaluation sheets for sub-contractors. It is important to record results of monitoring review inside information system;

- *monitoring of suppliers performances*. Possible supports are: process monitoring procedures; recurring audit sessions based on effectiveness indicators and in general on benchmarking indicators; *work-sheets* and *time-sheets;* procedures for supervision on works advancement and for cost accounting. It is important to record results of monitoring review inside information system;
- *monitoring of critical activities advancement* though specific work-sheets and time-sheets and specific monitoring procedures;
- *claim prevention on sub-contractors activities*. It can be useful to adopt special indicators, such as indexes regarding ratio between programmed and not programmed activities.
- *final control of suppliers services*. It is opportune to perform audit sessions based on client's satisfaction objectives. It is important to record results of audit review inside information system.

4. Conclusions

The evolution in building services market is now facing the need for an evolution of the traditional service delivery models. Both on demand side and on offer side the transition is towards the complete integration of different services; consequently the traditional model of service suppliers (mainly coming from the construction industry) needs new approaches in order manage the various complexity factors. The SCM "Supply Chain Management" approach seems to be particularly suitable and appropriate to give contributions for organizational and operational improvements in suppliers behaviours and, in general, for the maturation of an original culture in services field. It is therefore important that researchers and operators could join their efforts and interests about these themes also in order to smooth the progress of transfer and adaptation of principles, methods and tools from the industrial to the building sector.

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Challenging the ‘Uniqueness’ of FM Organisations in the UK

Sezgin Kaya,
Centre for Facilities Management, University of Salford (s.kaya@salford.ac.uk)
Prof. Keith Alexander,
Centre for Facilities Management, University of Salford (k.alexander@salford.ac.uk)

Abstract

FM organisations have long been argued for their being unique entities, like fingerprints... And when relating these organisations to each other, analysts and researchers use market sector based classification systems as the only criteria to group them. This paper is the first series of two papers, and demonstrates that current practice of relating FM organisations to each other in comparative studies has led to unintended results since it overlooks many significant characteristics of the Facilities Management organisations. This paper examines methods used in classification of organisations in general and then suggests a classification system for facilities management organisations.

We suggest in this paper that classification as an end product enables to relate FM organisations to each other in order to understand the similarities and dissimilarities between them. The outcome aims to be useful for those involved in comparative studies in FM organisations.

Keywords: Classification, FM Organisations, Market Sector based Classification

Introduction

In organisational studies, authors [1,2,3,4] argue that unless there is an adequate classification system, there is little guide for both practitioners and academics in understanding the organisations. It is therefore inappropriate to explore if what works in one organisation will work in another, and relate them to each other since there is no basis for knowing if the organisations are of the same type [4].

Yet, there is no classification system for FM organisations. And if we give Bailey the benefit of the doubt, without a classification system and rationale, we risk developing advanced concepts, reasoning, discourse and data analysis for FM organisations.

Bev Nutt [5] stresses the lack of relevancy and relativity in FM field, and estimates that: *“Only 40% of good FM practice can really be relevant to everyone in the world.”* Academic colleagues recognise the diversity and fragmentation in practice [6,7,8,9,10] and they attribute this diversity and fragmentation to the nature of 'client organisation' (henceforth referred as: context organisation) [11,12]. Operated within the context organisation [13], FM responds to specific problems [14,15] and fails to form universal or common conceptualisations. The response of FM to its clients therefore become contextual [16,17,18]. And relating FM organisations to each other hence is merely based on the definition and classification of context organisations, assuming that FM organisations operating in similar contexts behave similarly.

The fundamental of classification is to ascertain the key characteristics on which the classification is based. So the research question we adopted here is: *what are the fundamental characteristics (patterns) of Facilities Management organisations that make them similar or dissimilar*? This paper represents the characteristic variables of FM organisations, and suggest that when measured, they are enough to distinguish one from another.

This paper, at the onset, starts with the negative side effects of the current classification system in the UK, and compares it with both FM literature specifically and then organisational literature in general. It then proposes a framework of a system for classification of the FM organisation.

1.1 Current practice in classification of FM organisations

Relating one organisation to another is mostly practiced in comparative studies, where consultants or academics attempt to compare like with like to deliver to an objective. However, these studies have been heavily criticised because of them being shallow and dysfunctional for organisational needs [19,20].

To better analyse the rationale for the current practice in comparative studies, we conducted a series of 'focused interviews' with both consultants and clients who have previously involved in comparative research studies. We focused our query on the current classification rationale in FM, and asked respondents about the negative side effects of practice, and also their suggestions for developing better classification systems.

All of the interviewees agreed that the current classification rationale rooted in market sector based classification is pragmatic and cost efficient in nature e.g. Standard Industrial Classification (SIC).

The main advantage of classifying according to SIC is: one can explain organisations' response to similar operating environment—such as market sector and its pressures; regulatory influences — and organisations' exposure to those market pressures. However interviews also showed that taken SIC as *the only* matter of classification causes misinterpretation in analysing FM organisations. Interviewees highlighted the following negative side effects of this practice:

a) The current classification rationale only helps the weakest practice to become a standard practice.

b) If not go in-depth, can lead into wrong business decisions.

1.2 Classification in FM Literature

Becker [21] and Davis et al. [22]; Price [23] and Brochner [24]; and Williams [25 and Varcoe [26] have introduced three different sets of classification rationale for Facilities and FM organisations. The pioneers of the idea of classifying FM organisations were G. Davis and F. Becker [21, 22].

First, Davis and his team classified 18 context organisations according to nature of change (low change/high change) and the nature of work (routine/non-routine). To them, FM operates differently in different contexts because of the attempt to fit into the organisational change. Similarly Becker advocated that FM can be categorised according to the context organisation, and his FM typology is based on FM's response to its context.

Relations between FM and the organisational change, and FM organisation's response and responsibility to change became an area of research especially in the 1990s. Several authors [14, 15,21,27,28] emphasised the Facility or FM as a change mechanism to adapt the organisational resources like buildings, systems, processes for the changing conditions.

Secondly, Price [23] proposed a generic classification system that incorporates the relationships between the context organisation and its customers. He sustains Bitner's [29] servicescape[1] idea from her classical work and concludes that there are two dimensions in classifying facilities: complexity of the service provision and the speed of customer feedback. The speed of customer feedback is related to the visibility and the proximity of service delivery to the customers of the context organisation. Brochner [24] further suggests that the duration of service relationship as an indicator for classifying the 'settings'. He exemplifies the difference between a restaurant and a hotel setting, former being a short term interaction and latter a long term.

Thirdly, Williams [25] and Varcoe [26] took a procurement and service provider relations perspective in defining and characterising the patterns in FM organisations and the industry. Williams models Facilities Management organisations in the following categories:

I. Total in-house facilities management
II. Outsourcing as 'Single', 'Bundled' or 'Packaged' Contracts
III. Total facilities outsourcing: management contract
IV. Total facilities outsourcing: managing agent

In addition to these three sets of classification rationale, we added the fourth: personnel's expectations. The influence of personnel on the FM policies and practice are mentioned extensively

[1] In 1992, Bitner defines servicescape as the built environment surrounding the service. However at a later publication in 2000 she feels the need to expand this definition to include social environment. Her recent definition of servicescape is: "immediate physical and social environments surrounding a service experience, transaction or event" (Bitner, M.J. (2000) The Servicescape in (eds) Teresa A. Swartz and Dawn Iacobucci, Handbook of Services Marketing and Management, Sage Publications, Inc., Thousand Oaks, p.37)

in the context of workplace making [30], staff involvement to workplace and FM decisions [27,31,15,21,32,33], usability. The involvement and the positive experience are usually to highlight the importance of managing the personnel's expectations. The better the expectations are managed, the better an FM organisation performs [24,35]. User involvement is primarily considered as means to manage their expectations.

However, these different approaches for managing personnel expectations have not been classified in FM literature. Although authors (those mentioned above) have attempted to classify FM organisations or their practices in their own area of study, there is still no holistic research encompassing these suggested characteristics variables in FM.

These different points of views in FM literature show also the diversity in FM perspectives. Notwithstanding Grimshaw's [10] criticism about the diversity of FM practice, it is also clear that: so does the theory...

1.3 Classification in Organisational Studies

Classification of organisations is not new to the academic fields of organisational behaviour. One could look at the use of Standard Industrial Category (SIC) Codes to see the utility of such classification systems. However, researchers over thirty years developed typologies based on a wider variety of criteria including: size, use of technology, strategies employed, systems utilized, degree of environmental stability, and who benefits. However none of these studies purposively addressed classification of organisations as the main topic. Instead, authors built up their research on these classes and prove or disprove their assumptions as the outcome of their research. It is therefore, of little use for the purposes of this research. However, authors agree on the scrutiny of *organisational structures* as the first step to describe organisations.

Organisational structure, as formal representation of an organisation, gives clues about people, influencing lines [36], decision makers, terminologies, duplicated work orders and tasks and integration and synergies [37,38,39], and even political conflicts [40,41].

2. External Patterns—Out: Relations between FM and its Environment

From both FM and organisational studies literature and the conducted interviews, we concluded that the relations an FM organisation creates are through (a) FM and its environment, and (b) FM and its formal and positional structure in an organisation. Attributes of different objects can be categorised in two groups: External patterns and internal patterns [42]. In other words, one of the relationships is related to internal structure of FM and another to its external environment.

External environment is where the transactions take place. This may include suppliers, clients or customers, and competitors. In addition, there will be more general aspects of the environment which will have important effects, such as legal, technological, cultural and ethical developments. The FM organisation and its external environment are explained here by four patterns: customers, personnel, organisational change and sourcing options.

In describing the significance of the transaction between an organisation and its environment, Pugh [43] states that (p.97):

"All organisations are situated in an environment, be that business, governmental, educational or voluntary service. In this environment are other organisations and peoples with whom transactions take place. These will include suppliers, clients or customers, and competitors. In addition, there will be more general aspects of the environment which will have important effects, such as legal, technological, cultural and ethical developments".

Duncan [44] explains that characteristics of organisational environments are defined by the complexity and the dynamism. To compare, he illustrates that while banking industry operates in dynamic and complex, cardboard box industry operates in static and simple environment.

The external and internal patterns, or characterising variables used in this study are explained further below.

The context organisation is drawn like an amoeboid shape, representing the environment [45] in which FM organisation operates. The environment is defined as the source of inputs for the organisations and is the recipient of organisational outcomes [46.47]. We accepted context organisation as "the environment" for FM organisation.

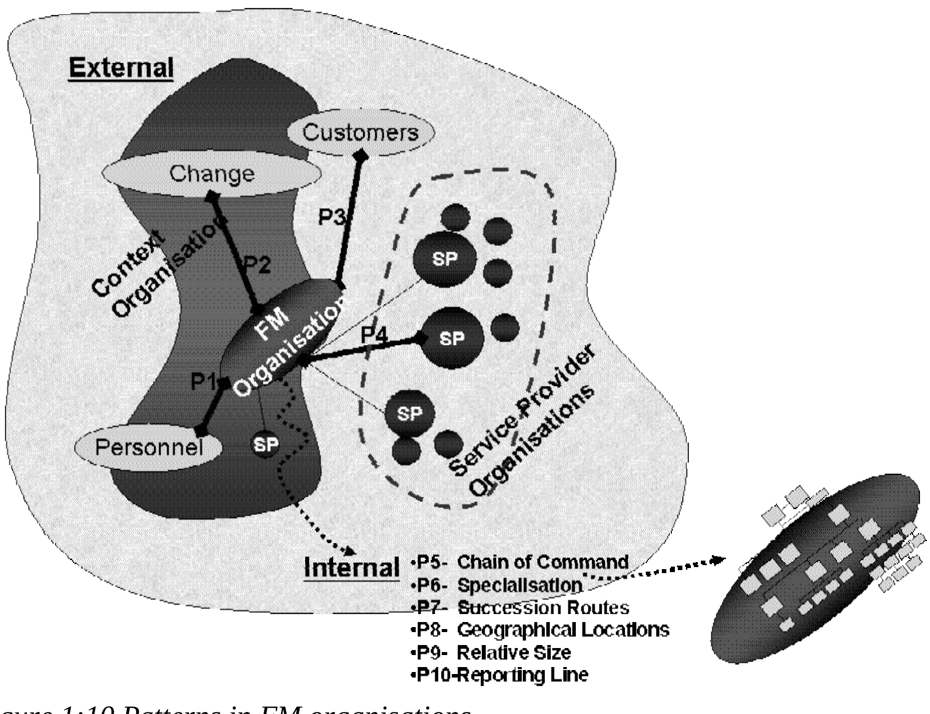

Figure 1:10 Patterns in FM organisations

Proposition 1: The external characteristics of FM organisations depend on its relations to the environment, more specifically to expectations of personnel, organisational change, visibility to customers and procurement options incorporating the service provider organisations.

Pattern 1 (P1): Occupancy profile

The quality of service delivery is driven by the personnel's expectations. Boyer [48] and Felder's [49] studies showed that there is a positive correlation between the occupational status and personnel's expectations from the company. However, this did not become apparent before Lee and Mitchell's study by the end of 1994. Their study discovered that professional background is the most critical parameter for managing the personnel's expectations in pursuit of employee retention [50,51,52].

In classifying the relationships between individuals and the employer organisation, Blau [53] and later Prandy [54] suggested nominal measures such as professional background (referred here as occupational profile) or occupational status as central to any sociological class scheme in organisations. They argue that "employee expectations change according to the professional background, which implies specific formal training and thus substantial homogeneity of background" [55].

This point was also stressed during the interviews. The interviewees stated that the level of quality in service delivery varies significantly according to the 'occupancy profile'. Some business departments are provided with better and higher quality services than the others. For example the building that accommodates CEO's office, is provided with a higher quality service than company's other buildings in its property portfolio.

This summarises the fact that unless the personnel's expectations are met, they might voluntarily leave the organisation, and therefore risk the company's performance [52,53,54].

More recent surveys by Office of Population Censuses and Surveys [55] classified employment and labour characteristics using the 'Standard Occupational Classification' (SOC), which consists of the following major groups:

I. Managers and Senior Officials
II. Professional Occupations
III. Associate Professional and Technical Occupations
IV. Administrative and Secretarial Occupations
V. Skilled Trades Occupations
VI. Personal Service Occupations
VII. Sales and Customer Service Occupations
VIII. Process, Plant and Machine Operatives
IX. Elementary Occupations

We used the SOC to identify the level of personnel expectations; i.e. the higher the rank in SOC, the higher the expectation. The distinction in rank also identifies the different patterns of expectations. To illustrate, out of the nine classes of SOC, the No.1, managers, executives are the professions with the highest expectations, and the occupations like elementary construction, agricultural, process plant occupations, come with the lowest expectations.

Pattern 2 (P2): Organisational change

Organisational change refers to forms of adapting the context organisation to its external environment and its requirements. Kaya and Williams' [57] previous study shows that there is a direct correlation between a company's churn rate and the speed of organisational change. Their findings substantiated Gladwin [58], Eley and Marmot [59] and FMA's [60] suggestions that the churn rate is an important indicator of change and dynamism in organisations.

However the churn rate should be monitored continuously. Gilleard and Yat-lung [19] criticise that comparative studies fail to address dynamic change by the use of static imperatives like churn rate. A snapshot assessment may give misleading results if the company goes to a business change during the period of evaluation. Kaya and Alexander [61] suggested some three to five years record of churn rate in referring to organisational change and its impact on the workplaces.

Pattern 3 (P3): Visibility to Customers[2]

Pattern 3 follows Price [23] and Brochner's [24] emphasis on the impact of physical setting and services (serviscapes) to customers' purchase intentions. We therefore suggest speed of customer feedback and duration of service relationship as two parameters for classifying facilities with respect to their visibility to customers.

The closer facilities services to the customers, the more visible they are, and therefore the faster the customer feedback. The longer the duration of service relationship, the more visible the services. In our analysis, we scored both the speed of feedback and the duration of services for the 22 surveyed organisations.

Pattern 4 (P4): Procurement Options

Pattern 4 follows Williams' [25] four types of procurement options as the indicator of structural relationships between FM and the service providers. We have earlier discussed that sourcing model and procurement options are the characteristics of the relationship between supply and demand.

The four external patterns dissolving relationships between FM and its environment, and the associated variables and attributes are summarised in the following table:

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[2] Customers are those the organisation is getting the benefit from. They are the raison d'etre for the organisation. The reader should be acknowledged that Drucker's (1954, p. 37), statement that the purpose of a firm was to create and keep customers – for "it is the customer who determines what a business is"

	Patterns	Variable	Independent Variables (IV)	Attributes
R1	Relations between FM and personnel Expectations of personnel from FM	Occupational status (Occupational profile)	See 9 categories above	Expectation score
R2	Relations between FM and organisational change	Workplace change	Churn Rate	% Percentage of the last 3 years
R3	Relations between FM and customers of context organisation	Visibility of FM services	Speed of customer feedback Duration of service relationship in the servicescape	Visibility Score
R4	Relations between FM and service providers	Procurement options	See 4 categories above	1-2-3-4

3. Internal Patterns—In: Formal Analysis of FM Organisations

FM organisations are no different than any other organisations. They have organisational structures, internal relationships and an organisational architecture. The formal representation of an organisation often takes the form of an organisational structure, where the relationships are represented.

Proposition 2: If FM organisations are not different than any other organisations, then organisational variables, such as hierarchy, specialisation, succession routes, geographical dispersion, size and reporting line should be the six internal patterns that define the formal analysis of an organisation.

These six dimensions are considered as the six patterns of an FM organisation with respect to its internal structure.

	Pattern	Variable	Independent Variables (IV)	Attribute
R5	Chain of Command	Organisational Structures	Hierarchy	# of levels between Head of FM and the Board member
R6	Specialisation	Organisational Structures	Span of Control	Max number of subordinates FM managers have management responsibilities
R7	Succession Routes	Organisational Structures	Reporting Director's span of control	# of positions represented for promotion to reporting director of FM. The higher the positions, the less succession opportunity
R8	Geographical Dispersion	Organisational Structures	Regions, states of countries FM has responsibilities	# of regions / states / countries
R9	Size	Size of FM Size of Context Organisation	Relative Size of FM	In-house FM staff per personnel
P10	Reporting Line	Organisational structures	The position or function to where FM is reporting to	1- Board 2- Property 3- HR 4- Operational Director 5- Finance Director

Pattern 5 (P5): Chain of Command

This refers to the unbroken line of authority that extends from the top of the organisation to the bottom. It can be measured by counting the number of levels in a typical organisational structure. It is one of the key characteristics to define and organisation. When people are talking about the hierarchy, tall structure, flat organisation they usually refer to gain of command in organisational structures.

In FM organisations the hierarchy can be measured by counting the number of lines that extends from the bottom of the FM up to the Board member.

Pattern 6 (P6): Specialisation

Child [62] emphasises that specialisation deals with the number of jobs broken down into narrow areas of work and responsibility so as to secure the benefits of specialisation. Specialisation is widely used in organisational analysis to refer to the dissemination of responsibilities according to the specific areas of expertise.

For the FM organisations surveyed in this Thesis, the focus is on the degree of specialisation; i.e how specialised are the FM organisations. This can be understood from the organisational charts by reading the maximum number of subordinates reporting to a direct line.

Pattern 7 (P7): Succession Routes under Reporting Line

It is a structural issue if the jobs and tasks should be grouped according to functions or product or service type. Succession route shows the ways of promoting vertically.

In FM organisations, the succession route is the flow in the organisational structure that leads into the reporting line. It is therefore if the Reporting Director's span of control is limited to three, then succession route is limited to three too because an FM emploee progressing his carreer in FM can be pushed upwards in the organisational ladder up to the reporting line.

Pattern 8 (P8): Geographical Dispersion

Organisations operating in different regions, countries locations also represent this geographical diversity in their management concerns. For example they represent regional managers dedicated for a specific region and structure the regional organisation accordingly. While in some cases this might give some autonomy, in some cases this is nothing but unnecessary fragmentation of business.

FM is no different to any other organisation, and in a diverse property portfolio it might structure itself in respect to the number of geographical locations that business operates.

Pattern 9 (P9): Relative Size

Size of the organisation [53,63,64,65] is one of the most important aspects of an organisation [66]. Blau [53] incorporated this relationship as one of the two major basic generalisations in his formal theory of organisations.

However, rather than referring to size of the FM organisation only, in this research we suggested to use 'relative size', since it reflects the weight of FM in the organisation. Relative size refers to size of FM and the context organisation. For instance, an FM organisation with 15 FM full time employees (FTE) responsible for 10,000 occupants is different than an FM organisation responsible for the same number of occupants with lesser FTE's. This is formulated as:

$$\text{No}= \frac{\textbf{Normalised } [\sum \textbf{ personnel}]}{\textbf{Normalised } [\sum \textbf{ FM employees}]}$$

This fraction is another attribute to understand what proportion of the population FM represents in the organisation (FM's catchment population).

These nine patterns suggested here are the characterising variables for FM organisations, each of which is associated with independent variables. When these patterns merge and come together, they can classify the organisations at a multi-dimensional space. This is explained further down.

Pattern 10 (P10): Reporting Line

Positional power in organisations plays a vital role in decision making. Although there are other kinds of power, the reporting line best represents the positional power amongst them. Relating the organisational literature to FM, authority and reporting line are both related to positional power; such that one step higher level of management to Head of FM is an indicator of decision authority in terms of positional power. This Thesis has only analysed the positional power as means to the reporting line of FM organisations.

To identify the patterns in reporting lines the author has asked the UK's six national service providers to list the variety in their client's reporting lines [67]. Five common reporting lines are identified in the UK, these are: Board, Property Director, HR Director, Operational Director and Finance Director

Depending on the reporting line, the policies, strategies and processes of FM organisation can change. It is therefore considered in this Thesis as another dimension that characterises the FM Organisations.

4. Conclusions

This paper demonstrated the characteristic variables, called here as patterns of FM organisations that make one client side FM organisation dissimilar or similar to another. These patterns differentiate the way in which the FM organisations are formed for their goal attainment.

Four of these patterns are related to the external environment of an FM organisation. These are expectations of personnel, organisational change, visibility to customers and procurement options. And six of them are related to the internal structure of an FM organisation. These are: chain of command, specialisation, succession routes, geographical dispersion, size and reporting line.

This paper prepares the background for further studies in classifying FM organisations to relate and understand them in relation to their similarities and dissimilarities. When the measures of these 10 patterns are close, it means that they are similar to each other. The successor for this paper is the illustration of this empirical study in an application to define and identify the FM organisations.

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Mapping distributed knowledge to assess quality of complex urban environments

Luiz Bautzer,
CSTB Centre Scientifique et Technique du Bâtiment – France (luiz.bautzer@cstb.fr)

Abstract

Municipal institutions and social housing corporations struggle to establish a efficient joint facilities management processes within economically and socially fragile urban areas. The key problem is establishing common understandings of constrained social situations. Through a concrete example, we explain the role of representation devices in bringing together knowledge about, on the one hand, day-to-day, facilities management and on the other hand, public management stakes concerning social housing. We finally present a dashboard that facilitates organisations in their efforts to measure their collaborative capabilities in achieving facilities management excellence in constrained urban areas.

Keywords: quality assessment, cross-boundary collaboration, urban regeneration, New Public Management

1. Purpose of the paper

Optimizing Facilities Management (FM) in public housing estates depends on the capability to articulate two apparently contradictory trends.

- ***minimizing coordination costs*** *:* on the one hand, the search for leaner and more cost-effective asset management processes favour governance principles designed to instil more (explicit) knowledge into better-aligned processes. Sophisticated asset management devices are developed to standardize coordination routines between specialized activities and manage cross-boundary collaboration. These devices are focused on control through rules, procedures and asset measurement techniques such as dashboards, planning devices and budgeting tools.

- ***managing unstable organisational interdependencies between facilities management contributors:*** on the other hand, as facilities management and maintenance performance is more and more the result of the capability to react adaptively to new and unforeseen circumstances due to citizens' practices, political agenda shifts, facilities managers need to *work and learn together* to cope with uncertainties.

Our paper is about the way FM teams build capabilities enabling them to cope with these two trends. We point out the impact of *quality definition devices* (FM standards, classification systems about unexpected events, data-processing tools, information repositories...) on building capabilities to manage the way *different* and nevertheless *interdependent* FM contributors *work and learn together* in poor urban housing environments.

Through qualitative case studies about seven cities of a French Region, [1] we highlight two main aspects about the way these quality assessment devices contribute to ***create and share knowledge*** through mutual adjustments between public housing institutions, municipal service providers and local political authorities:

- In a first part or this paper, we describe how key stakeholders (State administration, local authorities, urban services providers, public housing institutions) develop new *capabilities to represent collectively* "hybrid" FM processes bundling together technical and social knowledge about low-income families practices in their housing and urban environment.

- In a second part, we outline a "dashboard" measuring the organizational capabilities required to control and facilitate collaboration between *different* and nevertheless *interdependent* facilities management contributors; the "dashboard" allow FM teams to position themselves with regard to key capabilities in managing functional interdependences while preserving their own requirements according to the each phase of the facilities management process.

2. The context: coping with uncertainty

We have focused our research on the way Facilities Managers set up organizational routines to handle every day problems resulting from the lack of coordination between different institutions accountable for urban services of social housing estates situated in deprived urban areas. [2]

Our approach is based on qualitative case studies about a public program aimed at developing "arms length management" initiatives ("*Gestion Urbaine de Proximité*"). We highlight recent transformations initiated by New Public Management aimed at achieving affordable housing for economically and socially fragile populations. French administration [3] deployed since the early 2000' a contractual framework in order to formalise "service level agreements" between key service providers within housing estates. Latest transformations initiated by this contractual approach are designed to optimize public aid allocation to poor urban areas.[4]

The contractual framework is supposed to both develop business-like quality standards and assess FM teams' capabilities to solve complex urban problems resulting from social practices

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[1] Région des Pays de la Loire : Nantes, Angers, Le Mans, Allonnes, Laval, La Roche sur Yon, Saint Nazaire, Chollet.
[2] ZUS :Zones Urbaines Sensibles.
[3] An initiative called *« Gestion Urbaine de Proximité »* focused on developing social cohesion through a larger program called *« Politique de la ville »*
[4] A major move in this direction was the allocation of 4 billion euros to a new government agency (*ANRU - Agence Nationale pour le Renouvellement Urbain*) in order to create a new offer of 250 000 social rental residences envisages, the rehabilitation of 400 000 social rental residences and the demolition of 250 000 residences before 2011.

of vulnerable households. These problems are frequently linked to the fact that decision making processes depend on collecting dispersed information about the quality of services delivered within large-scale housing estates.

Facilities management teams need to develop capabilities enabling a combination of on the one hand, technical *standards* optimization and on the other hand, social awareness of the *specific* problems related to the fragile situation of the population living in these neighbourhoods. Our first diagnosis revealed that FM Key Performance Indicators of social housing institutions are still specialized, sector specific and poorly interoperable

Social housing corporations are predominantly focused on economic data expressing the return on investment of their housing park (turn-over, rent collection and arrears, vacancy rates). [5] Local authorities have developed throughout the past thirty years, large amounts of studies and informal knowledge about urban social practices. Their data is focused on inequalities in housing: mix of population, unemployment rates, special needs of minority groups and safety & security issues.

2.1. "Aligning processes" does not necessarily mean "instilling co-responsibility"

Facilities management teams in large scale housing face two main uncertainties:

- design and manage a *programme* to progressively and systematically up-grade the rapidly aging multi-storey dwellings characterized by mass housing construction techniques of the 70' and 80' ;
- Cope with *unexpected* events (vandalism, incivilities, etc...) that rapidly jeopardize quality of services delivered and generate heated discussions and (potentially) violent interactions with tenants.

There are at least two ways to deal with with the lack of coherence between planning FM activities and integrating disruptive events resulting from social practices.

The first way is to focus on "alignment" and minimising co-ordination costs. The search for leaner and more cost-effective organisations favoured initiatives designed to develop a business-like culture in traditional facilities management processes. Managers set-up quality standards that should be deployed by FM teams through "compulsory" and "unavoidable" processes. Market-oriented measurement techniques such as benchmarking and budgeting tools are supposed to achieve considerable cost reduction.

[5] Corporations are more and more aware about the need to manage more effectively data about tenants' complaints; a nationwide effort is being deployed in 2005 to systematically use "customer satisfaction surveys" in day to day management.

But, we observe that in complex urban environments, process alignment doesn't necessarily generate higher levels of satisfaction of poor households and security living in aging housing park.

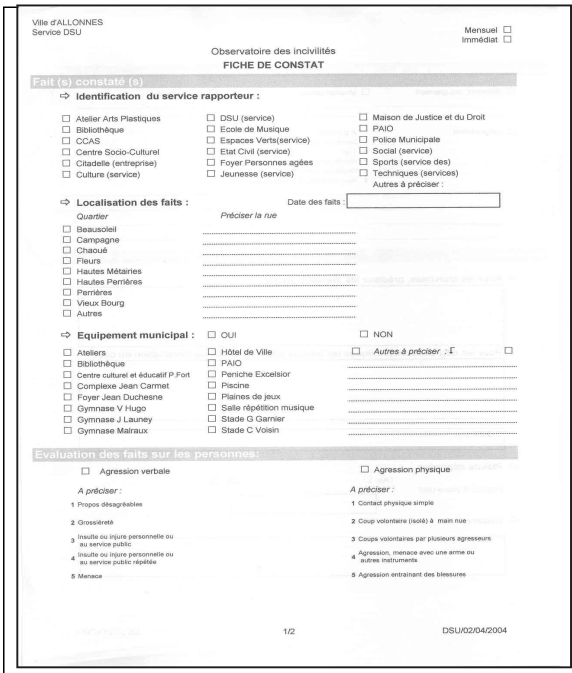
Approaches focused mostly on "control" reduces FM Team's capacity to cope with *unforeseen* events observed in the urban environment: *doing things by the book* within unquestionable and clearly defined structures diminished the more flexible forms of adjustments between social stakes and technical requirements.

An alternative way is to enable facilities managers to be able to deal with unforeseen events by enhancing the representation of every day (but nevertheless complex) problems.

Quality of services delivered within deprived urban areas, is considered as being a result of well-organized collaboration between different institutions. FM performance is based on the capability to work and learn *together*. Hereafter we describe an example of a simple device developed by local authorities of the city of Allonnes (France) to enhance their capabilities of dealing with numerous neighbourhood uncertainties encountered. The initial concern of the city council was the need to create a common means of representing problems faced by facilities managers and social workers during the summer months. During these holiday months, managers had less people at the "hot spots" of the neighbourhood where teenagers and young adults tended to carry out multiple forms of incivilities and degradation of urban equipment. The lack of resources acted as a spur to imagining alternative knowledge sharing, creation and re-use routines. To do this, municipal facilities management teams looked for a simple way to map unexpected events and improve follow-up procedures within the district. The resulting device was a two-fold representation characterised by two main components:

- a first page, sum up information about unexpected events,
- a second page, seize possible follow-up on curative measures and expected improvements.

The document was widely diffused in order to benefit from information supplied by "third parties".



Ville d'ALLONNES
Service DSU

Mensuel ☐
Immédiat ☐

Observatoire des incivilités
FICHE DE CONSTAT

Fait (s) constaté (s)

⇨ **Identification du service rapporteur :**

☐ Atelier Arts Plastiques
☐ Bibliothèque
☐ CCAS
☐ Centre Socio-Culturel
☐ Citadelle (entreprise)
☐ Culture (service)
☐ DSU (service)
☐ Ecole de Musique
☐ Espaces Verts(service)
☐ Etat Civil (service)
☐ Foyer Personnes agées
☐ Jeunesse (service)
☐ Maison de Justice et du Droit
☐ PAIO
☐ Police Municipale
☐ Social (service)
☐ Sports (service des)
☐ Techniques (services)
Autres à préciser :

⇨ **Localisation des faits :** Date des faits :

Quartier *Préciser la rue*

☐ Beausoleil
☐ Campagne
☐ Chaoué
☐ Fleurs
☐ Hautes Métairies
☐ Hautes Perrières
☐ Perrières
☐ Vieux Bourg
☐ Autres

⇨ **Equipement municipal :** ☐ OUI ☐ NON

☐ Ateliers
☐ Bibliothèque
☐ Centre culturel et éducatif P.Fort
☐ Complexe Jean Carmet
☐ Foyer Jean Duchesne
☐ Gymnase V Hugo
☐ Gymnase J Launey
☐ Gymnase Malraux
☐ Hôtel de Ville
☐ PAIO
☐ Peniche Excelsior
☐ Piscine
☐ Plaines de jeux
☐ Salle répétition musique
☐ Stade G Garnier
☐ Stade C Voisin
☐ *Autres à préciser* : ☐

Evaluation des faits sur les personnes:

☐ Agression verbale

A préciser :
1 Propos désagréables
2 Grossièreté
3 Insulte ou injure personnelle ou au service public
4 Insulte ou injure personnelle ou au service public répétée
5 Menace

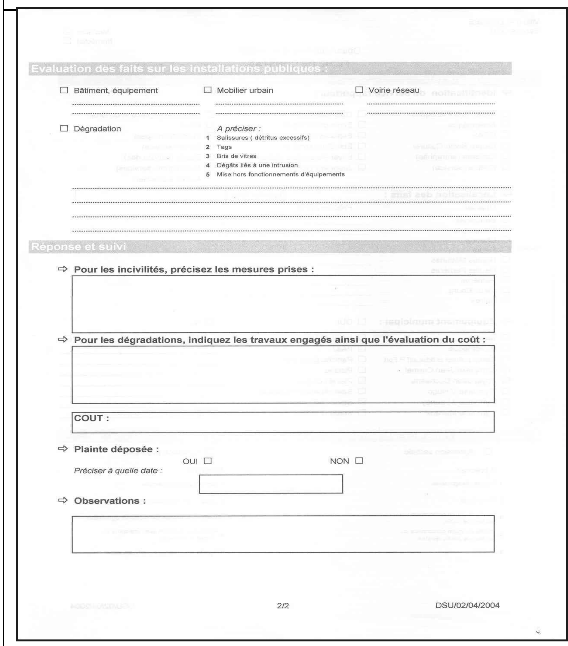
☐ Agression physique

A préciser :
1 Contact physique simple
2 Coup volontaire (isolé) à main nue
3 Coups volontaires par plusieurs agresseurs
4 Agression, menace avec une arme ou autres instruments
5 Agression entrainant des blessures

1/2 DSU/02/04/2004

The first page collects different forms of information to enhance the traceability:

- first step is the explicit identification of the institution that reported the event
- precisely identify who witnessed unexpected events,
- localize "hot spots"
- describe exactly the concerned urban equipment
- specify if there was verbal aggression and/or material deterioration



Evaluation des faits sur les installations publiques :

☐ Bâtiment, équipement ☐ Mobilier urbain ☐ Voirie réseau

☐ Dégradation

A préciser :
1 Salissures (détritus excessifs)
2 Tags
3 Bris de vitres
4 Dégâts liés à une intrusion
5 Mise hors fonctionnements d'équipements

Réponse et suivi

⇨ **Pour les incivilités, précisez les mesures prises :**

⇨ **Pour les dégradations, indiquez les travaux engagés ainsi que l'évaluation du coût :**

COUT :

⇨ **Plainte déposée :**

OUI ☐ NON ☐

Préciser à quelle date :

⇨ **Observations :**

2/2 DSU/02/04/2004

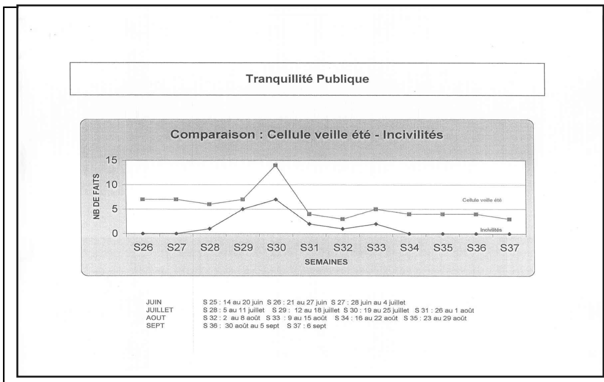
The second page, establish a link between factual information and the context where the event occurred by qualifying more precisely:

- *where ?* : dwelling and/or urban surroundings localization :
- *who* ? is accountable for curative actions? and *how ?* will follow-up be organized
- *how much* ? : costs and impact of curative actions undertaken; costs evaluation of repairs and follow-up on billing and insurances;
- *"and so what ?"* : traceability about potential legal pursuits (dates & qualitative observations).

This is an interesting example of an effort to "bundle" together information about non-programmed curative actions in order to produce a de-contextualized representation of the specific social practices of a district.

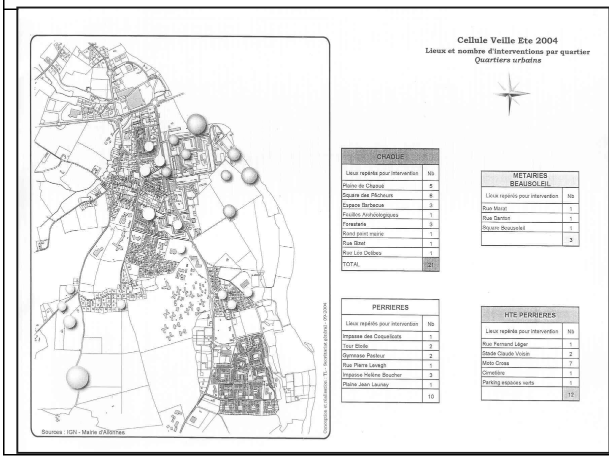
The detailed representation of the curatives actions in a district allows social housing managers and local government authorities to initiate the elaboration of a legitimate deliberation process incorporating both business-like criteria (optimization of facilities management processes) and welfare state ethical imperatives (improvements to obtain “affordable” quality of life in a poor district).

This approach enhances local team’s capabilities to represent coherently and publicly display *variations* of (unexpected) “vicinity problems”. We draw attention to this second step in the “*rhetorical”* [6] process which leads to a more legitimate representation of the “quality of life” in the district: formalising quality ***ratio variations*** is the basis of the rhetorical process leading to managerial ***accountability definition***. A simple data gathering device about day to day incivilities in the neighbourhood is the opportunity for qualifying responsibilities related to “exceptional” events in business-like facilities management processes.



Events are identified week by week. Seasonal peaks are identified so as that controversies [7] about accountability and resource allocation for proactive initiatives may be organized.

Therefore possible proactive initiatives may be organized in the following year to avoid this kind of disturbance.



Problems are also positioned in the urban space.

Simple software enables a clear identification of the frequency and the nature of the problems encountered by technical and social teams.

Priorities may be more *coherently* defined with regard to resource allocation.

[6] See also Laufer (2001) for a detailed explanation about the role of *rhetoric* and marketing techniques in legitimacy building processes of modern public management.
[7] Callon et.al. (2001), Latour (1987), Bowket and Star (1999).

LISTE DES SINISTRES

DATE	LIEU	NATURE DES DEGATS	MONTANT	REMBOURSEMENT	SOLDE
19-mars-04	ateliers municpaux	ordinateur, micro onde	6836,21	attente de la réponse de l'expert	
11-mars-04	Hôtel de ville	vitre	2137,4	1737,4	oui
02-mai-04	piscine	vitres	1190,03	790,03	oui
18-mai-04	stade garnier	armoire cassée vol maillots	980		
31-mai-04	piscine	porte	273,09	pas d'envoi franchise	
09-juin-04	complexe polyvalent	dégâts des eaux	non chiffré		
18-juin-04	podium couvert	lacerés cutter	251,16	pas assuré	
12-juil-04	complexe polyvalent	incendie, dégâts électrique	9387,64	passage de l'expert fait	
20-juin-04	gymnase J Launay	vitre	1227,3	827,3	oui
21-juin-04	ateliers municpaux	vitre	832,4	432,4	oui
13-juil-04	podium couvert	incendie	3 048,77	pas assuré	
15-juil-04	Ecole J Ferry	neon de cassé			
15-juil-04	ateliers municpaux	vitre, bombes de peinture			
16-juil-04	ateiers municipaux	vitre, vol de bombes peinture	406,31	sous franchise	
16-juil-04	maternelle Ferry	vol de vélo		attente inventaire de la directrice	
16-juil-04	ecole Massenet	accident sur jeux	1185,34	courrier à l'assurance	
26-juil-04	ateliers municipaux	vitre bombes de peinture	148,6		
06/09/2004	vitre mairie		371,88	sous franchise	
06/09/2004	vehicule s jeunesse	porte fracturée 9138WX 72			

A basis for a simple *benefits case* can be drawn from a spreadsheet adding up all costs related to a series of events in the neighbourhood.

Up-dating of budget programmes can be made and trade-offs may be discussed with local authorities.

In this case, more than just “aligning technical processes” and “coordinating team interventions”, local authorities designed a representation of the district practices that involved:

- articulating formal and informal knowledge sharing processes;
- combining individual skills to bundle together technical and social issues;
- capitalizing on unforeseen events to create knowledge enabling preventive actions in order to tackle constantly evolving social problems within these urban fringes of the city.

This representation of problems encountered during a specific period of time in the neighbourhood, creates pragmatic opportunities to establish “paths” between different forms of knowledge (individual-collective, tacit-explicit) where “exceptional” events are integrated into de-contextualised management procedures.

What seemed at first glance “exceptional” and unforeseen events (incivilities, destruction of urban equipment, etc.) caused by “deviant” youngsters gradually become an dimension of a “normal” facilities management process.

More *consistent programming* enables better co-ordination of curative actions which involve centralized municipal technical teams, local facilitators and social workers. Further detailed analysis of the data about apparently unsystematic events enabled pro-active initiatives to be implemented the following summer in the identified “hot spots” in the district.

Information transfer enabled by information repositories (light databases about recurrent incidents, technical documents about quality standards, Excell spreadsheets on curative actions costs, etc.) and light information and communication technology (e.mails, Intranet forums) counterbalance difficulties in frequently mobilising *all* the local teams involved in managing the district. Distributed co-ordination reduces the number of time-consuming face-to-face meetings.

3. A dashboard to assess FM capabilities building process

We highlighted the fact that mutual adjustments between public and private corporations, between technical experts, social workers and local authorities and – finally between the various institutional teams and citizens, are a key capability in deploying facilities management in constantly evolving neighbourhoods and unpredictable urban environments.

FM performance is a matter of building *capabilities to cope with uncertainty* rather then just setting an identified performance targets or service level agreements. The combination of different forms of knowledge creates a representation of FM processes that allows social housing managers and local government authorities to collaborate more effectively and securely share information about both the dwelling (internally) and the urban environment (externally).

FM teams are confronted to at least three key questions:

- *Firstly*, how to transfer information between different organisations, different sites, different teams?
- *Secondly*, how to integrate information about unexpected events into programmed facilities management processes?
- *Thirdly*, how to create the appropriate context that enables and encourages knowledge sharing and creation about potential facilities management improvements?

Our analysis shows that FM teams – in both public councils and private housing organizations - have difficulties in bringing together these three sets of questions. Working with a small team of FM project managers working in the seven cities involved in our research, we established a "road map" on which teams are able to situate themselves and rank their capabilities to address these key questions.

We describe hereafter these three domains of potential improvements in more detail and outline the progressive development levels of the corresponding capabilities.

3.1. Understand why unexpected events occur

Let us turn to the first set of questions. The introduction of a contractual definition of "service level agreements" of the service provided by different organisations [8] cause a lot of problems concerning the way *informal knowledge* is framed.

Teams need to develop their capabilities in prompting a new framing of unexpected events. This means being able to choose the right *questions* that trigger existing FM routines. It is more than just defining the content and the associated processes to codify and transfer "facilities management" data. It is rather choosing the right *problems* to be addressed in order to develop

[8] Public, semi-public and private organisations.

shared perspective about "doing" things together in the district. This requires a new approach and management skills focused on emergent information about the districts life, tenants' practices and their cultural specificities. The stages of evolution of capabilities related to representing functional interdependence are characterised in Table 1 below:

Table 1 – Framing functional interdependences

CONTROL	Top down approach focused on aligning FM "solutions" Functional interdependence as a "moral" injunction*: "teams must work together!"* No shared perspectives of the practical outcomes of the proposed enhancement of functional interdependence
FACILITATE	Identify knowledge "brokers" in charge of developing methodologies for identifying FM "problems" Quality assessment of user's needs done by technical experts
LISTEN	Aware of the need to involve users' communities Involve citizens to boost local initiatives and capture informal knowledge Develop FM skills to manage knowledge networking to analyse local populations practices in the neighbourhood
ASSESS	Development of a facilities management KPIs integrating informal "third parties" knowledge Link formal (budgetary) facilities management indicators and day to day quality of urban services (periodical surveys, …)
INTEGRATE	Assessment devices and survey results are integrated into the facilities management strategy Integration of short term facilities management indicators into budgets Communication on proactive FM initiatives to key stake holders (local authorities, elected officials)

3.2 Representing collectively functional interdependences through quality standards

A second type of capability concerns the way teams use the *As-is* diagnosis: how they create a shared view about current problems to enhance accountability definition. The importance of this type of capability is usually underestimated. When confronted to unexpected problems, FM managers jump immediately into curative actions guided by abstract *To-be* targets. These are usually defined by central experts and engineering oriented departments. In this case controversies are focused on FM "solutions". Each contributor to the FM process seeks to justify its variations of performance by pointing to problems caused by inconsistencies in services delivered by their counterparts. Creating a thorough diagnostic about the "problems" encountered facilitate teams to avoid controversies about conflicting "solutions." [9] Progress within this area is signalled by different stages shown in Table 2 below:

[9] An efficient way to establish this kind of organizational diagnostics is to walk around the neighbourhood to build collectively a shared picture of the situation. See. Allen and Bonetti (2004).

Table 2 – Representing functional interdependence

PASSIVE	Waiting to be confronted to unexpected events Random knowledge gathering about disruption in FM processes No systematic traceability about crises, incivilities, tags, etc.
AWARE	Aware of the need to involve key knowledge providers about potential problems in the neighbourhood Growing awareness of the importance of knowledge *re-use* for operational effectiveness (sharing lists of problems already solved)
ACTIVE	Involve "third parties" in "on the spot" diagnostics (local teams dealing day to day with neighbourhoods problems, technical experts) to clarify functional interdependence
OPTIMISE	Organise knowledge sources & implement a knowledge re-use strategy of existing dispersed k-bases Selecting best knowledge sources about unforeseen events based on various FM contributors
VALUE	Audit of knowledge re-use practice Measurement of "costs vs. benefits" of acquisition of new FM knowledge Action plan to map and manage overlaps in knowledge utilisation

3.3. Capabilities to communicate about FM performance

In order to diffuse efficiently ***To-be*** performance targets, FM teams need to go beyond the usual strategy consisting in defining a formal "quality charter" and communicating it through "top-down" initiatives. FM teams need therefore to address simultaneously two different initiatives:

- create more or less informal routines to share knowledge through day-to-day encounters to refine their ***As-is*** diagnosis about how unpredictable events disturb FM processes.
- establish stable ***To-be*** references and facilitate re-use of known information about current dysfunctions;

Confrontation about As-is "problems" and To-be "standards" creates the capabilities in going beyond the definition of de-contextualised "quality charters". The confrontations enable a more reliable *representation of performance variations.* As communication about expected performance targets becomes more en more effective teams are able to define and deploy pro-active initiatives. We have identified below a number of intermediate stages towards "best practices" in this area.

Table 3 – Capabilities to communicate about quality standards

PUSH	Use a push strategy for sharing knowledge through diffusion of "FM charters"
SELECT	Being aware of re-usability of documents produced to up-grade FM charter
INDEX	Define standardised guidelines for enhancing charters on quality standards Indexing documents for easy retrieval
CLIENT-FOCUS	Segmentation of user's needs Explain "how to use" the charter and/or related documents (tutorials) Add links to the document to point to the context (knowledge and people) / Best practices market (reward asset contributors)
DEMAND-DRIVEN	Diffuse charters and related documents only in response to an identified need Follow-up the re-use of diffused documents Put a value on key knowledge (metrics of use)

3.4. Organizing the representation of performance variations to secure information sharing

The third key area of action concerns the creation of the *context* to enable and encourage knowledge sharing and creation about FM performances. Designing such a context means developing a dialogue that can articulate both informal collaboration and formalized coordination. Here, organisational structures and physical conditions are important but not decisive.

What really "makes the difference" is the capability to set up links between day-to-day informal problem-solving and formalised co-ordination processes, "road-maps" between creative and fuzzy approaches to FM problems and practical outcomes with clear rules and formalised KPIs. These links can be established through a common set of diagnostics about the limits of current facilities management practices. [10] Organising "conversations" about key events [11], creating meaningful stories, building common languages and vocabularies are different ways to create a context that enables shared perspectives about "managing" knowledge. They also facilitate involvement of key actors in knowledge management initiatives.

Again, it is worth tracking the progress along the *formalisation* and *networking* paths separately, as the indications (shown in the Tables 4 and 5 below) are different:

[10] See Bonetti (2001)
[11] Carlile (2002)

Table 4 – Formalizing hybrid representations

NON-COORDINATED	Looking for FM tools to support formalised knowledge exchange Growing awareness of a limit of the informal management of knowledge
K-BASE	Attempt to gather the knowledge into knowledge bases Managing knowledge cycle through knowledge bases
K-BRICKS	"LEGO" approach to FM knowledge formalisation (best practices, references, methodologies…) Define categories of "LEGO" blocks to improve FM performance variations visibility
LINKS	Take into account the fuzziness of organizational knowledge Try to integrate experience and districts context with knowledge bricks
COMBINE	Organising "conversations" combining FM knowledge objects with face to face relationships & invest in organisational context

Table 5 - Networking

LOCAL	Informal knowledge is not structured in the neighbourhood Awareness of FM networks' fragility
BUILD	Awareness of manageability of FM networks Identify key collaborations around FM processes in the neighbourhood Managing organised links between informal networks
CONNECT	Enable knowledge re-use by communities of practices Organise face to face events about exemplary *"unexpected* problems solving *routines*"
WEB-BASED	Improving efficiency of knowledge transfer / re-use with ICTs Assessing FM contributors re-use practices Multiply connections through IT tools
INTERNALISE	Leadership's appropriation of FM management and involvement of local elected authorities in steering teams Hybrid representation of FM processes diffuse through all the layers of the accountable organisations

4. Conclusion: re-instilling uncertainties of "real life" through "hybrid" representations of FM processes

Our analysis of current practices within seven French cities of the Pays de la Loire region shows that FM teams working within social housing in deprived urban areas are facing the following paradox:

- the more public administration develop quality control devices to better manage technical and organizational risks due to constantly evolving poor neighbourhoods;
- the less local facilities managers are capable to deal with cross-organisational stakes and be involved in more unpredictable urban participatory policies.

To manage this paradox, teams are developing "hybrid" management tools to facilitate the articulations of different forms of knowledge about delivering urban services and taking into account the specific expectations of vulnerable households. Our findings show that the lack of shared quality assessment devices erodes the ability of facilities management teams to undertake FM initiatives in more “deliberative” agendas of urban planning and facilities management.

Research results highlight facilities managers’ efforts to *introduce more flexible workflows* for until now relatively low coordinated practices based on shared diagnostics about problems. Most managers, especially elected local authorities, tend to underestimate that agreeing on the “problem” is frequently more effective than having the optimum solution. The key difficulty is to bring all institutions accountable for the quality of services delivered throughout the neighbourhood to establish and share a new balance between technical solution and social problems. Quality assessment infrastructures play a key role – they bring together apparently different types of knowledge (social & technical). They help to design the “facilities management lifecycle” ***across*** organizational boundaries. The *“hybrid”* [12] and *“abbreviated”* [13] representations of quality of services would consequently facilitate collaboration across public and private institutions. Through these representations they *publicly display* their complementarities within new deliberative forums.

Finally, the capabilities building “dashboard” is a simple – “work in progress” type - device to bring FM teams to assess their present position in building governance capabilities to enhance facilities management of social housing estates exposed to unpredictable events within vulnerable urban environments.

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Facilities Management Studies in Lithuania

Arvydas Juodis,
Kaunas University of Technology, Lithuania (email: arvydas.juodis@ktu.lt)
Nerijus Varnas,
Kaunas University of Technology, Lithuania (email: n.varnas@ktu.lt)

Abstract

Construction project management is a new and effective activity in Lithuania. The demand for construction project managers is constantly increasing due to the higher amount of constructions that increased in our country within the last years by 20-30 per cent per year. Contracting authorities of construction projects give necessary investments for the implementation of their ideas; they wish an optimal achievement of the goal with no deeper consideration of the implementation process of the whole project. This concerns all the stages of construction project management. Facilities management is one of the least investigated stages of construction project management in Lithuania.

In Lithuania, the term *facilities management (FM)* originated in the scientific and practical activity not long ago. Each country has different level and scope of the development of facilities management activities. Therefore currently, the determination of the efficiency of FM activities under the conditions of Lithuania is a topical issue that requires the proper evaluation of current situation, determination of the best practical models and scientific tasks as well as consideration of the recommendations that would contribute to the development process of FM activities in Lithuania. The preparation of different specialists of this field in universities and other education institutions is particularly of great importance.

Keywords: construction project management, facilities management

1. Introduction

Under the conditions of market economy, all contracting authorities of constructions are to follow strict requirements assessing the costs, quality and duration of construction works. To satisfy the requirements becomes more and more complicated, because all the processes of work have a tendency to become more complex and the scope of specialization is constantly expanding. Contracting authorities of construction projects wish the optimal implementation of their ideas with no deeper consideration of the implementation of the whole process. They are ready to give all necessary investments for this. Such conditions determined the origin of a new field of activities – construction project management. This activity originated in Western Europe more than 30 years ago and currently is becoming more and more important.

Project management is the integration of management functions, management methodology and management technique in order to achieve the desirable final results of project implementation. In special literature resources the term construction project management appeared not long ago therefore there is no exact and standardized definition of this concept yet [5].

On the basis of the experience of foreign countries, in Lithuania the process of construction project implementation is divided into several stages (Fig. 1). In the stage of the determination of expedience of a construction project the goals, tasks, restrictions and possible implementation variants of the project are considered. According the common standards or analogs, the financial analysis evaluates the costs of a construction project depending on the variants of selected construction sites. The goal of such calculations is to evaluate investment demand and financing possibilities.

In the pre-design stage the legal issues of project implementation are analyzed (i.e., whether it is purposeful to purchase the land or better to lease it) and the conditions to obtain the construction permit are discussed. In this stage principal technical solutions are analyzed, optimal project variants are selected, estimation for construction costs according to common indices is presented and the duration of construction works is determined [5, 6, 7, 8].

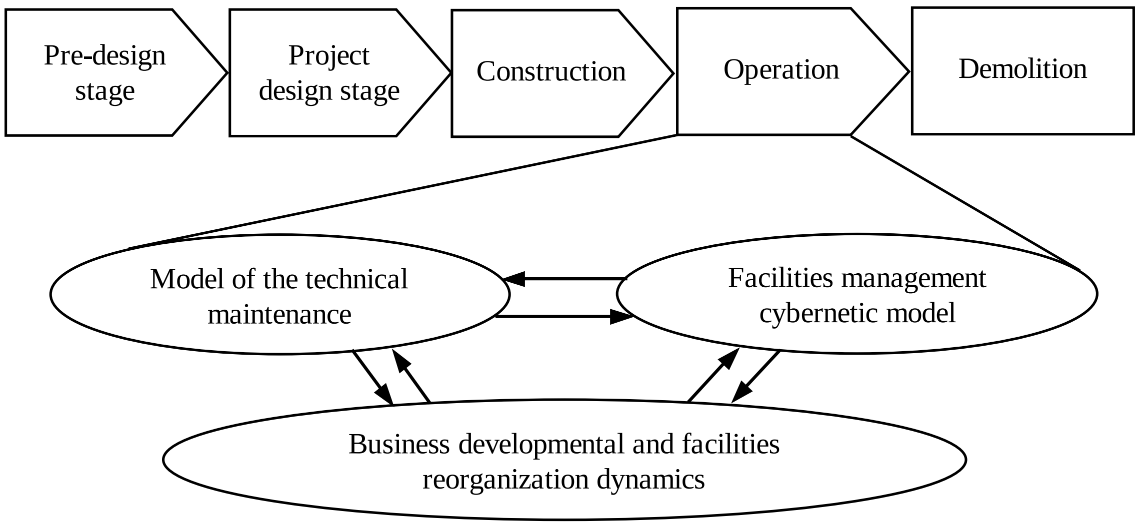

Figure 1: Constructions lifetime cycle and FM structural elements

During the project design stage the technical project of a construction is prepared. This part of the project includes a more detailed estimate. Having prepared the technical project and the estimate, a competition for the implementation of construction works is organized. The contractor-the winner is responsible for the engineering preparation of construction works, preparation of the implementation project of construction works and the implementation of construction works.

Before the operation of a building possible construction defects are eliminated. Then the building is ready to be used.

During the operation period of buildings different changes might occur that affect their operation qualities. Some changes may adversely affect comfort, domestic, work or industrial conditions; others may induce the disintegration of separate constructions or the whole building. This is due to the physical and moral depreciations of buildings. Physically depreciated buildings are often repaired: different elements are renovated, reinforced or replaced. Morally old buildings and the buildings with changed functions are reconstructed [15].

The maintenance and improvement of the functions of constructions within their lifetime require a purposeful implementation of strategic long-term organizational and economical tasks. Such activity is called facilities management [2].

Constructions used for different purposes have different constructional scheme, engineering equipment, main business technology, work regime and conditions (e.g., the activities of hospitals, gas stations, schools, etc.). Therefore the facilities management of different buildings has its individual peculiarities [14]. However, from the methodological point of view, common principles of FM activity are available [9, 10].

2. Problems and Tasks of Facilities Management in Lithuania

The term construction project management appeared in scientific and practical terminology in Lithuania about 10 years ago. The term facilities management started to be used about 5 years ago, because since then the construction project was understood and analyzed only until the onset of the operation period of a building.

The term facilities management comprises the object, its structure, operation functions and the whole operation system [11, 13]. Scientists of Lithuania and other countries give the following suggestion for the analysis of the facilities management: the problem is to be analyzed in administrative, technical, spatial (accommodation) and other services management aspects [16].

The effective activity of facilities management allows creating optimal conditions for the implementation of the main activities, the rational maintenance, repairing and modernization works of buildings; it also allows reducing operational costs of buildings as well as using efficiently the investments to ensure the modernization and necessary functionality of buildings [1, 4, 13].

In Lithuania, the maintenance of constructions is carried out in two ways: 1) the enterprise or owners of the building carry out all works by their potency or 2) facilities management services are provided by another enterprise according to the contract. Most enterprises and organizations in Lithuania carry out the maintenance of constructions by their own potential. Common industrial or added costs are used for this purpose, which makes up the greatest part of total expenses and adversely affect the competitiveness of the main activity of the enterprise. Construction maintenance departments are functioning inefficiently in the enterprise therefore this leads to higher expenses, compared to the costs needed for specialized construction maintenance enterprises.

Moreover, the quality of services is often insufficient as all works are usually done in the method of “fire fight”. This means that defects are eliminated too late, i.e. only when they appear, and this requires much higher expenses.

To summarize the scientific researches and practice of constructions maintenance in Lithuania, facilities management problems and tasks might be divided into several groups (Fig. 2).

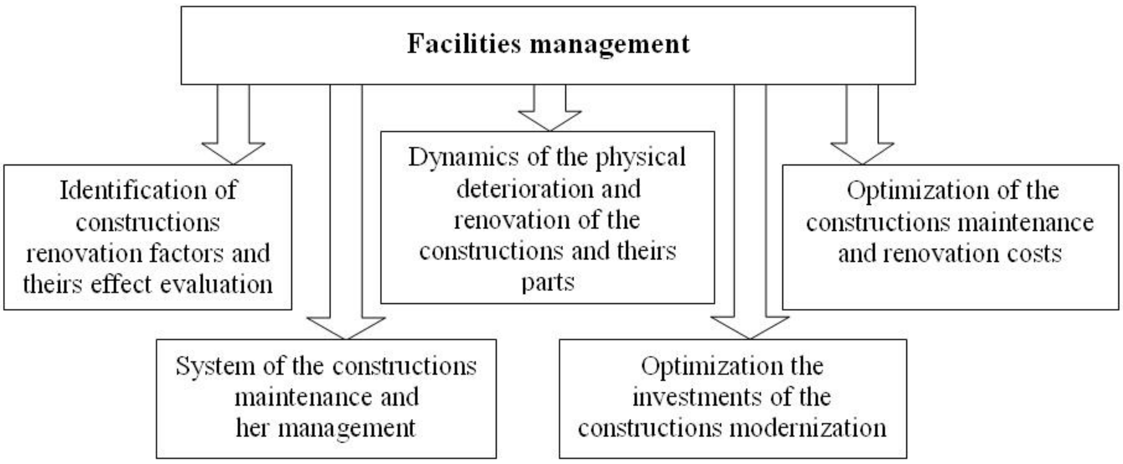

Figure 2: Tasks of facilities management scientific researches in Lithuania

In each group of tasks some studies have already been conducted. Lithuanian scientists have proposed the new multi-criteria evaluation method of the renovation of constructions and their separate elements. This method is based on the calculation of the effectiveness of a project or its components on common complex criterion evaluating the most important indices of the studied object. Moreover, the application of special software enables to create alternative solutions and to estimate them [16, 17, 18].

Scientific literature gives different reasons that determine the renovation of constructions. The reasons for the renovation of constructions in Lithuania are shown in Fig. 3.

Fig. 3 presents the results of scientific researches carried out on the determination of constructions renovation reasons in Lithuania. The results of those studies are needed for the prognosis of economy indices of constructions. The data of such kind of studies is different in each country. This is mainly influenced by the economical situation, traditions, legal environment, construction type and other conditions in every separate country.

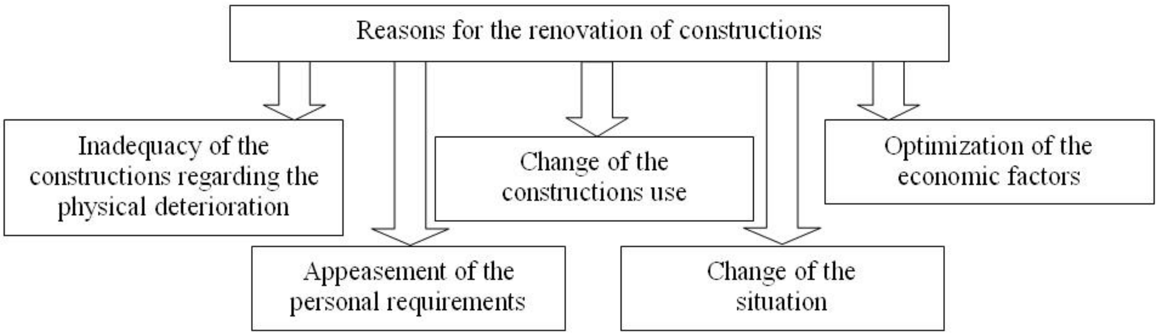

Figure 3: Possible reasons for the renovation of constructions in Lithuania

The dynamics of physical deterioration and reparation of constructions and their components makes the strongest impact on facilities management work structure the amount of necessary costs. During the construction operation period those costs and investments make up to 75% of total expenses during the construction lifetime period [3]. The amount of the costs depends on the solutions of a construction project and the effectiveness of facilities management activity during the construction operation time (Fig. 3). Having analyzed the dynamics of physical deterioration and reparation of constructions and their components, an optimal facilities management functioning model can be created.

The model of construction maintenance and reconstruction allows optimizing the amount of necessary costs and demand of investments during the construction operation period.

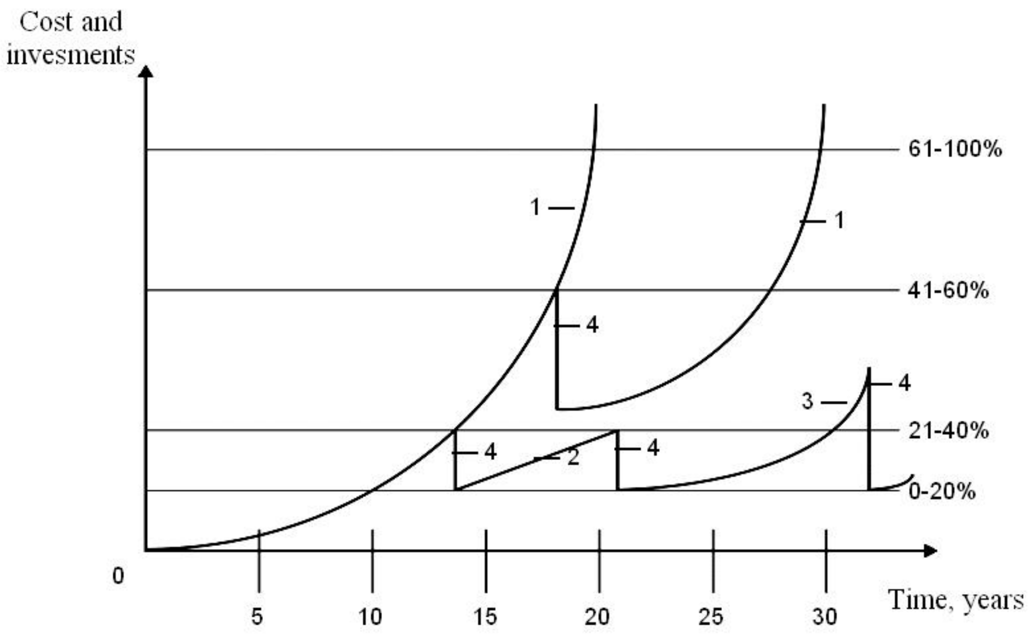

Figure 4: Changes in costs and investments during the construction operation period

Fig. 4 shows possible changes in costs and investments depending on the maintenance and reconstruction model of a building. Here: 1 – curve of natural deterioration of the construction; 2 – curve of construction deterioration when effective maintenance is performed; 3 – curve of construction deterioration when maintenance is performed; 4 – repair works of the construction.

Construction maintenance system and its management make a strong impact on the efficiency of construction operation. Therefore the creation and practical implementation of the management model of this activity has a strong practical and educational significance.

The transformation of management systems is strongly affected by the development of different studies and the practical application of their results. Facilities management cybernetics model might be created on the basis of the achievements in theory, applied mathematics, informatics and economics studies. Practical application of the facilities management cybernetics model determines the purposeful, reliable and effective functioning of an enterprise [12]. However, in practice this management model of an enterprise might be implemented only with sufficient normative, methodological, informational and legal resources of the management system [5].

Fig. 5 presents the scheme of a construction management cybernetic model. Such cybernetic interpretation of construction management allows to understand better the essence of construction management as well as to apply the main principles of such management for the achievement of the goal.

Fig. 5 gives systematical elements of the management model: resources, facilities management process, management apparatus, results, control information, regulation, inner and outer environment of the system.

Resources describe the totality of all means and devices necessary for the implementation of constructions management process. The structure of the resources and their provision intensity depend on the peculiarities of implemented constructions management solutions.

Facilities management process is described as a purposeful and effective performance of interrelated logically based activities when implementing rational (optimal) project solutions.

Results are systematical elements describing the final or transitional constructions management result expressed in the system of indices. This might include indices expressed in physical (material) or economical (efficient) indices, e.g. parameters characterizing technical state of a construction, amount of works performed, amount of costs, etc. The system of such indices is used for the control, analysis and correction of solutions. The creation and practical application of the index system determine the efficiency of construction management.

Control information is used to detect the variations of constructions management processes.

Regulation. Two principal systematic elements are regulated: resources and constructions management processes. On the basis of the regulations the variations of constructions management processes are eliminated and further rational (optimal) development is ensured.

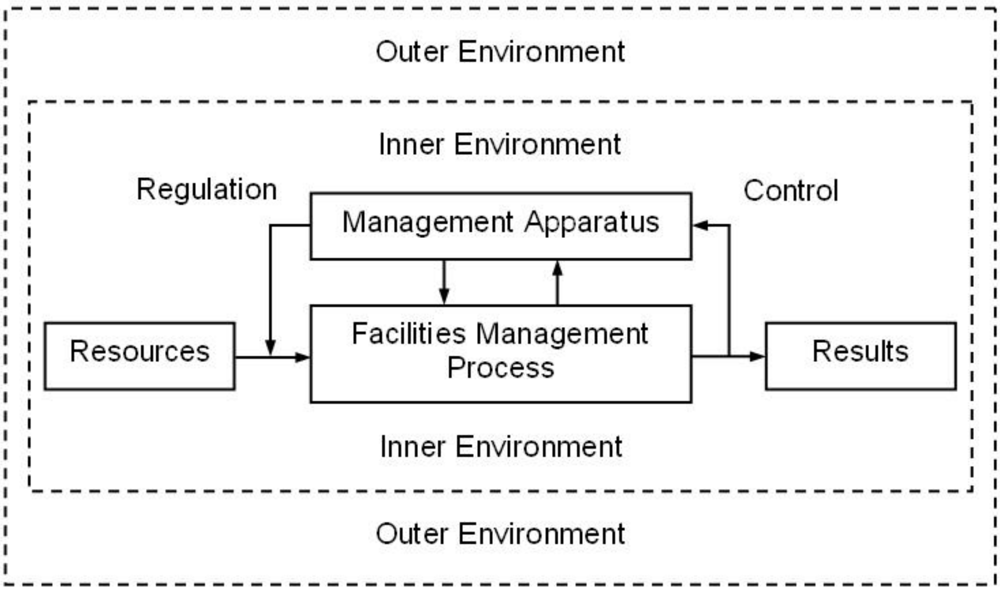

Figure 5: Scheme of the facilities management cybernetic model

Facilities management cybernetic model is a universal instrument that may be effectively applied in practice [10].

3. Preparation of Facilities Management Specialists in Lithuania

After Lithuania restored its independence in 1991, the transformation processes occurred in all spheres of activities. During this period the system of education and specialists training changed, too. The top priority was given to the transformation of the training system of different specialists as in the future the education, qualifications and learning of Lithuanian citizens will strongly influence national competitiveness and welfare of inhabitants of the state. The education and study system of Lithuania is affected by the development of market economy, the internationalization of all processes as well as the traditions of national culture [5, 6, 9].

The changes in functions and structure of Lithuanian economy determine the demand for certain specialists. As the experience of certain European countries shows, good economical results and high living standards may be achieved even without any material resources. In such case topical issues become education system and preparation of different specialists.

Internationalization processes gives more freedom for capital exchange and people movement as well as creates better possibilities for the development of economics and other fields of activities. On the other hand, it also sets new requirements for the professional training level of specialists and the application of scientific achievements in practice. This will be a top issue when determining the competitiveness of national economical systems in the international market [5, 6].

There is a three-stage study system in Lithuanian universities: background studies (bachelor's degree), master studies and scientific doctor studies.

Kaunas Technological University prepares specialists of different fields. All study programs were formed and implemented gradually, on demand, under suitable conditions and possibilities. Currently, a new master program suitable for Lithuania's economy – "Properties management" - is under implementation. This program comprises complex studies of construction project management, however most attention in this program is paid to the studies of facilities management activities.

Facilities management might be studied by bachelor graduates of construction engineering. The demand for such kind of specialists is constantly increasing in Lithuania. Objects of the activity of facilities management specialists might include various enterprises and organizations: industrial or commercial enterprises, offices, hotels, gas stations, hospitals, living complexes, educational institutions, etc. This might be functioning or temporally non-functioning objects [13].

4. Conclusions

The term construction project management appeared in scientific and practical terminology in Lithuania about 10 years ago. The term facilities management started to be used about 5 years ago. Currently, those interrelated activities have become particularly important in Lithuania. This might be explained by two reasons: 1) the amount of construction works is rapidly expanding and makes up 20-30% per year; 2) 70% of all investments are used for renovation, modernization and reconstruction of old buildings.

Thus, the demand for construction project managers is constantly increasing, and more attention is paid for the maintenanc3e, modernization and reconstruction of existing buildings. Moreover, enterprises of different business activities are trying to develop their competitiveness by reducing the functional costs of their activities. Such cost reducing possibilities might be detected in the construction maintenance and management system. As the tendencies of the development of enterprises show, those functions are often transmitted to certain specialized companies, which results in cost reduction by 30%. The effective functioning of construction maintenance enterprises is mainly determined by the selection of an optimal construction technical maintenance model as well as efficient application of investments for the modernization of buildings. To solve those problems, scientific studies need to be performed and best practical recommendations are needed.

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PUBLIC PRIVATE PARTNERSHIP: A SERVICE INNOVATION The Treasury Building case

Jean Carassus,
Centre Scientifique et Technique du Bâtiment (CSTB).Paris, France. carassus@cstb.fr

Abstract

A Public Private Partnership (PPP) contract combines the competences of a client, a bank, a designer, a construction company and a facilities manager, to finance, design, build and manage a building or an infrastructure.

It is a service innovation analysed through a case study: the PPP/PFI Treasury Building refurbishment and operation project in London. The analysis method is the Barcet and Tannery one [1], specifying the service as an aim, as a concept, as a process and using specific means and resources. PPP is a process service innovation, following a "methodological trajectory", which is the result of a change of competences and technical (material and immaterial) characteristics [2].

The main innovation through PPP is the combining of usually separated competences: client, architect, construction firm, facilities managers and users. This combining of competences is revolutionary in an industry where design and build have been for a long time separated from facilities management and use. This combining competences innovation is just beginning through a quite long learning by doing process.

Keywords: Public Private Partnership, service innovation, service key performance indicators, competences, facilities management.

1. Introduction

Most of the time, government or local authorities fund public buildings and infrastructures, and the building of the facility and its operation after completing are separated. On the one hand, the construction of the facility is provided by designers and construction firms through public procurement (design bid build, design and build, construction management)1, on the other hand,

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- [1]for a comparison between the different procurement procedures, see for example Konchar and Sanvido [3] for the US and UK procurement processes and the special issue of *Building Research and Information*, edited by Graham Winch, on procurement procedures in the European Union [4].

the public authority manages the operation and maintenance of the facility itself and with sub contractors (for heating, lifts, cleaning…).

Public private partnership (PPP) is a new way to finance, build and manage public buildings and infrastructures. Usually, in a PPP process, the public authority negotiates, through a competitive procurement process, a single contract with a private consortium specifying the funding, the design, the construction and the operation, for ten to forty years, of the facility. The public authority pays the investment and the operation through annual rents after the completion of the building. When the contract is achieved after ten to forty years, the facility is owned by the public authority. PPP is a feature of ongoing change of the construction sector, from the structures to the service [5] [6].

2. A service innovation

Even if the facility may be different on technical aspects through PPP, in comparison with a usual public procurement, this new way is obviously not a technological innovation. It is a service innovation

Gallouj [2] has highlighted five kinds of services, namely: « quasi products » (whenever the service is highly standardized), operational or manual services, informational or relational services, intellectual or professional services, and finally the packages of products and services.

The final service of a PPP process is the package of a product (the building) and a service (the management of the building),

Sundbo’s typology [7] inspired by Schumpeter’s one [8] specifies four service innovation categories:

- Service innovations: new service,
- Process innovations: change in the service elaboration procedures,
- Organizational innovations: change in the management modes,
- Marketing innovations: marketing, sales, and so forth.

PPP practice is a change in the package (building plus services) elaboration procedures; it is fundamentally a process innovation.

Gallouj [2] defines a service as a “set of characteristics and competences”, the final characteristics of the service Ym resulting from the simultaneous mobilization of competences (coming from the service provider -Cp- and the client -C’q-) and technical characteristics Tn (material and immaterial). Innovations are particular movements of those competences and characteristics.

According to him, service innovations evolve according to different possible “innovation trajectories”, namely:

- the material transformation trajectory ê M (Y), which corresponds in the alteration of the material basis of the service,
- the information processing trajectory ê I (Y), corresponding to new data, new uses of data, network sharing of information, etc,
- the methodological trajectory ê K (Y), dealing with the implementation of formalized methods for knowledge processing,
- the « pure » service trajectory ê C (Y) corresponds to the direct mobilization of competences, regardless of any material, informational or methodological support.

PPP is a service innovation evolving essentially according to a methodological trajectory through formalized methods, even if it normally makes necessary the use of new data and if alters the material basis (the building) through life cycle cost design. We will highlight the weight of the implementation of new formalized methods used to specify and to control the PPP process.

We have already analysed service innovations in the construction sector [9] [10]. How to analyse PPP as a service innovation? To study and set up a service innovation, Barcet and Tannery [1] suggest a method in four analysis levels summed up in the following table.

Table 1. The service innovation analysis method

Analysis level	Question	Topic	Meaning
1. The client system	What for? Whom for?	The functionalities	The service as an aim
2. The result of the performance	What?	The service product	The service as a concept
3. The supply system	How?	The performance	The service as a process
4. The means and resources	What with?	The tools, methods, information, technical means, skills, competences	To implement, or to obtain, means and competencies

From Barcet and Tannery (1998)

To be more specific, a PPP case will be analysed: the refurbishment and the operation of the Treasury Building in London. This project is one of the ten PPP cases studied in the UK, Italy, Denmark and France, by a French team, assisted by European experts [11] 2. The project is one of the notable British "Project Finance Initiative" (PFI) investments, in the political frame specified by the Conservative government in 1992, amended by the Labour government in 19973.

3. The service as an aim

The first analysis level is the service as an aim, the client system. Her Majesty Treasury (HMT) had three main goals through this PPP/PFI refurbishment project of its head offices:

- To spread the payment of a significant investment, in a context of low level of financial public means,
- To design a building to back a new business process in the ministry, focused on a team and network way of working more than a hierarchical one,
- To provide a high level of day to day service to the employees.

Usual public procurement systems do not allow differed payment of a public investment. Conversely, to design a building to back a new business process and to provide a high quality service to the end users are normally possible through usual public procurement procedures.

[2] Then this team made the framework of a French Public Sector Comparator (PSC), available at www.fondation-igd.org/ [12] and the PSC dedicated to the French hospitals. This PSC is included in the French PPP guide for hospitals, available at www.mainh.sante.gouv.fr/ppp.aspx [13]
[3] On recent evolution of British PFI, see Allen et alii [14], Weill and Biau [15], and the following websites: www.partnershipsUK.org.uk [16] , www.4ps.co.uk [17], www.nao.org.uk [18].

4. The service as a concept

The second analysis level is the service as a concept, the service product. The concept offered by the PPP/PFI process has two main characteristics:

- The private partner pays the investment, the public authority spreads the reimbursement through rents paid during a long period, the first rent being paid after the completion of the building,
- A single team, dealing with the funding, the design, the construction and the facilities management is responsible for the package, refurbished building plus the services provided for a long period.

This concept, in comparison with the usual public processes, is a very innovative one: commonly public procurement plans a payment of the investment by the public authority during the design and construction time, and separated processes for construction and facilities management.

5. The service as a process

The third analysis level is the service as a process, the supply system. The PPP/PFI process has four main characteristics:

- A new procurement system with, in the case of the Treasury Building, two tenders: one for the package building and services, one for the funding,
- A transfer of risks from the public authority to the private consortium,
- The valuation of the transferred risks in the amount of the rent,
- A long term partnership between the two parties.

In 1995, an invitation to tender was issued for the refurbishment and operation of the HM Treasury’s offices in London. Exchequer Partnership was selected in September 1996 as preferred bidder after a competitive procurement process, but Labour Government elected in 1997 considered it inappropriate to proceed at that time. Following a review of the project a contract was signed in August 1999. HMT had also to set up a new tender on funding which was concluded in January 2000 [19]. The facility was successfully delivered one month early in July 2002, when payment of the unitary annual charge for 35 years commenced.

The two parties negotiated a complex contract specifying the package design, refurbishment, hard and soft facilities management by Exchequer Partnership (EP), a Special Purpose Vehicle Company, created by a construction company (Bovis Lend Lease), a developer (Stanhope) and a facilities manager (Chesterton), and the funding through index-linked bonds insured by Ambac (monoline insurer). Johnson Workplace then controlled Chesterton. The facilities manager was no longer EP's shareholder. Forster and Partners are the architects of the project. Figure 1 sums up the present construction and property business system.

We have studied the first half of the refurbishment, the second one, specified by another PFI contract with the same partners, is in progress.

The risks allocated to the private consortium are:

- Obtaining Planning permission and listed building consents,
- Design and construction compliance to achieve the occupier brief and deliver output brief performance,

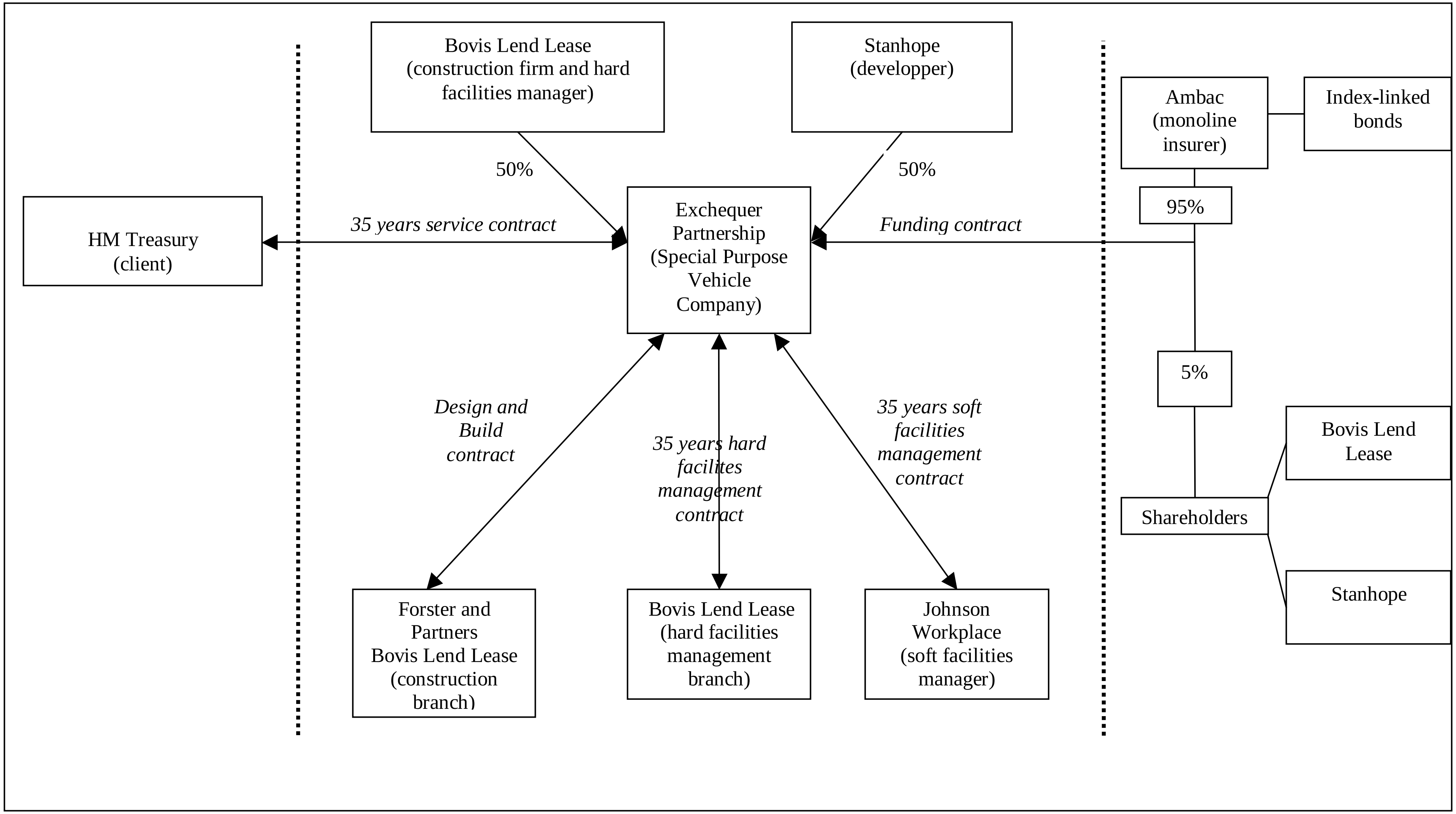


Figure 1. Treasury Building PPP/PFI project : the construction and property business system

- Construction and latent defects risk, which was significant in a poorly maintained 100 year old building,
- Service delivery risk, which lasts through the life-cycle of the facility. Many of these risks were then re-allocated to the FM sub-contractors by Exchequer Partnership (EP), although these risks were capped and above a threshold are retained by EP,
- Bankruptcy risk. Should EP fail, Ambac are obliged to step in to assure service delivery,
- Regulatory changes requiring changes in the output or occupier briefs,
- Letting risk i.e finding a tenant for other half of the building.

The risks shared include inflation, in that the unitary charge is index-linked. The risks retained by the Treasury include changes in user requirements implying changes in the output or occupational briefs other than those required due to changes in national regulations.

The valuation of the project and the transferred risks is embodied in an annual unitary charge of £14M during 35 years. The cost of the project was £141M, of which £112M represents design and refurbishment. The amount of £29M corresponds to the negotiation costs and the funding costs, among them, preparation and negotiation costs were about £7M for Exchequer Partnership.

The PPP/PFI process involves a long term partnership between the parties. According to the interviewees, this partnership works very well. In our opinion, success factors for such a partnership are:

- The willingness of the parties for the success of the HMT head offices refurbishment in a PFI process,
- The high level competences of the partners,
- The quality of the tools and methods (see infra)
- The profitability of the contract for the private partner.

No specific information is available on the profitability, but we think that it is very difficult to manage a serene partnership, when the contract has been under priced by the private partner and is not profitable4.

6. The methods and the competences

We are dealing now with the fourth analysis level suggested by Barcet and Tannery (1998), the means and resources one: tools, methods, information, technical means, skills, competences.

Our analysis highlights five aspects dealing with the means and resources:

- The competitive procurement process,
- The funding method,
- The occupier brief and associated tools,

[4] See for instance the problems of the under priced STEPS deal between Inland Revenue and Mapeley [20].

- The output brief and tied tools,
- The combining of usually separated competencies.

We will also underline some lacks, especially the need of operating costs data bases.

We did not get into details to analyse the competitive procurement process because we chose to study the Treasury Building case more than one year after completion of the refurbishment. In opposition to the usual procurement one, the PPP competitive procurement process is a performance-based one. The occupier brief and the output brief specify the results to be obtained but do not define the solutions to meet them. The private partner elaborates the practical means to reach the objectives and to measure the output.

The counterpart of this very productive process is the time and the cost. The negotiation between the public authority and the preferred bidder is long and pricey. The complexity of the long-term contract explains a part of the cost, but solutions have to be fund to moderate the cost of PPP/PFI contracts5.

The Labour government asked HMT to set up a separate tender for funding. An opportunity to innovate was created. Bank financing and bond financing competed. One solution was funds provided by one or several banks, through a negotiation between the project company and the bank. The other solution was funds provided by bond investors, through an agreement via an intermediary, a bond arranger.

Bond financing was chosen for three reasons (NAO 2001):

- The project length, at 37 years, including design and construction, is 4 years longer than the longest period for which banks would have been willing to lend,
- Index-linked finance can be cheaper than fixed rate finance and favours bonds,
- Monoline insurance of a bond reduces the interest rate bonds investors will require and increases the attraction of a wrapped, or insured, bond finance relative to bank borrowing.

Although bond financing was more competitive than bank financing at the time of Treasury funding competition this may not be always the case.

The occupier brief described the required functionality of the facility in technical terms. As we noticed one objective of HMT was a design to back a new business process in the ministry, focused on a team and network way of working more than a hierarchical one. This involved an occupier brief focused on a shift from wholly cellular to partially open plan offices. This activity included a pilot open-plan office. This choice and technical aspects were discussed in many meetings between the design team and Treasury staff, dealing with space design, access control and security, health and safety, information technologies, lift, signage and way…

[5] Public task forces promoting the best practices, technical expertises put in common, free practical PPP guides, standardised contracts or parts of contracts, control of the cost of the advisers are some solutions; but the problem is complex. We just notice that PPP can also concern, like in Italy, small and non complex projects involving local authorities and regional construction firms, without many advisers.

According to the architects, the quality of the occupier brief is one of the success factors of the project. After completion of the refurbishment, the Post Occupation Evaluation is the tool in relation to the occupier brief. This survey, made six months after moving in, dealt with:

- Place: aesthetics, temperature, lighting, cleanliness, workplace, space for concentrated work, space for collaborative work,
- Technology and services: telephones, filing, printing, shredders, information technologies, catering, reception,
- People and processes: feelings, communication, openness and transparency, flexibility in working practices, productivity and innovation.

The level of satisfaction was high: 83 % of respondents said that their working environment had improved in terms of functionality and afforded more opportunities for collaboration. Some critics concerned temperature monitoring, noise and privacy. To change attitudes regarding the suitability of open areas for “private” conversations was wished.

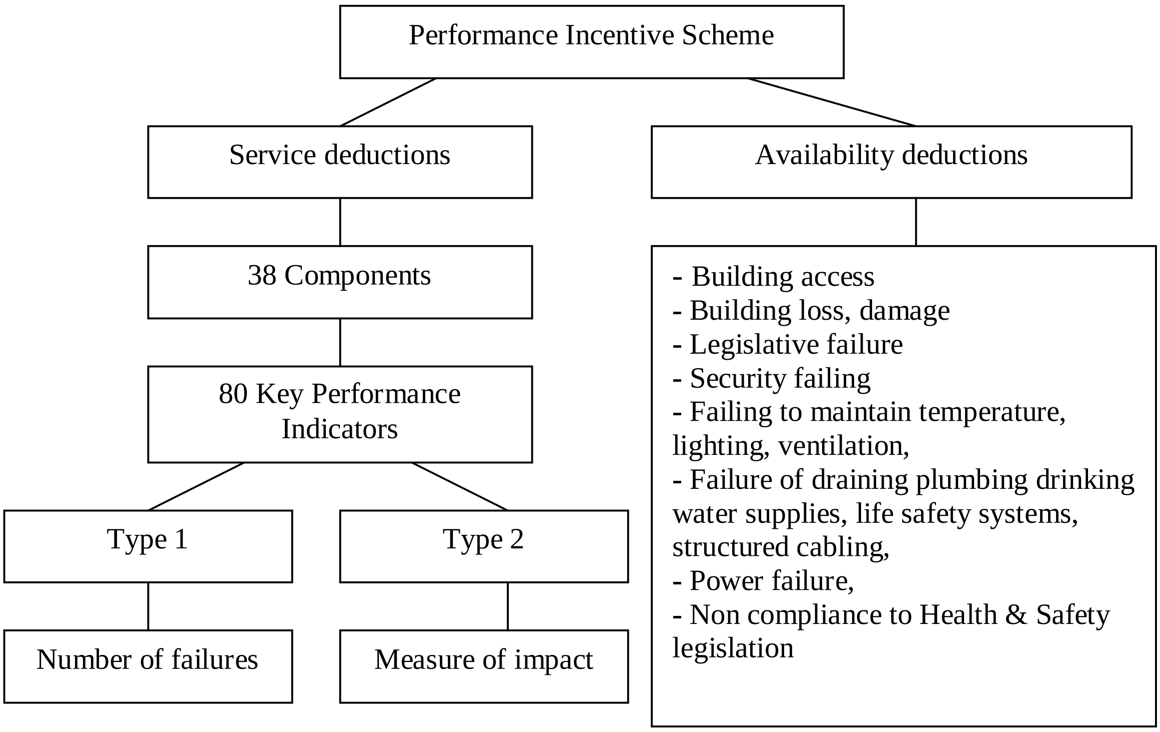
The output brief and tied tools sound very innovative. The output brief deals with the facilities management issues in terms of the service delivered to the users. Facilities management deals with eleven topics:

- Hard services: Mechanical, Electrical, Plumbing (MEP), lifts, building fabric, pest control, furniture,

- Soft services: security, cleaning, catering, waste management,

help desk and general facilities management being used for hard and soft FM.

A Performance Incentive Scheme specifies service and availability deductions. Service deductions concern 38 hard and soft facilities management components and are measured by 80 Key Performance Indicators (KPI). The 67 type one indicators involve financial penalties, the 13 type two indicators do not involve financial penalties.



Source: Exchequer Partner

Figure 2. The Performance Incentive Scheme

Audits of FM made four times per year by the monocline insurer and permanent control by HMT facilities managers fill up this rather sophisticated service control system.

The last topic dealing with methods and competences concerns maybe the most potentially innovative aspect of PPP: the combining of usually separated competences. Figure 3 sums up the separation of the different mobilized competences in separate contracts in a Design Bid Build process. Figure 4 illustrates the combining of the mobilized competences through a PPP long term contract.

The client as investor and as facilities manager, the architect, the construction firms, the facilities management subcontractors work usually in a separate way.

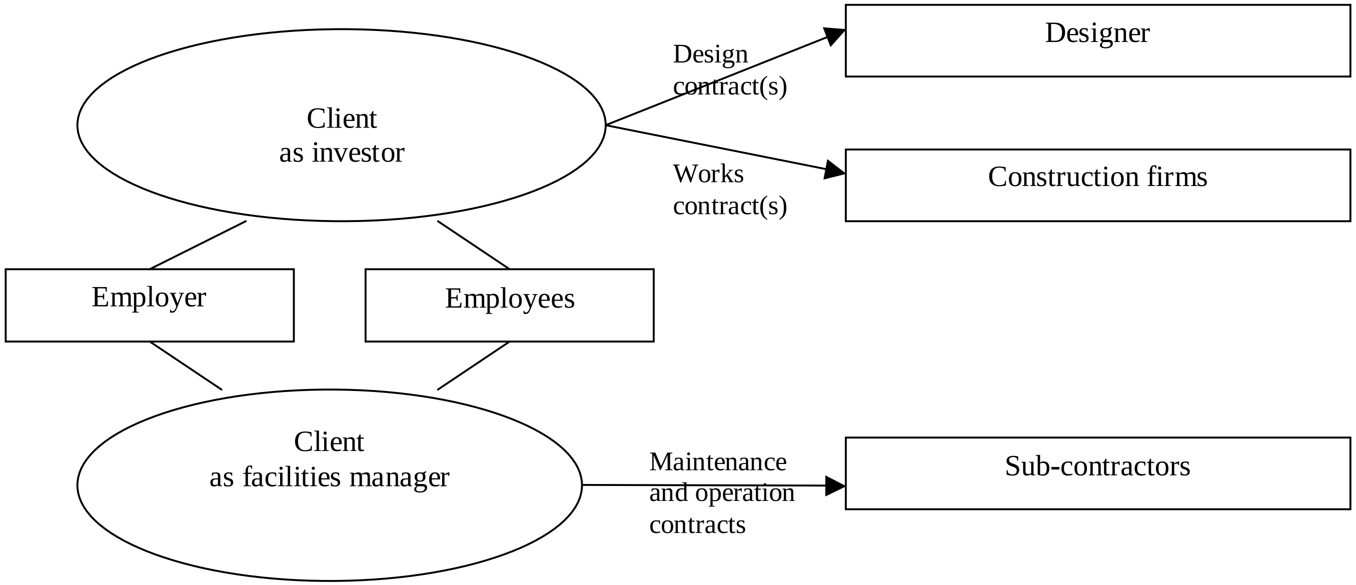


Figure 3. The separated competences in a Design Bid Build process

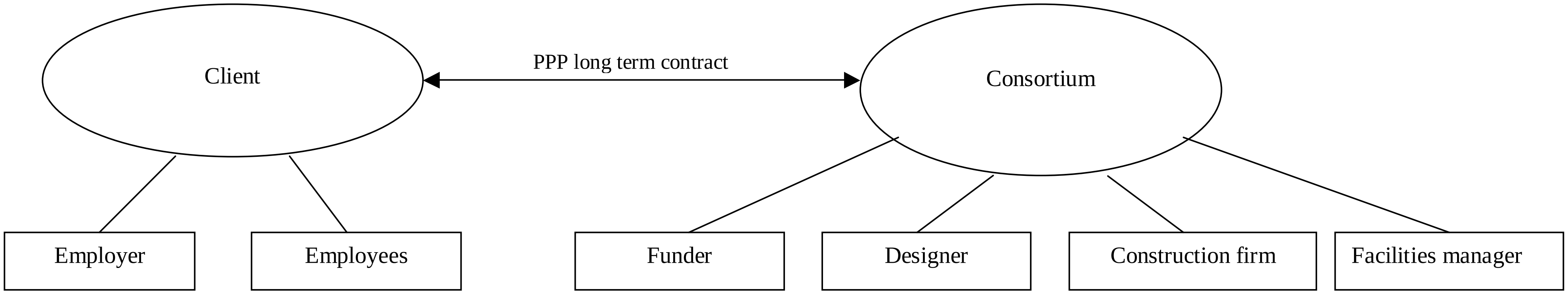


Figure 4. The combined competences in a PPP process

The PPP process obliges them to work together, the result of this combined work being written down in a long term contract. For the first time, the architects designed a building by working with the users and the facilities managers. They told us that this process forced them to look at the project in a new way. The combined competences of the architects and the facilities managers allowed to improve many aspects of the project: heat summer, ventilation, lighting, windows curtains, wall paint, carpet quality etc. The sophisticated service control system is also the result of combined competences of the client and the facilities managers.

The players are not used to do so. PPP is a “learning by doing” process which requires time to learn how to combine the competences. This implies a cultural revolution in the construction industry. For ages, construction and facilities management have been separated. New ways to work together as client, architect, construction firm, facilities managers have to be invented.

This also makes new tools necessary. For example, operation costs data bases are needed. Such data bases, giving the maintenance and operation costs and the link between them and the investment costs, are necessary. There must be practical life cycle costs data bases for each kind of building (offices, hospitals, schools, prisons…), based on real costs, not theoretical ones.

Those data bases and contract contents could be designed in a sustainable way, with new incentives, for example the gains of energy consumption being shared between the public and the private partners. Long term PPP contracts are a very good opportunity to design, build and manage buildings in an environmental friendly way.

7. Conclusion

The Barcet and Tannery (1998) method offers a comprehensive view of a service innovation. Success factors concern each of the four analysis levels. The players have to answer very clearly the strategic questions dealing with the service innovation: What for? What whom? What? How? What with?

The high level quality of the tools and the combined mobilized competences are key success factors of the innovation. We agree with Gallouj (2002) when he specifies a service innovation as the result of a change of the service provider’s and client’s competences, and technical (material and immaterial) characteristics of a process. The analysis of a PPP/PFI project, such as the Treasury Building one, a process service innovation following a methodological “trajectory”, confirms this definition.

The potential of innovation through PPP sounds high. The main innovation is the combining of usually separated competences. This combining of competences is revolutionary in an industry where construction has been for a long time separated from facilities management and use. The efficiency of the PPP process is that the players are obliged to write down in a long term contract the result of their innovative cooperation.

Innovation is just beginning. Practices will change progressively. Some innovations are still potential, such as practical life cycle costs data bases and long term sustainable facilities management.

Actually many PPP innovations could be used to improve the usual Design Bid Build and facilities management processes. Accurate occupier and output briefs, cooperation with the facilities managers and the users, financial incentives to make the works time shorter, multi service contracts, performance indicators, financial incentives for efficient operation are examples of PPP best practices which could be employed to improve usual procurement and facilities management processes.

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Towards the New Criteria of Elderly Housing by the Model of Independent Mobility

M. Himanen,
VTT Building and Transport, Helsinki University of Technology (mervi.himanen@vtt.fi)

Abstract

The approach of the new criteria starts from the existing knowledge, looks the needs and wishes of the seniors and uses the Models of Independent Living and Mobility as means of organising the design knowledge. The approach of the models is qualitative. The outcome of these concepts is shows in so called the activity cards, while the activity was chosen as a dominant factor from the four angles studied in this project of the elderly habitation: activities, abilities, resources and qualities. Another main variable of the Models is resources, which represents more the housing providers approach to the independent living of elderly. The end-user oriented housing design is looking the habitation from the residents perspective, and even in housing provision the activity based approach to habitation will increase while both market pull and technology push domain the design. The Models emphasise the idea that a starting point can be anywhere in the ball: activities, resources, qualities or abilities − depending on the situation and what kind of point of view is taken.

Keywords: housing, design criteria, senior citizens, independent living, end-user requirements, design criteria, Design-for-all, housing surroundings, Model of Independent Mobility

1.Background

This paper is drawing much from the EU Fifth Framework project Elderathome, The Prerequisites of the Elderly for living at home: Criteria for Dwellings, Surroundings and Facilities (QLK6-CT-2000-00405). The focus of the EU-project Elderathom is to develop criteria for dwellings, equipment, surroundings and services so that elderly people can live longer independently at home. Despite the fact, that large amount of general and detailed information is available about the expert knowledge on housing, surroundings and services of the elderly, this information is non-uniform and in a different level in each European country. Summaries and in depth focus on the basic criteria have been identified necessary. Improving the independent living conditions of the existing housing stock has been targeted. The idea has been to improve functioning, in order to obtain better convenience and usability by the elderly. The project will make an inventory of the state-of-the-art of criteria of products and facilities necessary for independent living, identify the wishes and needs of the elderly, identify the criteria for the manageability of housing and suggest new developments in order to contribute future independent living.

If comparison for finding wrights or wrongs, good or bad is not fertile, the identification of similarities and differences internationally in recommendations, regulations and design guidelines make it possible to understand national features and to learn from others when respecting the facts of universal human existence and housing phenomena due to various climatic conditions and rich housing traditions in Europe.

There are three forms of preventing the difficulties due to the impropriate housing condition for the aged residents: renovation and repair of present housing, moving or relying on assistive services, which substitute the difficulties due to the impropriate housing condition for the aged residents. Housing should in the first place satisfy the basic housing needs for shelter and the surroundings are designed accordingly. Apart from the technical aspects of the surroundings of the building, also the quality of the wider living environment is considered. In many cases, it is difficult to make difference between these two approaches to design. The expected better standard of living of elderly sets new questions. What are the modern targets of the good living and what is known about the physical and mental health promotion of elderly? How they have to be taken into account in design of housing, housing surroundings and facilities. Furthermore, how the housing and service providers as well as facilities management can promote new lifestyles of elderly?

The willingness of the elderly to renovate and repair their homes counts. The possibilities of renovating or repair existing housing stock are crucial, while elderly are not very willing to move although that alternative is not totally excluded either [1]. It is questionable if the use of assistive services is a good solution although in many cases a necessity. Renovation or repair is a one-off investment, but services cost repeatedly. The expectation of too high cost effects due creation of too many recommendations and regulations is a reason for deliberation in actions of authorities. It is an interested starting point for the project, while both authorities and voluntary work can benefit from accomplished new knowledge. On the other hand, also such businesses in this area as housing and service providers and facilities management can use this opportunity to reach knowledge of if the end-users or the customers are ready to bye their products.

It is very important to understand and to remember that the new criteria have no intentions to form any kind of minimum or maximum standard not to mention to aim to become a regulation. It is a checklist covering issues related to elderly housing for understanding and checking the situation in each case of elderly habitation.

Housing challenges many fields of sciences. It is a combination of social sciences, cultural history and ethics, economics and housing technology: transport design, town planning or zoning, landscaping, civil engineering, architecture, interior design, structural engineering, and HVAC, electricity and smart house technology. This challenging holistic approach includes also ecological and environmental psychological aspects. The knowledge of economics can be found out rather seldom from national economics, except from municipal economics and economies of households, but the more often from geographical economics, building economics, life-cycle-cost analyses, and from properties and facilities management.

The United Nations General Assembly adopted the UN Principles for Older People, in the year 1991. These call for action in many areas, among them:

− Independence: Older persons should have access to food, water, shelter, clothing, health care, work and other income-generating opportunities, education, training, and a life in safe environments.

− Participation: Older persons should remain integrated into community life and participate actively in the formulation of policies affecting their well-being.

− Care: Older persons should have access to social and legal services and to health care so that they can maintain an optimum level of physical, mental and emotional well-being. This should include full respect for dignity, beliefs, needs and privacy.

− Self-fulfilment: Older persons should have access to educational, cultural, spiritual and recreational resources and be able to develop their full potential.

− Dignity: Older persons should be able to live in dignity and security, be free of exploitation and physical or mental abuse and be treated fairly regardless of age, gender and racial or ethnic background.

Besides the regulations the Finnish housing designers and planners mainly have used the recommendations of the RT direction cards published by The Building Information Foundation (RTS, http://www.rts.fi/english.htm) and occasionally more detailed directions and recommendations including in the TTS Institute‘s Home Economic bulletins. VTT has established a product called VTT Building and Transport ProP® (Requirement Management System). It is a classification, which takes into consideration Finnish and international standards, norms and classifications. It includes all kind of housing and surroundings and is not specified in elderly. Similar classification is: PAYCO in Spain which automatically translates the clients' (with little or no previous experience) requirements into design specifications.

An electronic database called ARVI[1] (arvi.projekti.com) is under the way to become an addition source of valuable information of housing design criteria concentrating on the criteria which is taking into consideration the housing needs of the elderly and disabled. Also new experimental

[1]A method for design of housing for people with limited abilities in mobility and activity.

databases have been created such as VIRAPS[2] (http://viraps.uiah.fi/), which aims to an automatic system suggesting housing designs for the end-users who enter information of their housing needs into database.

There are two certificates for elderly housing in the Netherlands the Woon Keur Certificate (www.woonkeur.nl) and Seniorenlabel. The Europa House Group is constantly working together with the rules for housing in general, not particularly for elderly, but also taking the needs of special groups carefully into consideration.

A large group of people - people with disabilities, older people, children, tall and short people, people with prams, travellers carrying heavy luggage - can all encounter barriers and obstacles in the built environment. The "European concept for accessibility" states (1996):

> *"To ensure equal chances of participation in social and economic activities, everyone of any age, with or without any disability must be able to enter and use any part of the built environment as independently as possible."*

European Manual for Accessible Built Environment was formulated at the end of 1980's and the firs version of the manual was printed in 1990. The idea to write such a manual was initiated by the Central Co-ordinating Committee for the Promotion of Accessibility (CCPT) and the same organisation produced the manual. The objective was to bring about new initiatives to improve the accessibility of the built environment in the European Community. The manual is also hoped to help in standardisation work.

According to the European Manual for Accessible Built Environment all buildings open to the public must be fully accessible, while working places and dwellings can have a standard of accessibility in accordance with the rules of the individual country. Such buildings can be houses, shops, theatres, restaurants, public telephones, banking services, information kiosks, self-service systems, public transport facilities and places of work. In order to use an information and communication technology terminal or other ICT system, the built environment around it must be accessible.

[2] The Internet-based VIRAPS service brings user-orientation into the housing industry by connecting the databases of the various companies involved in the building process. The VIRAPS service allows customers to search the database for suitable apartments in their preferred areas. Customers planning their apartments with the VIRAPS service can customize them according to their wishes and make changes in their interior design. These decisions are divided into environment, construction and infill levels. The integrated cost-calculator keeps customers informed about how their choices affect the final cost of the apartment. User-orientation of the VIRAPS service benefits both customers and companies: customers can balance their needs and desires with the right price, while the companies can increase their turnover and adapt to the markets faster and more accurately.

2. Models of Independent Living and Mobility

The Models of Independent Living and Mobility of Elderly include four main elements or variables: activities, abilities, resources and qualities (Figure 1., Figure 2.). Models describe the idea of different variables needed to be taken into consideration when promoting wellbeing and supporting independent living at home. The Models represent the holistic approach in which different relevant factors are integrated. The variables ensure for example that making reparations meets the requirements of users.

Figure 1: The variables of models of Independent Living and Mobility

The normative mode (the form) of criteria shown in the activity cards (Table 1. to be published at www.vtt.fi) is telling both of the qualities of phenomenon and the reasons why one should have criteria of that kind formulated in easily opening manner. The expressions are focusing on rather needs and wishes than on solutions.

The Models of Independent Living and Mobility are means of organising the knowledge. The approach of the models is qualitative. The outcomes of these concepts are shown in the activity cards, while the activity was chosen as a dominant factor from the four angles of the Models. Another main variable of the Models is resources, which represents more the housing providers approach to the independent living of elderly. The end-user oriented housing design is looking the habitation from the residents perspective, and even in housing provision the activity based approach to habitation will increase while both market pull and technology push domain the design.

The approach of domestication is starting from the facilitation of activities of everyday living and the approach of the housing provision starts from the general principles of quality requirements of housing, which can be realised by certain business activities. The Models emphasise the idea that a starting point can be anywhere in the Model: activities, resources, qualities or abilities − depending on the situation and what kind of point of view is taken.

Figure 2: The Model of Independent Mobility of Elderly.

2.1 Activities

Common housing activities are care and keeping fit, eating, personal hygiene and dressing, moving, recreation, communication and self-actualization, sleeping and resting, gardening and maintenance, housework and storage. They were used in the Model of Independent Living. The Model of Independent Mobility is covering the same activities but looks at activities taking place outside home or activities, which connect home outside surroundings and services (Figure 2.). They can be compared with the Activities of Daily Living (ADL)-indicators, which are often used in the geriatric of a functional capacity of elderly. The activities are divided into the Physical Activities of Daily Living (PADL) and the Instrumental Activities of Daily Living (IADL). However, the new criteria look the activities also from the point of view of abilities when the ADL-indicators look them rather from the point of view of disabilities and limitations in everyday living. The criteria of surroundings can be tailored by the needs of accessing services, the activity level of the senior tenants and not only the current physical and psychological health condition but rather the promotion of health and function − even disease prevention in old age.

Mobility is a basic activity of all activities, which are related to surroundings of homes, the near neighbourhood and connections by information and communication technology and media from home.

2.2 Resources

The surroundings are defined as the area connecting the inhabitants to the outer world, services, activities and social life. The connections and access to services, transport and relatives, friends and other people are needed. This connection can be a concrete one as a corridor, a courtyard, a path. It can be a more abstract one as a link via communication technology or even as an access by virtual reality. These are the resources.

Apart from the technical aspects of the surroundings of the building, the quality of the wider living environment or neighbourhood has also been considered. From the geographical approach can be found that the housing surroundings does not mean the housing unit scale, but the building site condition and in certain extent the neighbourhood, which during a standard house building processes means the street in front of house(s) and the connections to the public municipal services: electricity, water and sewage pipelines if needed, and possible gas or district heating pipeline, and connections to telephone and other communication networks. Within the Elderathome project the neighbourhood was the space within the walking distance from home and surroundings is the area next to the houses. The walking distance is dependent on the ability to walk, but often it means the distance within around 15 minutes' walk. This is for a healthy person roughly 1 km (or a few hundred meters more).

The area in focus is the connecting channel like staircases, lobbies, terraces, courtyard and possible garden, walkways, parking, back lanes and connections to information and transport systems: private vehicles: (airplanes), cars, boats, motorcycles, cycles, public transport and pedestrian and cycling pathways. Examples of resources can be given as:

- Operable building elements (fence, ports, doors, stairs, ramps, lift, locking with doorbells, door telephones and video monitoring)
- Active structures (automated doors, windows, thresholds, curtains, shadings, etc.)
- Storage rooms near entrance for walkers, bikes, skies, other sport equipment, etc.
- Entrance halls or other space for to move or bring in and out goods (groceries, deliveries, repair equipment or furniture)
- Telecottages (and satellite offices), meeting and banqueting rooms, extra quest rooms, space for welfare service or maintenance providers
- Technical and maintenance spaces
- Shelter (shelter for entrance, terraces, barbeques, separate storage buildings, etc.)

− Yards and gardens

− Seats and rest areas on housing surroundings and in the neighbourhood

− Hobby and recreation areas and facilities (plays, shared equipment, etc.)

− Possible domestic appliances outdoors

− Paths (walking paths, sideways, shortcuts)

− Back lanes and streets

− Neighbouring housing, nature and public buildings

− Personal transportation: access to vehicles and parking places or storages

− Public transport: stations, stops and platforms, information (signs, signals, labels and timetables)

− Surfaces, coverings and pavements

− Location of personal business, services or public transport

− Telecommunication – media connections (e.g. gable television, satellite dishes), telephone and data lines, gables and antennas, personal devices of home health care e.g. wearable devices – pendant alarms, vital signs monitors, alarms for safety and security systems (burglar, fire).

2.3 Qualities

There are a good number of qualities, which belong to the general concept of good housing practice or building and maintaining housing. Any of them cannot be left without attention when designing and facilitating built environment. Still, certain ideas of them can be named more important to the criteria of surroundings than those of the dwelling or services (Figure 2,). For mobility, the accessible design (accessibility) is one of the main considerations. Other important qualities for mobility, physical surroundings and connections are availability, Design-for-All, sustainability, re-thinking of chains, safety and security, user-connectivity, usability, Technology-for-All and transparency. Such qualities as availability, affordability, Design-for-All, user-connectivity, productivity, quality engineering and standards, usability concern all activities and are not mentioned in the activity cards separately. However, some of them are not very well developed in the context of built environment: user-connectivity, usability, Technology-for-All and transparency.

The quality of multi-, inter- and transdisciplinarity is not mentioned in the list while it is everywhere present. For the need of easy access to the activity cards, a hierarchy of the qualities is helpful.

Qualities are essential for good design in any case, and cannot be excluded in criteria, which aim rather to a general checklist than to detailed instructions. In a complex modern world the basis of the design principles can be even forgotten during the sophisticated design work and there are almost never too many checklists. Most of these qualities are well known in the context of housing and building. Some of them might need some specification in the context of elderly housing.

2.4 Abilities

The Elderathome project is focusing on those, who are in old ages:

- Able to live independently in an improved environment,
- Able to live independently in an improved environment and with services provided at home or
- Willing to live in an environment designed specially for health promotion.

The Elderathome project is not especially interested in those who:

- Are able to live independently in any environment or
- Have health problems needing specialised care permanently.

Not all elderly have severe disabilities, but the prevalence of disability or limitations is the highest amongst this demographic group. In the old ages the physical abilities, senses and cognition tend to weaken. The impaired abilities often lead to a need of outside help or arrangements in the dwelling and they are especially significant when considering independent living at home. The abilities, however, not the disabilities make the independent living possible. However, many elderly can trust their long life experiences and their good psychological and social skills as well as their mentality in the independent living conditions, if something unexpected will happen or despite the impairments of old ages [3], [9]. On the other hand, also these previously mentioned abilities might fail and cause problems. Some elderly are for example too lonely or too scared in order to live alone or independently, although their physical condition would allow them to do so.

The abilities for the Model of Independent Mobility were determined together with Veli Himanen on the basis of the work we have done on human and technological intelligence [4], on CEN/CENELEC Guide 6 [1] and the latest literature on psychology, e.g.[1]. They are as follows:

- Physical (dexterity, movement, manipulation, reach, seizures, strength, voice)
- Psychological (temperament, feelings, behaviour patterns; habits, addiction, motivation)
- Emotion (the consequence of bodily reactions and mental modes due to stimulus, or sensing and feeling)
- Instinct (genetically programmed behaviour)
- Sociability (social relationships, group behaviour, social life and norms)

- Sensory (hearing, sight, taste, smell, touch, balance)
- Cognitive (understanding, integrating and processing of information)
- Intellect (know, comprehend and reason; knowledge management, memory, learning)
- Spiritual (intelligence for creativity or for satisfaction of needs, intuition to reach tacit knowledge and handle instincts with intelligence, mental growth and transcendency).

3.Implementation

New criteria is suggesting concepts for lacking existing design criteria and formulating criteria out of them shown by activity cards (Table 1.). A starting for organising the existing design criteria was found from the accessibility strategy of the Ministry of Transport and Communications Finland [10] covering equally all people, feasible for independent living of elderly housing and surroundings especially after the problem of noise and lack of light and awareness were added, classifying problems of environment:

- Differences between levels
- Need of space
- Reaching distance especially when carrying items
- Orientation especially in finding ones way if sight is not good
- Balance in stairs, ramps and vehicles
- Reach of small people and wheel chair users
- Lack of strength in opening doors
- Complexity in use of technology and in understanding information contents
- Safety of infrastructure and maintenance
- Allergy; respiratory in particular
- Inequality caused by environment
- Noise
- Lack of light
- Lack of awareness.

Table 1: An example of an activity card.

Criteria	Variable		
	QUALITY	**ABILITY**	**RESOURCE**
Reaching distance It is important to reach certain basic services and being active on daily basis in the surrounding neighbourhood or in local village, while the visits to rural centres and cities are done more occasionally. It is easy and appealing to move, walk or run and reach the needed destination for running errands, reaching services, meetings and visits, promoting physical and mental health. There is possibility and adequate easiness to use private car. The uses of vehicles for reaching cf. Transport.	Accessibility Re-thinking of chains Sustainability Eco-efficiency Flexibility Adaptability Assortment Safety & security Functionality Comfort & amenities Aesthetics	Physical Psychological Sociability Intellect	The routes are short. The ramps are not too steep and long. There are enough and comfortable resting places available in the housing surroundings and neighbourhood, in the paths and especially on the way to stops and stations. Parking places near dwellings are safe and conveniently arranged. Parking garages are social secure and are good to manage. The sitting areas; seats and other public furniture are attractive. There are shelters in the mobility area. Because it is difficult to carry items such as groceries and equipment for activities, there can be lockers for temporary storing along the routes. For chaining of various transport modes there are locked shelters for vehicles or moving aids for periodic storing also in the near neighbourhood (e.g. parking of a walker) or in the stations are available walkers and rollers for use during walks. The housing complexes are in attractive scale and the opening up is conveniently arranged and recognisable. Town planning is based on the human scale as well as the use of car (cf. Transport).
Need of space It is easy to use a walker and cycle or bike (or use a preferred means). When running errands in offices etc. it is possible to have enough space provided for to operate and put and have things in a safe place.	Accessibility Flexibility Adaptability Safety & security Functionality Comfort & amenities Aesthetics	Physical Psychological Sociability Spiritual	Sufficient dimensions, finish, design and layout of: o Shared spaces and spaces for entering and exiting o Courtyard and garden o Paths, ramps o Parking places, pathway form the parking area to the home entrance o Streets, walkways and alleys o Stops and stations o Plazas

The end-user interview revealed that senior citizens are not necessarily aware of the possibilities how the housing can aid independent living [1]. The aim of the criteria is to raise awareness of how built environment can help the elderly and other parties involved to plan the possible changes for provision of independent living in their present homes. The new criteria form, in the first place, a framework and a checklist for the occupants, designers and service providers for common understanding of needed changes of individual senior citizen's habitation. The new model can be used in two ways:

− As a tool for analysing the existing knowledge and as a tool for formulating the comprehension of the habitation of the elderly and formulating a criterion out of them

− It can serve as a planning tool for empirical cases and be a generator of new ideas for implementation and criteria.

The thinking behind the existing criteria seems to be based rather on common habitation in cities and in suburban areas than that in the rural areas or surroundings of private housing. Living in block of flats or in other types of common housing arrangements are in focus. The new criteria of surroundings are not − at least purposefully − making this type of discrimination between the habitation and living styles of elderly. The existing criteria are numerous rather of limitations than of alternative advices and solutions when facilitating the independent living. The human disabilities and impairment lead the thinking. The new criteria of surroundings tend to suggest some advancement of this respect by looking also the abilities of elderly due to e.g. long and rich life experience and the freedom of selecting alternative living styles and surroundings. Not always, but in some cases the long life experience stand for better awareness of ones abilities and their relation to the possibilities in life in general and also of what is possible due to the surrounding conditions including built environment. The better understanding of life makes the social relationships and social skills valuable.

4.Conclusions

There are two tasks for the criteria of surroundings. They shall be designed to avoid obstacles such as:

− Insecurity

− Costly economics of facilities management (high housing costs - affordability)

− Distance

− Uncomfortable design

− Unattractiveness

− Bad weather

− Arguments against bad sociality and too small privacy

− Physical obstacles

− Lack of connections: parking places, public transport, etc.

− Attitudes of housing mangers and other tenants,

− Interim obstacles

− Lack of binding regulations that specify preciously the interpretation of the concept of housing and surroundings of independent living of elderly,

− Lack of European wide harmonised advisory guidelines

− Ignorance and lack of awareness of the effect of built environment for independent living of elderly

− Elderly housing has not been regarded as big business

− Laws and building norms are too weak to facilitate independent living of elderly

− .

Such examples of the obstacles can be mentioned as public transportation may be inaccessible and unavailable; attendant care services may be inadequate and dehumanizing; income maintenance programs and health care assistance can be inadequate informed; or community facilities and programs may be unresponsive and inaccessible. In addition, individuals may not be able to get out of their homes or get around inside because of architectural barriers. Even in the housing environment there are numerous issues which people confront. Landlords may discriminate against elderly people. Landlords and tenants can be patronizing and create problems for visiting home care attendants. Housing can be unaffordable, especially for people with low to moderate incomes. Large housing projects are often unsafe and may not have adequate accessible neighborhood facilities. Also, many communities do not have emergency housing hostels and facilities which are physically accessible.

On the other hand, they can promote the quality of life and make the every-day life not only easy but also enjoyable. This part is not very fully covered in the existing knowledge of independent living and housing surroundings and neighbourhood.

Some suggestions for bettering the situation can be made:

− Inform the market

− Coordination between countries in creation of housing norms and specifications (EU Directives)

− Close collaboration between politicians, technicians and citizens

− The will to co-ordinate all the agents involved and programme the interventions

− Including the knowledge of special housing and surroundings concepts as the independent living of elderly in the education of architects and building engineers

− Making fully clear who is responsible for applying new concepts

− A more accurate analysis of the effects of adaptations of built environment for independent living of elderly

− Identifying the areas where common requirements are most important

− Facilitating the change in built environment for the independent living of elderly by supporting financing systems (loans, allowances).

Kose [7] has stated good questions about the design criteria of built environment of elderly:

"Safety: To what extent should safety be pursued?

Health: How healthy[3] an environment can be?
Function: How convenient should a house be? (How does one distinguish convenience from laziness?)
Comfort: How would a stimulus-free environment affect a human being?
Economy: Who will eventually bear the cost?"

The criteria of surroundings is highlighting not only the problems with built environment but the criteria cover also the way of having fun, pleasure, environmentally comfortable. Resources include possible solutions without any prejudice to what is suitable to offer to elderly; it is their own choice and a right of all to choose from what or from the best engineers and architects can offer.

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