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FACILITIES MANAGEMENT AND MAINTENENCE Human Elements in Facilities Management - Understanding the Needs of Our Customers

Proceedings of the CIBW70 2004 Hong Kong International Symposium Kowloon Shangri-La Hotel, Hong Kong 7th – 8th December 2004

Edited by

Danny Shiem-Shin Then The Hong Kong Polytechnic University Keith Jones

University of Greenwich

John Hinks Royal Bank of Scotland



Working Commission 70 Facilities Management and Maintenance

International Council for Research and Innovation in Building and Construction

Organised by

Department of Building Services Engineering The Hong Kong Polytechnic University International Council for Research and Innovation in Building and Construction

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Further Copies may be ordered by contacting:

Dr Danny S S Then. PhD, MSc, BSc(Hon), F.PFM, MBIFM, MCIOB, MCMI. Associate Professor, Programme Leader – Graduate Programme in Facility Management Department of Building Services Engineering The Hong Kong Polytechnic University

Tel: ++852 2766 4558 Fax: ++852 2765 7198 Email: bessthen@polyu.edu.hk



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International Council for Research and Innovation in Building and Construction

Foreword

Dr Wim Bakens CIB Secretary General



Working Commission W70 has a proud history of success and growth since its inception in the late 1970s, sustained by a common vision that the successful management of the built environment must embrace a holistic view of the built facilities as a sustainable business resource in an increasingly dynamic world.

In moving from a backroom function into a position of potential influence in developing strategies to support the achievement of business goals, the constant challenge for facilities management is, and will remain, the ability to continuously adapt and add value through providing innovative facilities solutions – whether that be a portfolio realignment as a result of corporate downsizing; introduction of flexible working practice; creating a teaming workplace environment or a radical outsourcing of traditionally in-house services.

It is particularly pleasing to note that despite a slight setback initially, CIBW70 has managed to maintain its biannual cycle of symposia. The theme of the 2004 Hong Kong Symposium reflects a timely consideration of human issues in the continuing development of facilities management and asset maintenance. I hope the Symposium will indeed turn out to be both a platform for the modern thinking experts in the area, and go a long way in raising awareness in the *Human Elements in Facilities Management*.



International Council for Research and Innovation in Building and Construction

Preface

Dr Danny Shiem-Shin Then

Joint-Coordinator CIB Working Commission W70 Facilities Management and Maintenance



The CIB Working Commission W70 on *Facilities Management and Maintenance* reflects the maturing and acceptance of a management approach of built facilities that is customer-focused and business-driven. The 2004 Hong Kong Symposium's theme on *The Human Elements in Facilities Management – Understanding the Needs of Our Customers*, provides a focus on the soft side of facilities management which is at the heart of most initiatives aimed at organisational (cultural) change and process improvements.

Over the last two decades of my involvement with CIBW70 I have seen shifts in focus from technical considerations to management issues in relation to the physical assets (i.e. buildings) in the 1970-80s, to integration of functional processes in the 1990s. In the 21st century, the emphasis seems to polarised towards a realisation that business outcomes have a better chance of being fulfilled when limited resources are appropriately combined to deliver set targets. In facilities management and maintenance, our efforts are often seen by the uninitiated as being reactive and defy effective management. The notion of innovations in FM seems alien to a business that is seen as both labour intensive and repetitive. Yet, in my opinion, it is the very diversity of facilities management that lends itself to innovative initiatives.

Providing support to business achievements in terms of appropriate facilities and support services is core to facilities management, whether in-housed or externally sourced. The main differentiator of good facilities management is no longer technical competences but relies on skilful procurement and management of resources (people, property and technology), grounded on a thorough understanding of supporting business needs within a level of affordability.

The broadening acceptance of facilities management as a profession is already evident in at least five continents. The skills set in facilities management potentially covers areas in strategic facilities planning; space planning and workplace strategies; asset management and maintenance; and facilities support service procurement and management. The creative potential in FM does not lie in looking at each of these areas in isolation. FM innovations must arise from new enabling processes, enhanced capabilities and new relationships between the various stakeholders. Clearly, there will be a period of adjustments in culture and training before real benefits can be realised. But there is no denying that we are in a period of development that offers opportunities for FM to be embedded as part of an overall business planning process. For multi-national businesses, the facilities dimensions are not longer national in context; very often, corporate facilities issues are dealt with on a regional or even global scale.

Working Commission W70 has, and will continue to be, a unique forum for voicing or even debating changes in education and training, research and practice, new relationships between stakeholders. FM is in the midst of transformations in the procurement of building and infrastructure and their associated services of ongoing management and maintenance. The continuing challenge of W70 is to remain relevant against this sea change brought about by convergence in digital and communication technologies and social transformation in lifestyles and work in the future.

The content of the CIBW70 2004 Hong Kong Symposium clearly testify to the diverse scope of facilities management and asset maintenance. This, in my opinion, is a big plus for the FM discipline when viewed from a corporate setting in a dynamic business environment. I sincerely hope the Symposium meet up to your expectations as a forum of exchange of knowledge and practice.

I am particularly grateful for the generous industry sponsorships from Hong Kong Land, EastPoint Property Management Ltd., Urban Group and the two FM professional institutions: The Hong Kong Institute of Facility Management and The International Facility Management Association (Hong Kong Chapter), In addition, I would also like to make a special mention of the *Royal Bank of Scotland FM Innovation Challenge*. A session of the Symposium has been devoted for the finalist of this unique competition; the winning institution will receive a fully funded doctoral scholarship.

I would like to express my appreciation and thanks to members of the Hong Kong 2004 Organising Committee and members of the Scientific Committee and to all contributing authors for their valued contributions. My thanks also to Moira Kwok for her expert handling of the venue arrangements; Persia Lai and May Chan from the General Office of BSE Department.

November 2004 Hong Kong

Contact Address:

Danny Shiem-shin Then, Associate Professor Department of Building Services Engineering The Hong Kong Polytechnic University Hung Hom, Kowloon Hong Kong CHINA

Tel: (852) 2766 4558 Fax: (852) 2765 7198

Email: <u>bessthen@polyu.edu.hk</u>



Hong Kong 2004 International Symposium

Facilities Management & Asset Maintenance 7-8 December 2004, Kowloon Shangri-La Hotel



The Human Element in Facilities Management: - Understanding the Needs of Our Customers

Keynote paper

A New FM Industry for a New World?

Peter McLennan

Course Director, Facility and Environment Management, University College London, UK

We stand in our own shadow and wonder why it is dark' Zen Koan

Peter will analyse whether the rise of the FM Industry was classically innovative and representative of *doing different things*; or whether what emerged was more a matter of just *doing things differently*. Taking the FM service supplier sector as its focus, Peter will debate the evidence for and against innovation in today's FM Industry. He will then consider the scope for, and mechanisms to ensure, future innovation. The roles of the FM client and the research community in FM innovation will also be discussed.

Peter McLennan is the joint course director of University College London's Facility and Environment Management programme. His teaching and research work in facility management is focused on defining, predicting and evaluating organisational requirements for the occupation and use of buildings. This work is best described as applications research working in collaboration with commercial organisations. His current development in the FM portfolio of work is the establishment of the Workplace Innovation Centre sponsored by the Royal Bank of Scotland.

MAINTAINING CUSTOMER SATISFACTION: AN ORGANISATIONAL JUSTICE APPROACH TO FACILITIES MANAGEMENT

Lisa Campbell

Edward Finch School of Construction Management and Engineering,

The University of Reading, UK

Abstract

Customer satisfaction with facilities changes is determined not only by the efficacy of a decision, but also by the communication and management of user expectations during its implementation. In every organisation there are unforeseen changes which bring about upheaval in the form of relocations, refurbishments or service changes. Such changes make it difficult for facilities managers to meet customer expectations. How can facilities managers satisfy the needs of customers when such needs change so frequently? *Organisational justice theory* advocates that where managers do not have the resources available to meet employee demands, the procedures used to divide what resources are available may be used to sustain satisfaction. Even in the face of mistakes and unsatisfied expectations, individuals will often be 'won over' by timely intervention and empathetic treatment. The strengths and weaknesses of different forms of procedural justice such as communication and participative decision making are discussed in the context of a multinational pharmaceutical organisation, and the theoretical background supporting the use of a service culture within facilities management is presented.

Keywords: Organisational justice, distributive justice, customer satisfaction, focus groups, participative decision making

INTRODUCTION

While many researchers have attempted to identify aspects of design and performance that most significantly affect end-user satisfaction, it may be argued that the management process involved in introducing such changes (e.g. a new facility or workplace) may be equally if not more influential. Finch (2004) proposed that customer satisfaction with facilities is determined not only by technical performance, but by "an intricate set of exchange processes" such as effective communication and management of expectations. Yet in every organisation there are uncontrollable variables and unforeseeable changes which result in alterations to deadlines and diminished resources. How can facilities managers satisfy the needs of customers when both these needs and the environment in which they are operating change so frequently? Uncertainties arise in (1) matching unpredictable space demands with supply; (2) managing refurbishment of outdated facilities; (3) conflicting approaches of in-house and contracted-out service providers; (4) dealing with the competing space and service demands of different departments; (5) combining long-term strategy (e.g. adjacency needs) with immediate requirements (e.g. arrival of new employees).

As the size of the organisation increases, so too does the complexity of the facilities strategy. Explaining to department heads that their needs have been built into the strategic plan and will be met over the coming four years is of little consequence when they have to deal with the imminent arrival of staff. So how can facilities and accommodation management groups appease their customers in the intermediate term? In this paper it is postulated that customer satisfaction can be achieved by adopting a service rather than a technical approach to the management of facilities, by focusing on *organisational justice* and maintaining perceptions of fairness amongst customers. More specifically, an emphasis is placed on *procedural justice*, as it is considered to be the most influential form of justice in the delivery of facilities management services.

The facilities management department participating in this research catered provided for over 7,000 employees in a multi-national pharmaceutical organisation. Over the course of the study,

more than 30 customers were interviewed as to their satisfaction regarding the facilities management services. In addition to this, the research team observed an established User Group Forum, composed of a cross-functional team of managers responsible affected by strategic and operational facilities management decisions.

The study provides an overview of organisational justice theory, before reviewing in detail the different forms that this may take. Each of the different forms of organisational justice is then considered individually, and discussed in the context of the participating organisation. Both the interviews that were conducted and observations that were made in the cross-functional decision making forum provided support for the theoretical framework that is presented. In this way, the paper addresses both the theoretical background of justice theory, and its application to the facilities management sector.

ORGANISATIONAL JUSTICE

Organisational justice may be defined as employee's perceptions of the fairness with which they have been treated by an organisation or organisations. There are a range of theoretical perspectives which examine the concept of organisational justice and the importance of maintaining perceptions of fairness in the workplace. Examples include equity theory (Adams, 1965), social exchange theory (Homans 1961), relative deprivation theory (Martin, 1981), justice motive theory (Lerner, 1977) and justice judgement model (Leventhal, 1976). Studies in these areas have shown that perceptions of injustice may not only lead to dissatisfaction, but also decreased job performance (Greenberg, 1988), poorer quality of work (Cowherd & Levine, 1992) and less co-operation with co-workers (Pfeffer & Langton, 1993). The two fundamental building blocks of organisational justice theory are distributive and procedural justice, which are now amongst the most widely researched concepts in this field. The primary distinction between these two forms of justice is that the former refers to what the outcomes of organisational decisions are, whilst the latter is concerned with how the decisions are made. A third dimension of organisational justice, called interactional justice, is concerned with the sensitivity with which information is communicated.

Distributive justice refers to the allocation of resources (Homans, 1961), or the perceived fairness of the outcomes that an individual receives from organisations (Folger & Cropanzano, 1998). Outcomes may be distributed on the basis of equality, need or contribution (Leventhal, 1976) and individuals determine the fairness of distribution through comparison with others. However, with the finding that the procedures used to determine outcomes can be more influential than the outcome itself, the emphasis has gradually shifted from distributive to procedural justice. Procedural justice, on the other hand, may be defined as the fairness of methods, mechanisms and processes used to determine outcomes (Folger & Cropanzano, 1998), or the perceived fairness of the procedures used in making decisions (Folger & Greenberg, 1985). Lind & Tyler (1988) investigated relational approaches to fairness and argued that norms that develop through identification with groups, lead individuals to develop a commitment to social procedures and power relations. These in turn are used to make decisions on procedural fairness. Fair procedures should be consistent, bias free, accurate, have correction mechanisms in the case of mistakes, take into account the concerns of all parties and be morally acceptable (Leventhal, 1980). Tyler & Bies (1990) identified five factors that influence employees' perceptions of procedural fairness in organisations; (1) adequate consideration of the viewpoints of others; (2) consistency in the criteria on which decisions are based; (3) bias-free; (4) the provision of timely feedback; and (5) effective communication of the basis for decisions. A sixth element which may be added to this (although it is perhaps arguable whether it represents and independent criterion) is whether decision makers themselves accept the terms which they are presenting to employees. Thibaut & Walker (1975) further subdivided procedural justice into two components, namely process control ("voice effect") and decision control ("choice effect"). Process control allows an individual to control the submission of evidence to support their case during the process, such as adjacency studies which require customers complete questionnaire that rate and explain the importance of working adjacent to specific work groups or departments. This information is then incorporated into the decision to relocate workgroups according to the needs specified. Decision control on the other hand refers to involvement in actual decision making, where for example department managers vote as to which workgroup should be given priority in the allocation of new space that has become available.

In terms of operational implementation of procedural justice, there are a number of forms which it may take and which can be placed on a continuum according to the level of employee involvement. Examples drawn from research conducted by Osburn et *al.* (1990) include;

Managers make decisions on their own, announce those decisions to employees, and then respond to questions

- Managers seek employees' views before making decisions
- Managers formulate temporary work groups to recommend solutions to particular problems
- Managers meet regularly with groups of employees to identify and recommend solutions
- Managers establish and participate in cross-functional problem solving teams
- Ongoing work groups assume expanded responsibility for achieving specific organisational goals.

The levels of employee involvement listed above are comparable to Tannenbaum & Schmidt's (1973) dimensions of leadership behaviour. They put forward a framework in which they specified gradients of (what we can now term) procedural justice, according to the use of authority by managers. These researchers identified seven different patterns that managers can choose from in relating to his or her employees, which can be placed on a continuum along the dimension of employee involvement:

- The manager makes the decision and announces it
- The manager "sells" his or her decision
- The manager presents his or her ideas and invites questions
- The manager presents a tentative decision subject to change
- The manager presents the problem, asks for suggestions and then makes the decision
- The manager defines the boundaries within which the decision must be made and passes the decision to the group
- The manager allows the group to make decisions within prescribed limits

Support for the beneficial effects of procedural justice and its supremacy to distributive justice in terms of influencing behaviour has emerged in a wide variety of settings. Thibaut & Walker (1975) examined the concept in a legal context and found that disputants were willing to accept a decision with which they had disagreed if they could see that the process by which it was decided was fair. Similarly, Tyler & Folger (1980) found in the context of police-citizen encounters, that individuals who felt they had been fairly treated had more positive evaluations of their dealings with the police, and of the police force in general, regardless of whether or not the police solved the problem which they had been called to address. It was reported by Greenberg (1987) that where outcomes or rewards were perceived as unfair, just procedures lead to an increase in the mean perceived fairness ratings of those outcomes. That is, perceptions of procedural justice can alter and influence perceptions of distributive justice. It was also demonstrated that fair procedures were perceived as fair independently of the outcomes of those procedures. This is consistent with the hypothesis put forward by Leventhal (1980) who proposed that "If the procedures are seen as fair, then the final distribution is likely to be accepted as fair even though it may be disadvantageous" (p. 36). Investigating this hypothesis in the context of a multi-national organisation, Kim & Maugborgne (1996) examined the effects of perceived procedural justice on manager's commitment to implement decisions. They found that as perceptions of procedural justice of the decision making process increased, their commitment to implementing the decisions (i.e. the outcome of that process) increased.

A further form of organisational justice which facilities managers may use to influence levels of satisfaction amongst customers. Inter-actional justice is defined as the quality of inter-personal treatment that an individual receives during the enactment of organisational procedures (Bies & Moag, 1986). Simply put, it is the manner in which information is communicated. In the context of facilities management, this involves taking on board the concerns of customers, listening to their needs, and displaying empathy and understanding. Bies & Moag (1986) reported that treating individuals affected by a decision in a courteous and civil manner helped to maintain perceptions of fairness. There are two distinct components of inter-actional justice, namely interpersonal sensitivity and social accounts (Folger & Cropanzano,1998). The former refers to maintaining a polite and considerate approach to others, whilst the latter includes the provision on adequate

explanations for undesirable outcomes. There has been much debate as to whether this represents an independent construct or whether it is a sub-type of procedural justice, but regardless of such debate, the results of research to date suggest that courteous treatment of individuals contributes to perceptions of fairness.

Dimensions of Procedural Justice in Service Provision

So what impact do these findings have on the role of facilities managers and their ability to sustain customer satisfaction? The findings highlight employees understanding that while managers are often unable to control outcomes, they can influence the procedures involved. Facilities managers do not have at their disposal the resources to satisfy the needs of all facilities management customers (i.e. the ability to maintain perceptions of distributive justice), however they do have the ability to affect how resources and services are distributed and allocated amongst customers in the organisation. As specified by Osburn et al. (1990), forms of procedural justice can be graded according to the level of employee involvement, or in this case, customer involvement. Customer participation in facilities management activities can range from one-way communication to participative decision making, to ongoing customer focus groups that recommend appropriate courses of action and engage in problem solving activities. Indeed, levels of input can even be increased so far as to grant customer focus groups authority to make decisions over which facilities managers have a veto.



Level of Facilities Management Customer Involvement

Figure 1: Graded Dimensions of Procedural Justice in Facilities Management Service Provision

ONE-WAY AND TWO-WAY COMMUNICATION

Communication may be seen as a form of process control (i.e. voice effect), or as a means of allowing employees to express their views on decisions affecting them. Simply put, it provides individuals with an opportunity for self-expression. Gibson (1981) proposed that there are two reasons why communication is of key importance within organisations. It is fundamental to the meeting of both economic needs (in the interests of survival or further progress, firms must communicate with their employees), and social needs (employees need to be consulted and involved in the business). According to Folgers (1986) referent cognitions theory, adequate explanations allow individuals to place their under compensation in context by helping them to understand that things could have been much worse. Supportive communication also reduces perceptions of uncertainty and reduces stress by helping employees to develop a sense of perceived control (Albrecht & Adelman, 1987). Numerous studies have demonstrated that communication represents a highly effective means of upholding the perceptions of fairness necessary to maintain satisfaction. Greenberg (1987) reported that even when individuals were unhappy with the outcome of a process, open communication lead to less dissatisfaction and fewer dysfunctional outcomes. Redding (1972) reported a positive correlation between a manager's open communication and employee's satisfaction with the relationship. In 1990. Greenberg conducted a study in which employees were informed that they would be receiving a 15% pay cut either with or without an explanation. He examined the effects on turnover and office theft and found a significant increase in both variables amongst employees who had not been provided with an explanation for the pay cut. Levels of turnover and theft amongst employees were parallel to the control group where employees were provided with a full explanation and an open questions-and-answers forum was held.

The benefits of effective communication are not confined to increased satisfaction. The Institute of Directors (1981) investigated organisational responses to the introduction of communication programmes and found that 65% of managers reported increases in productivity, 80% reported that there were improvements in morale and organisational loyalty, 46% reported reduced employee turnover, 41% reported decreases in absenteeism and 68% reported fewer industrial disputes. Only 3% of the 115 managers interviewed found that the introduction of a communication programme was ineffective in bringing about improvements. Some channels of communication (e.g. team briefings) were found to be more effective than others (e.g. company publications).

Methods of communication which may be employed by Facilities Managers include: meetings with line management; e-mails to the customers involved; a help desk to provide telephone support; and web based systems which allow customers to view the status of their requests. Based in a multi-national pharmaceutical organisation, over 30 semi-structured interviews were undertaken with facilities management customers across a wide range of departments. Customers were questioned as to the types of information they wished to receive, the mediums through which they would like it to be communicated, and the shortcomings of the existing communication process. The results revealed the strengths and weaknesses of the aforementioned mediums of communication between facilities management service providers and their customers. Whilst meetings with departmental managers lead to satisfaction at a managerial level, in practice, this information was not always disseminated amongst employees, particularly in larger departments. Meetings were also reported to be a highly time consuming method of communicating facilities management information with managers reporting that only 20 - 25% of agenda items were of direct relevance to their department. Whilst personal e-mails were welcomed, customers reported that circular e-mails were ineffective and reading them was not considered to be of high priority. The introduction of a web-based system to track requests was received positively by customers with the condition that it was accompanied by a personal point of contact, and it was emphasised that an automated system to which individuals could not respond should be avoided. A manned help desk which customers could contact to receive updates was the favoured medium of communication. The help desk should be able to provide customers with information on when their request will be completed, the reasons for alterations to timescales and should guide the customer through the procedures involved in processing their request.

PARTICIPATIVE DECISION MAKING AND THE USE OF FOCUS GROUPS

Continuing along the dimension of increased customer involvement, participative decision making (PDM) represents a powerful method for enabling procedural justice. PDM is defined by Heller et al. (1998) as "the totality of forms, i.e. direct (personal) or indirect (through representatives or institutions) and of intensities; i.e., ranging from minimal to comprehensive, by which individuals, groups, collectives secure their interests or contribute to the choice process through self-determined choices among possible actions during the decision process." (p. 42). The 1990s saw a trend in the decentralisation of decision making power, with organisations such as AT&T, General Electric, Eastman Kodak, Fiat, Motorola, United Technologies, Xerox and Ford moving decision rights to lower levels of the hierarchy (Dessein, 2002). Management studies have found the benefits of increasing employee involvement in decision making include lower job strain and dissatisfaction (Parker et al., 2002). It has been linked to increases in satisfaction (Miller & Monge, 1986), innovativeness (Hurley et al. 1998), motivation, commitment and communication of information (see Locke et al. (1997) for review). Studies have also reported PDM to be related to competence and efficiency as well as reduced costs (Hunt & Vogt, 1988; Marchington & Loveridge, 1979). Ashmos et al. (2002) argued that it not only provides a means to enhance motivation and commitment, but also knowledge generation and connectivity in an organisation. Other benefits include improved quality of decisions (Frost, Wakeley & Ruh, 1974) and increases in trust which in turn can reduce resistance to change amongst employees (Gabris & Kenneth, 1986; Carnevale & Wechsler, 1992).

Cropanzano & Folger (1989) demonstrated the beneficial effects of PDM as a form of procedural justice. They conducted a study in which participants were asked to perform two tasks, one of which would count towards earning a reward. One group were allowed to choose which of the two tasks would count whilst for the second group, the experimenter chose which task would count. Although all participants were informed that they had been unsuccessful on the task, feelings of unfair treatment were absent amongst participants who had been involved in the

decision making process. They concluded that when subjects were involved in decision making, feelings of unfair treatment were absent regardless of the outcome of the procedure. Researchers have shown that employee interest in participating in decision making is highest when decisions affect their own positions (Gardell, 1977) or when decisions directly impact on the work environment (Bartolke, Eschweiler, Flechsenberger & Tannenbaum, 1982). Placing PDM in the context of the current case study, the participating organisation established a User Group Forum which inputted into the decisions made by the facilities management department. In this forum, senior representatives from each department met with Facilities Managers at scheduled intervals to receive updates as to the organisations facilities management strategy, and to allocate available resources (primarily accommodation) to work groups. This afforded the managers participating in the User Group Forum the opportunity to voice their concerns, to input into the decision making process, and to view their own needs in the context of the needs of others in the organisation.

BARRIERS TO THE IMPLEMENTATION OF PARTICIPATIVE DECISION MAKING

Yet whilst there is strong theoretical support for the use of PDM, there are many barriers to the successful implementation of such processes. Management may resist PDM where it is seen to lead to a perceived loss of control. Dickenson (1982) reported evidence that managers were more supportive of PDM if it did not have a negative impact on their perceived power relative to others in the organisation. There is also a risk that such innovations will merely have 'lip-service' paid to them, when in reality the hierarchical control over decisions is maintained. Hecksher (1995) argued that PDM cannot decrease bureaucracy in an organisation unless it occurs together with redesign of work. Indeed, management may even encourage employee involvement in low level decisions in an effort to deflect interest from top level management (Drago & Wooden, 1991). Although it can be argued that power is not a zero-sum phenomenon, and that introducing PDM may therefore increase rather than decrease a manager's influence over his or her subordinates, coaching management to support such views is necessary if PDM initiatives are to succeed.

Research has also indicated that the efficacy of participative management techniques may be dependent upon organisational culture. Harrison & Stokes (1992) put forward a typology of 4 organisational cultures; (1) a centralised power culture, (2) a bureaucratic role culture, (3) a more autonomous task culture, and (4) an egalitarian person-support culture. Placing these on a continuum according to the level of autonomy and control that is granted to employees, it is logical to assume that PDM would be more consistent and more successful in cultures which encourage the distribution of power. More specifically, Sagie & Aycan (2003) have argued that the success of employee participation in decision making processes will differ along the dimensions of individualism/collectivism (i.e. the extent to which people define their identity as individuals versus as part of their normative group) and power distance (i.e. the extent to which a society considers the hierarchical distribution of power to be acceptable). These cultural dimension not only influence managements willingness to delegate decision making power, but also employee's willingness to participate. These researchers identified four methods of PDM employed by organisations; Face-to-face PDM (characterised by high individualism and low power distance), collective PDM (low individualism and low power distance), pseudo-PDM (high power distance and high individualism) and paternalistic PDM (high power distance and low individualism). They reported that the most common method in English speaking countries was face-to-face PDM, a finding which again offers support the argument that PDM acts as a form of procedural justice by providing employees with voice/choice effects.

Where there are limited resources, competing will undoubtedly be the dominant reaction from parties, resulting in dissatisfaction of those that are unsuccessful. Over the course of this research study, such difficulties became apparent at The User Group Forum as managers conflicted in the struggle to defend the interests and requirements of their work teams. So how can facilities management's facilitate a more collaborative approach to resource distribution? Yeung (1997) argued that in order for PDM to be effective, managers need to act as facilitators employing conflict resolution strategies such as "account giving, group choice, sympathising with dissenting viewpoints, hedging and attending to multiple standards." In addition to this, overcoming such conflicts requires setting of super-ordinate goals which highlight the common interests and operational interdependencies on the groups involved, encouraging them to not to look at what is most suitable for their group, but what is most profitable for the organisation. This

may be achieved by aligning facilities management activities with the organisation's business strategy.

Both research and history have demonstrated the power of super-ordinate goals in uniting disparate groups with conflicting interests. Goal setting theory offers a theoretical framework for harvesting the benefits of participative decision making whilst limiting interpersonal or inter-group conflict between parties. By setting super-ordinate goals which are clearly aligned with the business strategy, facilities managers may increase customer satisfaction through the use of a powerful form of procedural justice whilst minimising conflict and self interest of the parties involved in this process.

PARTICIPATIVE DECISION MAKING AND GOAL SETTING IN FM

The majority of the research reviewed thus far suggests that PDM offers an opportunity for facilities managers to maintain customer satisfaction even in the face of unsatisfied expectations. However, with all the complexities involved, is the process of establishing super-ordinate goals, managing conflict and overcoming cultural obstacles justified by the positive outcomes? In spite of the strong theoretical support, in practise, there are difficulties with the implementation of PDM techniques that offer strong arguments against their use in the field of facilities management. Observations at the User Group Forum in the participating organisation indicated that whilst it afforded individuals the opportunity to input into facilities management decisions, conflict was inevitable as many managers continued to defend the interests of their individual department rather than looking to prioritise facilities management resources in accordance with organisational goals. In some cases managers were receiving complaints from their subordinates on a daily basis, and their priority during these forums was therefore to minimise these complaints by 'winning' the resources necessary to deal with them, rather than looking at business benefit of resource allocation to the wider organisation. There were also complaints from participants that the forums represented a time consuming process which distracted from their primary functions. Whilst this is just one example of a PDM forum in the facilities management industry, it highlights that in reality, there are implementation difficulties of this form of procedural justice which limit its potential to increase customer satisfaction.

ORGANISATIONAL JUSTICE AND THE DEVELOPMENT OF A SERVICE CULTURE

"While, in the past, customer service may have been considered an afterthought to the primary facility management functions, there is no doubt that customer service today should be viewed as an integral strategy for increasing a facility department's effectiveness and value to the company it services" (Bandy, 2003, p. 323). Although PDM does not appear to represent the most suitable option, it is still argued that finding the appropriate level of customer involvement, and addressing and implementing organisational justice strategies in line with this will not only lead to increased customer satisfaction, but will help to transform the culture of facilities management into that of the service industry.

In her research into the development of service standards in the facilities management environment, Bandy (2003) described five steps involved in achieving customer satisfaction; (1) understanding customer's needs through research, (2) setting service standards, (3) communicating through leadership, (4) delivering the service, and (5) maintaining the service culture. As customer needs are constantly changing, the first of these stages needs to be monitored constantly. The second stage involves the development of service level agreements with the customer through the analysis of performance measurement of the facilities management department itself. The dimensions of service quality which should be monitored credibility, include accessibility, communication, competence, courtesy, reliability, responsiveness, security, tangibles and understanding of the customer. The third stage requires departmental managers to act as representatives for the customers, demonstrating their commitment to customer service by actively defending the customer's interests on a daily basis. Delivering the service involves putting the first three stages into place, motivating employees in the facilities management department to perform, and providing them with a senior manager to whom they can refer if a customer complaint escalates to a level where they no longer feel they can deal with it. Maintaining the service culture requires long term investment in the training, development and management of staff within the facilities management department to ensure that they have the skills and knowledge required to deliver the service.

APPLICATION OF SERVICE CULTURE TECHNIQUES IN FACILITIES MANAGEMENT

Whilst Bandy's (2003) model represents the ideal path to achieving customer satisfaction, this model serves to highlight the difficulty first introduced in the beginning of this article. Bandy's approach represents a long term strategy which can be successfully implemented only when facilities managers have the resources available to meet customer demands. Understanding customer needs through the use of techniques such as adjacency studies and predicted headcount models is a valuable but time consuming process. Setting service standards involves performance management measures of key variables. In the present study, the timescales involved in processing requests were identified by customers as the most important information that needed to be communicated. Therefore, these needed to be monitored, as did the variables which acted as predictors of these timescales, and process improvements implemented where timescales were not deemed to be satisfactory. The ten dimensions of service quality identified by Bandy (2003) also need to be examined on an on-going basis if customer satisfaction is to be maintained in the longer term. Communicating through leadership is a cultural change which again takes time to implement, particularly where at the customer-facing end of the business, increasing satisfaction has fallen secondary to the more technical areas of facilities management. In short, the improvement of service quality is a large scale operation and facilities managers still need to appease customers in the intermediate term. It is here that the use of procedural justice techniques plays a key role.

Observations in the participating organisation suggest that in the short term, two-way communication is the most appropriate form of organisational justice. Effective communication integrates the concept of inter-actional justice into the process as customers need to be treated with understanding, particularly when it has not been possible to meet their demand. Interviews with customers suggested that the information they considered to be most important were the *precise timescales* for the implementation of facilities management changes. Communication of more abstract information, such as the strategic facilities management plans (as opposed plans for their operational implementation), was not a priority with customers reporting that they were more interested in changes which would impact directly upon their own department. Using the company intranet as a medium of communication was not a favoured option. Customers commented that in organisations of that size, the volume of information stored on the Web was such that facilities management data relating specifically to their department would be too time consuming to locate. User Group Forums were time consuming and on occasion lead to conflict situations. Instead it was reported that the most appropriate medium for this communication was a help desk which actively contacts customers with updates as to the status of their requests.

Whilst there is strong theoretical support for the use of procedural justice techniques which have a greater level of customer involvement such as participative decision making, in practice there are many barriers to the successful implementation of such processes. Evidence of these difficulties emerged in the User Group Forum where conflicts arose regarding the distribution of facilities management resources. As a consequence, there were delays in decision making and ultimately in service delivery, indicating that PDM processes can in fact create more inefficiencies than efficiencies. Whilst there is evidence that setting super-ordinate goals which are in line with the organisations business strategy can unite the interests of disparate groups, a detailed understanding of the customer's long term facilities management needs is required before this can be achieved.

CONCLUSION

This review of organisational justice and its application to facilities management lends strong support to the argument that it is not just *what* is delivered that is important, but also the *way* in which it is delivered. Whilst meeting targets is not always possible, maintaining high levels of customer satisfaction can still be achieved through the effective use of procedural justice techniques. There are still many questions about the application of a service industry approach to facilities management that remain unanswered; Are the positive effects of improving communication with the customer sustained in the longer term or confined to the short term? How much time do procedural justice techniques "buy" the service provider? How beneficial is a customer-relations approach in maintaining satisfaction where expectations are continuously unmet? Applying the methods detailed in this paper to the delivery of services and developing appropriate quantitative measures of customer satisfaction will help to quantify and understand the benefits of the proposed approach and to fine tune the procedural justice techniques that will facilitate increased customer satisfaction.

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CUSTOMER RELATED FACILITIES MANAGEMENT PROCESS AND ITS MEASUREMENT: UNDERSTANDING THE NEEDS OF THE CUSTOMER

Dilanthi Amaratunga David Baldry Richard Haigh Research Institute for the Built and Human Environment The University of Salford

ABSTRACT

In the past, organisations could concentrate on their internal capabilities, emphasising product performance and technology innovation. Organisations that did not understand their customers' needs eventually found that competitors could make inroads by offering products or services better aligned to their customers' preferences. Many Facilities Management organisations today have a mission focused on the customer, and how the organisation is performing its customers' perspective has become a priority for the organisational management. How the FM organisation is performing through the eyes of its customers has therefore become a priority issue for facilities managers. This captures the ability of the organisation to provide quality goods and services, the effectiveness of their delivery, and overall customer service and satisfaction. It places importance on the organisation's ability to achieve its vision, and how it wants to be seen by its customers. This paper will discuss some of the important FM customer related processes and mechanisms associated with its measurement identified through a series of case studies carried out as part of a major research study.

Keywords: customer satisfaction, facilities management, performance measurement

CUSTOMER REQUIREMENTS ASSESSMENT IN FACILITIES MANAGEMENT

Customers are the most wanted people of today. Without them, there will be no market for services, no reason for enterprise, no income, no profit and no survival. Successful businesses today ask their customers what they really want and listen to the answers.

Within the FM setting, customer requirements assessment captures the ability of the FM organisation to provide quality services, the effectiveness of their delivery, and overall customer service and satisfaction. Many FM organisations, today have a mission focused on the customer requirements and how the organisation is performing from its customers' perspective and in satisfying its customers has become a priority for facilities managers. Mission and vision statements routinely declare their goal: "*Our customers are the focus of all we do and our customers' success is our success*", "*We understand our customers anticipating and exceeding their needs*", "Seek close and durable relationships, partnering for the long-term" and to provide "Effective services to an establish effective partnership with external customers". The current business trends demand that facilities managers translate their general mission statement on customer service into specific organisation processes that reflect the factors that really matter to customers. In a public organisation model the principal driver of performance is different than in the strictly commercial environment: for example customer and stakeholder interests take prominence over financial results. In general, public organisations have a different, perhaps greater, stewardship/fiduciary responsibility and focus than do private sector FM entities.

The re-focus of strategies onto customers instead of products has been undertaken in many of the case study organisations, as identified elsewhere in the paper. At the same time, there has been increasing recognition that the value created by an organisation is dependent on the satisfaction of employees as well as satisfaction of customers.

The virtues of becoming closer to the customer have been promoted in the business literature for some time (Naumann and Giel, 1995). It seems ironic then that many organisations didn't really understand what attributes are most important to customers. In fact, the process of initially identifying attributes is typically referred to as "discovery".

MEASURING FACILITIES MANAGEMENT CUSTOMER SATISFACTION

Customer related performance measures describe the way in which value may be created for customers and how customer demand for this value is to be satisfied. As already noted, customer relations represent a significant area of concern for facilities managers and indicate a need for performance measures which can adequately reflect important customer oriented factors. Customers' concerns tend to fall into four categories: time, quality, performance and service (Kaplan and Norton, 1992) and consist of measures relating to the most desired customer requirements. This part of the process is considered as the heart of the organisation. If the organisation fails to deliver the right products and services for cost effectively satisfying customer needs on the both short and long term, revenue will not be generated, and the business will wither and die. In this context, facilities managers should have a clear idea of their customer and business segments, and should select a set of core outcome measurements for those targeted segments. These outcome measures should represent the targets for an FM organisation's product and service development process.

RESEARCH METHODOLOGY

In order to explore issues which describe an understanding of the needs of the FM customer, a review of the literature was the initial step and this included an in-depth examination of literature relating to customer satisfaction and its management in organisations in general and in FM organisations in particular. Further, authors agreed the "case study" approach is the research strategy that matches better with the characteristics of the study. The preference of the case study strategy derives from the fact that the main research question in this work is in the form of "what". This allowed an in-depth investigation of the concepts of process thinking in FM in its real life context. A multi-dimensional case study survey across a number of sectors was carried out.

Table 1 outlines the eight case studies which were investigated (it is worthwhile to note that the abbreviations listed in the following table were used throughout this research to refer to the relevant case studies due to confidentiality of information associated with the case studies) (See Amaratunga (2000) for detailed information on case studies):

Industry sector
Public sector – Health
Public sector - Health
Public sector - Health
Public sector – Higher Education
Public sector – Higher Education
Public sector – Higher Education
Financial sector
Semi government sector

Table 1: Case study organisations

The decision to carry out a multi-dimensional case study survey across a number of sectors as identified in Table 1 was influenced by evidence from the literature survey that management perceptions of the role of facilities can vary considerably according to the type of business and the environment of the particular business sector. There is also the possibility that by confining the study to a particular sector not enough cases would be found to develop theory. The decision to extend the study to cover multi sector case study applications was also influenced by the fact that the process would strengthen external validity.

Within any FM organisation there are a number of customer-related critical success factors that require focused management attention to ensure requirements and expectations of the customers are met as effectively as possible while accommodating cost efficiency issues. In this context, preceding sections identify different FM customer related critical success factors and associated measurement techniques exposed identified through this study.

EXPLORING CRITICAL SUCCESS FACTORS AND ASSOCIATED MEASUREMENT TOOLS FOR MEASURING CUSTOMER RELATED PERFORMANCE IN FACILITIES MANAGEMENT

1. Quality

This is the customer's satisfaction with the quality of services delivered. Users of facilities services within organisations may view FM as a monopolistic supply, with quality and value being dictated by managers who are out of touch with the needs of the occupiers and the external customers who are unable to claim compensation for poor service. Schonberger (1990) proposes, *"each function in a business should be a customer of the next in chain"*, and advocated the use of the internal customer culture in order to improve service relationships between functions, eliminating internal conflict, enabling organisations to turn their competitive energy outwards – *"we should be fighting the enemy not ourselves"*. Front line employees who deal with external customers need support from service suppliers within their own organisation, and the total quality of the delivery chain is only as good as the individual links within it. Quality is an intrinsic part of customer service and yet quality evaluations are *"not made solely on the outcome of the service, they also involve evaluations of the process of the services"* (Parasuraman et al, 1985).

The primary focus of facilities customer service is to ensure that the customer derives maximum value from the service provision (Madeley, 1996). Albrecht and Zemke (1985) developed the customer service triangle as shown in Figure 1.



Figure 1: Customer service triangle [Source: Adapted from Albrecht and Zemke (1985).

In the above diagram, facilities strategy represent a statement of competitive advantage and value to customers, facilities systems represents processes, quality control, information and productivity, and facilities team represents facilities service provider teams.

The assessment programme of CACE FM was consistent with and supported CACE's core values and critical success factor strategies as listed in the CACE business plan, in customer orientation which measures how business decisions and actions are responsive to the customer's needs. In this sense, CACE FM captured information from its customers relating to quality of products and services delivered by its Facilities Directorate, degree of shared commitment among participants, implementation of best practice initiatives, and information on work environment quality.

Superior image of the services provided was a major theme within CALO FM. CALO FM communicated and demonstrated its reputation for quality of the service provided and innovation in order to maximise the perceived value to the customer: "*We need a brand image that positions us as an innovator*".

Measures for quality

The objective is to measure the service provided and it assesses how well the FM organisation manages its relationships with its customers and is a key indicator of the amount of emphasis and effort the FM organisation places on the satisfaction of its customers.

Customer satisfaction measures provide feedback on how well the organisation is doing and relates the extent of internal and external customer satisfaction with the quality of the information and services provided. The importance of customer satisfaction probably cannot be overemphasised. Customer satisfaction is a psychological concept that involves the feeling of well-being and pleasure that results from obtaining what one hopes for and expects from an appealing product and/or service (Butz and Goostein, 1996). Customer satisfaction can also be defined as satisfaction based on an outcome or a process (Pizam and Ellis, 1999). Vavra's (1997) outcome definition of customer satisfaction characterises satisfaction as the end-state resulting from the experience of consumption.

The NHS plan (Department of Health, 2000a) has set out a range of initiatives and requirements, which renew the emphasis on clean and tidy hospitals. The patient environment programme was set up accordingly and it is a national initiative which provides hospitals with support and framework within which to immediately improve standards of cleanliness and tidiness. Patient Environment Action Teams (PEAT) have been identified to undertake inspections of hospitals. PEAT members have been drawn from NHS professionals, including infection control nurses, domestic/hotel services managers and estates and facilities managers. Teams will also include patients' representatives and people from commercial organisations providing cleanliness services within the NHS. CACE FM, CABO FM and CAMA FM were all actively engaged in carrying out PEAT assessments and had undertaken a full assessment of current conditions and developed an action plan to bring standards up to excellent conditions. The elements which had been assessed were: entrances and main reception areas, internal decoration and signage, visitors toilets, smells, internal cleanliness and tidiness and external decoration.

Further, to track the specific goals of providing a continuous stream of attractive solutions, CACE FM measured its *customer satisfaction* (internal and external customers both) and information on quality of products and services delivered, range of service offered, and whether services were received in accordance with customer service requirements. Information on personalised quality services, shared commitment among service providers to improve quality and number of new services introduced were also collected through customer satisfaction surveys.

CALO had an innovative approach to *customer satisfaction* in its facilities division and identified five objectives for its customer satisfaction survey process:

- Determined the degree of customer satisfaction;
- Measured factors associated with the quality of their services;
- Identified the opportunities for process improvements;
- Established a baseline to measure improvements over time; and
- Benchmarked customer satisfaction relative to similar organisations as best in class.

In order to meet these objectives CALO FM used surveys with different timing. The customer satisfaction capturing process at CALO FM had helped not only to satisfy customers but also to achieve excellence in providing facilities services.

Help desks supported the procedures for handling service and job requests, incident handling and procedure management information to support the improvement of service quality at CASA

FM, but there was a need for investment in better-trained, more expert staff and good knowledge support systems. Periodic review of the day-to-day operational quality performance was key to continual improvement of the facilities services and a knowledgeable and responsive operator was a great asset to customers.

At CABO FM, a help desk cultivated a strong customer service orientation and a human face and demonstrated factual improvements in service. Help desk evolved to be the primary day-to-day service interface with the customer and the main monitor of service performance and incident handling.

2. Timeliness

This is the customers' degree of satisfaction with the timeliness of the delivery of facilities services. The attributes significant to the customer are linked directly to value added processes of whether the services are delivered on time within the organisation and are put into a form consistent with the quality and service partnerships measurements.

CAAB FM commented: "We have identified that customer satisfaction measurement has an advantage and it provides a customer view of our performance, which can then be compared to our internal perception. We now have a balanced view of our performance, together with some ideas of our strengths and weaknesses. Assuming that we are in a competitive marketplace, we still have information on how our customers view our performance. Our only comparative viewpoint of reference is ourselves. In any competitive environment, it is important to add the dimension of competitive comparison to our customer satisfaction information ". Accordingly, service delivery response time, timeliness of communication with customers and timeliness of contract completion were some of the issues that CAAB considered as important in capturing information from its customers.

CABO believed on "deliver on its promises" strategy and wanted to strengthen their reputation for value by focusing on delivering on specification and on-time to their customers. CABO believed that: "Unless service delivery is handled better, with more accuracy and punctuality they will have trouble convincing customers on services that they provide".

Measures for Timeliness

Satisfied customers are the mainstay of any business. Knowing what customers like and dislike can mean the difference between success and failure. Accordingly, *customer satisfaction surveys* are the most commonly used method for acquiring responses on timeliness. Almost all the case study organisations have some form of user feedback. Extent of internal and external customer satisfaction with the timeliness of different services and facilities provided is monitored through this mechanism.

One of CALO facilities managers commented: "We need customer satisfaction measurement because we need to satisfy our customers. Therefore, we need to fully understand what the customer wants from service before we can deliver to that expectation, and before we can ever hope to measure customer satisfaction accurately". Accordingly, CALO analysed response times and help desk calls and records absenteeism. Call handling desks and service support help desks had progressively become centres of excellence in service delivery, promoting creative environments and becoming proactive as well as reacting quickly to unforeseen events.

CALA kept records on whether services were delivered when needed, if milestones were consistently met, if service was received on schedule, whether CALA FM did a good job to prevent problems that may lead to delays in providing FM services, and whether FM services provided timely information regarding changes affecting other divisions' actions.

CALO had an organisational wide objective of 98% satisfied customers. Since the same approach was used throughout CALO, it was possible to benchmark the various parts of the organisation by comparing them with each other. In this way, CALO FM collected information from its customers on whether customer requirements were researched in a timely and accurate manner, if planning was effective in obtaining timely services, and whether CALO FM developed FM strategies early in the planning process and collaborated with other divisions of CALO.

3. Degree of service partnerships and communication

The perceptions, choices, and behaviour of all participants in the FM process affect the outcome of the service delivery. This element is based upon the degree of responsiveness of the FM team, the success of mechanisms which support teambuilding, and the degree of satisfaction with communications and problem solving.

For this critical success factor, the primary objectives are to provide effective service to and establish effective partnerships with, external and internal customers. Effective service and partnerships are key ingredients in assessing the health of any FM organisation in terms of satisfying customers' needs.

CACE FM identified collaboration, effectiveness of communication of FM objectives, flexibility of service delivery and degree of promotion of teamwork between FM and its customers as important issues to be captured from customers under this critical success factor.

The products that CAAB markets were all based on providing a high focus for customer service. Therefore, the customer relationships, and measuring the service provided, had become even more important. At CAAB FM, various methods were used to monitor customer perception of facilities service and associated relationships. Examples are satisfaction surveys, transaction based feedback cards and customer focus groups. CAAB had done some experiments with transaction-based feedback cards, which provide a continuous flow of information between regular surveys. The results from all sources were analysed, and improvement tables were compiled; every trend and comment logged, numbered, and allocated to an individual who was to take appropriate further action. The philosophy at CAAB FM was that every item of feedback represented an improvement opportunity.

At CAAB FM, a "distributor partnership" was considered as important as the organisation work closely with its service suppliers to ensure a superior experience for users by "*Positioning themselves as a strong business partner to attract the best service providers*".

Measures for service partnerships and communication

The extent to which customers are satisfied with effective partnerships was measured and the data for this measure came from *customer satisfaction surveys*, like the previous instances identified above. The measure provided feedback from customers regarding their satisfaction with the degree of partnerships that existed between FM functions and customers in terms of responsiveness, cooperation and level of communication.

Service partnerships were considered important in delivering an effective FM service within CACE FM. CACE FM worked closely with service suppliers to ensure a superior experience for users of facilities within CACE FM. CACE FM believed in positioning itself as a strong business partner to attract the best service suppliers. Regular *customer surveys* carried out provided information about the effectiveness and efficiency of such collaborations.

Customer perceptions on issues relating to: flexibility in trying to meet the customer requirements, communication between the customer and the CAMA FM, provision of adequate information to process actions, responsiveness to end users suggestions and recommendations and the standards of the manuals produced, were assessed at CAMA FM.

SUMMARY

In the rapidly changing business environment of the 1990s, becoming truly customer focused is essential for the survival and success of virtually any business. Meeting and exceeding customer expectations is no longer the domain of only innovative, world-class competitors (Naumann & Giel, 1995). Customer satisfaction is the leading criterion for determining the quality that is actually delivered to customers through the service and by the accompanying servicing (Vavra, 1997). Therefore, the measurement and achievement of a high level of customer satisfaction demonstrates the FM's attention to stakeholders' goals. As a performance measure, this method has the following merits:

- Easy to administer;
- Allows targets to be set against which actual performance could be measured;

- Allows transparency of FM operations; and
- Does not appear to have any dysfunctional consequences if pursued by the organisation.

Within the FM organisation there are a number of internal business processes that require focused management attention to ensure requirements and expectations are met as effectively as possible.

Further, measurement of customer satisfaction has received considerable interest in recent years. Customer satisfaction surveys are extensively used to determine the effectiveness of the FM system in providing quality services in a timely and accurate manner in meeting customer expectations. Customer satisfaction surveys also often provide a numerical value for the level of customer satisfaction, a percentage for example. Such index numbers indicate trends in satisfaction and allow correlations to be identified in order to assess the drivers and consequence of customer satisfaction. These surveys are utilised to obtain customer perceptions regarding the FM system and recommendations resulting from these surveys are promptly evaluated and results communicated to customers in a timely manner.

This paper has outlined three types of customer related critical success factors and associated performance measures uncovered primarily from the case studies. These critical success factors are quality, timeliness and degree of partnership and corporation. Following table (Table 2) summarises the findings:

Critical Success Factor	Associated Measurement Tools	
Quality		
Timeliness	Customer satisfaction surveys , help desk	
Degree of partnership and corporation	output	

Table 1: Types of customer related critical success factors and associated performance measures

These three types of issues provide a new perspective on the management of facilities which are aimed at increasing the effectiveness of the core organisation through increasing facilities performance. They are also a basis for the discussion around performance measurement in FM through the exposure of each type of critical success factor. Ultimately FM organisations shall use the measurement of customer satisfaction in dimensions identified above to identify the drivers of customer satisfaction so that they can develop long-term managed relationships with their customers.

It is not the existence of these types of success factors which is important issue for facilities managers but the way in which they are being measured, that is the exposure and the development of a shared understanding of each type of critical success factors and related measurement tools. The case study data provides evidence that it is always desirable to expose these performance measurement bases, as it is the first step in achieving a shared understanding or consensus within FM organisations.

An important point to note is that perceptions of performance are often more important than the FM organisation's actual performance in determining customer satisfaction. Even though the organisation's performance is outstanding, if customers perceives it to be poor or no better than the competition their satisfaction may well be low. If there is a shortfall between perceived performance and actual performance, the virtues of performance must be emphasised. It is also important to consider the importance that customers place on the different dimensions of performance. The organisation has to excel in aspects which customers care about most.

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STAKEHOLDER VALUE IN FACILITIES MANAGEMENT

K. G. Futcher Mona So Beatrice Wong EastPoint Property Management Services Ltd., Hong Kong – a Jardine Matheson Company

Abstract

This paper describes the approach taken in Hong Kong by a facilities management company to improve its business performance by adding value to the stakeholders of the company: namely, the staff, the customers, and the shareholders. The company has undertaken a series of change management initiatives to, among other things, improve skills, measure performance, and enable networked communication with the intention of providing additional mutual benefits to stakeholders. It is argued that these have provided tangible benefits to the stakeholders and as a result have increased the potential for profitability, reputation, and the growth of the company.

Keywords: facilities management; open-learning; performance measurement; management reporting.

INTRODUCTION

Change management is an essential feature of facilities management. Change is a peoplecentric requirement, businesses effect change through their people, facilities management is intrinsically aligned with the client's business needs and so facilities management is predominantly about meeting the changing needs of clients. Atkin and Brooks (2004) have stated, 'From a world in which stability was the norm, we have come to a time where normality itself is a state of change.' They postulate a definition that incorporates the 'people-side' of business and couples it to the workplace, namely, 'the process, tools and techniques to manage the people-side of business change to achieve a required outcome and to realise that change effectively within the social infrastructure of the workplace'. This paper describes how EastPoint exemplifies the notion of Atkins and Brooks of a facilities management organisation venturing towards a project management style of operation. Actions are translated into projects, enabling them to be subject to an established discipline with a proven methodology, techniques, tools and metrics. The benefit is in the control that can be exercised over delivery to quality, time and cost objectives.

An essential element of the change wrought is a transition from ad hoc response to service needs to working within a regulated process framework that ensures a quality assured delivery of outcomes whilst promoting flexibility and personal initiative. This has required an extensive skills enhancement training of all staff with mandatory competence testing. This has been achieved by the development of a modular open learning training course. A consequential benefit has been a faster rate of achieving full staff efficiencies than previously possible.

Multi-attribute performance monitoring (Futcher et al, 2004) has provided stakeholders with an assurance of quality service delivery based on objectivity, representative sampling, and reliability that is shared with the stakeholders as a routine. This is important to provide realistic comparison of performance versus minimum standards, expectancies and perceptions according to the Parasuraman *et al* model. (Parasuraman *et al*, 1985)

Communications and information pipelines across a wide area network of desk top computers has created conduits of information that are provided to staff to empower them in delivering a better service, customers with a real time interface onto performance data relating to their properties, and the shareholders with feedback loops and monitoring to ensure better standards of governance and management.

EASTPOINT – A CASE STUDY

EastPoint Property Management Services Ltd (EastPoint) was first established by the Jardine Matheson Group in the early 1980's as an offshoot of another business. It has been re-branded several times and steadily grown over two decades of operation. The company provides property-related management services including: property management, facilities management, asset management and property consultancy services in Hong Kong and Macau with consultant services offered in China. The company manages a large portfolio of Hong Kong properties. Over ten per cent of the population of Hong Kong live or work within these properties based upon the numbers of residential, commercial and retail units contained within these sites. The 'common area' footprint is so large that considerably more than the resident population seek daily services from EastPoint staff.

The company employs a broad range of 3,000 staff varying from time to time as the ebb and flow of work requires. One in six of these personnel are 'white collar' staff, the remainder are predominantly 'blue-collar' building supervisors/attendants and other frontline operatives at the properties. The professional property and facilities managers are managing a blue collar workforce typically two decades older than themselves. The professionals require a tertiary education as a prerequisite for employment: with the majority holding further professional diplomas and higher degrees. They are multi-lingual. In contrast, the blue collar workforce require a minimal-level education for employment such as completion of secondary school to Form 2 or 3 and must be eligible to hold a Security and Guarding Licence issued by the government authority. Their principal language is Cantonese with basic skills in spoken English. The average length of employment is 4 years for white collar staff and 3 years for frontline personnel. High turnover of staff and the corresponding need to recruit and train replacement personnel, particularly at the entry level, to perform in accordance with company quality standards, key performance indicators agreed with clients, and operating procedures is an ongoing feature of the business.

The company is centralised for business efficiency but provides customer-centric, decentralised services at the many property sites it is managing. This operational differentiation requires a high degree of procedural integration to achieve high standards of customer service and to accord with ISO9000:2000 quality accreditation. IT business, communications, and management information systems are increasingly used to integrate the business at the managerial level. At the front-line, the manning level is dictated by the deployment of hands-on resources. Business efficiency and customer satisfaction are achieved if these personnel perform their duties well.

In late 1998, the company achieved ISO9000 quality accreditation for its property and facilities management operations based upon quality system documentation written in-house in accordance with the prevailing ISO standards. That sterile form of documentation proved inappropriate for training professional and managerial staff in the ethos and procedures of the company. It was meaningless to the blue collar staff. They were trained on-the-job by their managers. In 1999, the company set about revitalising its standards so as to achieve a market advantage in the delivery of consistent high quality services and outstanding customer service. This objective was to be met through staff training based upon an open learning approach to on-the-job training. At the same time the quality standards were enlarged to embrace a health and safety and environmental control system.

FACILITATING CHANGE

Change management can be seen therefore as a powerful tool in itself, as it helps the organisation maintain focus on its strategic business objectives whilst identifying and bringing about the operational transformations that will help to deliver them. As the dynamics of the workplace change, so too will facilities management have to change to enable organisations implement strategies that assume change as a normal feature of business life. (Atkins and Brooks, 2004)

EastPoint has adopted a task orientated approach to delivering change within an established organisation. Processes are re-engineered through a broad set of coordinated activities to establish continual process improvements in business governance, risk management, quality standards and performance, and business metrics. Management by projects has become the

norm for the planning and execution of the actions, small or large, that are required to bring about change in the organisation. Personnel holding strategic roles are given training in project management to an internationally accredited qualification so they are practically equipped to deliver projects on time and within budget. As a result, a number of tangible products and techniques have become firmly implanted in the organisation's business. An office policy manual, quality manual and derivative products are best-in-class examples of procedural instruction (Atkins and Brooks, 2004). Risk assessments of tender submissions are based on Monte Carlo analysis and used to provide upside and downside appreciation of the risks inherent in the tender and pricing sensitivities in real terms.

The company moved to exception reporting style of management with individuals empowered to perform and operational processes reduced on a Pareto basis. The first task was to refine existing procedures by weeding out non-productive activities and processes, and by ensuring that customer satisfaction was given prominence in operational processes. For these reasons, the paper trails required for ISO quality assurance were discarded if they failed to contribute directly to productivity or customer satisfaction. Performance monitoring was by exception. All pro-forma were reviewed for service need, standardised in readiness for porting to electronicallyenabled processes on the organisation's intranet. The intention was to cut operational procedures to the minimum or otherwise validate them as essential to the business. The second task was to author new documentation that would serve as a technical reference for the organisation. Concurrently, business re-structuring took place in two stages. The property management department was reorganised early to redistribute responsibilities and to breakdown the walls that had traditionally existed between the established divisions in the organisation. It has given greater emphasis and new direction to the business support functions-for example quality control has been replaced by performance management and work improvement. This has created space for accelerating the development of up-and-coming talent within the organisation. Executive director roles have been defined and are used to empower specific individuals to take up a leadership role in one of three key enterprise areas of the organisation: commercial, operations and business administration. All executive directors report directly to the Managing Director and thereby to the Board.

EastPoint recognised the improved efficiency and effectiveness that would be achieved by organising its business around workflow management and re-engineered business processes. This action had the added benefit of creating tangible new products and processes that clearly demonstrated business change. It has enabled the organisation to focus on reducing transaction costs within its business operations. The organisation has also recognised that the business potential was changing to community care with an increasing need for the delivery of services at the personal level. Especially important in the context of relationship management is a distribution network that enables delivery of collateral items or messages on a personal basis to more than 10% of the population of Hong Kong. For EastPoint, the physical distribution network already exists, so the organisation has built an electronic network that will enable communications based on B2C intranet technology. It is also one step closer to creating an edistribution network for the sale of services and commodities that can be distributed by EastPoint's physical distribution network. Reducing transaction costs through e-enabled integration of a differentiated and decentralised business is likely to add significant value to EastPoint's procurement chain and offers better ways of deploying on-site operational resources. The organisation thus sees strategic competitive advantage from its B2C communications with the people in its communities and from B2B communications with its suppliers and other stakeholders in the business.

EASTPOINT OPEN LEARNING PROGRAMME

Property management is a people-industry and unfortunately, it's also an industry with rather high turnover rate. There is constantly a need to train the newly recruited staff on the fundamentals of property management. At the same time, EastPoint is also recruiting undergraduates for its professional grade entry level from various different disciplines. Again, the need to quickly transfer fundamental knowledge on property management to these young and bright undergraduates to enable them to perform their job according to the Company's expectation is substantial.

The open-learning programme (OLP) is used to provide property management training to all 3,200 employees using a technical manual, and derivative open-learning workbooks, which were developed as part of a mentoring approach to on-the job training. Twelve operational areas were identified for the open-learning training programme. Each workbook was produced for easy reading. They included simple learning exercises to reinforce the learning process. As such, they are a personal study aid designed by experienced personnel in the organisation. Each workbook relates to sections in the Technical Manual. It is a reference book on the 'who, what, where, when and how' of the work process. Workbooks are not used in isolation. Users are encouraged to discuss them, to get answers on their questions from more experienced colleagues such as supervisors, or peers, and to make reference to the technical manual. As a result of this authoring effort the following set of documents printed in English is provided for each professional or support staff of the company:

- Coaching Guide
- Technical Manual
- Building Security Workbook
- Building Maintenance Workbook
- Customer Service & Quality -Workbook
- Disciplinary Matters Workbook
- Emergencies Workbook
- Financial Analysis Workbook
- Managing Staff Performance Workbook
- Operations Workbook
- Presentation Skills Workbook
- Property Management Workbook
- Staff Recruitment & Selection Workbook
- Staff Training & Development Workbook

Another set of documents written in Chinese is provided to building supervisors and attendants:

- Coaching Guide
- Guideline
- Building Maintenance Coaching Note
- Building Security Coaching Note
- Emergencies Coaching Note
- Personnel Issues Coaching Note

The OLP is complemented by an in-house training centre, which was introduced in 2001 as a cost saving and work improvement measure. Previously, the organisation's on-going need for security-related training of building personnel was outsourced. Establishing the training centre has provided:

- an upgrade in the quality of training and on-the-job performance
- annual cost savings compared to other training options and new revenue generated by the marketing of vocational training provided by EastPoint
- substantially improved the organisation's reputation with the police authority which imposes controls over how property is managed

The Human Resources Department is accountable for the implementation of the training programme. The 12 workbooks are provided to the professional staff in batches of 3. The four other workbooks, written in Chinese, are provided to the frontline staff with other learning aids called 'Guidelines'. These are simple reminders of the key actions to be taken in certain circumstances. At any one point of time, the professional staff might have 3-4 workbooks on hand. Each batch of workbooks will cover a variety of topics to make learning more interesting. Each workbook begins with a section listing a number of learning objectives. It describes what will be known when that part of the study is completed. In each workbook, there are a number of exercises labeled "Activity" or "Thinking Point". The answers must be written in the workbook to show to the training supervisors. In most cases, there is no perfect answer to these exercises. Sometimes an appropriate answer is suggested. Each exercise is designed to make the participant stop and think about a particular point or concept that is explained in the reading. At

the end of each workbook, there is a "Key Points" section. This gives a useful a summary of the important information explained in the workbook.

Personal coaching, sometimes called 'mentoring', is an important part of the open learning process. At each property, an on-site professional staff will be selected and appointed to be a coach, or mentor, to assist the frontline staff in their self-study. The coach/mentor will be trained for this role. Written assessments arranged by the Human Resources Department will take place before the distribution of the next workbook. The coaches/mentors will also receive a set of these documents.

In addition, there are learning-reinforcement training sessions for professional staff. This enables them to benefit through sharing practical work experience with peers. In a typical learning-reinforcement training session, a hypothetical situation will be used to stimulate role-play and discussion among the trainees. These sessions will include a range of important issues covered in the workbooks. Participation in the learning-reinforcement training sessions is also used to assess the learning achieved. Written assessments are used for this purpose. A similar process is done for the frontline staff. Mentors give advice to the professional and support staff whenever it is needed. The satisfactory completion of the open-learning programme is included in the Company annual appraisal of staff performance. Individuals will be told their results. The results will be recorded in training records kept by the Human Resources Department. Staff performance will be used to assess the performance of the mentor.

The approach taken was due to a need to improve their quality system documentation for competitive advantage. All subsequent actions were undertaken using in-house resource except for layout design and technical authoring. The cost of production was US\$105,000 for in-house resources plus US\$ 32,000 for the consultant services for the production of the Technical Manual, open learning materials, and workshops. Printing of the documents cost US\$ 92,000. The features of this production approach are summarised in Table 1.

Aspect	Action	Ву
Business processes	Re-engineered	In-house
Business documentation	Existing plethora ad hoc originals	In-house
Open-learning innovation	Create	In-house
Learning material design	Create	Consultants
Technical authoring	Create	Consultants
Edit/review	QA	In-house
Publication/printing	Production	In-house
Mentoring	Resource	In-house
Trainers	Resource	In-house
e-learning	Web-based Technical Manual	In-house

Table 1: Production and delivery methodology for the EastPoint OLP

Table 2 states the results of the OLP by mid 2004. The passing rate is calculated by taking the result of the staff's first attempt at the assessment. As at the end of August, 2004, the results from 16 workbooks have been recorded. It is worth noting that the Building Staff's performance has generally been better than the Office Staff with passing rate of 4 workbooks well over 90%. This is compared with an average passing rate of 82% for building staff. The highest passing rate was for Volume 9 – Building Management & Maintenance and the workbook with lowest passing rate was the first workbook – Volume 6 – Managing Operation. In addition to assessment, the Company asked the participants to provide feedback on the content/usefulness of the workbooks studied. Generally, feedback on the OLP was positive with staff finding the workbooks useful and the OLP rewarding. At the same time, there were participants suggesting improvements such as replacing multiple-choice questions with open questioning, or including practice questions in the workbooks. Comments on the mentoring scheme was balanced, some described it as useful, whilst others found it inadequate mostly for reasons poor interpersonal communications, which has been addressed through reinforcement mentoring training.
	Medium	Nos of staff	Passing Rate	Average Score
Vol. 1 Property Management	English	180	76%	59
Vol. 2 Customer Service & Quality	English	278	94%	71
Vol. 3 Managing Staff Performance	English	232	86%	63
Vol. 4 Building Security	Chinese	1,802	98%	77
Vol. 5 Security and Safety	English	208	87%	62
Vol. 6 Managing Operation	English	215	74%	58
Vol. 7 Staff Recruitment	English	238	90%	66
Vol. 8 Property Maintenance	Chinese	1,845	97%	76
Vol. 9 Building Management	English	191	98%	75
Vol. 10 Handling Emergencies	English	297	91%	68
Vol. 11 Handling Disciplinary Matters	English	251	87%	68
Vol. 12 Managing People	Chinese	1820	75%	58
Vol. 13 Financial Analysis	English	214	65%	58
Vol. 14 Presentation Skills	English	235	84%	68
Vol. 15 Staff Training & Development	English	215	69%	61
Vol. 16 Handling Emergencies	Chinese	1394	96%	74
Vol. 17 Regulatory Requirement	English	59	92%	72

Table 2: Competency Results for the OLP

An important element of the OLP was the mentoring scheme. In preparation for the launch of the OLP, some 90 mentors were trained in early 2003. Approximately 25 of the trained mentors were office staff, mostly line managers. For building staff, more than 60 senior building supervisors were trained, and they were mostly very experienced property supervisors for large properties. These mentors were assigned with responsibility for leading, coaching and providing support to their team of staff in their self-study under the OLP. Materials were developed for discussion such that the mentors can reinforce the learning of his/her team. With natural attrition and the growing need of mentorship, 15 additional mentors were being trained in December 2003. At mid-2004, 300 office personnel and 2000 building personnel have been trained. This equates to 656 hours training. The Programme helped the Company to make a saving of HK\$ 1 million in terms of training cost when compared with using traditional classroom training. The estimations made above are based on training sessions of 3 hours for building staff and 1 hour for office staff for each of the workbooks in a group of 40 and 20 respectively. As a token of the Company's appreciation for the hard work, the Company provides gift vouchers to the top 3 scores in the assessment of each workbook. So far, more than 50 staff members have already received the voucher for scoring highest marks in the assessment of 10 workbooks. Names of top scorers for each workbook are publicised on the company Intranet. Individual assessment result was incorporated in the Performance Appraisal Review and the OLP result also formed part of the score for bonus review. With the completion of its first year, the team is now looking to extend the subject area. Two additional workbooks, Regulatory Requirement and Technical Training have been published. It is expected that the identification, review and production of additional workbooks will be an ongoing development.

CUSTOMER EXPECTANCY AND MULTI-ATTRIBUTE PERFORMANCE FEEDBACK

Service quality is a measure of how well the service delivered meets customer expectations, resulting from comparing these with the actual performances on both the outcome and the process dimensions of the service. From the provider's perspective, delivering service quality means conforming to or exceeding these expectations consistently (Jafari, 2000). In terms of the services sector, 'service quality is a measure of how well the service level delivered matches customers expectations' (Parasuraman *et al.*, 1985). Furthermore, 'perceived quality is also

result of a consumers comparison of expected service with perceived service.' Their qualitative research in their initial study (1985), found that service quality had ten underlying dimensions. Later (1988), these were consolidated into a five-dimensional index:

- **Tangibles** the appearance of physical facilities, equipment, personnel and communication materials
- **Reliability** the ability to perform the promised service dependably and accurately
- **Responsiveness** the willingness to help customers and provide prompt service
- Assurance the knowledge and courtesy of employees and their ability to convey trust and confidence
- **Empathy** the caring, individualized attention the firm provides its customers

In 1988, the same authors defined perceived quality as 'a global judgement or attitude relating to the superiority of the service'. When 'expected service (ES)' is greater than 'perceived service (PS)', then 'perceived quality' is less than satisfactory. When ES is equal to PS, then 'perceived quality' is satisfactory. While if ES is less than PS, then 'perceived quality' is more than satisfactory. According to the study of Ingram and Daskalakis (1999), we can use the five dimensional index described above to assess the gap between ES and PS. Organisations determined to attain a unique position and advantage in the competitive business world of today most likely realize the importance of delivering high quality service by meeting or exceeding customers' expectations. Thus a means to measure customers' perceptions of an organisations service quality becomes necessary. Executives who are truly dedicated to service quality must work with a continuous process for monitoring customers' perceptions of service quality, identifying the causes of service-quality shortfalls and taking appropriate action to improve the quality of service (Zeithaml, 1990). In should be borne in mind the 'expected service' should also establish the cost to be paid i.e. the service value.

Service quality itself is an abstract construct because of three features in which it differs from goods in terms of production, consumption and evaluation: **services are intangible** as they are experiences rather than physical objects, **services are heterogenous** because services often vary from producer to producer, from day to day, and from consumer to consumer, and for many services the **production and consumption of services are inseparable and simultaneous activities** (Gronoos, 1982: Parasuraman et al., 1988; Zeithaml et al 1990). Service quality is a judgement about the superiority of a service (Robinson, 1999), quality refers to the extent to which a service is what it claims to be (Mudie and Cotton, 1993), it is the fulfillment of customers' expectations (Edvardsson et al 1994), and can therefore only be defined by customers (Palmer, 1994).

The service quality model in Figure 1 provides a means of appreciating the issues in delivering service that achieves customer satisfaction by closing the gaps (Payne, 1993).

- Gap 5 is fundamental, it is ES-PS and a function of the four other gaps. Key determinants of the service expected by customers include word-of-mouth communications, personal needs, past experiences, and external communications from the service provider (Zeithaml et al, 1990)
- Gap 1 is the difference between the customers expectations and what the management perceives the customer expects (Parasuraman et al, 1985). Management has to obtain knowledge and understanding of customer' expectations (Zeithaml et al, 1990)
- Gap 2 is the difference between management's perceptions of customer expectation and the quality specifications set for the service. (Parasuraman et al, 1985). When applying standards that actually project what customers expect, customer's perceptions of service quality can improve, minmising or even closing the gap. (Zeithaml et al, 1990)
- Gap 3 is the difference between the service quality specifications and the actual service delivery (Parasuraman et al, 1985).
- Gap 4 is the difference between the service delivery and external communications (Parasuraman et al, 1985). When more is promised than delivered. (Kotler et al, 1996)



Figure 1: Parasuraman et al's service quality model (1985)

In the zone of tolerance, the customers expectancy of service quality is measured at two levels, namely:

- Desired Service The level of service representing a blend of what customers believe can be and should be provided;
- Adequate Service The minimum level of service that customers are willing to accept presumably at this price.



This work is useful in considering pricing and performance for built environment services. A review of the continuing validity of this early work and of subsequent greater detail produced by the original researchers is provided by Grapentine in 1998. This is further useful in bringing together concepts of value for money on both sides of a contract.

Figure 2: Parasuraman's 'zone of tolerance' concept.(1985)

EastPoint has maintained quality assurance certification to ISO9000 series since 1999. That certification has been upgraded since then to the latest 2000 version of ISO9001 and to include accreditation in 'occupational health and safety (OHSAS18001)' and also environmental control systems (ISO14001). Since 2000, EastPoint has carried out an annual Customer Satisfaction Survey in the form of standard format 'tick-the-box' questionnaire. This is a standard requirement for accreditation to ISO9001:2000 standards of quality assurance. It is also a feature of the

Baldridge method of assessment of company performance used by EastPoint for self assessment of managerial performance and strategic development. It is, none-the-less, regarded by the company as an imperfect measure of customer satisfaction: due to less than 9% response from the population surveyed; a tendency for satisfied customers to be passive and not motivated to respond; it is too coarse a measure, at too long an interval, for management to respond to adverse trends; and it is a reactive rather than proactive assessment. From an EastPoint point of view, the issue in knowing customer satisfaction is to achieve a rational measurement of performance from a stakeholder viewpoint that includes a broad range of objective measures to offset the natural bias in customer satisfaction surveys in which a majority do not respond. In this context, rational, means based on objective measurement; performance, means the actual standards achieved by EastPoint personnel and systems against benchmark minimum standards set by the Company and/or stakeholders expectations, and or norms for the industry. Whilst, stakeholders are the Board: the executive management: the operations management; operatives; direct clients, such as Incorporated Owners Committees or the Hong Kong Housing Authority; and indirect clients such as owners, tenants or visitors to managed properties.

<u>Wide-range of objective measures</u>, means all practicable measures of performance in existence or to be innovated in 2003. EastPoint introduced a methodology in 2004 that uses multi-attribute indicators of performance as a means to indicate more objectively stakeholder satisfaction. We currently measure twelve independent indicators of performance that are related to customer satisfaction. Table 3 places these measures of importance in order of their validity as a measure of customer satisfaction based upon the following nine attributes of each metric:

- Objective/subjective data is gathered;
- Is the data range broad (rich) and therefore more indicative of performance;
- Is the data consistent each time it is measured;
- Is the measurement monthly, quarterly, half yearly, or random;
- Is the measurement free of bias;
- Does the measured data come from a credible source;
- Is measurement process credible;
- Is the measurement representative of the portfolio;
- How is the metric related to customer satisfaction, (H/M/L)?

Table 3: Combination of measurements for an overall benchmark of customer satisfaction

Performance measure	Metric	Wgt	Score
1) CRM/Help Desk	47%	1.0	8%
2) External audit by the HKQAA	68%	0.9	11%
 Internal audit of the EastPoint integrated management systems 	66%	0.8	10%
4) Directors Inspections	64%	0.7	8%
5) Customer Satisfaction Report by Service Centre	72%	0.6	8%
6) Annual customer satisfaction surveys	74%	0.5	7%
7) Client assessments	69%	0.4	5%
8) Night Audits	98%	0.3	5%
9) Six monthly staff satisfaction surveys	60%	0.2	2%
10) Property Managers Inspections	NA	0.1	NA
Total =	618%	Total =	64.4%

On the basis of this evaluation, weighting between 1 to 0 is applied to the remainder to reflect relative validity as a measure of customer satisfaction. The performance measures noted in Table 3 are recorded each month, or as appropriate, and reported in the Directors Monthly report accompanied by a trend analysis commentary.

CONCLUSION

Facilities management is fundamentally a service industry in which people provide services to people. EastPoint has taken a multi-tasking approach to develop its people and processes for this nature of business. Change management programmes have established new processes and information pipelines. Staff have been empowered and trained to predetermined levels of competency to use their initiative within a framework of lean core processes. The delivery of these services and performance in general is objectively measured to provide a feedback of service that is judged in terms of customer perceptions, expectancy and customer relationship. Information pipelines feed this information in real time to the management of the business and to its clients. It also recognised that the service quality modelling is applicable to the service industry of the built environment.

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THE IMPACT OF ONLINE BUYING ON CAPE TOWN SHOPPING CENTRES: A SURVEY OF SHOPPERS

Cattell, K.S. Michell, K.A. McGaffin, R. Department of Construction Economics and Management, University of Cape Town, South Africa

Abstract

The growth of online shopping is a matter of concern for those involved in the development and management of shopping centres. This paper reports on the findings of completed case studies of four major Cape Town shopping centres where two hundred consumers were interviewed. The aim of the research was to establish the attitudes to conventional and online shopping in a developing country context, with a view to understanding whether or not shopping centres are under threat from the rise in e-retailing.

The findings show that ecommerce will be part of a natural progression where shopping mall developers and traditional retailers will be affected. This includes the potential for consumers to embrace online shopping. It was concluded that the convenience of online shopping is attractive and it is likely to grow commensurately with consumers' perceptions about the security of Internet transactions. In addition, it is likely that online shopping for services such as banking and travel will grow more immediately than shopping for basic goods. However, it cannot be concluded that the shopping centres studied are under threat of extinction. Conversely, they are popular venues that provide entertainment and the opportunity for social interaction and shopping centre management must be prepared.

Keywords: Ecommerce; online shopping; shoppertainment

INTRODUCTION

The real estate industry has always played a fundamental role in society in providing physical space for people and firms to perform their day-to-day activities (McMahan 2000). Retailers view the Internet with concern and this is understandable as there are high set up costs for the necessary distribution systems while operating in a rapidly changing market place (Politzer 1999). The benefits of ecommerce are that they can give customers the maximum choice in when, where and how they shop and facilitates access to the global market (Arthur Andersen and Rosen Consulting Group 2000). Ecommerce is becoming a mainstream mode of shopping as more retailers and 'etailers' set up transactional web sites, and Internet users become accustomed to using the Internet as an alternative retail 'location' (Politzer 1999).

The College of Estate Management's (2001, 2002) investigations into the impact of online shopping on retail property in the UK are topical, coming, as the first report did at the height of the dot com boom. Studies of this nature are useful in that they deal in detail with issues that many in the facilities management industry have little direct knowledge of and good reason to be concerned over. A statement made by Lester Thurow, MIT professor of economics and management, is typical of what causes this concern (cited in College of Estate Management 2001:1)

"You'd better sell your shopping centres. In 2010 half of the retail stores in America will be closed because half of all purchasing will occur online. The whole notion of an automobile-based infrastructure is dead"

Are shopping centres under threat from ecommerce? Some, labeled 'armageddonists' (who predict the demise of the high street and traditional shopping) believe so. Others, who argue that physical shopping will continue to dominate, do not (College of Estate Management 2001).

The earlier literature on the subject suggested that the most obvious area to be affected by the growth in ecommerce would be the high street. Retailers have a great deal of money invested in shop portfolios and are continuing to focus most of the attention on upgrading and improving their mainstream retail activities (Politzer 1999). Verdict (1999) argued that medium sized high streets would lose in the retail landscape, by not being able to add value to the consumer's overall shopping needs and experience compared with both the new electronic medium, and also large shopping centres. More recent literature (see reference to College of Estate Management (2001) findings below), sheds light on such predictions.

Donald (2001) found that 55% of the consumers he interviewed did not enjoy shopping for items like groceries and commodities, and that 86% enjoyed shopping for goods that interested them *i.e.* goods other than groceries and commodities. Donald (2001) also found that 55% of his sample enjoyed 'window-shopping' and browsing in stores, while 46% claimed that they only went shopping with specific purchases in mind. These findings suggest what types of changes might occur in the tenant mix of shopping centres as online buying becomes more attractive and highlights a potential upcoming need for managers to focus on how they intend to continue to attract consumers to shopping centres.

In this regard, 'shoppertainment' is an important and growing phenomenon. For many, shopping is a leisure activity and a computer screen cannot offer them the same level of experience or social interaction. Developers are rising to meet the challenge by creating a shopping experience. Bluewater Park is at the pinnacle of this approach in Europe with cafes, a boating lake and mountain bike track, as well as 155,669 square metres of state-of-the-art retail space (Arthur Andersen and Rosen Consulting Group 2000). Entertainment-oriented retailers are the fastest growing segment of retail. In the past the actual act of shopping was entertaining. Today consumers are demanding more than just product selection and service to encourage consumption. Movie theatres, restaurants, sports facilities, health clubs, spas, game centres, clubs and entertainment memorabilia shops are examples of the changing retail tenant mix in shopping centres. Simon's Mall of America is a 333 000 square metre mall and amusement park, which attracted more than 40 million visitors in 1998. Comparatively, Las Vegas receives 32 million tourists each year. The centre's 500 stores reported average sales of \$7200 per square metre relative to average mall tenant sales of \$2700 per square metre. Simon's Forum Shops are theme oriented, have less anchors and report record sales of \$10 800 per square metre (Arthur Andersen and Rosen Consulting Group 2000:11). Kardstadt, the largest department store chain in Europe, now includes in-store Cyber Cafes, where consumers can shop and compare product prices online and in a social setting. Disney Quest, Nike Town and REI are additional examples of experience focused retail projects, attracting record numbers of visitors (Politzer 1999:7).

The first College of Estate Management (2001) study identified investors/developers, retailers, and shoppers as key stakeholders. The first two groups and their advisors (surveyors) were surveyed by postal questionnaire and some direct interviews with experts in the field. The sample of shoppers was surveyed in a case study of a shopping district in a large town in the South East of England (fictitiously named 'Cyberton'), with the elements of the case including a focus group, live shopping centre data and the 469 shopper survey responses. The study also used scenarios for the 2000 to 2005 period which were designed to indicate "how ecommerce might divert offline sales to the online channel, how this effect may vary across different types of goods,[and] how the potential lost store-based sales may impact on rental growth prospects nationally and locally."

The College of Estate Management's (2001) study focused on the effect of ecommerce on retail in general, not shopping centres specifically. Nevertheless, a section of its findings is worth summarizing, where the authors debunk some myths. Firstly, they conclude that ecommerce will not mean the death of the high street, but some parts are under threat – notably, financial services and travel. Stores with a strong brand who integrate ecommerce into their existing operations are likely to be successful. Secondly, they argue that retail property values will not decline solely because of the growth of ecommerce. This, they argue is already occurring in the UK because of 'normal' market conditions – oversupply of retail space and pessimistic investor sentiment. Thirdly, the notion that the future lies with the dot.coms seems unlikely to be true. Rather, they see a multi-channel future dominated by 'bricks and clicks' – a physical presence coupled with an online sales channel. Fourthly, their response to the myth that 'retail property will be deadweight' is that this is false - because even etailers need physical property from which to operate.

The rationale for the South African study described in this paper is as follows. The studies conducted by the College of Estate Management (2001, 2002) in 2000 and 2001 are set in the UK, a developed country, and the inputs obtained from shoppers came from subjects living in a town known to have a high degree of Internet access and a major primary shopping centre. The question of the extent to which their findings might be representative of the situation in developing countries is obviously worth pursuing.

The intuitive answer to this question if we consider the continent of Africa, which comprises 46 developing countries (excluding islands), is that they are probably not transferable. The US Central Intelligence Agency's (2004) World Factbook 2004, recorded the estimated world population of internet users to be 604.1 million in 2002, of which 11.2 million are in Africa (see Appendix A). Fifty-two percent (52%) of African internet users come from two countries – South Africa (3.1million, 28%) and Egypt (2.7 million, 24%). Reflected as percentages of the total population, South Africa has 7.3% and Egypt has 3.5% internet users. By comparison, the US has the largest number of internet users in the world (159 million, or 54% of the total population) and the UK has the sixth largest (25 million, or 41.5%). Other countries with large populations typically have lower percentages - e.g. China (79.5 million, or 6%), India (18.4 million, or 2%) and Russia (6 million, or 4%). Japan is an exception with 57.2 million internet users, representing 45% of the total population (Central Intelligence Agency 2004). These numbers give one a sense of the potential for online buying to take root and grow, but it is interesting to see them in context - in 2000, only 0.8% of all US retail sales can be attributed to online buying and only 0.7% of all UK retail sales (by 2001 the UK percentage had grown to an estimated 1.5% to 1.9%) (College of Estate Management 2001, 2002).

Against this background, it is argued that conditions in developing countries are different and that data obtained in the context described by the College of Estate Management's (2001, 2002) studies are not automatically transferable to the developing country context. South Africa is by far the most significant user of the Internet in Africa and its major cities of Johannesburg/Pretoria, Durban and Cape Town have retail facilities that are essentially no different to what one would find in the developed world. For example, Cape Town, which has a population of 3.2 million, has three regional shopping centres of approximately 45 000 square metres each, one of 80 000 square metres and one of 120 000 square metres. The major difference between the cities of South Africa and those in the developed countries is that the large urban populations are heterogeneous with vast disparities in wealth between the rich and poor. South African unemployment is estimated to be about 31% and approximately half of the population live below the poverty line (Central Intelligence Agency 2004).

The research reported in this paper aimed to provide an insight into what effect, if any, ecommerce in the form of online buying has had, or could potentially have, on Cape Town shopping centres. This was done by investigating: extent of Internet access and from where it is gained; what shoppers buy online and why; why people visit shopping centres and how satisfied they are with what centres offer; and the potential for online purchasing to increase if the perceived security risk was eliminated. In the following sections, first selected findings of the Cape Town study are presented, and in the analysis these are compared wherever possible with those of the College of Estate Management's (2001) study. Finally, conclusions are drawn.

THE SURVEY

The survey was conducted in four Cape Town shopping centres. The intention was to target consumers who were likely to be Internet users and to whom the notion of online shopping would be acceptable. Thus, the choice of shopping centres was deliberately confined to those frequented by middle and upper income consumers, on the assumption that they would best suit this profile. The four centres are not named in this paper due to confidentiality agreements. They were all situated in the greater Cape Town area (three were approximately 45 000 square metres and one was 120 000 square metres).

Selection of respondents and characteristics of the sample

Non-probability sampling was used to select two hundred consumers (fifty per centre). Respondents were selected randomly by the field workers who were positioned at various points inside the shopping centres. These points were selected so as to ensure that the interviewer would be exposed to the maximum volume of shoppers whose destinations might variously be supermarkets, cinemas, banking facilities, restaurants, music outlets and general line shops. Locations comprised a combination of stationary positions near cinemas and music shops, outside major anchor tenant supermarkets, and 'roving' along the pedestrian routes to line shops. Interviews were held on weekdays from mid-morning until evening to ensure that all types of visitors to the centres had a chance of being included.

The distribution of ages of the shoppers surveyed were: under 21 years -21%; 22-30 years -38%; 31-35 years -27%; and over 35 years -16%. Data regarding the gender of the respondents were only gathered from two of the centres (*i.e.* 100 respondents), where it was found that 45% were male and 55% female.

Satisfaction With and Purpose of Visit to Shopping Centre

A majority of consumers (54%) preferred these shopping centres to others closer to their homes, while 31% did not. This response suggests that consumers wants are satisfied at these centres and it further indicated that they were willing to travel to the shopping centre they prefer. Shoppers' levels of satisfaction can be seen in the following findings. Eighty-seven percent (87%) rated the quality of the centres and 84% believed that the variety of goods and tenant mix were excellent. Sixty percent (60%) said that they got good service at the centres and 61% felt that the security provided by centre management was good. Fifty-three percent (53%) felt that the centres provided a good atmosphere for shopping and 63% were impressed with the entertainment facilities. There is an indication in these responses that shopping centres are regarded by consumers as more than just shopping venues. This is also evident in the findings regarding why respondents had come to the centres on the survey days. Based on the total sample of 200, 30.5% indicated that they had come to shop only, 25.5% had come for entertainment only, and 44% came for both. The research then sought to establish whether or not consumers would still frequent shopping centres for entertainment if they did most of their shopping online. In this regard, 76% said that they would. A majority (57%) felt that entertainment is a part of shopping, which indicates that entertainment will be an important factor in keeping shopping centres full in a climate of escalating online shopping

It was expected that parking would be a big issue. Cape Town's public transport system is inadequate and the primary mode of transportation of the target population for the survey is their own vehicle. The sensitivity around parking relates to the cost thereof. Of the four shopping centres included in the study, two have free outdoor parking options to the undercover parking provided. The other two centres only offer undercover parking which is reasonably priced. One of the centres offering both free and undercover parking, charges parking rates that are generally considered expensive. Against this background, it was found that the majority (85%) of respondents travel to the centres in their own vehicles, 39% were unhappy with the parking facilities, and 52% considered the parking fees to be too expensive. Notwithstanding this, 45% did not regard parking costs as a deterrent from coming to the centres.

Internet Access

The results show that 72% of the shoppers surveyed had access to the Internet in some form or another and 28% had no access. Thirty three percent (33%) had access at home only, 10% at work only, 42% at home and work, and 15% used Internet cafes. The 15% who only had access through Internet cafés, should probably be classified as having no access for the purposes of comparison with the College of Estate Management (2001) results which only listed 'home', 'work', 'home and work' and 'no access' as choices. If this were done, the above figures would change to 62% with and 38% without access and the place of access would change to 39% at home only, 12% at work only and 49% at both home and work.

What Shoppers Buy Online and Why

There were two main reasons why shoppers said that they either do, or would buy online - convenience (68.5%) and cheaper prices (41%). The following percentages are of the 124 respondents who had internet access either at home, at work, or both. Goods and services they bought online, either at the time of the survey, or 'always' were: accommodation and travel services – 57.3%; Banking – 67.7%; Books – 4.8%; Groceries – 0%; Music – 25.8%; Tickets (entertainment) – 35.5%.

Potential for Growth in Online Buying

Factors such as dislike of tedious shopping and less than complete satisfaction with shopping centres raise the question of whether online buying might grow in response. Respondents were asked what deterred them from buying online. The biggest deterrent, reported by 57% of the respondents, was the fear that credit card transactions were not secure. Other factors included a preference for the physical act of shopping (34%) and fears that it would be inconvenient to return goods purchased online (27%).

Fifty percent (50%) of the total sample of consumers said that they would definitely shop online if they were absolutely sure that their credit card details would be secure, 25% would be quite likely to, and 15% were uncertain. The potential for growth in online shopping is evident in the following responses to the question regarding what shoppers would be prepared to buy online if credit card security could be guaranteed. Accommodation and travel services – 75%; Banking – 51.5%; Books – 19%; Groceries – 18.5%; Music – 33%; Tickets (entertainment) – 39.5%. These responses are hypothetical and came from the entire sample of 200, including those who said that they did not have internet access, which means that they should not be compared against the percentages in the section above describing what shoppers currently buy online. For such a comparison, we need the actual numbers, which are given in Table 1.

	No. currently/always buying online	No. who would buy online if secure	Growth potential (rounded off)
Accommodation and travel services	71	150	211%
Banking	84	103	123%
Books	6	38	633%
Groceries	1	37	3700%
Music	32	66	206%
Tickets (entertainment)	44	79	180%

Table 1: Potential for growth in online buying

ANALYSIS

The selected findings of the Cape Town study presented above are discussed in this section and compared wherever possible with those of the College of Estate Management's (2001) study.

The majority (65%) of Cape Town shoppers were between the ages of 22 and 35. The 'Cyberton' sample recorded 53% in the 25 to 44 age group. It is unclear whether there is sufficient a difference here to have caused distortions in the data, but the samples were deemed reasonably similar enough to have made the comparisons that follow.

The selection of respondents is obviously crucial to this kind of study. Results will probably vary according to month of the year, days of the week, time of day, and who the interviewer is. The College of Estate Management (2001) study conducted shopper interviews on two days – a Wednesday and a Saturday. This was probably more sensible than our selection of weekdays only for the Cape Town study. However, it must be noted that the investigation in the UK study was not confined to the shopping centre itself, but to the town centre in which there were also shopping centres. In the UK study, interviewers were positioned at the entrance to the major shopping centre, the secondary shopping centre and in the streets of the shopping district. The differences between the two studies in terms of when data were gathered may well account for some biases in the results, as was evident in the UK study, where weekend surveys revealed far larger numbers of male respondents than weekday surveys.

The College of Estate Management's (2001) UK survey produced exactly the same finding regarding Internet access as our Cape Town results (72% with access and 28% with no access). Where they obtained this access differed. Compared with Capetonians, the proportion of UK respondents who had access at home only was 25% greater and the proportion of UK respondents who had access at work only was100% greater. The proportion of respondents who had access at home and work was 12% greater in the Cape Town study than was found in the UK sample. No UK respondents were reported to have access through Internet cafés only, but 15% of the Capetonian sample did so. If the adjustment proposed above in the reporting of the results is made, *i.e.* that Cape Town respondents with access through internet cafés only are treated as having no access for the purposes of comparison with the College of Estate Management's (2001) results, we then find that the places of access of the (revised) 62% of Capetonians with Internet access are as follows. The proportion of UK respondents who had access at home only was 8% greater and the proportion of UK respondents who had access at work only was 72% greater, compared with Capetonians. The proportion who had access at home and work was 31% greater in the Cape Town study than was found in the UK sample. The most important of all of these findings appears to be that the proportion of respondents who had access from work only was far greater in the UK than in the Cape Town survey. Also, if we adopt the revised figures (excluding Internet café access), 16% more UK shoppers had access than the Cape Town sample. This suggests that more UK employers provide computers and internet access for employees than do South African employers. The implications of this finding for facility managers, is that a comparable number of middle- to upper-income South Africans are online and thus the infrastructure is in place for growth in online shopping, which has potential implications for the tenant mixes and viability of shopping centres.

A question not explored in the Cape Town study, but asked in the UK study, is worth mentioning here. The question concerned what respondents used the Internet for and it was found that 45% of those with Internet access did not use it to shop, but 26% researched products and 19% used it to compare prices. Thus it seems that one cannot infer from high levels of internet access that high levels of online buying will follow.

Since three-quarters of the Cape Town sample had Internet access from home, this is probably the primary point of access for shopping and leisure. Here it should be noted that the high cost of local phone calls could well limit the rate of growth in online shopping, if access is gained via a dial-up connection. Online stores would have to provide an incentive to shop online, like significantly lower prices.

Comparing the UK and Cape Town findings on what shoppers actually bought online, see Table 2, there seems to be little in common, except music purchases, which are reasonable similar percentages (26% and 37%).

	Cape Town Shoppers	'Cyberton' shoppers
Accommodation and travel services	57%	23%
Banking	68%	9%
Books	5%	37%
Groceries	0%	9%
Music	26%	37%
Entertainment tickets	36%	-

Table 2: What shoppers bought online

The highest use of the Internet by Cape Town shoppers was for online banking, where 68% reported this use. The relatively low percentage (9%) of 'Cyberton' shoppers who used it for this purpose is a surprising finding. To adequately explain this, one would need to discuss the differences between the banking systems in the two countries, which is beyond the scope of this paper. On the surface it would appear that the UK banking system is convenient and cheap enough to use without needing to consider the option of online banking. It is call centre based and these call centres were aggressively established before the establishment of the internet. The South African system, in terms of what customers can do, when they can do it, and what it costs, appear to be sufficiently unattractive to the extent that internet banking appears to be a better alternative. The other differences between the two sets of findings appear to reflect cultural and cost differences. For example, imported books are very expensive in South Africa, so book purchasers are typically relatively wealthy people.

The Cape Town study showed relatively high levels of satisfaction by shoppers with the shopping centres included in the study. They were clearly prepared to travel to the centres in preference to closer alternatives. Any concerns about parking facilities and costs were insufficient to deter them. If we then consider that one-quarter had gone to the centres for entertainment only, and 44% had gone for a combination of both shopping and entertainment, and considering that large percentages had Internet access and did already purchase certain goods online, it seems clear that shopping centres are not under threat of extinction from online buying. They appear to be important places for social interaction and entertainment - 57% of the respondents considered it important for entertainment to be a part of shopping, notwithstanding the finding that 43% were neutral on the issue. Verdict (1999) suggested that entertainment-oriented retailers are the fastest growing segment of retail. Consumers are demanding more than just product selection and service to encourage consumption. Movie theatres, restaurants, sports facilities, health clubs, spas, game centres, clubs and entertainment memorabilia shops are examples of the changing retail tenant mix in shopping centres. The literature also suggests that theme orientated shopping centres as are found in the USA and the UK are beginning to appear in South Africa. The message for facility managers with shopping centres in their portfolios, is that shifts may well be required in tenant mix and stores/entertainment ratios, if online buying escalates to the extent that current mixes and trading patterns are affected.

The Cape Town research findings suggest that the greatest impact online shopping will have in the short term will be a reduction in the space occupied by service providers such as financial services and travel agents, since there is a clear interest in this kind of shopping to occur online. A factor inhibiting the growth of online shopping is shoppers' fears of security risks over the Internet. Once these fears are eliminated, there could be a substantial increase in online shopping and therefore a greater need by facility and centre managers to anticipate a decline in foot traffic. Table 1 gives an indication of where this growth might occur – the biggest opportunity for growth being the purchasing of groceries. South Africa has only two major grocery e-tailers, which are ironically the first two anchor tenants any shopping centre looks to attract. Growth in online grocery shopping is likely to be influenced by this.

CONCLUSIONS

It is concluded that the convenience of online shopping is attractive and it is likely to grow commensurately with consumers' perceptions about the security of Internet transactions. In

addition, it is likely that online shopping for services such as banking and travel will grow more immediately than shopping for basic goods. What this means for shopping centres owners and their facility managers and is that they will have to ensure that their shopping centre managers stay ahead of the game by anticipating these changes and developing strategies to attract consumers to their centres. Given the interest in shopping centres as places of entertainment as well as shopping, it is likely that the provision of more entertainment facilities within centres will have this effect. It cannot be concluded that the viability of the shopping centres in which the study was conducted are threatened by online shopping. On the contrary, they appear to be popular venues that provide entertainment and the opportunity for social interaction.

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APPENDIX A

African Internet Users

(Source: Central Intelligence Agency 2004)

	Millions		
Country	2002	2003	Total
Algeria	0.500		
Angola	0.041		
Benin		0.070	
Botswana	0.060		
Burkina Faso		0.048	
Burundi		0.014	
Cameroon		0.060	
Central African Republic	0.005		
Chad	0.015		
Democratic Republic of Congo	0.050		
Djibouti	-	-	
Egypt		2.700	
Equatorial Guinea	0.002		
Eritrea		0.010	
Ethiopia		0.075	
Gabon		0.035	
Ghana	0.170		
Guinea		0.040	
Guinea-Bissau		0.019	
Cote d'Ivoire	0.090		
Kenya	0.400		
Lesotho	0.021		
Liberia	0.001		
Libya		0.160	
Malawi		0.036	
Mali	0.025		
Mauritania	0.010		
Mozambique	0.050		
Morocco		0.800	
Namibia		0.065	
Niger	0.015		
Nigeria		0.750	
Rep of Congo		0.015	
Rwanda	0.025		
Senegal		0.225	
Sierra Leone	0.008		
Somalia	0.089		
South Africa	3.100		
Sudan		0.300	
Swaziland		0.027	1
Tanzania		0.250	
The Gambia	0.025		
Τοαο		0.210	1
Western Sahara	-	-	1
Zambia		0.068	1
Zimbabwe	0.500		1
Total Africa	5.202	5.977	11.179

THE EFFECT OF ICTS ON RETAIL SPACE – A SOUTH AFRICA PERSPECTIVE

K.S. Cattell K.A. Michell

R. McGaffin

Department of Construction Economics and Management, University of Cape Town, South Africa

Abstract

The proponents of e-commerce have attributed Internet access and connectivity to changes in the nature of work and shopping patterns across the globe. This is not necessarily the case for developing countries. This paper reports on the findings of an interview survey of centre managers and retail investors. This research addresses the question of what effect the development and growth of the information and communication technologies (ICTs) are having on commercial space. The findings show that both centre managers and retail investors did not experience any net reduction in retail space as a result of e-commerce. Furthermore, that the trends did not indicate a shift in space towards warehouses and management of the new relationships which would emerge as a direct result of on-line shopping. The research further indicated that both centre managers and investors were optimistic about future retail developments and are positioning themselves for changes in tenant mix by introducing internet cafes and other entertainment related activities within retail centres.

Keywords: ICTs; retail centres; on-line buying; e-commerce

INTRODUCTION

Advancements in ICTs and Internet connectivity are global phenomena that have had an impact on the nature of work across the globe. The growth of ICTs and the incorporation of the Internet in commercial transactions has realized a number of challenges for the management of physical real estate. The primary impact in the retail sector will be in a reduction for the demand for retail space via property values and rental income. The impact of e-commerce on retail, rental income, and therefore property values, will differ according to the availability of technological infrastructure, size of the real estate physical assets and the attitude of property management, tenants and consumers to on-line buying (De Kare-Silver, 1999). In this environment, the challenge faced by the retail centre manager is to balance tenant letting trends with consumer shopping behaviour.

LITERATURE REVIEW

With the proliferation of business web site catalogues and on-line buying, it is clear that it is and will increasingly become more possible to shop in a way that is quite different from the traditional method. On-line buying is in its infancy and it is not known when it will peak so that a fair comparison can be made with physical shopping (Timmers 1999). While some (e.g. Mander (2001) and McMahan (2000)) argue that on-line buying could ultimately cause a reduction in the demand for physical shopping space, Timmers (1999) regards this as a premature generalisation. However, Miller (1996) has stressed that e-commerce is global in nature and it is able to change the nature of work (Miller 1996).

In any study involving on-line buying, a useful starting point is to consider internet access. Dixon and Wright (2002) note that changes in the demographics, work patterns, affluence and mobility of consumers have shaped internet retailing. Income and education are believed to play a significant role in determining the likelihood of individuals having Internet access (OECD 2001).

However, Chen (2000) has argued that it is difficult to prove that income, education and age are significant factors in whether an individual will actually buy on-line.

What sort of products are well suited to on-line buying? De Kare-Silver (1999) finds that there is a relationship between the attributes of consumers and the characteristics of products that influences what they would buy on-line. Products which appeal to consumers' senses of touch, taste and smell, were found to be unsuitable for electronic selling. Rather, products that can be perceived through sound and light are more suited to this mode of sale or purchase (De Kare-Silver 1999). Consumer attributes and attitudes such as "habit-die-hards" (conservatives who prefer traditional shopping), "ethical buyers" (would only purchase on-line if legal and ethical), "experimenters" (like to try new things), "convenience-frenzied" (interested in time saving alternatives), and "value shoppers" (mercenaries) interested in good value for money), when combined with the product characteristics could facilitate or frustrate electronic shopping (De Kare-Silver 1999). For example, if the product characteristic has an electronic appeal and the consumer is familiar and confident about it, on-line selling for that particular product is potentially high.

Why do people shop on-line? Understanding this question is the key to understanding the extent (which has not yet been determined) to which on-line trading might be threatening the survival of South African retail centres, "a sector worth at least R50bn" (US\$1=R6.50) (Muller 2000). Chen (2000) argued that only a small proportion of the total South African market purchases on-line and that such purchasers are highly educated and have above average incomes. Worthington-Smith (2000) however, distinguished between buying and shopping tendencies that characterize the South African consumers. For example, if the consumer knows what is required, the function resorts to the one of buying and on-line purchasing becomes a convenient ordering system. Worthington-Smith (2000) also argued that the internet is an effective research medium when a desired product is not known. South African consumers are according to Worthington-Smith (2000) still suspicious of on-line buying. There is an emerging consensus that consumer demand is changing and that this is fuelling the e-commerce revolution. The findings of Tapscott (1999), De Kare-Silver (1999), Kotler (1999), Rabianski (2001) and Rahman and Raisinghani (2000) suggest that those who page the World Wide Web, seek information and buy products on-line are "time-starved". A major reason why time-starved consumers prefer on-line shopping is to avoid the problems of inadequate car parking facilities and poor access to retail centres. Changes in the nature of work and where it occurs are also a contributing factor as people working from home on computers have both the means and the incentive to browse the Web and shop (Miller 1996; OECD 2001; Struthers 2000; Borsuk 2001).

What effect can on-line buying have on retail space and rental income? The demand for retail space in a retail centre is related to the total population of potential consumers as this population has a direct impact on the level of stock kept in stores and the amount of space leased for that purpose (Fanning et al. 1994). Some argue that the growth in on-line trading will reduce the amount of space needed for storage at the actual retail centre (Borsuk 2001). A reduction in the demand for space in retail centres would negatively affect the potential of the asset to produce a return (Ball et al. 1998). It would also result in under-utilised physical assets (De Kare-Silver 1999). Apart from the effects on the amount of physical space needed, Baen (1999) argued that most retail centre tenants' leases do not contain a provision for off-site sales and this has sufficiently serious value implications for the owners that commercial leases should be altered to take account of on-line and catalogue sales. An evaluation of the impact of on-line buying on the demand for retail space would need to involve an analysis of consumers in the trade area, including access to the ICTs and their shopping patterns (Rabianski 2001). An extreme view (McMahan 2000; Mander 2001; Muller 2000) holds that on-line buying will kill retail property, through declining values resulting from lower rentals. McMahan (2000) amplifies this to include the threat of a direct reduction in aggregate physical space as well as a reduction in the number of functions performed in the space. Another view (College of Estate Management 2001) argues that on-line buying will lead to lower rental growth, higher yields and lower capital values and returns, but it will not mean the death of retail centres. However, there will be a shift (from traditional retail to warehouse), rather than a decrease, in rental space demanded and that only transport costs will increase.

Shoppertainment, or the introduction into retail centres of entertainment such as higher quality restaurants, large movie theatres and children's entertainment, Imax theatres and theme parks (Worthington-Smith 2000) is a growing trend. Christiansen et al. (1999) found that a relationship

exists between the entertainment value of retail centres and their sales per square foot, annual customer turnover, average lease rates and percentage of space leased. The shoppertainment trend is thus more of a proactive business growth strategy than a response to e-commerce.

To date, little evidence exists on the nature and the impact of ICTs on South African retail space. The purpose of this research study was to examine the effect of the development and growth of ICTs on retail space.

THE SURVEY

Methodology

The research involved 94 respondents in total, including 30 consumers, 56 retailers, 4 retail centre managers and 4 retail centre investors. All of the retail centres were in Cape Town, two in the central CBD area, and two either in or *en route* to the northern CBD area.

The reason for the inclusion of consumers was to gain first hand information regarding their use of the Internet for shopping. A non-probability quota sampling survey was done on the sample of thirty consumers (fifteen each from two of the retail centres) over the period of two days. A pilot study was conducted prior to the main survey, which revealed that there were no problems with the questionnaire. The consumer survey was designed in such a way that it would reveal the relationship between demographics, attitudes to on-line shopping and entertainment value and some retail centre attributes such as the size, security and convenience. The survey covered demographic characteristics of consumers, internet access, general attitudes to shopping, attitudes to on-line shopping and interest in shoppertainment.

It was obviously not possible to survey all consumers who shop on-line, so retailers (retail centre tenants) were also surveyed to assess the effect, if any, that on-line buying was having on their sales. Another motive for including retailers was that they would be able to give more accurate information than centre managers on the volume of on-line transactions and what this implies for the future of retail centre tenant mixes. Tenants were selected who traded in the following goods and services: fashion, groceries, home and kitchen appliances, jewelry, travel bookings, CDs and DVDs, books, general gifts, furniture, cell phones, computers and florists.

The managers of the four retail centres were interviewed. It was hoped that they would give an indication of letting trends and the impacts of on-line shopping on the demand for retail space. Four representatives of organisations involved in retail property investment and development were also interviewed with the expectation that they would contribute an overall view of trends in retail space investment at the portfolio level and provide insights into the effect of the ICTs on retail space in general.

Results of the Consumer Survey

The consumer survey was directed at middle- to upper- income groups. The majority of the consumers surveyed were in the age group 21 - 30 (54%) and a further 30% of those surveyed were in the 36-50 years of age group. In terms of educational qualification, 33% had a matriculation certificate, 30% had a diploma, 13% had an undergraduate degree and a further 24% had a postgraduate qualification. The average monthly income of those surveyed was R8000 – R11000 per month. In addition, 73% of the consumers surveyed were employed and 16% self-employed. Based on this demographic profile it can be argued that the required target market in South Africa was surveyed.

In attempting to establish the extent of internet access amongst consumers, 97% surveyed had access to the internet, of which 30% had access at home only, 30% had access at work only and 37% access at both home and work. In addition, 83% of the consumers have had internet access for more than 2 years and use the internet for a combination of banking, communication, work, entertainment & news.

The views and attitudes of shoppers were investigated in terms of a number of issues related to shopping. Table 1 below depicts the consumers attitudes towards the activity of shopping. It was anticipated that their responses would provide some insight on whether their use of the Internet and shopping behaviour resulted from their disapproval of traditional shopping patterns. It can be

seen from Table 1 that 40% of the respondents agreed that shopping is time consuming and 37% neutral.

	Agree	Neutral	Disagree
Shopping is time consuming	40%	37%	23%
Enjoy shopping	63%	27%	10%
Only shop for specific goods	77%	20%	3%
Do research & shop for specials	50%	17%	33%
My week days are very busy	83%	10%	7%
I view shopping as social event	53%	10%	37%
I view shopping as merely a necessity	30%	27%	43%
Only buy products on sale	30%	27%	43%

Table 1: Attitudes to shopping

The majority of consumers enjoy the act of shopping (63%). This correlates with the fact that 77% of consumers only shop for specific goods and 50% shop for specials in the centre. 83% of those surveyed indicated that are busy during the week and only really come to the centre at the weekends. The view that shopping is a social event is only supported by 57% of consumers and 37% of the consumers disagreed with this statement.

Consumers were asked to indicate their reasons for going to retail centre. Interestingly, 37% of the respondents indicated that they went to the retail centre for socialisation and entertainment purposes, and only 27% indicated that it was to shop only. Furthermore, consumers were asked to indicate the extent to which the retail centre meets their needs. It can be seen from Table 2 that the majority (70%) agreed that the centre was meeting their needs as a consumer, while 17% were not happy with the centre.

Table 2: Meeting Consumer Needs

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
33%	37%	13%	17%	0%

The consumer survey also sought to determine consumer attitudes to on-line shopping. 77% of consumers surveyed indicated that they did not spend their time on the Internet ordering goods on-line. Furthermore, when they did undertake transactions over the internet, books, banking, music and air travel are the most favoured on-line activities (50%). Consumers stated that their reasons for undertaking transactions over the internet were primarily convenience (47%) and time saving (37%). Their reasons for not buying on-line were a preference to shopping physically (40%), a lack of trust in the security of the internet (17%) and issues of confidentiality (17%). When asked if they would have a preference for a virtual retail centre, 40% agreed, 33% were neutral and 27% disagreed.

Consumers were asked to rate their level of satisfaction with the retail centre in terms of its location and its entertainment value. Table 3 shows that 80% of the consumers were satisfied with the location and the entertainment provided in these centres.

Table 3: Rating of retail ce	entre location and entertainment
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Highly Satisfied	Satisfied	Neutral	Dissatisfied	Very Dissatisfied
33%	47%	10%	7%	3%

Consumers were asked to indicate whether or not they would continue to frequent the retail centre despite undertaking their shopping over the internet - 87% of consumers indicated that they would continue to visit the retail centre. It can be assumed from an earlier question that their reason for continuing to visit the centre would be for socialisation and entertainment. Following on this from question, consumers were asked what the significance of the entertainment value of the retail centre is to them. It can be seen from Table 4 that 80% see the entertainment value of the centre as being important to them.

Table 4: Significance of entertainment value of the retail centre

Very Important	Important	Neutral	Not Important	Unimportant
43%	37%	7%	13%	0%

Clearly the consumer survey has indicated that consumers do not only go to retail centres to buy goods and services, but also for the purpose of social experience and entertainment. The contemporary notion of shoppertainment is supported and therefore will improve the image of a retail centre and will maintain the foot traffic through the centre.

Results of the Survey of Retail Centre Managers and Investors

75% of retail centre management saw e-commerce as an opportunity with new challenges in terms of merchandising. Responses from investors indicated that they experienced marked changes in retail investment, but these changes were largely attributed to the decentralisation of the CBD and not to e-commerce. When retail management were asked what the current retail letting trends are in relation to e-commerce, 100% indicated that they had seen no change. In contrast, Investors (75%) felt that there were new areas of development that could be investigated in retail centres, for example web kiosks and rewards programmes.

Retail centre management was asked if e-commerce has had any effect in reducing the demand for retail space. 100% responded that e-commerce had not affected the demand for retail space in the Cape Metropolitan area. Retail centre managers further indicated that there had been no changes in tenant composition and they were not considering changing their tenant profile.

Results of the Survey of Retailers/Retail Centre Tenants

In conducting the survey of retailers, there were three main objectives, namely:

- Whether there are on-line transactions in their shops and the percentage of sales through the Internet,
- Changes that were made to retailing activities as a result of e-commerce, and,
- What threats and opportunities e-commerce has brought to the retailer.

In meeting these objectives, the views and attitudes of retailers were sought on the effect of the development of on-line transactions in their business. The responses received were varied and were dependent on the store type. It can be seen from Table 5 that in specific store types, like groceries, department stores and book stores, the majority of retailers believe that e-commerce has had a positive effect on their business. Whilst some store types like jewellery and sports stores stated that e-commerce has had no effect on their transactions.

Store type	Positive effect	No effect	Negative effect
Grocery	67%	0%	33%
Home, kitchen & furniture	40%	30%	30%
Sports and travel	16%	50%	34%
Books and Publishing	80%	0%	20%
Music	50%	25%	25%
Jewellers	16%	68%	16%
Children's toys and gifts	50%	50%	0%
Fashion	40%	20%	40%
Computers, cell phones & optometrist	50%	0%	50%
Florists, plant and pet food shops	0%	50%	50%

Table 5: Views and attitudes on the development of on-line transactions

Tenants were asked to indicate whether or not they have any on-line transactions in their business. Once again the results were varied and dependent on the type of store. Homeware stores (90%), Sports and travel stores (67%) and the Book stores (60%) indicated that they have in-store on-line transactions. Whilst 66% of grocery stores and jewellery stores, 100% of children's toy stores and 70% of fashion stores indicated that they do not have any in-store on-line transactions.

Store type	Opportunities	Threats	Neutral
Grocery	75%	25%	0%
Home, kitchen & furniture	60%	0%	10%
Sports and travel	67%	0%	33%
Books and Publishing	80%	20%	0%
Music	100%	0%	0%
Jewellers	33%	33%	34%
Children's toys and gifts	75%	0%	25%
Fashion	30%	30%	40%
Computers, cell phones & optometrist	50%	25%	25%
Florists, plant and pet food shops	75%	0%	25%

Table 6: Opportunities and threats presented by e-commerce to retailers

When asked what changes the tenant had made to their retailing activities as a result of on-line buying, all store types indicated that they had made no changes to their retailing activities as a result of on-line buying. Furthermore, the majority of tenants indicated that they regard the growth of e-commerce as an opportunity to their business. Table 6 depicts the results of this question. It can be seen the those store types the most confident of the opportunity presented by on-line buying were grocery and department stores, books and publishing, music stores, children's toy stores and florists, plant and pet food shops.

CONCLUSIONS

This study sought to investigate the effect of the development and growth of ICTs on commercial space. The findings show that both centre managers and retail investors did not experience any net reduction in retail space as a result of e-commerce. Furthermore, that the trends did not indicate a shift in space towards warehouses and management of the new relationships which would emerge as a direct result of on-line shopping. The research further indicated that both centre managers and investors were optimistic about future retail developments and are positioning themselves for changes in tenant mix by introducing internet cafes and other entertainment related activities within retail centres. Clearly, there are social costs and benefits to internet access and connectivity. However these can only be assessed in terms of their impact on shopping and the change in the nature of work.

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A THERMAL INSULATION SYSTEM FOR EXTERIOR WALLS IN RENOVATION WORKS DEVELOPED BY JAPAN PAINTING CONTRACTORS ASSOCIATION

K. Motohashi

Building Research Institute, Tsukuba-City, Japan **S. Osawa, M. Kimura, R. Hirasaka and T. Takahashi** Japan Painting Contractors Association, Tokyo, Japan

Abstract

In Japan, a market of maintenance and modernization works has been growing steadily although new construction investment has been shrinking. Japan Painting Contractors Association (JPCA) has been looking for new technologies in maintenance and modernization of buildings. JPCA has been surveying not only new re-painting technologies but also additional upgrading technologies in order to add more value to maintenance and modernization works and JPCA has standardized a thermal insulation system of external walls for this purpose.

The Japanese government has been carrying out various policies for the implementation of the Kyoto Protocol. The promotion of thermal insulation systems is becoming one of the important policies of the Japanese government. Therefore, it is expected that more attention will be paid to thermal insulation systems of external walls in upgrading works of existing buildings.

In this context, the Japan Painting Contractors Association (JPCA) has developed a standardized work specification of a thermal insulation system for external walls for upgrading and renovation works. This paper introduces the background for the standardization of such thermal insulation work and the promotion by th JPCA as a preferred system of thermal insulation system in building renovation works.

Keywords: Exterior wall; paint contractor; renovation work; thermal insulation system; upgrading work

INTRODUCTION

The total output of construction works in Japan has been shrinking since the start of the 1990s.. Table 1 shows the trend in the Japanese economy and construction investment reported by Research Institute of Construction and Economy (2003).

The overall construction investment in FY2003 is expected to fall by 4.7% in nominal terms to 53.882 trillion yen compared to FY2002. A decrease of 8.8%, 1.8% and 0.9% are expected, for government construction investment, private residential investment and private non-residential construction investment respectively. In FY2004 nominal construction investment is expected to fall again by 3.4%, to 52.073 trillion yen.

Fiscal year	1990	1995	1999	2000	2001	2002	2003	2004
Nominal Cl	81.440	79.017	68.504	66.142	60.830	56.520	53.882	52.073
(Increase rate)	11.4%	0.3%	-4.1%	-3.4%	-8.0%	-7.1%	-4.7%	-3.4%
Nominal government CI	25.748	35.199	31.938	29.963	27.790	24.950	22.753	21.336
(Increase rate)	6.0%	5.8%	-6.0%	-6.2%	-7.3%	-10.2%	-8.8%	-6.2%
Nominal private CI	25.722	24.313	20.724	20.276	18.580	17.930	17.607	17.476
(Increase rate)	9.3%	-5.2%	4.9%	-2.2%	-8.4%	-3.5%	-1.8%	-0.7%
Nominal private NR CI	29.970	19.505	15.842	15.903	14.470	13.640	13.521	13.261
(Increase rate)	18.4%	-1.8%	-10.4%	0.4%	-9.0%	-5.7%	-0.9%	-1.9%
Real CI	85.442	79.020	69.874	67.314	62.540	58.500	56.160	54.659
(Increase rate)	7.7%	0.2%	-3.1%	-3.7%	-7.1%	-6.5%	-4.0%	-2.7%

Table 1: Trends in construction investment (Research Institute of Construction and Economy, 2003)

Notes: Unit: trillion yen. Real CI is based on 1995 prices.

CI : construction investment NR: non-residential

Private NR CI = private non-residential construction investment + private civil engineering investment

Total construction investment have been shrinking progressively since FY2001. The Research Institute of Construction and Economy (2001) pointed out that the market for maintenance and modernisation will grow in the medium to long term as shown in Table 2. The overall maintenance and modernisation market is estimated to be 21.1 trillion yen in FY2000. It is projected grow to 25.2-25.5 trillion yen in FY2010 under an average GDP growth rate of 2.0%. It is projected for further growth to 28.2-29.0 trillion yen by FY2020.

Table 2: Future trends in the maintenance and modernisation market (Research Institute of Construction and Economy, 2003)

		FY2000	FY2005	FY2010	FY2015	FY2020
	Public	6.0	6.8	7.3	7.7	7.9
Case 1	Private residential	6.1	6.8	7.3	7.7	7.9
	Private non-residential	9.0	9.6	10.9	12.4	13.8
	Total	21.1	23.2	25.5	27.8	29.6
		FY2000	FY2005	FY2010	FY2015	FY2020
	Public	6.0	6.6	7.0	7.2	7.2
Case 2	Private residential	6.1	6.8	7.3	7.7	7.9
	Private non-residential	9.0	9.6	10.9	12.4	13.8
	Total	21.1	23.1	25.2	27.2	28.9
		FY2000	FY2005	FY2010	FY2015	FY2020
	Public	6.0	6.8	7.3	7.7	7.9
Case 3	Private residential	6.1	6.8	7.3	7.7	7.9
	Private non-residential	9.0	9.6	10.9	11.9	13.1
	Total	21.1	23.2	25.5	27.3	29.0
	Total	21.1 FY2000	23.2 FY2005	25.5 FY2010	27.3 FY2015	29.0 FY2020
	Total Public	21.1 FY2000 6.0	23.2 FY2005 6.6	25.5 FY2010 7.0	27.3 FY2015 7.2	29.0 FY2020 7.2
Case 4	Total Public Private residential	21.1 FY2000 6.0 6.1	23.2 FY2005 6.6 6.8	25.5 FY2010 7.0 7.3	27.3 FY2015 7.2 7.7	29.0 FY2020 7.2 7.9
Case 4	Total Public Private residential Private non-residential	21.1 FY2000 6.0 6.1 9.0	23.2 FY2005 6.6 6.8 9.6	25.5 FY2010 7.0 7.3 10.9	27.3 FY2015 7.2 7.7 11.9	29.0 FY2020 7.2 7.9 13.1

Notes for Table 2: Unit: trillion yen

Case 1: GDP growth rate; 2.0% during FY2001-2010; 2.5% during FY2011-2020 Growth of public construction investment; 0% during FY2001-2020

- Case 2: GDP growth rate; 2.0% during FY2001-2010; 2.5% during FY2011-2020 Growth of public construction investment: -2% during FY2001-2010; 0% during FY2011-2020
- Case 3: GDP growth rate; 2.0% during FY2001-2010; 1.5% during FY2011-2020 Growth of public construction investment; 0% during FY2001-2020
- Case 4: GDP growth rate; 2.0% during FY2001-2010; 1.5% during FY2011-2020
 - Growth of public construction investment; -2% during FY2001-2010; 0% during FY2011-2020

The Japan Painting Contractors Association (JPCA) which is a bona fide non-profits organization under the auspice of Ministry of Land, Infrastructure and Transport, has been collecting the output data from about 3,000 members. The data in Figure 1 above, indicates that percentages of maintenance and modernization output have been increasing although the total output has been declining. The increase in maintenance and modernization output also reflect an increased demand for painting works. In this context, JPCA has been conducting various R&D projects for its members with an emphasis on maintenance and modernization technologies. It is important that such R&D activities are focusing on not only re-painting technologies but also upgrading technologies which make it possible for painting contractors to carry out value-added renovation works. The JPCA consequently selected thermal insulation work for external walls as one of such upgrading works because of the following reasons.

- Among various thermal insulation systems, JPCA selected a thermal insulation system which is applicable for external walls by the use of coating techniques. One of the main drivers is that painters from the industry can apply their coating skills in the execution of the new thermal insulation system.
- 2) The Japanese government has been carrying out various policies for the implementation of the Kyoto Protocol. Among various policies, the promotion of thermal insulation systems is one of the important policies of the Government. Therefore, it is expected that the use of thermal insulation systems for external walls will be more emphasized in upgrading works of existing buildings.



Figure 1: Comparison between new construction and maintenance & modernisation in JPCA output



Figure 2: Types of thermal insulation systems for exterior walls

STANDARDIZATION OF THERMAL INSULATION WORKS IN JPCA

Classification of thermal insulation systems

The use of thermal insulation for external walls in renovation work is already promoted in the publication: "Standard specification of modernisation works," approved by Governmental Building Department, Ministry of Land, Infrastructure and Transport (2003). Four types of thermal insulation systems shown in Figure 2 are specified in the standard specification of the Ministry. The JPCA selected the bonding type thermal insulation system as illustrated in Figure 2 above. A key motivation is the applicability of painting skill by existing painters and has developed a detailed work specification in accordance with the standard specification of the Ministry.

Outlines of standardized thermal insulation work

A structure of the thermal insulation system is shown in Figure 3. Prior to installation of the thermal insulation system, the substrate should be examined to ensure applicability of the system. The system can be applied to the following substrates.

- 1) Concrete + (surface finishing)
- 2) Concrete + cement mortar layers + (surface finishing)
- 3) Concrete + (cement mortar layers) + tile finishing

The substrates shall be free from any defects such as spalling, delamination, cracking, etc. In case of presence of such defects, they shall be repaired by patching with mortar, epoxy injection, sealing, etc. according to standardised specifications. Consequently, the insulation system is applied to the substrates which are sound, dry, tightly fixed and flat. Further the substrate shall be properly prepared to be free of foreign materials, such as, oil, dust, dirt, form-paint, wax, water repellants, moisture, frost and any other materials that inhibit adhesion.

Expanded polystyrene (EPS) form boards are bonded to the substrates by use of polymer modified cement mortar (PCM) as a binder. The quality of the EPS has to meet to the standards as prescribed by JIS A 9511 (2003). The PCM is installed on the EPS boards first, then the EPS boards with PCM are installed on the external walls.

After installation of the EPS boards, PCM and reinforcing glass mesh are installed on the EPS boards. The PCM should be coated to fully embed the reinforcing glass mesh. After embedding

the glass mesh, a new surface finishing material is coated on it. Tile finishing can not be applied on the thermal insulation board.



Figure 3: Structure of the thermal insulation system for exterior walls

An educational program for the thermal insulation system

JPCA has set a 3-days' educational program for supervisors of the insulation system in order to ensure quality of their insulation works. Only the registered painter approved by Ministry of Health, Labor and Welfare can participate in the program. Licenses for supervising the insulation works on site are given to the participants of the program if they pass the final examination. The program consists of both lectures and practice training as shown in Table 3.

Lecture	Practice training
Thermal insulation Thermal insulation for exterior walls Detail of executing method Specification Substrate preparation Execution planning Execution management Cost calculations Case study Management of workers	Preparation of the substrates Cutting of expanded polystyrene Mixing of adhesive (Polymer modified cement mortar) Installation of the adhesive Installation of EPS board Surface preparation of EPS board Embedding reinforcing glass mesh Polymer modified cement mortar coating Surface finishing
Renovation method for exterior walls Regulation on fire prevention	

Table 3: Curriculum of the educational program for supervisors

DEVELOPMENT OF EVALUATION TOOL FOR THERMAL INSULATION WORK

One of the barriers for advancing thermal insulation works in renovation works is the potential difficulties in explaining the merits of the thermal insulation system to building owners and users. In this context, JPCA has developed a computer software for evaluation of the thermal insulation system. The JPCA software includes calculations of thermal simulation, prediction of due condensation, predicted mean vote (PMV) based on ISO 77330 (1994), life cycle cost (LCC) estimation, life cycle carbon dioxide (LC-CO₂) estimation, and work efficiency estimation programs for the renovation works with and without the thermal insulation system.



Figure 4: Example of the computer outputs in the evaluation tool

An example of computer outputs is shown in Figure 4. By inputting the basic data obtained from design stage into a computer, the software will generate an output as shown in Figure 4 above instantly.

Table 4 shows input data, calculations or algorithm, and output data from the software evaluation tool. Although there are still rooms for improvement in the user friendliness of the software application, this tool is useful for demonstrating the beneficial effects of thermal insulation.

Input data	Calculations or algorithm	Output data
 Meteorological data Dimension and shape of building Physical data of building envelope Indoor amount of heat, ventilation schedule, times of ventilation Amount of clothes and exercise in rooms Cost of materials, maintenance and renovation intervals, life time, amount of CO₂ Duration of works 	 Unsteady thermal calculations [Solar designer, TRNSYS (/COMIS)] PMV: Fanger / ISO 7330) Due condensation: Steady state calculation LCC calculation: Based on technical reports of national research projects LC-CO₂ calculation: Based on the guideline issued by Architectural Institute Japan 	 Comparison of room temperature, floor temperature, wall temperature, and their daily changes LCC, maintenance and renovation schedule Total evaluation on effects of a thermal insulation system (As shown in Fig. 4)

Table 4: Input data, calculations or algorithm, and output data for the evaluation tool

CONCLUSION

The market for maintenance and modernization works has been growing steadily since FY2000, although new construction investments have been shrinking. JPCA has been looking for new technologies in maintenance and modernization works. JPCA has been surveying not only new re-painting technologies but also additional upgrading technologies including thermal insulation of external walls.

In this context, JPCA has established the standard thermal insulation work by the use of polystyrene form as a thermal insulation material among various thermal insulation systems on the Japanese market. The established system is acceptable for painting workers because of similarity in practicing skills. JPCA has also established an educational and training program for qualifying supervisors who are managing actual thermal insulation works. The curriculum consists of lectures and practical training of workmanship.

JPCA has further developed a computer software for demonstrating the effect of thermal insulation in renovation works. It has been found that such tool is useful for justifying renovation work including thermal insulation works. Post occupancy evaluation and other measurements have been carried out in some upgraded buildings in order to illustrate the positive effects of thermal insulation of external walls.

It is important for paint contractors to suggest value-added and environmentally friendly renovation works in order to increase their output shares. The development of the standardized renovation work including the thermal insulation system is one of such activities conducted by JPCA

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THERMAL INSULATION EFFECT OF A RENEWAL WATERPROOFING SYSTEM FOR CONCRETE ROOFS

T. Kondo
A. Noboru
Institute of Technologists, Saitama, Japan
I. Fujimoto
Center for Better Living, Tsukuba, Japan
K. Motohashi
Building Research Institute, Tsukuba, Japan

Abstract

A new renewal system for concrete roofs by application of prefabricated fiber reinforced polyester (FRP) panels and anchoring has been reported in the CIB W70 Brisbane 2000 Symposium.

Thermal insulation systems are very important for the global environment and energy-saving. The renewal waterproofing system has a useful thermal insulation effect because it utilizes a polystyrene foam insulation board at the back of the FRP panel. In this paper, the thermal insulation effect of the renewal waterproofing system was researched through thermal calculations and experiments. The difference of the roof insulation effect between common conventional asphalt waterproofing system and the above FRP panel waterproofing system was compared in each case by the loss of energy. As a result of calculations, the thermal penetration rate of the FRP panel waterproofing system reduced energy consumption to 55% of the asphalt system. According to temperature measurements in each element, the thermal resistance of the FRP system was about four times as much as the asphalt system. The equivalent energy of an outside insulation system was controlled to about 40% of an inside insulation system and the energy-saving effect of the outside insulation system was more useful than the inside insulation system.

Keywords: Energy-saving; FRP; Insulation; Renewal; Waterproofing

INTRODUCTION

A new renewal system for concrete roofs by application of prefabricated fiber reinforced polyester (FRP) panels and anchoring for the renewal construction of existing buildings, which allows a shorter renewal construction term and to accelerate the reduction of labor, has already been reported in the CIB W70 Brisbane 2000 Symposium by Dr. Kondo. The system was approved in 2001 through the technology certification system of the Japan Building Center. It is considered that the system has a thermal insulation effect because a section of the system has a thermal insulation layer (40 mm thick polystyrene foam board) at the back of the FRP panel.

Nowadays, protection of the global environment is the most important theme throughout the world and energy-saving within a building itself is demanded. Not only better maintenance are required, but also functional improvements in existing buildings are needed as well.

With this as the background, the energy-saving effect after the renewal construction of a system was studied through thermal insulation evaluation of the renewed roof element and temperature measurements in the renewed building.

A conventional inside thermal insulation system, where the thermal insulation is installed inside of the building structure, has been mainly applied as the traditional building thermal insulation system. However, an outside thermal insulation system, where the thermal insulation is set up outside of the building structure, has recently gained attention in Japan. The outside thermal insulation system is superior to the inside thermal insulation system because the former is not

only expected an inhibition effect for thermal accumulation but also to provide a prevention effect for the structural material. However, it has not been possible to differentiate the former from the latter because the thermal insulation effect is theoretically considered based on calculations with thermal constants. Therefore, the thermal insulation effect was considered by the results of heating experiments for both thermal insulation systems.

CASE STUDY OF THE THERMAL INSULATION EFFECT

Evaluation method for the thermal insulation effect

Energy consumptions for the FRP waterproofing system were calculated by the heat loss through thermal penetration and were compared with energy consumption for a non-covering type of common conventional asphalt waterproofing system.

Heat loss in a building structure during air-conditioning is in proportion to the thermal penetration rate K. The thermal penetration rate is calculated using formula (1).

$$K = I/(I/\alpha_{i0} + \Sigma I/\lambda + I/\alpha_{i})$$
(1)

Where

K: Thermal penetration rate (W/m²K) α_{io} : Outside thermal conductivity (W/m²K)

 α_i : Inside thermal conductivity (W/m²K)

 λ : Thermal conductivity of each material (W/m²K)

I: Thickness of each material (m) In this case, α_0 =30 and α_i =7.5 were adopted.

Case Study

A section of the non-covering type of common conventional asphalt waterproofing system is shown in Figure 1 and the FRP waterproofing system in Figure 2. The thermal penetration rates in each case are calculated using formula (1) with the numbers in Table 1.



Figure 1: A section of the asphalt waterproofing

Figure 2: A section of the FRP panel waterproofing

50

(mm)

Insulation board

Material	Asphal <u>t</u>	FRP	Insulator	Concrete
λ (W/m²K)	0.232	0.24	0.036	1.3
l (m)	0.008	0.002	0.04	0.15

Table 1: The thermal constants of materials

Each thermal penetration rate is as follows;

Case of asphalt waterproofing system Case of FRP panel waterproofing system $K_1 = 2.892 (W/m^2 K)$ $K_2=0.771$ (W/m²K)

(2)

Supposing that heat loss from other elements except the roof is the same in both cases, the heat loss constant during air-conditioning is calculated using formula (2) with each value of the thermal penetration rate.

$$W=\Sigma An K_n + 0.35N V_r$$

Where

W: Total heat loss constant (W/K) *n*: Total number of external walls *An*: Area of external walls (m²) *Kn*: Heat penetration rate (W/m²K) *N*: Ventilation times by draft (times/h) *V*_{*i*}: Building volume (m³)

Supposing that a building volume is $27m^3$, the total number of external walls is 1 by only the roof and the ventilation time is 1, the heat loss constant in each waterproofing system is calculated using each thermal penetration K₁ and K₂. The results of calculation result are shown in Table 2.

Table 2: Total heat loss constant in each waterproofing system

Waterproofing system	Total heat loss constant	
Asphalt	35.5	
FRP panel	15.8	(Unit: W/K)

Heating consumption energy during January (winter) and air-conditioner consumption energy during July (summer) in Tokyo are calculated in both cases. A degree day (Dti - Dtoc), which is an index, is applied because application of a heater and air-conditioner is influenced not only by the season but also by the degree of coldness. The heating degree day (degrees Centigrade day /year) is the integrated temperature difference from set up temperature on every day, and it increases in the cold area. It is calculated using formula (3).

$$Dti - Dtoc = \sum (ti - to)$$
(3)

Where

ti: Room temperature (degrees Centigrade) *to*: Mean outdoor temperature a day (degrees Centigrade) S: Days that *to* is lower than *toc*

Supposing that the set up room temperature is 20 degrees Centigrade, the heating degree days in every month in Tokyo, which is calculated by the mean temperature, is shown in Table 3.

Table 3: The heating degree days (HDD) in every month in Tokyo

Month	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Mean Temp.	7.6	6.0	9.4	14.5	19.8	22.5	27.7	28.3	25.6	18.8	13.3	8.8
HDD	12.4	14.0	10.6	5.5	2.5	7.7	8.3	5.6	1.2	1.2	6.7	11.2

*Air-conditioner is applied from June until September, and heater is applied from November until April.

The consumption energy by air-conditioner in winter and summer is estimated by formula (4).

$$Q_H = 0.086 W (Dti - Dtoc)$$

Where Q_{H} : The consumption energy by air-conditioner (MJ)

The calculation results of the consumption energy in January and July in Tokyo are shown in Table 4.

(4)

In the case where the FRP panel waterproofing system is applied on the roof, the consumption energy is controlled to about 55 % lower than the common asphalt waterproofing system.

Table 4: The consumption energy in January and July in Tokyo for each waterproofing system

Waterproofing system	January	July	
Asphalt	38.9	24.2	
FRP panel	16.8	10.5	(Unit: N

TEMPERATURE MEASUREMENT IN AN ACTUAL CONSTRUCTED BUILDING

Measurement Method

The FRP panel waterproofing system has been applied on the roof of a 2-story office building that is constructed by reinforced concrete. Temperature was measured by thermo couples on the FRP panel surface, the back face (existing roof surface), back face of the concrete slab, and for room temperature and outside temperature. The room temperature was measured at about a 1.5 m height from the floor and the outside temperature was measured at about a 1 m height from the ground, where was not in direct sunlight on the north side of the building. The thermo couple was covered with aluminum foil to avoid the effect of air current.

Results and consideration

Representative temperature measurement results are shown in Figure 3. The temperature on the FRP panel surface increases from sunrise and the maximum temperature reaches 50 to 60 degrees Centigrade in spring and summer, and 20 degrees Centigrade in winter, which is much higher than the air temperature. On the other hand, the temperature on the back surface of the FRP panel does not change much and is not lower than the air temperature. The back face of the FRP panel reaches a maximum 25 degrees Centigrade lower than the panel surface during the day in summer, and conversely, 7 degrees Centigrade higher after sunset in midwinter. A case of temperature change with the heating is shown in Figure 3. In this case, the room temperature rapidly increases from 9 am when heating started and it gradually dropped at about 10 pm when the heater was stopped.



Time (Hour) Figure 3: Temperature change during January 22, 2002, when it was sunny

The surface temperature of the roof is generally increased higher than the air temperature because it was exposed to direct sunlight. If the material, which has a small heat capacity and a low heat conductivity, is applied to the surface of the element and other material that has a large heat capacity is placed inside of the surface material, penetration of heat from the outside and release of heat from the inside are reduced. Therefore, the element has four times the thermo resistance as compared with a common conventional waterproofing system without covering. The FRP panel waterproofing system gives this type of additional performance to the roof and it is expected to provide energy-saving throughout the year.

COMPARISON OF AN INSIDE INSULATION SYSTEM WITH AN OUTSIDE INSULATION SYSTEM

Experiment Method

The test specimens were boxes and a volume of the box was about 1m³. One face of the specimen was made up of a concrete plate (150mm in thickness) and the other faces were made up of polystyrene foam boards (100 mm in thickness). Specimen No. 1 was applied with the FRP waterproofing system outside the concrete plate. Specimen No. 2 was installed common polyurethane foam board (25 mm in thickness) inside the concrete. The specimens were heated by infrared bulbs for 8 hours and were placed in room temperature for 16 hours. The cycle of

heating and cooling was repeated 8 times. The temperatures were measured on the center of the concrete plate section, the back face of the concrete, inside of the specimens, and the concrete surface or outside surface of the specimens. The experiment method is shown in Figure 4.



Figure 4: The experiment method

Results and consideration

The temperature measurement results are shown in Figure 5 to 7.







Figure 6: Temperature change on the concrete plate


Figure 7: Temperature change in the specimens

Maximum temperature on the outside surface of the specimen No. 1 is 75 degrees Centigrade and the minimum is 15 degrees Centigrade. The maximum temperature on the outside surface of the specimen No. 2 is 59 degrees Centigrade and the minimum is 24 degrees Centigrade. The outside surface temperature change of the specimen No. 1, which is the outside thermal insulation system is larger than the specimen NO. 2. In the outside thermal insulation system, the heat capacity of the surface material and the insulator is small, and it was easier to warm and cool than the exposed concrete case. On the other hand, the temperature of the concrete inside had almost no change in the outside insulation system and temperature change of the inside insulation system is bigger than the former because the concrete is placed outside of the insulation layer. Furthermore, the space temperature inside of the specimen is almost constant in the outside insulation system, but the inner temperature in the inside insulation system also widely changes by the temperature change of the concrete. It is considered that a difference of the insulation effect depends on the position of the insulation layer and the outside thermal insulation system is more advantageous than the inside system to maintain constant inner space temperature.

The energy amount that is needed to maintain 20 degrees Centigrade, a temperature of the inner space in the outside insulation system, is about 40% in the case of the inside insulation system as shown in Figure 8. It is judged that the outside insulation system is more energy-efficient than the inside system, and the former can cut down the use of air-conditioner 40%, compared to the latter.



Figure 8: Equivalent energy that is needed to maintain 20 degrees Centigrade

CONCLUSIONS

In this paper, the insulation effects of both the inside and the outside thermal insulation systems were considered. The conclusions reached are as follows.

- (1) The energy consumption of the FRP waterproofing system was reduced by about 55% as compared with the common conventional asphalt waterproofing system.
- (2) The thermal resistance of the FRP waterproofing system was 4 times of the common waterproofing system without surface covering.
- (3) The temperature change of the back face of the FRP panel was lower than the panel surface and the roof surface temperature was affected more by the air temperature than sunshine.
- (4) The outside insulation system is more energy-saving than the inside system and the former is able to reduce about 40% of the latter.

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WORKPLACE AND ORGANIZATIONAL CULTURE

Alenka I. Temeljotov Salaj Joint Services of the Government, Slovenia, Europe Dušan Zupančič Velko S. Rus University of Ljubljana, Slovenia, Europe

Abstract

Real estate could be the object of interdisciplinary scientific research. In this research the relation of an individual with real estate was studied according to the technical, social, psychosocial, historical, cultural and economical influences (Rus, 2000). The real estate evaluation is placed in important relation with the perception of social climate and the manifestation of efficiency. Presented is the analysis of the relation between the real estate status of family and the social climate, self-evaluation of the family members and values, different orientations, life style, identity and efficiency of the individual.

We looked into the influences of the real estate characteristics of workplaces on the feelings of workers and their efficiency. We tried to answer to the following questions: do particular perceptions of different organizational characteristics, especially resistance of organizational leadership (as perceived from the side of respondents) against different organizational changes differentiate between two groups of respondents: between 1/ leadership and expert structure of a very successful Slovene company and 2/ owners and employees of Slovene real estate agencies. The second aspect of the problem is expressed in the question, if sex and group membership (owners and employees of real estate agencies, architects and engineers from Slovene city Maribor and publicly important persons) influence the evaluation of proper workplace. We were also interested into the structure of perceptions, how the characteristics of real estates, connected with the workplace influence the feeling and conditions at work.

Five groups of participants were included in the research: (i) well-known persons employed mostly in important state and media institutions, (ii) owners and employees in real estate agencies, (iii) construction experts from the Maribor region, (iv) leaders and experts from a very successful Slovene production company and (v) students of psychology from the Ljubljana University.

Perceptions of mentioned resistances significantly discriminate between members of real estate agencies and between the members of a very successful Slovene company, with real estate characteristics specially contributing to the difference between the groups. No significant main effect of sex and age on the evaluation of workplace was discovered, but their interaction effect was significant on the p=0.07 level. A three-factor structure of perceptions connected with the workplace influence their feelings and conditions at work were identified. The discriminating function showed a relatively high correlation with variables concerning traffic, the age of the building, floor, material, architectural design, color, orientation, accessibility, modern technology, and the needs for renovation, new construction and official flats. The factor analysis of the same perceptions showed a three-factor structure.

Keywords: efficiency, real estate, workplace, organizational culture

INTRODUCTION

The main intention of this research is to explore the relation between the individual and real estate, and vice versa, with the aim that a future investor, economist, architect, urban designer, and financial expert would know what kind of surroundings a particular person (dis)likes, what do (or does not) he/she wish, what is his/her (dis)inclination, what kind of influence some real estate element has on the individual – all seen through the focus of working efficiency, the efficiency of the organization, social problems, health situation, and life style.

We took up a very extensive research because of the fact that this kind of research has not been made yet. We set up the basic hypothesis that life cycles of real estate do not only evidence technical-technological and economic factors but are a result of the perception of participants during the real estate process:

- The expectation that the set of predictive manifest variables, which point to the perception of the degree of acceptance of proposals concerning different organizational processes and characteristics at the level of one and only discriminatory function, significantly differs between the groups of the leading and expert staff in a very successful production company and the owners and employees in real-estate agencies;
- Evaluations of the workplace differ substantially according to group affiliation (owners and employees in real-estate agencies, public opinion leaders, employees in construction sector from the Maribor region), according to gender, and according to the interactive effect of group affiliation and gender;
- General mood at work differs according to infrastructural and real-estate characteristics of working surroundings.



Figure 1: The model of the relation between individual orientation and real estate

For the purpose of verification we carried out a research of different groups of participants with a wide set of different questionnaires, scales and differentials. Most of them were developed precisely for this research, and their instrumentation showed measurable characteristics. Results were analyzed according to statistical programs (SPSS and subprograms for uni-variable, bi-variable and multi-variable analyses).

POSSIBLE ASPECTS IN TREATING REAL ESTATE

In treating real estate and the relation of an individual to real estate we start from the basic concept of value and worth. Rokeach (1960) claimed that the value is a permanent conviction, a specific mode of behavior or ultimate state of existence, which is personally or socially desired more than the opposite mode of behavior or ultimate state of existence; this is also how he defines the

concept of value system. It is a rather permanent organization and structure of convictions; in the continuum of relative importance it concerns personally and socially more desirous modes of behavior and ultimate state of existence. The worth of real estate itself is relative, it depends on a variety of its own objective and subjective elements, as well as on the surroundings, the individual, society and social norms. Aristotle said that the worth of property has been made for man and that it only persists in the mind of the individual. One of the most important real-estate theorists Ratcliff (1949) argued that the only worth of property is the one that has been ascribed to it by man.

In the history of human being, the model of justice is connected with the issues of human rights in the widest sense of the word, with their declarations and possibilities to exercise them: economical, political, cultural, social and health-care rights, the rights for quality-life and personal self-realization, the right to own property, to have a religion, and so on. It is the individual as the highest universal value, and human rights in the widest sense of the term and with the possibility of being realized, that ensure pervasive functional and attractive models of justice instead of their limitation merely on a certain group of people (Rus, 1993).

A very important aspect of the relation between people is the equality in their relationships. This notion could be discussed on micro or macro-social levels, as equality in the relationship between individuals or between groups, even big groups, as well as a problem of relations in the society. Walster and Bersheid (1978) believe that the perception of inequality in the relation has a frustrating effect. This is the reason why people tend to reestablish the relation of equality. There are different theories dealing with the reestablishment of balance, such as the theories of homeostasis, standpoints, and cognitive dissonance.



Figure 2: Possibilities of dealing with real estate from different aspects

A very important source of information about people is communication. Mutual relationships are expressed through verbal and non-verbal communication, which is also the language of emotion and interpersonal relationships. Berne (1973) claims that a huge amount of everyday conversation performs the function of social participation and preservation of relationships, rather than the information-communication function. The place in which we live, work, have fun or recreate can also have a communicational value. Meetings with the superiors in their offices represent one example of the description of the actors at the meeting. Features of physical environment can function as social interaction taking place in a certain environment.

Social psychology is both personal and socio-interactive, focused on both an individual and small and big groups. In its dealing with 'individual psychology', social psychology deals with basic psychological processes: cognition, emotion and motivation.

A standpoint towards somebody or something can be represented as the relationship on three levels (components). This relationship has three characteristics: cognitive, emotional or evaluating, and readiness to behave in a certain way. Real estate can be discussed from the psychological

aspect of sensorial or social perception, including the esthetic perception of real estate (different kinds and ranges of real estate – from furniture and garden houses to landscape, part of a settlement, or a whole city). From the anthropological standpoint we can discuss real estate as a symbol, an element of identity, or from the property aspects. Real estate and its features from the psychological, legal-proprietarily and economical aspects are one of the basics problems of modern societies in transition, including Slovenia.

From the marketing point of view real estate could be interesting on every level of the market network, and it can have its ergonomic part (real estate and economic effort in the working process, safety at work, accommodation to psychological characteristics of the employment) and its ecological part (real estate and different psychological aspects of the environment, such as the phenomenon of crowd (Baum & Paulus, 1991) or even emotions (Russel & Snodgrass, 1991)).

The beauty of the nature and cultural identity are the leader characteristics of the landscape and architecture. National identity is tied on special society conception about the space, which is designed by the separate component and selected country types (Kučan, 1998).

Real estate could be discussed from the standpoint of 'social psychology of material possession' (Dittmar, 1992). From this point of view we could speak about intrusive qualities of objects (permanence, economy, financial evaluation, rarity, esthetics), instrumentality (general usefulness, possibility of special activities with the object), about other characteristics linked with the use (enabling social contacts, entertainment, relaxation, freedom, independence, financial safety, information, knowledge, privacy or loneliness), about effort needed for the acquisition and maintenance of real estate, emotional characteristics related to the property (emotional attachment, regulator of emotion, escapism, emotional 'therapy', comfort in safety, self-confidence), about the manner of self-expression (for oneself, for others, individuation, as a symbol of future personal aims or of personal skills and capacities), personal (or social, political, economic, cultural) history (in relation with events and places, in connection with the past, as a symbol of continuity (or a symbol of the relationship with other people, companies and groups).

A SPECIAL ASPECT OF ORGANIZATIONAL CULTURE AND SOCIAL-CULTURAL PSYCHOLOGY

In the framework of social psychology, real estate could be a subject of different spheres: economic social psychology, marketing, social psychology of law, social psychology of material possession, social-cultural psychology, psychology of art and semiotics, environmental psychology (Polič, 2001), and also it can include combine social strategies (Stokols, 1991).

The existing specialized literature dealing with real estate from the standpoint of psychological, economic, legal or technological aspects, is short of an interdisciplinary (theoretical) approach to the discussed problems.

The notion of real estate is also one of the basic categories describing the concept of 'culture' both on global and organizational levels. Special questions in the analysis of the impact of real estate and the attitude that real estate could have on the common culture and the efficiency, deal with the signs of efficiency, which could be discussed in the sense of attaining the productivity and social-emotional goals of the organization. The organizational and 'wider' culture could be discussed also as one whole complex of variables, which comprise objective characteristics of organizational structure, processes, efficiency, social climate, leadership, communication, values in different aspects of material infrastructure (Trice & Beyer, 1993).

Our research problem has some different aspects.

- We were interested in, if perceived orientation (of leadership structure) connecting organization culture, functions and characteristics, discriminate between two groups of respondents (leaders and experts from the very successful production company and owners or employees of real estate agencies in Slovenia).
- In what extent individual infrastructure and real estate characteristics connected with workplace influence feelings and conditions at work?

- The other aspect of the problem was, if there is any influence of sex and group membership on the evaluation of working place.

The main hypotheses are:

- Perceived resistance (connected with different organizational functions) of the leadership structure in the correspondent enterprise differentiates between two groups of respondents: between 1/top management (leadership and expert structures) of the analyzed very successful Slovene company and between 2/ group of owners and employees of analyzed real estate agencies. Perceived acceptance connecting the following organizational functions were taken into account as predictors, discriminating between two groups (two levels of criterion): resistance connecting 'delegation to mandates and responsibilities', 'construction modernization of existing objects', 'consideration of proposals of subordinates', 'transformations in ownership', 'trust in working abilities of subordinates', 'utilization of discipline steps', 'construction of new buildings' and 'estimation of working efficiency of subordinates'.
- Perceptions, how leadership accept different proposals connecting organizational culture and functioning differentiate between two groups of respondents: between 1/top management (leadership and expert structures) of the analyzed very successful Slovene company and between 2/ group of owners and employees of analyzed real – estate agencies. Connecting the following characteristics of organizational culture and function were taken into account as predictors, discriminating between two groups (two levels of criterion): perceived acceptance connecting 'housing problems', 'trade union', 'rewarding for work', 'employment of new workers', 'working conditions', 'suitability of arrangement', 'building', 'development', 'quarrels' or 'misunderstandings' and 'organizational of works'.
- We expect significant effect of factor 'sex' and factor 'group membership' on dependent variable 'evaluation of workplace' (summative score). We expect so significant main effects, as significant interactive effect.

PARTICIPIANTS

The research comprised five groups:

- a group of leaders and experts from the very successive production company from Slovenia (n=90, M=2.92 (category from 30-40 age), 55% men, 45% women);
- owners or employees of real estate agencies in Slovenia (n=31, M=43.55, SD=12.66, 40% women, 60% men);
- employees in the field of construction business in Maribor, Slovenia (n=28, M=37.36, SD=10.82, 57% women, 43% men);
- employees in the public sector and state institutions from Slovenia (n=24, M=39.20, SD=14.00, 60% women, 40% men);
- students of psychology from the Ljubljana University, Slovenia (n=25, M=25.80, SD=5.8, 90% women, 10% men).

APPLIED INSTRUMENTS

Questions given in the research are only one part of a wide questionnaire used also in other research projects. The following two groups of questions were formulated – selected for our research.

- 1. Questions about the perceived resistance of the leaders connected with organizational characteristics of the company in which they are employed. Perceived resistance was measured on the 7 point scale (1=resistance is very small, ..., 7=resistance is very big, it blocks the changes).
- 2. Perceived consideration of the propositions concerning different organizational processes and characteristics. In what extent are the working conditions or the feelings at the workplace

influenced by the following characteristics: transport, orientation, the age of the building, the floor on which a person works, the material from which it is build, accessibility, the arrangement of rooms, the color of rooms, modern technology and modern furniture (1=doesn't influence at all,...,5=very influence). All the groups answered the questions (except the group of leaders and experts from the production company group).

3. Evaluation of the proper work place was obtained as summative score, using the semantic differential with seven point bipolar continuums (example: space enough 1 2 3 4 5 6 7 not space enough). The following bipolar attributes 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. We wished to find out whether the set of variables expressing evaluation of different groups of people – the real-estate agents' group, the Maribor group and the public sector group – discriminate the criteria variables. Internal consistency of the instrument was identified for each of three compared groups. Cronbach's alpha in each group was higher than 0.80.

Data in Slovene company were collected by psychologist Maja Meško, and data from sample from Maribor were collected by Tina Škrinjar, the architect.

RESULTS AND DISCUSSION

Table 1/1: Statistics of discriminate analyse

Wilk's lambda	χ²	Eigen value	Df	Р
0.843	17.54	0.19	8	0.02

Table 1/2: Correlation between the manifest variables and the canonical discriminate functions

Manifest variable	Function 1
Delegation of mandates and responsibilities	0.62
Construction modernization of existing objects	0.58
Consideration of proposals of subordinates	0.57
Transformations in ownership	0.56
Trust in working abilities of subordinates	0.43
Utilization of discipline steps	0.41
Construction of new buildings	0.33
Estimation of working efficiency of subordinates	0.14

The first and the only possible discriminative function was discovered as significant on the 0.02 risk level (see Table 1/1).

Between the predictors, contributing to the discrimination between the groups, the following manifest variables have relatively highest correlation with discriminative function: 'delegation of mandates and responsibilities', 'construction modernization of existing objects', 'consideration of proposals of subordinates' and 'transformations in ownership'. Correlation between the manifest variables and the canonical discriminate functions (p<0.05) in the question of the 'resistance of leaders connected with organizational characteristics' show that many predictor variables are important for the discrimination. But from the standpoint of real estate the variable is of great interest; it correlates closely with the canonical discriminate function, which means that the question of the resistance of leaders connected with construction modernization of the existing objects is very significant for the classification the participants. Centroids (look table 1/3) show clear distinction between employees in the very successful production company and owners or employees in real estate companies.

Table 1/3: Representation of group centroid values

Criteria variable	Function 1
1 – Production company	-0.239
2 – Real estate agency	0.763

On the one side we have a typical industrial company occupied with the production and marketing of products; on the other hand we have a service company that deals with transactions in real estate. The relationship to the surrounding environment is perceived differently, and it depends on the affiliation to the group. Investments in the reconstruction of buildings are important from the standpoint of status symbols, better feelings of employees and also from the functional standpoint: to bring new technology, more adequate for the modern ways of functioning. From the standpoint of big industry, the more important aspect of workplace is effective production rather than beneficial working conditions. Its prime interested is the modernization of process technologies and reorganization of workplaces.

Table 2/1: Statistics of discriminate analyse

Wilk's lambda	χ ²	Eigen value	Df	Р
0.484	81.23	1.00	10	0.00

Table 2/2: Correlation between manifest variables and canonical discriminate functions

Manifest variable	Function 1
Housing problems	0.71
Trade union	0.38
Rewarding for work	0.29
Employment of new workers	0.25
Working conditions	-0.15
Suitability of arrangement	0.12
Building	0.10
Development	-0.10
Quarrels, misunderstandings	-0.09
Organizational of work	-0.07

The first and the only possible discriminative function was discovered as significant on the 0.00 risk level (see Table 2/1). Between the predictors, contributing to the discrimination between two levels of criterion variable (expression of the approval of proposals (by leaders) in regard with different organizational processes and characteristics), the only one manifest variable has relatively highest correlation with discriminative function: 'housing problems'.

Centroids (see Table 2/3) show even bigger distinction between employees in the very successful production company and owners or employees in real estate companies.

Table 2/3: Representation of group centroid values

Criteria variable		Function 1
1	Production company	0.701
2	Real estate agency	-1.494

Throughout the history, the housing problem has been one of the most burning problems of working class. Even nowadays, buying or renting a flat is a big problem in our country, particularly because there are not enough apartments on the market. The state endeavors to arrange relations on the real-estate market with different subventions by real estate funds (favorable savings, loans, leasing, renting conditions). Urban planning policies of towns are also very important, and they try to follow the needs by filling up empty spaces between buildings, allowing replacement constructions in cases of abandoned industrial or army structures, allowing new constructions on the outskirts of towns, and similar.

Variable	Communality	Factor	Eigenvalue	Percent of explained variance	Cumulative %
Transport	1	1	4.10	41.0	41.0
Orientation	1	2	1.91	19.1	60.2
Age	1	3	1.12	11.2	71.4
Floor	1	4	0.73	7.3	78.7
Material	1	5	0.65	6.5	85.3

Table 3/1: Statistics of Factor Analysis

Note. Only two variables with eigenvalue < 1.00 are presented in the table.

Variable	Factor 1	Factor 2	Factor 3
Transport	.78	.11	.01
Orientation	.74	.30	02
Age of the building	.86	.11	.13
Floor of the workplace	.56	.40	29
Building material	.79	.25	08
Accessibility	.36	.80	13
Arrangement of rooms	.22	.86	.07
Colors	.14	.70	.37
New technologies	.09	02	.92
Modern furniture	13	.15	.83

Table 3/2: Matrix of Factor saturation (VARIMAX rotation)

We were interested in what extent individual infrastructure and real-estate characteristics connected with workplace influence the feeling and conditions at work? Three groups were chosen, basically on their experiences with the real estate market: owners or employees of real-estate agencies, public leaders and students of psychology. According to the Kaiser criterion (intrinsic value is equal or bigger than 1) we extracted tree factors: the first factor, 'functional accommodation', explains almost 41% of the whole variance; the second factor, 'semiotics', 19%; and the third factor, 'intelligence of the building', 11% - all together 71,4% of the whole variance.

The first factor, 'functional accommodation', correlates with the variables: age, material, transport, orientation, and floor. All correlations show different principles of designing in the past and in the present, including functional character of spaces, dimensions, orientations, useful surfaces per number of employees, organization of spaces, and the use of material and accessibility of location in regard to traffic facilities. Today one of the main orientations of investment is economical feasibility and this also determines the design in order to attain the best efficiency for the minimum invested means. One of the major current impacts on urbanization is the economical influence (Goodall, 1987); it could be said that 'urbanization means the transformation of society'. A successful design of urban systems has to take account of modern economical factors. The location of business is very important, taking account of the growing traffic and the trend of moving out and living in the outskirts of bigger cities (Pogačnik, 1986), the flows of traffic and the access to parking places.

The second factor, 'semiotics' correlates with the following variables: arrangement of rooms, accessibility, and colors of the rooms. The organization of rooms and also their correct arrangement is one of the fundamental steps of architectural designing. Organization of rooms takes account of the internal functional logic and its dependence on external spaces (Koželj, 1987). Colors that surround us in the living or working space are very important for working conditions. Neutral colors of workplace are acceptable, which have little influence on feelings and which are psychologically 'purifying' (Korelc, 2001).

The third factor, 'intelligence of the building', correlates with coefficients bigger then 0.50 – with the variables: new technology and modern furniture. This is understandable and expected. It tells us

that nowadays modern information links and modern micro-environment are normal conditions for working processes regardless if they take place in old or new buildings.

Workplace	Group of participants				
	Real-estate agency	Public sector	Maribor		
Women	57.91	40.28	56.56		
	(n=11)	(n=7)	(n=16)		
Men	52.79	57.62	54.17		
	(n=14)	(n=8)	(n=12)		

Table 4: Means of the "evaluation of proper work place"

Note. "Evaluation of proper work place" is an evaluative score.

Table 4 presents results of the survey of expectations. Individual influences of independent variables were taken into account: 'Affiliation to the group'(owners and employees in the real-estate agencies, well-known persons from state or media institutions, and building experts from the Maribor region), independent variables 'sex' and their interaction with the dependent variable: workplace.



Figure 3: Interaction of group - membership and sex on evaluation of proper workplace

- 1/ affiliation to the group (owners and employees in real-estate agencies, well-known persons from state or media institutions, and building experts from the Maribor region);
- 2/ sex: women, men;
- F age (1) = 1.59; p= 0.21;
- F sex (1) = 1.72; p= 0.19;
- F group (2) = 1.70; p= 0.19;
- F sex x group (2) = 2.79; p= 0.07.

We did not accept our alternative hypotheses connecting the main effects, but interactive effect was discovered as significant on the 0.07 risk level. Inspection of the cells in the table shows relatively highest positive evaluation by the groups of women real estate and public sector. We pay attention to small numerous in some conditions (men and women from the public sector) for the estimation of workplace where men from the group 'well-known persons' have valued their workplace more positively than women from the same group. As Musek (1987) wrote, human beings organize their space so that the most pleasant, good and positivistic tones come to the focus of their attention.

CONCLUSIONS

This research tried to brighten some researcher questions:

 if the set of variables, which express evaluations of different organizations and groups of participant, discriminate the organizational resistance and consideration criteria according to the real estate characteristics,

- which workplace characteristics influence on the working conditions or the feelings,
- if groups of participants differ between themselves according to the sense of real estate characteristics of working place.

We found out that the question of the perceived resistance of leaders connected with construction modernization of the existing objects (Table 1) is very significant for the classification the participants of different organizations (production group and real-estate agents group) and also the question of the housing problem (Table 2) is the most significant for the classification the participants in regard to the expression of the approval of proposal (by leaders).

The factor analyses statistics show us (Table 3) which individual infrastructure and real-estate characteristics connected with the workplace influence the feeling and condition at work, we named factors as 'functional accommodation', 'semiotics' and 'intelligence of the building factor'.

The examination of main individual effects of independent variables 'affiliation to the group' (Table 4) and 'sex' didn't show the influence on the dependent variable 'characteristics of workplace'; on the other side, the interaction between the main factors was discovered as significant on the 0.07 risk level.

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ORGANIZATIONAL DYNAMICS AND THE NEED TO MANAGE FACILITIES OVER TIME

Michael Fenker

Laboratoire Espaces Travail (LET), School of Architecture Paris-La-Villette, France

ABSTRACT

A great deal of research supporting a closer tie between organisational change and intervention on the facilities generally refers to a model showing the congruence between the technical system and the social system. While managing congruence is often seen as linking strategic decision making and intervention in the technical system, facilities management tends to separate the temporality of the intervention in the workplace from that of the activity taking place in the workspace.

This paper wants to contribute to the notion of facilities management as an ongoing process by analysing different aspects of organization dynamics and by developing the idea that the perception of the built environment is continuously changing during the collective action in which an organisation is engaged. Our analysis accepts space as a resource that can contribute to the construction and negotiation of meaning within the collective action, either implicitly during the action, or explicitly, particularly during the transformation of the workplace and its formal evaluation. Space is a resource because, through the representation that people mobilizes, it conveys a body of knowledge that is directly or indirectly linked to the appropriateness that exists between the action and the physical facilities, among which people use those that give meaning to the situation or that allows them to act. Consequently, the management of the spatial resource appears not just to be an adjustment between the physical facilities and the organisation in function of the objectives being pursued, but also an aspect of the negotiation of meanings during the action.

Keywords: organization dynamics; organisational learning; situated action; workplace design and management

INTRODUCTION

Competitive positioning, market developments, technological innovation and new management methods are, among others, factors that make change a major concern in a large number of companies. Over and above the diversity of practices and the ultimate aims of change management, it can be seen that certain problems occur in a recurrent manner, particularly those concerning knowledge management¹ and the capacity of companies to adapt².

Facilities management (FM), like all other professions involved in the management and production of workplace, does not escape from these problems. A company engaged in a change process cannot avoid inventing other forms of spatial occupation or, at the very least, question itself as to the approach it takes in this matter. This illustrates the overlap between organisational and spatial facets but does not provide a satisfactory understanding of the way in

¹ In particular, see the special issue of the French management review: Revue française de gestion, n°149 "Management des savoirs", March – April 2004.

² In particular, see Hammer M. (2001) *The Agenda: What every business must do to dominate the decade*, New York, Crown Business.

which space management can contribute to the achieving the objectives being pursued by organisational change. Certain FM professionals consider that flexibility in the occupation of the workplace is an important factor in contributing to organisational agility. Approaches such as the reversibility of buildings, the reconfiguration or standardisation of layouts, the withdrawal of capital invested in property, ad-hoc spaces distributed over the country, etc. are based on this position. The lack of well-researched analysis makes it difficult to evaluate these approaches and make available the resulting knowledge.

Our contribution to the thinking on FM practices and knowledge is based on an analysis maintaining that the relevance of space does not simply depend on changing the physical facilities or a services offer. Our analysis proposes a reading of the organisational and spatial dynamic that integrates the deeply open nature of the compromises developed by participants in collective actions. These compromises affect the relevance of resources and the means, much in the same way that the perception of resources affects the detailing of compromises. In this approach, the relevance of the resources, including spatial resources, reveals itself to be the result of building meaning between those participating in the collective action.

ORGANIZATIONAL DYNAMICS

Organizational change as the aim of the strategic decision

An analysis of organizational change is generally based on the concept of process. Van de Ven and de Polle (1995) define this process as a progression of events within an organisational entity over time. Change, being a type of event, is an empiric observation of the differences relating to form, quality or status over the duration of an organisational entity. The entity can be a job carried out by an individual, a work group, an organisational strategy, a programme, a product or the entire organisation (Van de Ven A. H. et Poole M.S., 1995, p. 510).

Managerial literature gives extensive coverage to the analysis of change through the observation of changes within the economic, political, technological or social context of an organisational entity. Within the framework of market – organisation relations, the problem of adapting an organisation to external events or the management of events that might generate a competitive advantage³ have been examined in great detail in terms of strategic decision-making⁴.

One way of analysing the position of organisations vis-à-vis change consists in reflecting on the values that underlie the management of the occurrence of events. Beer and Nohria (2000) state that there are two ways of approaching change within organisations: theory E and theory O. The first is based on economic values, using financial incitements, staff reductions and restructuring, while the second is based on organisational capacity, implying the development of a "culture" and competences through individual and group learning. The priority given to one or other of the two approaches has an impact on the developed or perceived meaning of the actions taken by an organisation. Beer and Nohria state that, in practical terms, the two theories are often applied simultaneously.

A large number of works, analysed by Allouche and Schmidt (1995), reflect these two perspectives. The authors examine these positions within the concepts of "strategic flexibility" and "strategic management of human resources". The first concept is specifically present in the works on the strategic transformation model and in the *reengineering* model. The second concept is used by approaches that consider the development of a "system of values", the detailing of the objectives pursued, and the reinforcing of a company "identity" as essentials in the managing of activities within the organisational dynamic.

³ In particular, see: WERNERFELT B. (1984), « A resourced-based view of the firm », *Strategic Management Journal*, vol 5, pp. 171-180. BARNEY J. (1991), « Firms resources and sustained competitive advantage », *Journal of Management*, vol 17, N°1, p. 99-120.

⁴ Chandler A. The visible hand, (will be completed)

The very open nature of the internal dynamic

The uncertainty accompanying the appearance or the progression of events raises a considerable problem in terms of managing change. However, the perspective of market – organisation relations alone is not sufficient to fully understand this problem. The analysis of collective action, recently enriched by the growing interest of management sciences in distributed cognition, gives access to another aspect of uncertainty, being the dynamics of compromises developed by participants for a given management situation⁵.

To establish how the action is determined, one can, as proposed by Girin (1990), distinguish between the motives for the action on the one hand and, on the other, the contexts of the action. The motives of the action are represented by the fact of having a result that must be achieved, "to be based on the logic of bounded rationality, to the sense of the term given by Simon" and to conclude with "agreements negotiated between the participants". The action context is: what determine the choices made, in other words, what makes it possible to give meaning to an event, an act or a message. This analysis shows the dynamic as being generated by the diversity of the rationality of the players and by the interpretations given to events during the course of an action.

The uncertainty of events is therefore not just maintained by the changing context but also by the very open nature of the compromises worked out between the players. These types of compromises take into consideration "not just the appropriateness of the means used to achieve the result, but also their appropriateness given the various other objectives being pursued by the participants" (Girin J. 1990, pp. 141 – 182).

This aspect of uncertainty is also present in works that perceive change as a "constructivist" process in which the route taken depends on the interpretations made within a given situation. In his work on sensemaking, Karl Weick (1995) distinguishes between uncertainty and ambiguity. Uncertainty corresponds to ignorance or the absence of interpretations that would allow sense to be made of a situation. Ambiguity exists when the players are overwhelmed by all the possible interpretations of a given situation. Consequently, the problem of uncertainty incorporates an element of *meaning* that is absent in the action, not explained or difficult to understand, that would permit the linking of various objectives pursued and direct the interpretation of events. This position is reminiscent of the work carried out by Wenger (1998) on communities of practice and learning. According to this author, experience is a negotiation of meaning within a continuous process that implies the participation in a situation and a reification of experience.

Our analysis simultaneously concerns a discussion on the determination of the management situation, which could include the perspective of determination by strategic decision, a perspective placing emphasis on the idea of the players' free will, and a discussion on the way in which relations between the participants and the physical facilities articulate with one another during the action. In other words, it is the way in which the facilities become incorporated into the action. Our analysis should therefore take into consideration the various moments where decisions are made concerning the appropriateness of means to pursue a result. Consequently, it is not just a moment of designing or maintaining of means that is generally analysed by the FM, but also a moment of action.

SPATIAL DYNAMICS

The presence of these various moments in the management of physical facilities underlines the fact that the appropriateness of means, or the effect that it produces, cannot be considered to be stable over time. In addition we have noted that appropriateness cannot be understood as targeting a single pursued objective and, consequently, it does not have an exclusive or unequivocal nature. Given the diversity of the objectives pursued and the changes to which they are subjected, the physical facilities should not be envisaged as the single object of management that can be enclosed or retain its appropriateness to the pursuit of a result over time. The single object of management needs to include the relation between the participants in the situation and

⁵ The concept of *management situation* refers to the idea that participants must, within a given time period, carry out a collective action that will lead to a result subjected to external judgment.

the physical facilities. This relationship appears a priori to be as decisive for the appropriateness of the physical facilities as the facilities themselves. We believe that this distinction is important as it is often forgotten in FM approaches. We feel it is significant that FM often indifferently describes space, the physical environment, buildings, equipment, information technology, etc. as the object of its activity. However, the term space is not of the same order as the other terms used. Space is not defined by something that is purely physical but rather makes reference to the relations between the subjects and a given workplace. An examination of the concept of space reveals the complexity of this relationship, a complexity that largely exceeds the concept chosen by FM in its interrogation on the "services" offer with regards its "clients".

As a result, FM is confronted with a dual organisational and spatial dynamic.

Managing space means managing representations

This position is based on the concept of space advanced by Lefebvre (1974), being that of space as a "social product". It requires an analysis of the way in which an organisation places itself in relation to space by questioning the representation that it mobilises. The representation is not simply an effect of the status of this relationship but necessarily an intentionality, a project concerning this status (Lautier, 1999).

In this situation, it necessary to distinguish between place or physical facilities, and between space(s) or spatiality. Lautier (1999, p.176) writes: "Space can be seen as a system of social relations, mediatized by a physical organisation". Space therefore refers back to the diversity of positions in social relations between the occupants of a place. For Lautier (1999, p.214): "[space] is the representation that organises the perception of this place for a subject (individual or collective)". Consequently, space changes according to the representations that the subjects mobilise according to their position, their interest, their origins or their project vis-à-vis other subjects. In spatiality, the name given to a plurality of spaces, different representations and different points of view of a given situation exist side by side, become superimposed or oppose one another. The resulting concept of conflict and instability of perceptions lead the author (Lautier 1999, p.67) to underline: "Managing space first requires representational management".

The concepts and meaning that the subjects attach to the representations, their contradictions and the way they change, should lie in the centre of a concern that sees in space the real object of FM. In this case, thinking concerning the representations linked to the physical facilities becomes all that more important as they necessarily concern objectives being sought by a subject, either individual or collective, or the way of achieving an objective. The internal dynamics, inasmuch as they refer to an iterative process of constructing meaning, constantly engender situations that subject the physical facilities to the challenge of representation that the subjects have developed concerning the action. There either exists a correspondence or a break between what the physical facilities "propose as a reading" and what the situation "requires as a reading". Consequently, changing situations require that the relation between action, representation and the physical facilities be managed in time to avoid a breakdown. The concept of developing representations, via its proximity to the concept of developing knowledge through experience, as analysed by Argyris and Schön (1978), make it possible to envisage FM making a contribution to change management by the construction of meaning in function of situations and representations conveyed by the workplace.

The difficulty of apprehending FM in terms of managing the dynamics

Our analysis raises the absence of models able to explain this dual dynamic and the position of FM to it. A great deal of research supporting a closer tie between organisational change and intervention on the physical facilities generally refers to a model showing the congruence between the technical system and the social system. This research separates the temporality of the intervention in the workplace from that of action taking place within the workplace⁶, often by separating the work and the place in which it is carried out. It does not develop any problems concerning the modification of the perception of the form during the action. The concerned researchers believe that organisational change is more the product of external events than due to the occupation of the workplace. The change is managed by explicit decisions and rational

⁶ These positions are defended, especially in the works by Duffy (1993) and Becker (1999, 2001).

logic based on the strategic planning and the evolution of the economic, technical or social context. The appropriateness between the physical facilities and the action addressed is, a priori, defined and the construction of meaning is carried out independently from the course taken by the action. If one follows through the logic of these positions, the players have no other choice than to manage the organisational dynamic, a priori by intervening on the physical facilities "upstream" from the management situations concerning the occupants of the workplace. One of the rare means studied to better manage uncertainty and to prolong the development of the appropriateness concerning the situation in which the action is to take place is that of flexibility and the reconfiguration of the physical facilities. The insufficiency of the positions cited above, expressed as models, lies in the fact that they only place the development of compromises in the implementation phase of facilities. They do not propose any explanation on the construction of meaning during the action. These positions suppose a static vision of the relation between form and meaning.

Another divergence between research work in the FM field and our reading of the dynamics concerns the question of the relation between organisational learning and the occupation of the workplace. Some research has analysed the framework within which the change in the physical facilities is organised to contribute to the learning of new routines⁷. Curiously, this research often restrains the learning process during the phase preceding the occupation of the workplace. The participation of the occupants in the definition of the programme or in the design of the facilities is considered to be a decisive learning element. The occupation of the facilities, rather than being analysed as the continuity of this process and even the key element, is above all analysed as being the moment for evaluating the obtained results. The change in uses and meaning is not taken into account as an organizational learning process based on a spatial practice⁸.

A lack of knowledge concerning the significances in play in the situation and the participation of interpretation of the form in the construction of meaning also appears in certain research on the evaluation of buildings. It is worth noting that Preiser (1984, 1997) considers post-occupancy evaluation as an approach whose aim is to evaluate whether or not the decisions taken during the design or renovation process of a building contribute to the performance of the occupants⁹.

However, this research only offers little contribution to our problem of appropriateness of space that is affected not only by the transformation of a form but also by the interpretation process of those involved in an action and the reciprocity phenomenon between the perception of the form and the perception of the situation.

3. TOWARDS THE MANAGEMENT OF THE SPATIAL RESOURCE

In our attempt to reconcile organisational dynamics and spatial dynamics in the problems faced by FM, one useful element is to introduce the concept of resource to take account of the physical facilities interpretation phenomenon.

⁷ We notably refer here to the case of the SOL firm in Finland which based itself on the office transformation process to accompany the restructuring of its sales units. This case has been specifically analysed by Becker and Steele (1995).

Another case is that of the Swedish Post that managed the transformation of its property stock to contribute to the learning of new routines by its agents within the scope of its privatisation process. Concerning this, see Larson E. (2002).

Research carried out by Granath, Adler and Lindahl (1999) analyses the engineering department of a firm in the electrical equipment sector that is engaged in a design process that simultaneously covers the physical facilities, the technical system and the work organisation.

⁸ However, certain works concerning this phenomenon by Fenker (2003) and Granath, Adler and Lindahl (1999) should also be noted.

⁹ The performance of places of work is often examined on the basis of the building capacity concept. It is only recently that certain research in the FM sector has questioned the effective use of these capacities. A study recently begun by a European group of researchers concerns the ease of use and the utilities of work places as perceived by the occupants (see CIB TG51 "Usability of work places" under the direction of Keith Alexander.)

The concept of resource plays an important role in research looking at the problems of distributed cognition in the organization theory. Girin (1995) analyses organization as being a set of heterogeneous elements. From the distributed cognition, he picks out a conception of the subject of the knowledge, the competence and the action that is no longer that of the individual or even that of the group. He develops the idea that the agent is made up from composite entities that associate employees, objects, physical spaces, machines, documents, etc. (Girin J. 1995, p. 235).

The author continues: "Consequently, the term organisational set is held to designate these types of heterogeneous combinations provided with a mandate 'within' an organisation. In other words, the organisational set is an agent (an agency) and this agent is a composite (a layout) of various resources, among which can notably be found the human resources, the physical resources and the symbolic resources" (Girin J. 1995, p. 235).

By privileging the term "spatial resource" over "space", we wanted to simultaneously underline that the space can effectively be seen as a resource at the service of the players, their projects or the organisational efficiency, and indicate that the various interpretations of the physical facilities can co-exist, oppose one another and be renewed within the observed situations. While the *mobilisation* of the spatial resource is therefore a process of attributing meaning to the physical facilities to accomplish an action and pursue an objective, it is also the meaning that the physical facilities spontaneously present in the action through the accumulated knowledge of the spatial forms.

A resource to construct meaning

The analysis accepts space as a resource that can contribute to the construction and negotiation of meaning within the collective action, either implicitly during the action, or explicitly, particularly during the transformation of the workplace and its formal evaluation. Space is a resource because, through the representation, it conveys a body of knowledge that is directly or indirectly linked to the appropriateness that exists between the action and the physical facilities, among which the players use those that give meaning to the situation or that allows them to act. Consequently, the management of the spatial resource appears not just to be an adjustment between the physical facilities and the organisation in function of the objectives being pursued, but also an aspect of the negotiation of what is "real" during the action. This implies that the search for a compromise between the various objectives is pursued by the participants through an adjustment of the representation or the way of dealing with the situation. Space, which in the end is a collective action coordination device, is not therefore just an arrangement of common interests, but also a means of regulating the various interests.

The development of a compromise is linked to the reciprocal perception that players have of the way in which they place themselves in relation to space. The knowledge mobilised during the discussions enabled the players to evaluate and negotiate their position within the action taking place and, through this, their position vis-à-vis the collective project. This eminently implicit evaluation process of the positions held by the players inevitably includes an evaluation of the relevance of the physical facilities for the action, the collective project and the way in which the concerned pursued objectives change in the representation made by the players.

The implicit or explicit management of the spatial resource that takes place by the transformation of the form, by the adjustment of objectives or by the manner in which the players are involved in a relationship with the form during the action, is not just a body of knowledge, it is also the construction of new knowledge that contributes to the development of the collective project and its greater understanding.

CONCLUSION

This concept of the spatial resource supports the idea of multiple temporalities in which the transformation of the relationships between the players and the physical facilities happens. It clearly reveals the interest there is in envisaging space management in the continuity between an intervention that consists in objectifying the representation, or including it in the form and the mobilisation of the spatial resource during the action that consists in identifying the action and continuing or amending the meaning attributed to the form. The concept of the modification of relationship between the representation and the form allows us to identify the on-going game of players positioning themselves vis-à-vis the collective project and the action. From this point of

view, the intervention on the form is nothing other than a continuity of this game with, potentially, the possibility of thinking up new rules that take into consideration the increasing knowledge of the participants. This body of knowledge is the one that the form will propose to the occupants the appropriate management situation. To have an effect, this knowledge must be reiterated and amended by the occupants.

Our reading of organisational and spatial dynamics raises also two issues concerning FM practices: the temporalities of space management, that professionals generally limit to being either upstream or downstream from the collective action, and the role of occupants and other *stakeholders* in the management process, which should be understood to be that of the player contributing to the appropriateness between the action addressed and the space.

Insofar as the first point is concerned, our analysis could encourage professionals to seek a regular evaluation of the knowledge relating to corporate projects and the contexts that could be mobilised to interpret the spatial resource. The consideration of this body of knowledge requires, on the one hand, a certain period of observation and participation in the management situation by all the concerned parties and, on the other, the analysis tools to objectify the representation of the appropriateness between the form and the collective action. This proposal clearly runs into practical problems and should be the subject of future research.

Concerning the second point, our analysis also imposes a different reading of the interplay between players. On the one hand, it permits the questioning of certain aspects of the exchanges between management and designer. Despite the specific body of knowledge held by each player, a factor that obviously should not be denied is the cooperation of these players in terms of the shared construction of knowledge which is essential to incorporate the representation in the form. Another aspect of this is the traditional separation between utilisation and use, excluding the designer from having a direct relationship with the occupants and the way they occupy the workplace. However, we feel it is possible for the designer and, more generally, for the professional responsible for the design and the management of the workplace, to intervene in different ways vis-à-vis the representation of the form-action relationship that goes further than simply modifying the form. On the other hand, we feel it important to go beyond the designer-manager couple by introducing a third component. This takes the occupant into consideration not just as a "client" but also as a player concerned by the appropriateness between form and action. The fact that the occupant simultaneously holds knowledge concerning the construction of this degree of appropriateness and a level of independence in how this should be achieved encourages us to integrate the occupant as a player whose role is as essential as that of the other two in managing the space, including during the workplace design phase.

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THE ORGANIZATION BEHAVIOR COMPONENT OF FACILITIES MANAGEMENT – BECOMING PART OF THE BUSINESS PROCESS

Sheldon Robert Goldstine

Eckland Consultants Inc. USA

Abstract

This paper discusses the results of a 2002 survey developed by Sheldon Goldstine for the International Society of Facilities Executives (ISFE) for distribution to its membership. The research focused on the importance of the Facility Function and the need to expand the role of Facility Management within a company infrastructure, by improving overall organization participation and communication in both short- and long-term facility-planning processes.

The questionnaire was distributed and managed electronically through ISFE's web site. The respondents represented a broad range of industries, with the majority being in the design, construction and real estate management sectors. Analysis of the survey indicates a need to improve communication between various departments, outsourced providers and the Facility Function. It appears that formalizing communication and responsibility relationships would improve the quality and quantity of exchanged information and the probability that individual department and corporate expectations would be met or exceeded.

As corporate and institutional strategic programs evolve to better utilize real estate in relation to organizational and strategic business goals, executive management appears to be becoming more aware of the value-added benefits derived from including real estate functions as part of an organization's business process.

Keywords: Information; perception; process; future benefits

INTRODUCTION

Corporations, institutions and government agencies are developing and implementing a variety of strategic business programs to improve real estate utilization. They have been responding to internal real estate needs and to the many changes occurring in the delivery of design, construction and real estate services. Design/build, out-tasking and outsourcing real estate functions have become commonplace.

As corporate and institutional strategic programs evolve to better utilize real estate in relation to organization and strategic business goals, executive management is becoming more aware of the need to improve communication between executive management and real estate staff. In order to increase the probability that real estate staff would receive required comprehensive short- and long-range facility planning information that is sensitive to corporate goals and strategic plans, executive management, including department leaders, would need to become involved early, during the building design and space planning process.

Implementing participative organizational concepts similar to those utilized to improve managerial functions would also likely lead to improved real estate functions. The process is complex since it will likely involve many internal department personnel as well as out-tasked and outsourced professionals. The key is to start early and to share critical information that will affect long-term facility utilization.

We anticipate that the effect would be to encourage facility designs that are more consistent with and adaptive to an organization's short- and long-term goals and strategic business plans... resulting in building designs that are more conducive to organizational change in terms of construction cost and time required to adjust to anticipated changing market and/or institutional

demand, i.e., real estate utilization programs that lead to more cost-effective operation of facilities and improved productivity from the employees who work in them.

Comparative theoretical analysis

Business and Industry has relied upon management theorists including Frederick Winslow Taylor, who formalized the principles of scientific management; Frank and Lillian Gilbreth, who developed theories on human motivation and studies on motion to improve productivity; and George Elton Mayo, famous for his Hawthorne Experiments, conducted at the Hawthorne Works of the Western Electric Company that concerned human relations and motivation theory. Mayo's research and writings on motivation, participatory management and team building influenced the development of the human relations school of management.

Abraham H. Maslow's investigations into human behavior led to his hierarchy of needs. Douglas McGregor developed two motivation models called Theory X and Y, concerning the behavior of people at work. Rensis Likert researched organization profitability, labor relations, and the use of human assets vis-à-vis management styles and systems. Frederick Hertzberg contributed to organization behavior thinking through his theories on hygiene and motivation. David C. McClelland's work has provided insight into workers' need and motivation for achievement. Chris Argyris compared bureaucratic (Theory X) type organizations to humanistic (participative Theory Y) organizations with emphasis on bureaucratic values that still dominate most organizations and their impact on organizational problems.

Scientific management and participative organizational behavior theories utilized to improve employee productivity and organization performance have not been effectively applied to facility management functions in organizations vis-à-vis building design and short- and long-term building utilization.

Including real estate functions as part of an organization's "business process" and employing participative management concepts similar to those utilized to improve managerial functions could also improve real estate functions. The process would be complex since it will likely involve many internal department personnel as well as outsourced professionals, all of whom would be influenced by executive management's acceptance and promulgation of employing scientific and participative management concepts to building utilization and design.

METHODS AND TECHNIQUES

The research focused on the importance of the Facility Function and the need to expand the role of Facility Management (FM) within a company infrastructure, by improving overall organization participation and communication in both the short- and long-term facility planning processes, i.e., improving the quality and quantity of information provided to the Facility Function and outsourced consultants. We received 54 responses, approximately 20 percent of the ISFE membership. The research we completed in cooperation with the ISFE was referenced in the lead editorial in the October 2002 issue of <u>Buildings</u>. The study per se helps to understand the need to improve communication; however, it can also add to the body of knowledge leading to further research on improving the sustainability of buildings and their ability to better serve the short- and long-term needs of the people and equipment they house.

Our research was generally based upon "push" technology where the ISFE membership was notified by e-mail on several occasions about the intent of our survey and its location on the ISFE web site. The survey included general industry, job description, out-tasked and outsourced services and communication-related questions; these were generally scaled by yes, no and level-of-importance response options. The generalizations derived from the study indicate a need to improve the quality and quantity of information shared between the Facility Function and other organization departments; further, the study indicates a need to motivate executive management to become more involved in the facility planning process and to accept and promulgate scientific management organization behavior programs in order to more effectively plan facilities for their short- and long-term needs. The theoretical generalization concerns similar issues focused on effective communication and employing proven organizational theory concepts to the building design and space planning processes. The research, at this stage, did not include a pull review, i.e., where survey participants could select their own information sources.

Comparative research and literature

Danny Sheim-Shin Then's "Integration of facilities provision and facilities support service provision – A management process model," included in the proceedings of the CIB W70 2002 Global Symposium, discusses a need to bring "...alignment between business strategic direction, organizational structure, work processes and the enabling physical environment; the organization's strategic intent must clearly reflect the facilities dimensions in its strategic business plans."

In 1999, the International Facility Management Association (IFMA) completed a study, "Outlook on Outsourcing – Research Report #20," to identify how its members manage outsourcing within their organizations. Approximately 4,000 members were randomly contacted, resulting in 539 responses (approximately 15 percent). The IFMA outsourcing survey results indicated that outtasking (i.e., hiring of individual, specialized vendors – architectural design, interior design, housekeeping, food services, etc.) was employed by approximately 85 percent of the respondents, while 12 percent outsourced to full-service, single-source vendors to provide packaged services. IFMA reported that 3 percent of the respondents internally manage all facility management services.

Comparing the 1999 IFMA outsourcing survey to a similar IFMA survey conducted in 1993 (referred to in the 1999 IFMA outsourcing survey) generally indicates that more facility managers are out-tasking major moves, architectural design, furniture maintenance, construction management and utilities maintenance. It has become common for an organization's executive management to encourage out-tasking and outsourcing of real estate services. Full-service real estate service provider vendors have been successfully demonstrating efficiency and offering cost-saving programs. Cost savings from out-tasking design, housekeeping, food services, grounds maintenance, etc., can also be measured as an accounting function.

In 1996, IFMA retained Gelb Consulting Group, Inc. to conduct a survey of senior managers concerning their attitudes and expectations of the facility management function. The study, "Views from the Top... Executives Evaluate the Facility Management Function," included an initial sample of 3,663 IFMA members, which was later reduced to a final sample of 626 members. Approximately 40 percent (252 responses) of the final sample returned questionnaires.

Executive respondents were concerned about reducing costs, increasing productivity and aiding competitiveness. "However, 60% think of their facilities as a cost of doing business or a resource that enables the organization to function." Other concerns deemed important include sound financial management, successful project accomplishment, accurate and timely information concerning costs, having direct communication between executive management and facility managers ("but not in boardroom meetings"), and more facility manager proactive suggestions concerning equipment, procedures, needs assessments and long-range planning.

In general, the IFMA Views from the Top survey indicates that there appears to be an acceptance that facility management is in a period of evolution. "In the future, about half of all facility management departments will consist of a small core staff that relies on contract workers and vendors to meet the majority of facility management needs." The question remains about how an organization's core facility management staff will maximize their contributions by becoming more aware of short- and long-term goals and strategic business plans to more effectively respond to changing needs based on shorted business cycles and market demand.

Dan Brathal and Mark Langemo in their 2004 book, High-Performance Facilities Management – A guide for Total Workplace Design and Management, state in Chapter 3, Engaging Senior Management in Facilities Management Endeavors, "If senior management decides to make something a high priority it gets approved, funded, staffed, and accomplished! If senior management doesn't seem to care, progress will be difficult!" Brathal and Langemo go on to say, "Strategic plans for facilities management need to be carefully developed and correlated with overall strategic plans, goals, and objectives of entire organizations." Their book cites examples from companies including 3M where facility managers need the support and input from their organization's in-house staff and leadership in addition to out-tasked and outsourced service providers.

SURVEY RESULTS AND DISCUSSION

The survey respondents represent a broad range of industries, with the majority being in the design, construction and real estate management sectors. Several questions are presented below and/or discussed, with the full questionnaire being available for reference and review.

Question 4. Are you an outsourced real estate services provider serving one (or more) organization(s)?



Twenty-nine percent of the respondents reported that they are outsourced real estate service providers, serving one or more organizations. The majority of the outsourced responses were generally divided equally among Operations and Maintenance, Strategic Planning, Facility Programming, Architectural, Engineering, Facility Design, Program Management, Project Management, and Construction Management. Least represented were Real Estate Brokers and Building Contractors.

Question 5. Number of facilities managed: Total facilities managed, all responses: 4,896

Question 8. Total square feet of all facilities managed:



The total number of facilities managed by in-house FM respondents was 4,896, with 31% managing less than 1M sf; 41%, 1-5M sf; 13%, 5-10M sf; 6%, 10-15M sf; 3%, 15-20M sf; 0%, 20-25M sf, and 6%, 25-50M sf. Forty-nine percent of the in-house FM respondents reported that they manage facilities totally with in-house staff.

Question 10. Do you manage your real estate in-house with some assistance by outsourced real estate management services consultants?



If the answer to Question 10 is YES, please select the kinds of outsourced consultants from the following list: Real Estate Management Firms; Real Estate Due Diligence Firms; Management Consultant Firms.

• Other (please describe below):



Other 2 Selections: Broker Contacts and Brokerage

In-house FM respondents who reported that they manage real estate with some assistance by outsourced consultants gave the following responses: 50% utilize Real Estate Management Firms; 15%, Real Estate Due Diligence Firms; 29%, Management Consultant Firms, and 6%, Broker Contacts and Brokerage.

Question 13. How much lead-time do you typically receive concerning space reconfiguration within existing facilities?



• For projects 1,000 - 5,000 Square Feet (SF):

• Do you feel that the time allotted is adequate?



• Do you feel that you received adequate input from in-house departmental staff to meet short-term (one-year) space planning needs?



• Do you feel that you received adequate input from in-house departmental staff to meet long-term (three- to five-year) space planning needs?



• After construction completion and occupancy, do you typically need to re-program design plans to implement major space reconfigurations to meet long-term (three- to five-year) space planning needs?



Thirty-seven percent of the in-house FM respondents reported that lead-times were not adequate for either small- or large-space reconfigurations within existing facilities. When in-house FM was asked about receiving input from other in-house departmental staff, 31% of the FM respondents indicated that input received was not adequate to meet short-term (one-year) or long-term (three-to five-year) space planning needs. Therefore, it was not unexpected that 51% of the in-house FM respondents reported that after construction completion and occupancy, they typically need

to design and implement major space reconfigurations to meet long-term occupancy needs and expectations.

Question 14. How much lead-time do you typically receive concerning planning for new facilities or major building additions?



• Do you feel that the time allotted is usually adequate?



• Do you feel that you received adequate input from in-house departmental staff to meet short-term (one-year) space planning needs?



• Do you feel that you received adequate input from in-house departmental staff to meet long-term (three- to five-year) space planning needs?



• After construction completion and occupancy, do you typically need to reprogram design plans to implement major space reconfiguration to meet long-term (three- to five-year) space planning needs?



In-house FM responses to questions concerning lead-times for planning new facilities or major building additions were generally similar to responses regarding reconfigurations within existing facilities, except that 67% reported that they do not receive input from in-house departmental staff that is adequate for assessing long-term space planning requirements.

When asked to rank communication relationships vis-à-vis their importance in programming new facilities or major additions, in-house FM respondents by and large ranked Executive Management and Departmental Staff input as Very Important to Somewhat Important. Communications involving Legal Departmental Staff, Outsourced Real Estate Consultants, Architectural/Engineering Design Team, Construction Manager, General Contractor and the Mechanical and Electrical Contractor were ranked as Very Important to Neutral. None was ranked as Somewhat Unimportant or Very Unimportant.

Furthermore, when in-house FM was asked to rank the importance of various procedures in improving facility planning and communication processes -- obtaining more timely information, obtaining more complete information, obtaining more Executive Management Staff and/or Department Management Staff input in the facility programming and planning process, and improving existing in-house channels of communication -- responses ranged mostly from Very Important to Neutral.

Executive Management Issues

Issues affecting executive management acceptance and promulgation of proven scientific management and participative organizational behavior theories with regard to facility utilization and design, include the following:

- Historically, corporations and institutions have viewed buildings as a cost of doing business to house machinery and employees for the production of goods and services.
- Management tools have not been developed that could measure the effect of applying organization behavior theories to facility planning and design vis-à-vis employee productivity, organization performance and facility utilization. Part of this issue concerns the fact that benefits that could be derived from comprehensive and time-consuming facility planning efforts would not be realized until a future need or sets of needs would arise.
- Executive management and department leaders are not aware of the benefits that could be derived from sharing vital company information with facility management functions that could significantly and dramatically affect employee productivity and organization performance vis-à-vis organization goals and short- and long-term strategic business plans.
- Facility managers are not aware of the benefits that could be derived from sharing vital company information with facility management functions that could significantly and dramatically affect productivity and the organization and short- and long-term strategic business plans.
- Incentives are not in place that would influence executive management, department leaders and facility managers to collaborate and share information that would benefit an organization.

CONCLUSIONS

Analysis of the survey indicates a need to improve communication between an organization's inhouse departments and outsourced providers with the Facility Function. The survey suggests that current business practices in general do not consider real estate functions to be as important as other significant business functions such as marketing and finance vis-à-vis strategic business planning. However, in order for business functions to work more efficiently, effectively, and more in concert with each other, building programming, space planning and real estate functions need to be thoroughly considered based on their individuality and relationships throughout some time frame into the future. In addition, real estate should be planned and designed to efficiently and effectively adapt to changes in an organization's strategic business plans.

Including real estate functions as part of an organization's "business process" requires more involvement by in-house facility function personnel as well as outsourced professionals. Providing more complete and accurate information will allow in-house real estate personnel to better assist Architects and other real estate professionals in developing better real estate programs, leading to improved real estate utilization and productivity. This is an organizational change/management issue that will require executive management review, acceptance and policy directives.

Executive management needs to be enlightened to the short- and long-term benefits of encouraging the Facility Function to become more involved, aware and empowered to act on meeting short- and long-term company goals and strategic business plans. Comprehensive information needs to be gathered, analyzed and applied to achieve on-target design and planning results.

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ENVIRONMENTAL CONTRIBUTION OF OFFICE BUILDINGS TO THE USER ORGANIZATION'S ENVIRONMENTAL IMPACT

S. Junnila

Jaakko Pöyry Infra Consulting **M. Nousiainen** Helsinki University of Technology

Abstract

The study uses life cycle assessment to quantify the environmental impact of a service sector company with the aim of demonstrating the importance of office-use. The result showed that whilst the office represented only 7 % of the organization's costs the actual use of the office was responsible for almost half of the environmental impact of the organization. Other environmentally important activities were found to be commuting, business travel and the use of office equipment. Office supplies and purchased services only had a minor impact on the environmental performance of the studied organization. The result suggests that the environmental performance of an office building and facility management could have a key role in the environmental management of a service sector company.

Keywords: environmental management; life cycle assessment; office building; service company

INTRODUCTION

The building and construction sector is known to be responsible for a large part of the environmental impact that results from human activities (UNEP 2003a, Worldwatch 1995). For example, in both the European Union and the U.S., the construction and building sector has been estimated to be responsible for roughly 40% of the overall environmental burden (U.S. DOE 2002, Sjöström 2000, UNEP 1999).

At the same time, many companies in service industries have started to manage their environmental issues. Currently, service and light industry companies are active in acquiring certified environmental managements systems (ISO 14001 2001). Similarly, most large companies, both in Europe and the U.S., have named the environment as a strategic issue in their operations and thus have defined environmental objectives for their operations (Nousiainen & Junnila 2004). As a result interest in the environmental performance of office buildings has grown. Some service companies have identified the use of office buildings as being among their top priorities in environmental management (Nousiainen & Junnila 2004). Similarly, in the UK, some 25% of new office buildings acquire an environmental assessment and certificate (Hasegawa 2002).

However, only a small number of all buildings are actually office buildings. The majority of buildings are residential buildings. For example, in the European Union residential buildings have been estimated to represent over 70% of the total building stock (Petersdorff el al. 2004). Similarly, in Finland the percentage of residential buildings has been reported to be over 60% of all buildings (Pajakkala 1998). The rest of the buildings are made up of production facilities, schools, commercial buildings, etc. The percentage of office buildings is only around 5% of the total building stock.

When establishing environmental objectives an organization should consider its significant environmental aspects (ISO 14001 1996). Significant aspects are those that have or can have a significant impact on the environment. From a facilities management perspective the important question is whether the use of office buildings is an environmentally significant activity for the company or not. If the use of office buildings were found to be important in the environmental strategy of user organizations, it would further increase the value of skilled facilities management and asset maintenance.

At the moment, there are very few quantitative studies that examine the significance of the use of office buildings in service industry companies. Graedel and Saxton (2002) have analyzed environmental performance in telecommunication facilities using a semi-quantitative screening life cycle assessment. They have stated that in telecommunication facilities the areas producing the greatest environmental impact are the services provided by the user organization and the facility operations. However, the difference between the above mentioned and other life cycle stages is reported to be relatively small. One of the first studies that paid attention to environmental issues in service sector was Graedel 1998. He compared auto repair services using a streamlined life cycle assessment and stated that facility operations are an area with a potential for environmental improvement. There are also other studies, such as Rosenblum et al. (2000), that have assessed the environmental impact of service sector companies, but those have mostly treated the issue at societal scale.

In all industries, the service sector included, comprehensive life cycle assessment studies are generally absent, which hinders effective environmental impact assessment (Seuring 2001). Nevertheless, it's clear that companies would prefer to use quantitative environmental indicators in their environmental management and environmental reporting (Kolk 2003). A quantitative life cycle assessment would make a valuable contribution to the environmental management of such companies (Stewart et al. 1999).

This study quantifies the environmental impact of a service sector company and identifies the environmentally significant activities. The study puts into perspective the use of office buildings by making a comparison with the other activities of a service sector company. It also compares the environmental impact and costs resulting from different activities.

THE RESEARCH DESIGN

Method

A single-case study approach and a life-cycle assessment (LCA) framework were used to estimate the environmental impact of a company. The LCA performed was limited to a screening LCA. This was because existing emission data were mostly used and the focus was on the identification of key issues (Lindfors et al. 1995).

Scope of the LCA

The scope of the LCA covers one year in the operation of a service sector organization. The functional unit of the LCA is the yearly operation of an organization per one employee. The company studied is an international engineering and consulting company, which has its headquarters in Finland. The majority of the company's operations are in Europe, but some are also in Asia and South America. The case organization has around 50 employees, who are situated in one office building in Southern Finland. The company rents its premises.

The LCA performed included all the organization's activities. The activities were defined based on the organization's bookkeeping records. Commuting by the company's personnel was also included in the LCA, although this is typically not controlled by the company. Commuting was included because it is closely related to the working processes of a service company and it is often voluntarily included in the environmental objectives of a service company. For those activities that involved capital investment, the repayment periods used in the environmental calculation were: buildings 50 years, furniture 8 years, PC and other similar electrical office equipment 4 years, and mobile phones 2 years. The main characteristics of the inputs of the studied system are presented in Table 1.

MAIN CHARACTERISTICS OF THE SYSTI	EM
Infrastructure	
Electricity mix, combined heat and power	45 % gas
	25 % coal
	11 % nuclear
	16 % hydro
	3 % others
District heating,	66 % gas
combined heat and power	33 % coal
	1 % others
Water treatment plant, efficiency	94 % BOD,w
	90 % P, w
	80 % N, w
Transport network	Yes car
	Yes bus
	Yes local train, etc.
	Yes pedestrian
Facility	
Space utilization efficiency	21 net-m2/person
Electricity consumption	28 kWh/m3/yr
Heat consumption	23 kWh/m3/yr
Expected life cycle	50 years
Maintenance ranges	
-external envelope	40 years
-roof	30 years
-ventilation plant	25 years
-external surfaces	15 years
-internal surfaces	10 years
Wastes	148 kg/person/yr
-sorting rate	44 %
Business travel	3476 km/person/yr
Flights	50 %
Personal car	50 %
Others	0 %
Office equipment	
Furniture, expected life cycle	8 years
Computers, expected life cycle	4 years
Mobile phones, expected life cycle	2 years
Paper and other office supplies	
Papers	101 kg/person/yr
Office supplies	178 €/person/yr
Services	18 k€/person/yr
Commuting	9891 km/person/yr
Passenger car	75 %
Buss	9 %
Rail	9 %
Cycle, walk, etc.	7 %

Table 1: The main input characteristics of the studied service sector organization.

The LCA inventory proceeded using the following main steps:

- 1) The activities of the company were divided into two groups, intangible and tangible expenses, based on a detailed profit and loss statement. Intangible expenses included such items as wages and salaries, social expenses, and daily allowances. The tangible costs included materials, energy, and purchased services.
- 2) The tangible expenses were matched to the original invoices, and based on these invoices the amount and type of material, energy and services was quantified.
- 3) The commuting data were collected based on a questionnaire, where the employees were asked questions about both the length and the means of their primary and secondary transportation.
- 4) The LCA model was based on data from tangible expenses and commuting.

The primary data in the inventory stage, i.e. the data directly obtained from the case organization, were from the year 2001. The data were compiled mainly based on the profit and loss statement and the detailed bookkeeping of the company. Other data sources used were interviews, archival records and direct observations. The primary data for activities were collected under six main headings: services, use of office building, business travel, equipment, office supplies and commuting. The services included advertising, banking and insurance, catering and restaurant services, cleaning, computer, education and training, entertainment, medical, post and telecommunication, publishing and printing, and engineering and consulting services. The officeuse main group consisted of operational electricity and heat, the original construction of the office facility (i.e. building materials, construction work, maintenance and demolition), waste management, and other facility related operations (i.e. water and wastewater treatment, courtyard care). The travel consisted of business travel divided into flights (i.e. short and longdistance flights), use of passenger cars, other business travel (i.e. buses, rail, ferries). The office equipment consisted of furniture, manufacturing of electrical office equipment, and electricity for operating the equipment. The office supplies consisted of A4 sheet (i.e. all white and copy paper, and envelopes), books and papers (i.e. books, periodicals, newspapers, magazines), and other office supplies (i.e. pencils, rubbers, etc.). The commuting included travelling by passenger car, bus, rail, walking, cycle, or motorcycle,

The secondary data from the inventory (data obtained from published sources) were collected both from the actual material, component and energy producers in Finland, and from different LCA databases. All the main inputs were followed from "cradle to grave". The data for building materials were taken from the environmental declaration of building materials (Neuvonen 2002). The data for other materials were taken from commercial LCA databases (KCL-ECO 2003, SimaPro 2002, Boustead 1997). Energy production data were collected from the actual energy providers in Finland (Helsingin Energia 2000, Ahonen 2000) with the complementation of the upstream emissions from a Finnish LCA database for energy (Virtanen et al. 1996). Water treatment data were taken from the actual company providing water and wastewater services in the area (Helsingin vesi 1999). The transportation data were taken from a public LIPASTO database (Mäkelä 2002) with an up-stream complementation from the above mentioned commercial databases. The data for services were taken from SimaPro (2002) using economicinput-output tables. The benefits (reduced emissions) gained by combined heat and power production, typical in Finland, were allocated to the products in proportion to the fuel consumption of the alternative non-CHP production plants (Liikanen 1999). The quality of used data was targeted at the level of "satisfactory", which corresponds to the third highest level (3 of 5) in the selected framework (Lindfors et al. 1995, Weidema & Wesnæs 1996).

The following impact categories were included in the impact assessment: climate change, acidification, eutrophication, and dispersion of harmful substances, which included summer smog and heavy metals. The impact categories were chosen according to those designated by the Finnish Environmental Institute with the exception of ozone depletion (Rosenström & Palosaari 2002). The potential environmental impact in selected categories were calculated using KCL-ECO (2003) LCA software and characterized with the equivalency factors suggested by the European Commission (1997). The impact assessment was conducted only at the end of the mandatory stage of the impact assessment, where the emissions from the inventory were classified and characterized but not valuated (UNEP 2003b). However, in some figures the average environmental contribution of activities has been presented in order to help interpret the result. A remark should be made here that the calculation of an average impact already includes

a subjective assumption (weighting) that all impact categories are of equal value, and belongs thus to the optional elements of an LCA.

RESULTS AND DISCUSSION

Environmental impact of the case organization

The environmental impact and tangible expenses of the case organization are presented in Table 2 and the relevant proportions in Figure 1. As can be seen from the figures, the expenses do not correlate with the impact. The services activity, for example, produces the most expenses of all the activities but the least impact. Also, equipment and office supplies have higher expenses than their impact. In contrast, office-use and business travel have a lower proportion of expenses than their impact, and finally commuting results in no expense to the organization but, nevertheless, has a relatively high impact.

	Expenses	Climate change	Acidification	Summer smog	Eutrophication	Heavy metals
	k€	Mg CO2-equiv.	kg SO2-equiv.	kg C2H4-equiv.	kg PO4-equiv.	g Pb-equiv.
Services	18	0.08	0.07	0.29	0.01	0.00
Office-use	5	1.89	5.12	1.24	0.63	0.53
Travel	1	0.52	2.04	0.44	0.36	0.00
Equipment	4	0.19	0.74	0.15	0.10	0.16
Office supp.	1	0.04	0.24	0.25	0.08	0.06
Commuting	0	0.88	4.90	1.62	0.87	0.00
Total	29	3.61	13.10	3.98	2.05	0.75

Table 2. Environmental impact and tangible expenses of the case organization.



Figure 1: The contribution of the case organization to environmental impact and tangible expenses. The results are presented in terms of the main activities. The two columns in the figure are the proportion of tangible expenses and the average impact caused by the activities. The average impact is the average value of all the studied impact categories (shown by the lines in the figure).

From the range of individual activities, the use of the office impacts on the environment the most. Its average contribution to the environmental impact is around 45%, ranging from 30% in the eutrophication category to 70% in the heavy metals category. Another activity that has a substantial impact is commuting, being around 30% of the average impact, ranging from 0% to 40%. Business travel and office equipment have an average impact of around 10% each. The two remaining activities, services and office supplies, clearly produce less environmental impact, below 5%.

The contribution of activities in different impact categories varies considerably. The use of the office building has the highest impact in the heavy metals, climate change and acidification categories and commuting in the eutrophication and summer smog categories. Business travel has a relatively high contribution to the eutrophication, acidification and climate change category,
and office equipment to the heavy metals category. However, as can be seen from Figure 1, the environmental profile of activities is relatively similar in almost all the impact categories, with heavy metals being the only clear exception.

Office-use versus other activities

Here both the expenses and the environmental impact of the office-use of the case organization are compared to those of other activities. The idea is to compare the contribution of the office building in both economic (budget) and environmental (impact) terms. Both the tangible and intangible activities of the case organization are included in the calculations.

The comparison of expenses and the impact of the office-use and other activities of the case organization is presented in Figure 2. As can be seen from the chart office-use is responsible for only 7 % of the overall expenses in the case organization but produces on average around 45 % of the environmental impact. The office-use impact on the environment is greatest in the heavy metals and climate change categories, 70% and 50%, and the least in the eutrophication and heavy metals categories, at around 30%.



Figure 2: Contribution of the use of the office to the overall expenses and environmental impact of the service organization.

Data quality assessment

The suitability of the used data for the purpose of the study was assessed with a qualitative assessment framework designed for LCA studies (Lindfors et al. 1995). The results of the data quality assessment are presented in Table 3. Data quality indicators score generally 3 or less, as targeted, which corresponds to the following qualities: calculated data based on measurements and partly on assumptions, verified information from an enterprise with an interest in the study, representative data from a small number of sites, data that is less than five years old, average data from a larger area in which the area under study is included, and data from processes and materials under study but partly from different technologies. The only activities scoring worse than the targeted figure were services and office supplies with a technical correlation indicator, but since those two activities have only a minor effect on the environmental impact, they should not significantly affect the validity of the overall findings.

Data Quality Table*	Services	Office-use	Travel	Equipment	Office supplies	Commuting
Acquisition method	3	3	3	3	3	3
Independence of data supplier	2	2	2	2	2	2
Representativeness	2	2	2	2	2	2
Temporal correlation	3	2	2	2	3	2
Geographical correlation	3	2	2	2	2	2
Technological correlation	4	2	2	3	4	3

Table 3: The scores of the data quality assessment according Lindfors et.al. (1995).

*Maximum quality = 1, Minimum quality = 5

One of the main limitations of the study relates to the single-case study method used. A single case cannot be representative, and thus no generalization is possible based on these results alone. In this sense, the result only shows that LCA is suitable for assessing the significant environmental aspects of a single company, which in itself is quite unusual. However, the result can indicate that in some cases the use of an office building can have a major impact on a company's environmental performance whilst at the same time being responsible for only a fraction of its expenses. Furthermore, when the result of this study is compared to other, industry based, studies, we can find support for moderate generalizations being drawn from the results. Both SwissRe (2002) and Royal & SunAlliance (2001) have stated in their company reports that the use of offices account for a major share of their environmental emissions.

CONCLUSIONS

The study quantified the environmental impact of a service sector company with the aim of demonstrating the importance of office-use. The result showed that whilst only representing 7 % of the company's expenses the use of an office caused almost half of the environmental impact of the organization. If the result were to be applied more generally, it would imply that facility management should have a key role in the environmental management of a service sector company. Because sustainability, and especially the environment, is a strategic issue in many service sector companies, the environmental importance of office-use can provide an excellent opportunity for facilities management organizations to enhance their position in the strategic decision making process of companies.

At present, it seems that bookkeeping in companies does not support environmental management sufficiently, therefore the importance of office-use and facilities management cannot always be easily detected. One reason may be that in many cases the user of the office building does not own the building, and so facilities management is an external service and does not directly belong within the management sphere of the user organization. The practical implication of the results could be in the environmental management of a service sector company. By defining the characteristic values of their own organization and comparing them to the characteristic values of the studied organization (Table 1), an environmental manager could easily map the potentially significant environmental aspects of the organization. The result could also be used as the impetus for a facilities management organization to invest in environmental competence.

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ACHIEVING A SUSTAINABLE URBAN ENVIRONMENT: WORKING WITH EXISTING BUILDINGS

Keith Jones University of Greenwich Derek Clements-Croome University of Reading AbuBakr Bahaj University of Southampton David Gann Imperial College, London

Abstract

Achieving the goal of sustainable development continues to be one of the major global challenges of our era. To date the vast majority of work has focused on improving the sustainability of the design and construction phases of the building life cycle. Whilst the outputs from this work are beginning to have an effect on the sustainability of new buildings, because of the legacy of the existing building stock, it is unlikely that it will produce a sustainable urban environment in the short to medium term.

In reality only a small percentage of the worlds built environment is replaced each year, over the next 20 years much of the built environment will comprise that which already exists or is in the planning stage. If the built environment is to address the changing needs of society in a more sustainable manner, then the construction industry will have to work largely with buildings that already exist. Thus the challenge facing built environment professionals working at the post construction phase of the building life cycle is to find ways of improving the sustainable performance of existing built facilities. This paper will examine these challenges and will outline a major new research initiative underway in the UK to address the issues pertinent to achieving a sustainable urban environment through the maintenance and refurbishment of the existing building stock.

Keywords: Building Façade; Building Maintenance; Sustainability.

INTRODUCTION

The sustainability debate has come a long way since the energy crisis of the 1970's first focussed world attention on the profligate manner with which humankind was consuming the Earth's natural resources. Brundtland (1987) produced a definition of sustainable development as that which "...meets the needs of the present without compromising the ability of future generations to meet their own needs...' and this has focussed much of the thinking about sustainability over the past 15 years. The debate was broadened in 1992 at the United Nations Rio Earth Summit where Agenda 21 (UN Department of Economic & Social Affairs 1992) was formulated as guidance for those working towards a more sustainable future and again at Kyoto (UN Framework Convention on Climate Change 1997) where the impact of climate change was considered and then at Johannesburg (UN World Summit on Sustainable Development, 2002) where obstacles to the implementation of Agenda 21were examined and a new way forward proposed.

In 1999 the UK Government (DETR, 1999) produced its strategy for sustainable development which identified four aims: social progress which recognises the needs of everyone; effective protection of the environment; prudent use of natural resources; and maintenance of high and stable levels of economic growth.

In 2000 the UK Government released a second report 'Building a better quality of life – a strategy for sustainable construction' (DETR, 2000) which identified the role that the construction industry could play in improving the collective quality of life of UK citizens. The report identified 10 action areas for the industry to take account of: the reuse of existing built assets; designing for minimum waste; aiming for lean construction; minimising energy in construction; minimising energy in use; reducing pollution; preserving and enhancing bio-diversity; conserving water resources; having respect for people and their local environment; and setting targets to monitor performance and to better manage/reduce the impact of buildings on the environment.

In 2001 a further report by the UK Built Environment and Transportation Foresight Panel, Constructing the Future (DTI 2001) examined the future needs of the UK's built environment and drew attention to the fact that as only a small percentage of it is replaced each year, over the next 20 years, much of the built environment will comprise that which already exists or is in the planning stage. If this is indeed the case then, if the UK's built environment is to address the changing needs of society in a more sustainable manner, the construction industry will have to work largely with buildings that already exist. In its summary the Foresight Report made a number of recommendations including: the promotion of 'smart' buildings and infrastructure; improvements in the health and safety of those employed in the construction industry; enabling supply chain integration; investing in people; improving existing built facilities; exploiting global competitiveness; embracing sustainability; increasing investment returns; and the need to plan ahead. In addition to the recommendations the report also outlined the changing demands that would be placed on the built environment (population demographics, knowledge based working practices, climate change etc) and suggested specific actions around whole life thinking and the use of advanced technology, materials and processes which would be needed to address them. Indeed, with respect to the improvement of existing built facilities the report called for the development of innovative processes, technologies and components for the maintenance, repair and refurbishment of the built assets identifying in particular the potential for new technologies and 'intelligent' products to improve living and working environments and enable information feedback to improve construction quality.

It is against the above that a new UK based multi-disciplinary research consortium in the Design Construction and Operation of Buildings for People (IDCOP) was developed. The IDCOP consortium is led by a management committee drawn from the University of Greenwich, the University of Reading, Southampton University, Imperial College, London and Ove Arup. The remainder of this paper will outline the work of the consortium as it relates to existing buildings.

AIMS OF THE IDCOP CONSORTIUM

Work on developing the **IDCOP** consortium began in November 2001, when a number of academics and industry attended a 2 dav representatives workshop hosted by the Engineering and Physical Sciences Research Council (EPSRC). The aims of the workshop were multi-disciplinary to identify possible research teams which could begin to address the research issues pertinent to achieving sustainable urban а One outcome of the environment. workshop was the formation of the IDCOP consortium. Following the workshop the IDCOP core team conducted a series of face-to-face and virtual meetings with other SUE consortia and the EPSRC to refine the "initiating innovation change model" which had been developed by the whole IDCOP consortium at the workshop (Figure 1). Through these meeting the



Figure 1: The initiating innovation change model

following factors emerged to shape the consortium's vision:

- People are at the core of sustainability. Thus, the focus of the work of the consortium should relate directly to the spaces which most people occupy during their typical day;
- The vast majority of the urban environment has been constructed. Manipulating this built infrastructure to improve its impact on people in a sustainable way is singularly the most difficult and challenging issue facing built environment professional in the UK;
- Processes, strategies and technological developments could be extended to new build.

In essence, the research team identified the need to study people focused systems, derive models and theories that explain and describe the systems, and investigate how innovative technology could be used for new/improved products and processes which would reduce any adverse affects of buildings on the environment. In particular the research team aims to better understand the:

- impact that the use of buildings have on the environment and quality of life of occupants/users;
- changing demands being made of existing buildings (e.g. life style changes, climate change etc);
- potential for technical/operational developments to improve the performance of the building; and
- barriers to implementation (i.e. stakeholder reticence, the role of whole life thinking etc).

Through a better understanding of the above the research team hope to provide the fundamental knowledge necessary to underpin demonstrable advances in improving the sustainability of existing buildings on the environment over the short to medium term.

THE IDCOP CONSORTIUM RESEARCH FRAMEWORK

In order to assist in the conversion of the consortiums broad aims to more focused objectives the team developed a theoretical framework to describe the innovation that is required if the existing built environment is to be made more sustainable (Figure 2).



Figure 2: Interaction between research themes and key drivers.

In an attempt to achieve a more sustainable urban environment it is first necessary to establish the baseline knowledge, for each of the key drivers, from which improvements can be made (Theme 1). Whilst this will ostensibly involve the study of Products, People and Processes it will also be necessary to examine how People relate to both Products and Processes. Once the baseline knowledge has been established innovative solutions need to be developed to meet the opportunities for improvement (Theme 2). However these solutions must not solely focus on the technological development of new Products and Processes but must also examine how People will relate to the Products and Processes. In this way People's concerns/desires can be addressed during the development of the new Products and Processes. If the new Products and Processes are to have a positive impact on the sustainability of the urban environment then they will need to be widely adopted. Theme 3, which is ostensibly People focused, will examine alternative implementation strategies to ensure that the new Products and Processes that emerge from the project will indeed make a demonstrable improvement to the sustainability of the urban environment.

THE IDCOP RESEARCH PROGRAMME

Through a detailed consideration of the theoretical framework it became clear that to address all the issues pertinent to improving the sustainable performance of the UK's existing building stock was beyond both the scope and resources of the consortium. As such a more narrow focus to the research project was sought. Through a series of discussions both within the IDCOP consortium and with other interested parties the role of the building façade as a mediator between internal and external environments was identified as key contributor to the sustainability of existing buildings.

The façades of most existing buildings can be considered as passive systems. They act primarily as a climate moderator receiving the impacts of sun and wind whilst controlling the amount of air, sunlight, and sound passing through to the occupants. Consequently their performance directly impacts on the consumption of energy required to maintain a quality internal environment. So how well are existing UK building façades performing? If they are underperforming what can be done to the façade to improve their performance? How will changing demands affect their performance requirements? Could, a dynamic façade be developed which would optimise the energy exchanges to produce an environment conducive to maintaining a high level of well-being and consequently high productivity in the workplace whilst minimising energy consumption and pollution? What further research would be needed to achieve such an evolution?

In addition to their direct impact on the internal building environment building façades also consume significant resources over their life time through routine maintenance and refurbishment. But, are our current approaches to maintenance and refurbishment sustainable? Is there inherent waste within maintenance planning systems? How should environmental and social issues be considered as part of building life cycle analysis? How will changing performance demands be reflected within life cycle modelling? Could an active façade provide performance data that could reduce the levels of waste associated with its maintenance and refurbishment and improve the reliability of life cycle performance models? What further research would be needed to achieve such change?

I order to achieve a dynamic façade within existing buildings would require both the development of innovative products and processes to improve the buildings performance and, implementation strategies to ensure the acceptance of the products and processes amongst the stakeholder groups associated with the maintenance, refurbishment and use of the building (Clements-Croome et al, 2003). Further, developing these products, processes and strategies would demand a systemic, holistic approach which examined the interactions between the technologies and those who live and work within the building as well as the science and engineering required to develop the technologies. Thus in focussing on the building façade the research team identified the core objectives for the IDCOP consortium. These are to:

 explore the technical, economic, social and environmental implications for the development and use of building façades as 'environmental mediators';

- develop new rules, standards and procedures for their design, production and maintenance; and
- establish implementation strategies to ensure the effective take up of the research outputs by industry and the wider research community.

In addressing these objectives the research will take account of changing social attitudes and behaviour towards building use, of new national and global performance targets for energy and emissions control, and the results of predictive models of climate change.

IDCOP WORK PROGRAMME

Following the formulation of the research objectives the consortium members established an integrated work programme in which researchers from each of the academic partners worked together in multi-disciplinary teams. The work programme comprises three specific work packages.

Work package 1 (Responsive building envelopes) seeks to develop and integrate various innovative façade components into existing building envelopes. The integration of solar gain control and natural lighting into a building façade should result in enhancement in the performance of the sustainable built environment and result in a major contribution to energy efficiency through a decrease in consumption, enhancement of thermal comfort and a reduction in CO_2 . The effectiveness of the solutions will be assessed in live building tests. Work package 1 is further broken down into the following sub packages

- *WP1.1: Potential of Smart Façades in the UK Built Environment:* This sub package will encompass UK climate and building stock analysis and a comparison will be made with the building stock of Southampton University.
- WP1.2: Fabrication and Evaluation of Holographic Optical Elements (Double Glazing Units): This sub package will seek to develop a miniature tracking HOE system which is autonomously powered and incorporated within a standard double glazed unit.
- WP1.3: Development and Evaluation of Smart Glazing systems: This work package will combine simulation of performance of dynamic façade components in the building envelope with practical measurement and assessments obtained from real-time monitoring and control of a room fitted with electrochromic and HOE glazings elements.
- WP1.4: Demonstration of SMART Façades: In this sub package the simulation work carried out previously will be extended through its associated practical projects. The prototype designs will be incorporated into a test-bed room and its performance evaluated for both thermal and illumination effects. Comparative analysis of computer modelling and the data acquired from other real installations will allow feedback to and from occupiers / managers, aid prototype refinement and model validation.

Work Package 2 (Improving the sustainability of existing building envelopes) seeks to develop new processes, technologies and components for the operation, maintenance, repair and refurbishment of existing built assets that reduces their adverse impact on the environment (reduces waste and consumption of energy) whilst improving living and working conditions. Work package 2 is broken down into the following sub packages:

- *WP2.1: Sustainable Maintenance and Refurbishment of Buildings:* This sub package seeks to develop a new approach, based around whole life thinking, to maintenance and refurbishment planning which will reduce the levels of waste associated with maintaining a building and provide the opportunity to programme environmental and social improvements as part of the maintenance/refurbishment cycle. The new approach will be based on the development of a Through Life Environmental Business Model (Clenets-Croome et al, 2003). The use of the model will result in more efficient and effective maintenance/refurbishment planning which will allow incremental improvements to be made to the sustainability of existing buildings.
- WP2.2: Embedded Sensor Technology and Occupant Behaviour: This sub package seeks to investigate the extent to which embedded sensor technology, retrofitted to existing buildings,

can be used to covertly manage energy consumption and overtly provide information on the performance of buildings which stimulate changes in occupier behaviour to consume less energy. The use of these sensors will result in major contribution to energy efficiency through a decrease in consumption, enhancement of thermal comfort and a reduction in CO_2 .

• *WP2.3:* Intelligent Buildings for Personalisation: This sub package seeks to develop personalised micro-environments which create a pleasant and up-lifting atmosphere. The relationships between the buildings and human beings can be seen as a semiotic process. The outcomes of tested techniques using intelligent agents will enhance negotiation and collaboration between all stakeholders in design of personalised buildings.

Work Package 3 (An integrating vision for a sustainable built environment) seeks to integrate the work of IDCOP and provide the infra-structure for the exchange of ideas and development of cross cutting issues. The programme will also facilitate exchanges between members of the IDCOP consortium, other SUE Consortium and the International academic community. The package is broken down into the following sub packages.

- WP3.1: Indicators for Mapping and Measuring Robustness, Resilience and Adaptiveness: The issues of developing a sustainable urban environment present a new interdisciplinary challenge. This sub package will develop a mechanism for integrating the consortium's work across SUE IDCOP projects, developing and providing new metrics to support exchange of knowledge and exploration of emerging issues.
- *WP3.2: Extending Vision for a Sustainable Built Environment:* This sub package will extend the mechanisms developed above to include other SUE consortia and International Research Groups.
- WP3.3: Achieving a Sustainable Built Environment through the Maintenance and Refurbishment of Existing Buildings: This sub package will examine the fundamental issues that need to be addressed if routine maintenance and refurbishment is to act as a vehicle for improving the sustainability of the existing built environment (Jones et al, 2003, Jones et al, 2004).

All the work packages are subject to annual review and modification may be made to reflect research findings and changing external conditions.

EXPECTED OUTCOMES

The aim of IDCOP is to study people focused systems, to derive models and theories that explain and describe the systems, and investigate how innovative technology can be used for new/improved products and processes which will reduce any adverse affects of the buildings on the environment and improve the quality of life for occupants in an economically viable manner (Figure 3).

As a consequence of the study built environment stakeholders should have:

- a greater understanding of the performance, in terms of sustainability of existing buildings and of the options for improvement;
- a greater understanding of interactions between people and the buildings they manage and use;
- access to a range of prototype technologies, developed specifically for retrofit to existing buildings that can reduce the consumption of non-renewable resources and provide a high quality indoor environment;
- access to a range of prototype technologies to provide performance data for a more sustainable building maintenance and refurbishment model;
- access to whole life building performance models and toolkits; and
- access to explanatory models to evaluate the impact of new products and processes to improve the sustainability of existing buildings.



Figure 3: IDCOP Project Rationale

The ultimate success of the IDCOP consortium will be judged against the take up of these outputs by both Industry and the research community.

SUMMARY

The project outlined in this paper is one of 14 related projects being funded by the Engineering and Physical Science Research Council through its Sustainable Urban Environments programme to address the wide ranging issues related to achieving a sustainable urban environment. The focus of this project is on the micro (building) level where the researchers believe a better understanding of the fundamental relationships between buildings, people and the environment is required if real improvements in the 'sustainable' performance of the urban environment are to be achieved. It is hoped that the fundamental knowledge resulting from this project will be taken up by the various built environment stakeholder groups and that demonstrable improvements to the existing built environment will be seen in the short to medium term.

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METHODOLOGY OF PROJECT BASED STUDY ON ACTIVATION AND RENEWAL OF BUILDING STOCKS - TOKYO METROPOLITAN UNIVERSITY 21ST CENTURY COE PROGRAM

Y. Kitsutaka S. Fukao T. Yoshikawa M. Tsunoda N. Sunaga Tokyo Metropolitan University, Tokyo, Japan

Abstract

In Tokyo, as in many of the world's major cities, the accumulation of building stocks during the second half of the 20th century was accompanied by qualitative changes over time. Today, those building stocks are both massive and diverse, and their utilization has become a crucial issue in Japan's rapidly maturing major cities. The same challenge will confront major cities in Asia and throughout the world. In this paper, the outline of Tokyo Metropolitan University 21st Center of Excellence (COE) program was shown and the new methodology of project based study on activation and renewal of building stocks proposed in the COE program was described. This program titled "Development of Technologies for Activation and Renewal of Building Stocks in Megalopolis" was approved by the Ministry of Education, Culture, Sports, Science and Technology in Japan. The goal of this COE program will be to rebuild the framework for new approaches to architectural engineering in the 21st century by disseminating the results of this work. The research and education methods used for this purpose will be based on collaboration among the various fields of architectural engineering. Specific buildings will be targeted for research linked to project implementation. From a research viewpoint, the aim is to rebuild a genuinely comprehensive framework for architectural engineering, using an approach that might be called "urban architecture time-space diversity harmonization engineering". This will be achieved through the practical implementation of leading-edge stock utilization projects.

Keywords: Building stocks; COE program; conversion; harmonization; renewal

INTRODUCTION

In the second half of the 20th century, many cities in Japan and other countries experienced an unprecedented surge of construction activity. This resulted in the accumulation of massive building stocks, especially in megalopolises such as Tokyo, Osaka, Mexico City, Los Angeles, Hong Kong and Singapore. Experts are now stating that these urban building stocks need to be renewed and activated, and that measures must be taken to ensure that such facilities continue to be used sustainably in the 21st century. Our ability to meet this challenge using the manufacturing-based urban and architectural engineering methods of the 20th century is limited. We need to develop a new framework for technologies for maintaining the usefulness of products. There is also need for human resources with expertise in these fields of technology to work not only within educational and research institutions, but also as experts with advanced specialist skills that can be applied in the real world.

The Meta-technology Center for Metropolitan Metamorphosis Methods (4-Met) will link advanced research with practical activities. Its aims are to develop a technology structure that approaches urban building stocks from the perspectives of both time and space, and to develop human resources with profound knowledge of specialist technologies and broad perspectives to work in both academia and industry. The academic focus of the Center will be architectural engineering. However, its coverage will not be limited to existing areas of sub-specialization, such as planning, structural technology, and the environment. Instead, the Center will build a new meta-technology framework encompassing the various technologies that intersect with existing sub-specialities, with the aim of developing technologies for the activation and renewal of megalopolis building

stocks. Element technologies from existing sub-specialties will be repositioned within that framework, and the Center will carry out research on new technologies required to bridge any gaps.

The existing sub-specialties of architectural engineering have sought standard solutions that are clear but simplistic. The improvement of urban building stocks, which vary widely in both time and space, will require individualized solutions. The Center will use projects to develop individualized solutions. Instead of focusing simply on specific problems, those solutions will offer spin-off benefits and universality. The accumulation of methodologies that allow diversity to be harmonized will lead to the development of a new framework. The Center proposes to pioneer and establish a new academic field: "urban architecture time-space diversity harmonization engineering".

OUTLINE OF TOKYO METROPOLITAN UNIVERSITY 21ST CENTURY COE PROGRAM

The 21st Century COE Program

This program was established with the introduction of grants for the establishment of research centers in fiscal 2002, under the June 2001 "Policies for the Structural Reform of Universities" by the Japan Society for the Promotion of Science. To ensure that Japanese universities can carry out educational and research activities on a par with the world's best universities, it is necessary to foster a competitive environment by introducing the principle of competition based on third-party assessments. There must be greater competition among universities, whether national, municipal or private. This program seeks to form world-class centers for research and education in Japanese universities, with the aim of raising research levels and developing creative human resources who will rank among the best in the world. The policy is designed to facilitate the development of unique and internationally competitive universities through the provision of prioritized support. Detailed information can be found at http://www.jsps.go.jp/j-21coe/.

In the category of mechanical engineering, civil engineering, architecture and other types of engineering, to which architecture belongs, applications were called for in fiscal 2003. Tokyo Metropolitan University 21st Century COE Program of "Development of Technologies for Activation and Renewal of Building Stocks in Megalopolis" is one of 23 that were approved.

Why this COE program is both necessary and important

The massive urban building stocks accumulated by postwar Japan are the product of successive quantitative waves. Another key feature is the diversity of quality. For example, Japan's building stocks include low-quality buildings erected during the immediate postwar period, uniform, mass-produced buildings dating from the high-growth era, and buildings that reflect the rich variety of design that was a feature of the bubble era. More recently, substantial new stocks have been accumulated through urban renewal projects and other activities. Within the next decade or so, Japan's population will start to shrink. The era of mass construction will end, and the updating of urban building stocks will decelerate dramatically. However, the provision of quality living spaces will be a basic requirement for survival in an era of competition among the world's cities.

These trends affecting Japan's cities have important and urgent implications for the Center's efforts to develop urban architecture time-space diversity harmonization engineering as the basis for the activation and renewal of megalopolis building stocks, and to train human resources for this field through project implementation. However, research approaches in Japanese graduate schools have tended not to focus on project implementation. From a world perspective, Europe is gradually accumulating stocks of buildings with long life expectancies, and there has also been progress toward the activation and renewal of stocks. However, the technology structure is vastly different from that in Japan, where the natural environment is more difficult and building stocks are younger. Construction activity has remained buoyant and relatively stable in the United States, and there is limited interest in stocks. However, the transition to a sustainable society will eventually become a major issue. Developing countries, such as China and other Asian countries, are following a path similar to Japan's, though with a time lag of a dozen or more years. They too will surely face the same problems as Japan but with increased seriousness in the near future.

The formation of centers for research and education concerning the activation and renewal of urban building stocks is thus an important and essential priority not only for Japan, but for the entire world. Because technology structures in Europe are significantly different from those in

Japan, there will be scope for complementation with work carried out at the Center. Because this field of study has not yet evolved in the United States, Japan will be able to take the initiative and can be expected to rank alongside Europe as a world leader in research activities in this area. The results of work at the Center are likely to be applied in many countries.

Characteristics of the center formation process

The Center formation plan is unique in three ways.

(1) Proposal of new comprehensive approach

There have long been calls for a comprehensive approach to architectural engineering, but in practice most research systems have been specialized. Even where a comprehensive approach was targeted, the results were often broad but shallow. By linking meta-technology based on practical projects with element technologies, the Center aims to develop "T-shaped" human resources with broad and comprehensive practical abilities forming the crossbar, and deep specialist knowledge forming the upright.

(2) Research linked to project implementation

The Center will realize this new comprehensive approach by forming a research base that focuses not on conventional specialized research, but on project-linked research with the emphasis on linkage between practicality and sub-specialties. Teaching staff and students in a wide range of sub-specialties will collaborate flexibly on projects that emphasize new ideas. While cooperating with society, the Center will also strive to propose innovative ideas in keeping with its role as a university-based organization. In this way, the scope of doctorate programs, which have traditionally focused on specialist education and the training of researchers, will be expanded and used to train human resources who also have the practical knowledge needed to produce comprehensive solutions to new problems relating to the activation and renewal of diverse urban building stocks.

(3) Research and education base located in a municipal university in the Tokyo megalopolis

The Center will take advantage of its social and geographical positioning to study ways to fulfill its role. It aims to build a technology structure that will allow the activation and renewal of building stocks from both the time and space perspectives in order to continually maintain and improve the quality of human spaces in cities, and to train human resources to support this framework through education, research and practical work. Initially there will be no major interdisciplinary initiatives beyond the scope of architectural engineering. However, the Center eventually aims to work with those in related fields, such as urban sociology, at a new municipal university to be established by the Tokyo Metropolitan Government.

What the center aims to achieve

The Center aims to produce the following research and educational results by its final target year (fiscal 2007).

(1) Results of research linked to project implementation

- A. The Center will take advantage of its location in an area with many apartment buildings to develop comprehensive activation and renewal technology and produce specific proposals concerning apartment-type public housing built during the high-growth era.
- B. Urban renewal activity has produced massive supplies of large-scale office buildings. The Center will develop comprehensive methodologies concerning the conversion of surplus floor space in relatively small non-residential facilities in central Tokyo into housing.
- C. The Center will work with local authorities to develop public facility network adjustment technology for residential areas formed during the high-growth era.
- D. Methods for converting existing stocks into environment-friendly facilities will be developed and applied to model projects.
- E. The Center will develop methods for progressively improving high-density wooden housing areas into harmonized housing by integrating improvement methods.

(2) Proposal of Meta-Technology for the Activation and Renewal of Urban Building Stocks

By comprehensively reviewing the results of these projects, the Center will build a new framework of methodologies relating to technologies for the development of safe, comfortable and attractive urban buildings that meet the needs of sustainable society.

(3) Development of educators and researchers with profound specialist knowledge and broad perspectives, and highly specialized human resources to work in industry

Human resources with realistic and wide-ranging perspectives in relation to the aforementioned new framework will be supplied both for education and research and for industry. These people will gain practical experience and profound academic knowledge of related fields through participation in the aforementioned projects.



Fig. 1 Outline of study and education

Academic and social significance of achievement in research and education

In addition to research relating to the repair and functional restoration of conventional buildings, the Center will also conduct research into dynamic building renewal technologies that can adapt to changes in the various external factors that occur in urban environments. It will also conduct research into building utilization with the aim of creating new architectural added value. Through this work, the Center will obtain specific research findings based on various aspects of building stock activation and renewal. It will also propose a new framework that will lead to an exploration of the potential for next-generation architectural engineering. From a social perspective, the Center will contribute to the implementation of policies, plans and technologies for the renewal of urban environments, thereby helping to create cities that human beings will find truly enriching and attractive. As part of its contribution to the creation of a sustainable urban society, the Center is expected to function as an interface on the architectural engineering side of collaboration between architectural engineering and other city-related fields.

RESEARCH CENTER FORMATION PLAN

Over view of plan

For the purposes of this research, the new architectural engineering paradigm that is needed for the stock-oriented society will be defined in terms of the establishment of technologies for the development of beautiful cities and buildings that are environment-friendly, provide safety and comfort, and meet the needs of sustainable society. As described below, research will be linked to the implementation of projects based on actual architectural activities. Also, original methods for effectively using stocks will be established on the basis of project research results. This will be achieved by adjusting and harmonizing solutions that reflect changes in cities and buildings over time, to develop a field that might be called "urban architecture time-space diversity harmonization engineering", as a methodology for the exploration of individualized solutions that can be applied universally to stock utilization.

A. Proposal of comprehensive improvement models to create new value in public apartment complexes erected during Japan's high-growth era

The Center will collaborate with project managers to undertake total remodeling projects that flexibly accommodate new residential formats for both aged people and younger generations. Depending on the format, functions, degree of deterioration and other characteristics of existing apartment housing, the Center will consider improvement methods that create new value and

result in the conversion of facilities into attractive building complexes that retain their autonomy.



Fig. 2 Project-A: Improvement models

B. Proposal of improvement models that include the conversion of non-residential inner-city facilities into apartment housing or welfare housing, etc.

Building stocks in single-function, non-residential, inner-city areas will be converted to residential and other uses. Conversion technologies that are appropriate for these facilities will be studied from the perspectives of planning, facilities and material construction methods. New seismic diagnosis and anti-seismic retrofitting methods will be applied to turn the facilities into long-life urban stocks.



Fig.3 Project-B: Facilities conversion

C. Formulation of model plans for the readjustment of public facility networks in residential areas formed during the high-growth era

The Center will propose model plans for the relocation of public facilities, such as welfare and education facilities, in planned cities, such as Tama New Town, and in natural cities. These plans will be designed to allow existing stocks to be utilized as they are converted into facility networks for improved operating efficiency. The Center will implement and follow up projects in collaboration with local governments.



Fig.4: Project-C: Public facility network

D. Development of methods for the conversion of existing stocks to environment-friendly facilities, and the application of those methods to model projects

By combining element technologies, such as rooftop greening and perimeter buffer zones, with comprehensive environmental assessment methods, these technologies can be effectively used to improve existing building stocks, and to convert stocks that are easy to maintain and manage into multipurpose facilities, such as facilities that meet the needs of the aged.

E. Model projects for the phased improvement of environment-friendly housing in high-density wooden housing areas

The Center will collaborate with NPOs and other organizations to formulate stock improvement plans that are realistic rather than restrictive for limited areas. The Center will propose measures and implement model projects to improve actual disaster prevention performance and earthquake safety in building stocks that consist of multiple buildings. These projects will be linked to improvement plans.

F. Creation of framework for urban architecture time-space diversity harmonization engineering

Knowledge gained through these projects will be used to explore, develop and propose a new

meta-technology framework for the activation and renewal of urban building stocks.

Over view of research methodology

Research projects will normally last around three years. The Center will ensure that practical research is always responsive to the needs of society. There will be no projects focusing solely on individualized specialist areas. Instead, there will be a collaborative structure spanning multiple areas of architecture. The Center will establish a Research Promotion Strategy Section to provide overall coordination. Under the operational management of the Research Promotion Strategy Section, the Center will collaborate with outside organizations in Japan and overseas and adopt projects with a strong international content. The social benefits of research results will be taken into account at all times. Project results will be subject to third-party assessment to provide feedback for research methodologies. Project themes will evolve constantly in step with current needs and advances in architectural technology.

EDUCATION IMPLEMENTATION PLAN

Education goals

The educational goal of the Center's doctorate program is to train world-class human resources with comprehensive and practical knowledge as doctorate-level technology experts and research specialists capable of meeting the new architectural engineering needs of the 21st century. Specifically, the Center will use project-linked research to train new educators and researchers who possess not only advanced specialist technology but also broad perspectives that can be applied to the real world, as well as highly specialized human resources to work in industry.

Education system

Educational courses provided by the Center will be attached to conventional doctorate programs in architectural engineering. Students, including those in conventional programs, will participate in practical projects relevant to their specialist fields. Through that experience, they will learn attitudes to architecture that are appropriate to their roles, which are crucial to the future of architectural engineering, as researchers, educators and workers in industry. This approach will help students to gain a new understanding of the positioning of existing specialist fields. It will also help them to develop broad perspectives. Those wishing to gain degrees through the Center's practical research course will then be invited to participate in various ways, including the presentation and selection of project implementation plans. In principle, the course will provide education and research programs on an on-the-job training basis. The chief course instructor and other instructors will carry out of research and educational activities. In addition to practical research, the Center will introduce internship programs with research organizations in Japan and overseas. These programs will allow students to develop comprehensive research management skills. In their senior years, students will be allowed to participate in project-based research as project chiefs. This will help to develop their ability to carry out research independently. Each year these educational activities will produce a number of graduates with broad perspectives and advanced specialist and practical knowledge.

Practical fields of education

The Center will provide students with valuable data about cities and architecture in the Tokyo Metropolitan Area, and ample opportunities for exploration through new project-based research. The basic resources used for these activities will include the results of collaborative research between the architecture program and universities, government organizations and businesses in Japan and overseas, as well as results gained through cooperation with municipal research institutions in Tokyo, the Tokyo Metropolitan University, the Tokyo Metropolitan Government and regional governments within the Tokyo Metropolitan Area. This environment, which can only be provided at a university established by the Tokyo Metropolitan Government, will help to train professionals with practical skills encompassing all aspects of cities and architecture. In addition, the Center will provide opportunities for the publication of research findings in Japan and overseas. To create additional opportunities for research and practical work, students will be encouraged to propose projects.

Educational structure

The Center's educational programs will consist of flexible explorations of specialist fields and element technologies, as well as project-based education with the emphasis on lateral collaboration. The Center's faculty covers a balanced range of fields and uses a free and open approach to education that is not confined to a formal lecture structure. Students will develop through participation in a variety of collaborative research. This approach, which is also manifested in the external assessment system, will be a feature of education at the Center.

Student support

To create an environment in which talented students, whether from Japan or overseas, can concentrate on their research, the research assistant system will be expanded to provide opportunities for training in educational research. The existing travel subsidy scheme for students wishing to present papers at international conferences will also be expanded. In addition, the Center will encourage the free flow of ideas by operating a system of research incentive payments for students who produce excellent results or propose unique research plans. The Center will also establish a research commercialization subsidy scheme through an academia-industry collaboration system based on the experience of the Tokyo Metropolitan University as the core university in the TAMA Industrial Vitalization Association.

FEATURES OF CENTER

Accumulation of methodologies focusing on individualized solutions with universally

The Center will provide a forum not only for the pursuit of truth, but also for the implementation of practical projects leading to the accumulation of methodologies that produce flexible individualized solutions. Another key feature will be the Center's role in the international dissemination of those methodologies. The construction of buildings and urban structures in Tokyo and other Japanese megalopolises in the second half of the 20th century witnessed dramatic changes in the methods used, which is reflected in the extreme diversity of building stocks. Moreover, totally different conditions can be observed in inner-city and suburban areas. The next three decades are expected to bring rapid changes in the state of stocks.

The effective activation and renewal of these diverse building stocks cannot be achieved through standardized solutions based on the architectural engineering of the 20th century, and it will be necessary to apply methodologies that are capable of producing individualized solutions. Specific solutions are not enough; individualized solutions with a universality that also leads to spin-off benefits in other areas are also needed. The most promising approach is to use practical projects to accumulate methodologies capable of harmonizing diversity. An important feature of the Center is its ability to apply this approach to the training of educators and researchers with practical expertise, as well as technical experts with advanced professional knowledge.

Faculty optimized for integration of advanced specialist research and practical projects

Private-sector organizations are already implementing numerous building stock improvement projects based on the pursuit of individualized solutions. However, many of these projects employ specific solutions that lack universality. Typically they result in showy, short-term renovations, and in most cases the methodologies are not made public. With this program, projects are based on research in specialist fields, and the results, together with the processes involved, are published.

One of the most important features of the Center is the excellence of its staff. Staff members have previously worked in various organizations, including architectural practices, and their wide-ranging experience includes not only architectural design, but also architectural structures, facilities, and law. Their achievements encompass practical work as well as research, making them the ideal team for research linked to practical projects.

Collaboration with society and government

As a university established by the Tokyo Metropolitan Government, the Tokyo Metropolitan University has a long history of involvement in efforts to overcome problems affecting urban building stocks in megalopolises. Its research achievements have been widely applied in actual construction projects. Evidence of its strength in this area includes the research achievements of its Urban Studies Institute and Faculty of Urban Science. The Center will collaborate closely with

these organizations in its projects. Many of those implementing projects under this doctorate program are highly influential because of their involvement in numerous research committees, including commissions advising government ministries and local governments. Particularly significant in terms of the Center's goals is the role of these people as opinion leaders with views that are reflected in policies relating to the activation and renewal of urban buildings for the stock-oriented society.

An international disseminator of information

Because of the historical circumstances surrounding Japan's modernization in the late 19th and early 20th centuries, architectural science in Japan has been based primarily in engineering departments. This situation, which is perhaps unique to Japan, has had a beneficial effect in the sense that architectural engineering has evolved in Japan as an integrated field of engineering. There are no organizations equivalent to the Architectural Institute of Japan in Europe or North America. There are only international organizations in specific fields, such as the International Association for Earthquake Engineering. The Architectural Institute of Japan is therefore expected to serve as an important international forum for integrated engineering. In terms of the Center's aims, Japanese architectural engineering has a particular advantage in relation to the proposal of new comprehensive approaches to the activation and renewal of urban building stocks. This is an important feature of the Center's work from an international perspective.

CONCLUSION

In this paper, outline and methodology of COE program on activation and renewal of building stocks was described. This program will result in the creation of a Center of Excellence called the "Meta-technology Center for Metropolitan Metamorphosis Methods" ("4-Met Center"). The 4-Met Center will offer cities throughout the world the results of its research, in the form of innovative and attractive renewal projects, together with knowledge and technologies gained through that process, as information that can be applied repeatedly in cities that face similar problems. The young researchers and experts associated with the 4-Met Center will gain advanced capabilities and will be able to take pride in this experience as they undertake other research or work in industry in the future.

REFERENCE

The 21st Century COE Program: Japan Society for the Promotion of Science, The Ministry of Education, Culture, Sports, Science and Technology, <u>http://www.jsps.go.jp/j-21coe/</u>.

NOTE: Authors of this paper are member of the COE program research promotion strategy section, and S. Fukao is a leader of COE program.

ECONOMIC EFFICIENCY AND REDUCTION IN ENERGY CONSUMPTION BASED ON RENOVATION OF EXISTING OFFICE BUILDINGS

Hiroshi Sugita Saburo Murakawa Graduate School of Engineering, Hiroshima University, Japan Goro Seki Nikken Sekkei LTtd.

Abstract

As recycling systems become more advanced in civilized communities, demand is growing for the renovation of existing buildings, and there is a public need for comprehensive evaluation of renovation plans. This paper analyzes the relationship between economic efficiency and reduction in energy consumption based on case studies of five renovation projects for existing office buildings (Buildings T, M, N, K, and A). We propose a method to evaluate renovation projects from an environmental standpoint with consideration for cost effectiveness in order to facilitate the evaluation of renovation on two axes, economic efficiency and reduction in energy consumption. The proposed method is applied to 20 environmental indicators for green technology projects which have been developed by the Ministry of Land, Infrastructure and Transport (MLIT). Our evaluation of five renovation projects by the proposed method shows improved economic efficiency and reduced energy consumption at three of the sites (Buildings T, M, and N). The evaluation of 20 indicators of green technology shows that controlling the number of heat sources is the most effective method of renovation.

Keywords: Effective renovations; Energy consumption; Life Cycle Cost; Office Buildings

Introduction

At present, as measures to conserve the global environment are being implemented in a variety of fields, there is also an urgent need to reduce emissions from the construction sector, which accounts for nearly 40% of domestic carbon dioxide emissions. Buildings need to include consideration for the global environment while also providing comfort and safety.

In response to these demands, the Ministry of Land, Infrastructure and Transport (MLIT) has developed guidelines for green building diagnosis and renovation (Reference 1) with regard to renovation plans for existing government buildings. MLIT has conducted a comprehensive investigation of the energy consumption related to building maintenance after renovation with green technology to reduce the energy consumption throughout a building's life cycle. In relation to these kinds of renovations, the guidelines cover calculation of the reduction in energy consumption (reduction in Life Cycle Carbon dioxide, LCCO₂) and Life Cycle Cost (LCC), an economic indicator for buildings.

In this paper, we have determined the effects of renovation in the buildings under investigation, focusing on the operational stage following renovations. For the evaluation of renovation projects on the dual axes of economy and reduction in energy consumption ^(Note 1), we proposed and applied a method to evaluate renovation projects from an environmental standpoint with consideration for cost effectiveness. Next we selected model government buildings for use as a standard with regard to quantitative determination of both the economic and environmental effects of green technologies described in aforementioned Reference 1, and clarified their relationship according to calculations of LCCO2 and LCC with the time of green renovations as the starting point. Last, from the small amount of literature that has looked at LCCO2 and LCC as paired indicators following renovations, we took the standard of Reference 1 which we used as a guide. We have described the results of evaluation in five cases which were compared by

application of the proposed evaluation method with regard to green technologies and the renovations of the buildings under investigation.

SUMMARY OF INVESTIGATION

Summary of buildings under investigation

We studied five office buildings in Tokyo which will be identified as Buildings T, M, N, K, and A. Table 1 shows an outline of these buildings. They were built between 1966 and 1973, so the buildings are between 30 and 37 years old. Partial renovations had been performed on each building, but major renovations were implemented when the buildings were between 25 and 35 years old. Table 2 summarizes the renovations and costs for each building. Individual zone air conditioning/heating was introduced in all of the buildings except Building T. Most of the buildings were fitted with HF fluorescent lighting and OA access floors, and electrical outlets were upgraded for higher capacities. As the second half of Table 2 indicates, renovation costs

	100	ic i. Ourinnary of a	ne bullulings invest	galou	
				Note: Building ages	are as of February 2004
	Building T	Building M	Building N	Building K	Building A
Site area	8,922.5 m ²	1777.7 m ²	2105.1 m ²	772.2 m ²	-
Building area	4508.3 m ²	1605.1 m ²	1606.5 m ²	637.7 m ²	693.1 m ²
Floor area	47036.4 m ²	20132.8 m ²	13333.4 m ²	5419.2 m ²	5622.7 m ²
Construction	S and SRC	SRC	SRC	SRC	SRC
Stories	4 basement levels, 16 stories above ground, and 3 penthouse levels	3 basement levels, 9 stories above ground, and 4 penthouse levels	2 basement levels, 9 stories above ground, and 3 penthouse levels	1 basement level and 8 stories above ground	1 basement level and 7 stories above ground
Date completed	8/1/1970	6/1/1966	3/1/1973	8/21/1972	3/30/1970
Age	33 years	37 years	30 years	31 years	33 years
Time of renovations	5/15/2001-10/31/2001	7/1/2001-3/31/2002	5/16/2001-11/12/2001	10/1/1999-3/31/2000	10/1995-5/6/1996
Age when renovated	30 years	35 years	28 years	27 years	25 years
Purpose	Office building	Office building	Office building	Office building	Office building
Location	Chiyoda-ku, Tokyo	Chiyoda-ku, Tokyo	Chiyoda-ku, Tokyo	Chiyoda-ku, Tokyo	Chuo-ku, Tokyo



Before renovations:

Building	Building T	Building M	Building N	Building K	Building A
Architectural:	Aluminum outoin walla	Drocost concrete	As-cast concrete, spray	Aluminum panel with	Aluminum panel with
Exterior finish	Aluminum curtain waiis	Flecasi concrete	tile	baked finish	baked finish
	None (except some	None (except some	None (except some	Nana	None (except some
OA access hours	areas)	areas)	areas)	None	areas)
Ceiling height	2,600 mm	2,450 mm	2,489 mm	2,550 mm	2,500 mm
Moveble lead	200 kg/m^2	300 kg/m^2	300 kg/m ² , 500 kg/m ² in	300 kg/m^2	
	300 kg/m	500 kg/m	some areas	300 kg/III	
Air conditioning/ventilation	Central	Central	Central	Central	Central
Electrical:	About 20, 20 $\lambda/h/m^2$	$20 \lambda (A/m^2)$	About 20 $\lambda/4$ /m ²	About 20 $\lambda/A/m^2$	About 20 $\lambda/A/m^2$
Outlet capacity	About 20-30 VA/III	30 VA/III	About 20 VA/III	About 20 VA/III	About 20 VA/III
Desktop illumination	About 500 Lx	About 750 Lx	About 500 Lx	About 500 Lx	About 500 Lx
Light fixtures	FL fluorescent lights	HF fluorescent lights	FL fluorescent lights	FL fluorescent lights	FL fluorescent lights
Socurity oquinmont		Electric locks and card			
Security equipment		readers			
Distribution switchboards	On each fleer	On each fleer	On each fleer	On each fleer	On each fleer
/terminal boards	On each hoor	On each noor	On each hoor	On each noor	On each noor
Water supply, drainage and		Kitchenette and			
sanitation:	Kitchenette	restroome	Kitchenette	Kitchenette	Kitchenette
Hot water supply		resuborris			

After renovations:

Building	Building T	Building M	Building N	Building K	Building A
Architectural: Exterior finish		Aluminum curtain walls		Aluminum extrusion panels (45 x 90 magnetic tile in some areas)	-
OA access floors	All floors, 80 mm	All floors, 70 mm	All floors, 80 mm	All floors, 50 mm	None (except some areas)
Ceiling height	2,600 mm	2,600 mm	2, 600 mm	2,500 mm	2,500 mm
Movable load	300 kg/m ²	300 kg/m ²	300 kg/m ² , 500 kg/m ² in some areas	300 kg/m ²	
Air conditioning/ventilation	Central (with smaller unit controls)	Individual zone air conditioning	Individual zone air conditioning	Individual zone air conditioning	Individual zone air conditioning
Electrical: Outlet capacity	50 VA/m ²	50 VA/m ²	40 VA/m ²	50 VA/m ²	About 30 VA/m ²
Desktop illumination	600 Lx	750 Lx	600 Lx	760 Lx	600 Lx
Light fixtures	HF fluorescent lights (continuous dimming)	HF fluorescent lights	HF fluorescent lights (stepped dimming)	HF fluorescent lights	HF fluorescent lights
Security equipment	Electric locks and card readers	Electric locks and card readers	Electric locks and card readers	Electric locks and card readers	
Distribution switchboards/terminal boards	Provided for each tenant	Provided for each tenant	Provided for each tenant	Provided for each tenant	Provided for each tenant
Water supply, drainage and sanitation: Hot water supply	Kitchenette and restrooms	Kitchenette and restrooms	Kitchenette and restrooms	Kitchenette and restrooms	Kitchenette
Renovation costs (¥1000/m ²)	108.03	161.43	106.87	169.05	43.92

amounted to about $\pm 100,000/m^2$ in Buildings T and N, which were fitted with individual zone air conditioning/heating, HF fluorescent lighting, OA access floors, and upgraded electrical outlets with higher capacities. Renovation costs were higher for Buildings M and K, which received seismic retrofitting, and exterior redecoration, and lower for Building A, which did not receive OA access floors or a security system.

Content of investigation

To determine the effects of renovations, data was collected on electricity, gas, kerosene, and water usage and associated costs at each of the five buildings under investigation. Table 3 shows the scope of data collected. We were able to collect data for one year before and after renovations for each building. Annual data was divided into fiscal years (April through March) for this study, so the data below will refer to fiscal years.

	Time covered by collected data	Time of renovations
Building T	4/1992 - 3/2003	5/2001 - 10/2001
Building M	4/1998 - 3/2003	7/2001 - 3/2002
Building N	4/1992 - 3/2003	5/2001 - 11/2001
Building K	4/1998 - 3/2003	10/1999 - 3/2000
Building A	4/1994 - 3/2003	10/1995 - 5/1996

Table 3: Scope of collected data

Proposal of a method for environmental evaluation of renovation projects with consideration for cost effectiveness

The following is a summary of the aforementioned method for environmental evaluation of renovation projects with consideration for cost effectiveness which we are proposing.

① Economic recovery period [years] (Note 2)

 $I \swarrow (R_{BM} - R_{AM})$

Since this method evaluates renovations according to their effectiveness at the stage of operations following renovations, the economic recovery period is obtained by dividing the renovation costs by the annual reduction in running costs.

I : Renovation costs $[\frac{1}{2}/m^2]$

 R_{BM} : Running costs before renovations [¥/y•m²]

 R_{AM} : Running costs after renovations [$\frac{1}{2}$ /y•m²]

② Reduction in energy consumption with regard to renovation costs [joules/¥1] (Note 3)

 $\{(\mathbf{R}_{BE}\!-\!\mathbf{R}_{AE}) \times T\} \nearrow I$

The planned usable lifetime of equipment is multiplied by the annual reduction in energy consumption resulting from renovations, and this is divided by renovation costs in order to obtain the reduction in energy consumption with regard to renovation costs. ^(Note 4)

I : Renovation costs $[\frac{4}{m^2}]$

 R_{BE} : Energy consumption before renovations $[J/y \cdot m^2]$

 R_{AE} : Energy consumption after renovations [J/ y•m²]

T : Planned usable lifetime of equipment [years, determined arbitrarily]

Index of improvement in environmental consideration [no unit]

 $[\{(\mathbf{R}_{BE} - \mathbf{R}_{AE}) \times T\} / I] / \{I/(\mathbf{R}_{BM} - \mathbf{R}_{AM})\}$

The index of improvement in environmental consideration is defined as the amount of reduction in energy consumption with regard to renovation costs, divided by the economic recovery period. This is an index for the evaluation of renovation projects on the dual axes of economy and reduction in energy consumption. Later we will discuss the detailed evaluation of renovation projects using this index. If both and are positive values, then the larger the index, the more effective the renovation project is judged to be. Then this paper not covered the influence of the varying tariff rates, fuel costs change and inflation rate.

Study of renovation effectiveness

Reduction in running costs

Figure 1 shows changes in electricity, gas, kerosene, and water usage fees over the period from 1992 to 2002 in Building T as an example. (Note 5) The renovations were performed in 2001. Although there have been slight variations according to the year, we see below that the renovations produced a reduction of $\frac{1}{670}$ /m²/year compared to the previous year, or 2000.

5.37 [$\pm 1000/m^2/y$] (in FY 2000) - 3.70 [$\pm 1000/m^2/y$] (in FY 2002)= 1.67 [$\pm 1000/m^2/y$]

We conducted similar calculations for the other four buildings, obtaining the findings shown in Table 4. Running costs were lower in Buildings T, M, and N but higher in Buildings K and A.



Fig. 1. Changes in energy usage fees for Bld.T

Table 4	. Reduc	ction in ru	inning co	sts	
	of the	buildings	sinvestig	ated	
				[¥10	00
	Duritation of T	Durilation of MA	Dividation of M	Dividadina at 14	Г

	[¥1000/y•m ²]				$000/y \cdot m^2$]
	Building T	Building M	Building N	Building K	Building A
R _{BM}	5.37	4.11	4.47	5.06	3.21
R _{AM}	3.70	3.24	3.42	5.99	3.30
Reduction	1.67	0.88	1.05	-0.94	-0.09

3,000 2,500 2,000 1,500 0 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 Fiscal year

Fig. 2. Changes in energy consumption at Bld. T

Table 5.Reduction in energy consumption
of the buildings investigated

		-	[MJ/y•m ²]		
	Building T	Building M	Building N	Building K	Building A
R _{BM}	2519.17	1802.72	2078.95	1991.46	1185.02
R _{AM}	2247.60	1630.36	2027.91	2982.38	1277.97
Reduction	271.57	172.36	51.04	-990.92	-92.95

Reduction in energy consumption

As shown in Note 4, the reduction in energy consumption is obtained by converting electricity, gas, and kerosene usage into primary energy consumption. The coefficients used in this conversion were 10.25 mega joules per kilowatt-hour of electricity ^(Note 6), 45.90 mega joules per cubic meter of gas ^(Note 7), and 37.00 mega joules per liter of kerosene ^(Note 6).

Figure 2 shows energy consumption at Building T over the period from 1992 to 2002. Similar to the reduction in running costs, the reduction in energy consumption per unit of area due to the renovations was calculated to be 271.57 mega joules/ m^2 /year, as follows.

2,519.17 [$MJ/m^2/y$] (in FY 2000) - 2,247.60 [$MJ/m^2/y$] (in FY 2002)= 271.57 $MJ/m^2/y$

We conducted similar calculations for the other four buildings, obtaining the findings shown in Table 5.

Evaluation of renovations

We applied the proposed method of evaluation in the five renovation projects according to the renovation costs determined by investigation, along with the reductions in running costs and energy consumption as calculated above. The process followed is shown below, taking Building T as an example.

①Economic recovery period

Renovation costs: $I = 108.03 [\$1000/m^2]$

Reduction in running costs due to renovations: $R_{BM} - R_{AM} = 1.67 [\$1000/m^2/y]$

Therefore, the economic recovery period is: I / $(R_{BM} - R_{AM}) = 108.03 / 1.67 = 65$ [years]

2 Reduction in energy consumption with regard to renovation costs

Reduction in energy consumption due to renovations: $R_{BE}-R_{AE} = 271.57 [MJ/m^2/y]$

Planned usable lifetime of equipment (Note 8): T = 30 [years]

Therefore, the reduction in energy consumption with regard to renovation costs is:

 $(R_{BE} - R_{AE}) \times T / I = 271.57 \times 30 / 108.03 = 75.42 [MJ/¥1,000]$

③Index of improvement in environmental consideration

Based on the results of (1) and (2), the index of improvement in environmental consideration is calculated as follows: $[\{(R_{BE}-R_{AE}) \times T\} / I] / \{I / R_{BM}-R_{AM}\} = 75.42 / 65 = 1.1603$

We conducted similar calculations for the other four buildings, obtaining the findings shown in Table 6. The values obtained for the index of improvement in environmental consideration are distributed as shown in Fig. 3.

Depending on whether the values of (1) and (2) are positive or negative, the index of improvement in environmental consideration can be classified into the following four groups.

① Group I (Buildings T, M, and N)

In the first quadrant, renovation projects are effective in reducing the energy consumption, and the renovation costs are recoverable. In this quadrant, a higher index of improvement in environmental consideration indicates higher effectiveness.

② Group II (no applicable buildings)

In the second quadrant, renovation projects are effective in reducing the energy consumption, but the renovation costs are not recoverable.

③ Group III (Buildings K and A)

In the third quadrant, both the energy consumption and running costs are increased.

④ Group IV (no applicable buildings)

In the fourth quadrant, renovation projects are not effective in reducing the energy consumption, but the renovation costs are recoverable.

Under this classification, the renovation projects of Buildings T, M, and N belong to Group I since they include consideration for both economy and the environment. Comparing values of the index within the same group (Group I), we see that the renovation project of Building T had the highest effectiveness.



Economic recovery period (years)

Fig. 3. Index of improvement in environmental consideration at buildings investigated

Summary of the guidelines for green building diagnosis and renovation

In green diagnosis for a green government building project, the areas in need of greening are determined through analysis of factors such as energy usage by the government building in question, taking the state of building utilization into consideration. In order to predict the effects of greening with regard to the introduction of applicable green technologies, the government building in question is classified according to location and size as defined in Reference 1, and LCCO2 and LCC are calculated with the time of building renovations as the starting point. Table 7 shows the four regions used to classify building location. There are two categories of building size: 3,000 m² model government buildings and 15,000 m² model government buildings.

Table 7. Regions used to classify building location

I. Hokkaido	II. Sendai	III. Tokyo	IV. Kagoshima

Table 8. Green technology items

1.	Roof external heat insulation	 Controlling the number of heat source units
2.	Outer wall external heat insulation 1	Ice thermal storage
3.	Outer wall external heat insulation 2	 Gas heat source system with large temperature differential
4.	Window heat insulation, solar radiation shielding (reflective glass)	15. Cold/hot water pump VWV system
5.	Window heat insulation, solar radiation shielding (insulating glass)	16. Coolant water pump VWV system
6.	Light fixtures 1 (high efficiency lighting)	 Air conditioner VAV system
7.	Light fixtures 2 (high efficiency lighting)	18. Reduced fan speed for air conditioner coil
8.	Light fixtures 3 (high efficiency lighting)	Higher efficiency heat sources
9.	Light fixtures 4 (high efficiency lighting)	20. Solar water heating
10.	Power receiving and transforming equipment	21. Use of rainwater
11.	Solar power generation equipment	22. Elevator VVVF

Therefore, there are a total of eight patterns used to classify government buildings, consisting of both categories of building size in each of the four regions.

Relationship between LCCO₂ and LCC with regard to introduction of green technologies

To clarify the relationship between LCCO2 and LCC with regard to the introduction of green technologies, we calculated LCCO2 and LCC for each of the eight patterns, assuming introduction of the green technologies listed in Reference 1. The green technologies indicated in Reference 1 are shown in Table 8.

In a comparison by stages (graph not included) of green renovation and conventional renovation for government buildings of the 3,000 m^2 and 15,000 m^2 models, many items showed increases in both LCCO2 and LCC at the renovation stage, while there was a tendency for LCCO2 and LCC to remain constant or decline during the operational stage. In the totals for all stages, LCCO2 declined for most items while LCC increased. By comparing across regions, it was found that the introduction of green technologies for electric lighting was effective in each region, regardless of regional differences.

Evaluation of renovations through introduction of green technologies

In this study, the proposed evaluation method was applied to 20 items of green technology for application in 15,000 $\rm m^2$ model buildings. The calculation process is shown below, taking the example of controlling the number of heat source units.

 $(1) Economic recovery period <math display="inline">^{(Note \; 9)}$

Renovation costs: $I = 29.00 [\$1000/m^2]$

Reduction in running costs due to renovations: R_{BM} - $R_{AM} = 0.22 [\$1000/m^2/y]$

Therefore, the economic recovery period is: $I / (R_{BM} - R_{AM}) = 29.00 / 0.22 = 132$ [years]

②Reduction in energy consumption with regard to renovation costs (Note 10)

Reduction in energy consumption due to renovations: $R_{BE} - R_{AE} = 2.68 [kgC/y \cdot m^2]$

Planned usable lifetime of equipment (Note 11): T = 100 [years]

Therefore, the reduction in energy consumption with regard to renovation costs is as follows:

 $(R_{BE} - R_{AE}) \times T / I = 2.68 \times 100 / 29 = 9.24 [kgC/¥1,000]$

③Index of improvement in environmental consideration

Based on the results obtained in (1) and (2) above, the index of improvement in environmental consideration is as follows:

$$[\{(\mathbf{R}_{BE} - \mathbf{R}_{AE}) \times T\} / I] / \{I / \mathbf{R}_{BM} - \mathbf{R}_{AM}\} = 9.24 / 132 = 0.0700$$

Similar calculations were conducted for the other 19 items. The conditions obtained are shown in Table 9. Fig 4 shows the distribution of the index of improvement in environmental consideration for the 13 items with an economic recovery period of 800 years or less.

Figure 4 shows that the evaluation index falls into the first quadrant (Group I) in each case. According to the proposed evaluation method, each of the green technologies is recognized as effective for renovations in terms of both economy and reduction in energy consumption.



Table 9: Conditions calculated for green technologies

Verifying the index of improvement in environmental consideration

The relative values of the index of improvement in environmental consideration in five cases of building renovations have been determined through comparison of the results obtained by applying the proposed evaluation method to these five cases and to the green technologies. In Reference 1, carbon dioxide emissions are used as an index to measure the energy consumption of green technologies. Therefore, with regard to the five cases of building renovations as well, we converted electricity, gas, and kerosene usage into carbon dioxide emissions (Note 12) and recalculated the reduction in energy consumption and the index of improvement in environmental consideration. Here, we will not show the calculations used to obtain the reduction in energy consumption for each building.





Table 10: Reduction in energy consumption of	
the buildings investigated (kgC/y•m ²)

			<u> </u>			
		Building T	Building M	Building N	Building K	Building A
-	R _{BE}	100.52	66.94	76.79	73.63	41.38
	R _{AE}	84.67	59.30	74.79	114.81	44.63
	Reduction	15.85	7.64	2.00	-41.18	-3.25

Table 11: Conditions calculated for the buildings investigated

	Economic recovery period [years]	Reduction in energy consumption with regard to renovation costs [kgC/¥1000]		
Building T	65	4.40		
Building M	184	1.42		
Building N	102	0.56		
Building K	-180	-7.30		
Building A	-505	-2.22		

in Table 10. Table 11 shows the calculated conditions based on those results, and Fig. 5 shows the distribution of values obtained for the index of improvement in environmental consideration.

Comparing these calculated values with the index of improvement in environmental consideration for the green technologies as shown in Fig. 4, we see that the values are quite similar for "controlling the number of heat source units" and "ice thermal storage + large temperature differential" for Building T, and "high efficiency lighting 1-2" and "air conditioner VAV" for Building M. Similar effects are recognized from these green technologies for both buildings.

Conclusion

In this paper, we have determined the effects of renovations in the buildings under investigation in terms of reducing running costs and energy consumption, focusing on the operational stage following renovations. To evaluate renovation projects on the dual axes of economy and reduction in energy consumption, we have proposed a method for the environmental evaluation of renovation projects with consideration for cost effectiveness, and discussed the applicability of this method.

Last, from the small amount of literature that has looked at $LCCO_2$ and LCC as paired indicators following renovations, we took the standard of Reference 1 which we used as a guide. The index of improvement in environmental consideration was determined through comparison based on application of the proposed evaluation method to renovations in the buildings under investigation and to the green technologies indicated in Reference 1.

Notes

- Note 1: For the purposes of this study, the reduction in energy consumption is limited to the reduction in energy consumption at the operational stage following renovations.
- Note 2: The economic recovery period is rounded to the nearest year. It is assumed that the reduction in running costs will not change over time.
- Note 3: It is assumed that the reduction in energy consumption will not change over time.
- Note 4: Here, the reduction in energy consumption is expressed in terms of conversion of electricity, gas, and kerosene usage to primary energy.
- Note 5: For Building T, we were able to obtain data from fiscal 2000 on the fees charged for kerosene and the amount used.
- Note 6: The coefficients indicated in the implementation rules of the Law Regarding the Rationalization of Energy Use were used in these calculations.
- Note 7: In these calculations, we used the coefficients indicated by the Agency of Natural Resources and Energy as reference values for the calorific values of various types of energy sources.
- Note 8: Here, we used T = 30 as a trial.
- Note 9: In the application of the proposed evaluation method to each green technology, we supposed that a change was made from conventional renovation to green renovation as described in Reference 2. Therefore, when calculating the economic recovery period, we divided the green renovation costs by the difference in annual running costs between conventional renovations and green renovations.
- Note 10: For the same reasons as explained in Note 9, the difference between conventional renovations and green renovations at the operational stage was used as the annual reduction. In Reference 2, carbon dioxide emissions are used as an index of the energy consumption; so we have also used carbon dioxide emissions here as a measure of the energy consumption.
- Note 11: We used the value of T = 100, the same as in Reference 2.
- Note 12: In these calculations, we used the coefficients indicated in the implementation order of the Law on Measures Against Global Warming.

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REUSING AND MANAGING THE "REAL ALBERGO DE' POVERI" OF NAPLES: EVALUATION AND RE-DESIGN FOR IMPROVED EFFICIENCY

Gabriella Caterina, Maria Rita Pinto, Katia Fabbricatti, Stefania Oppido

Dipartimento di Configurazione e Attuazione dell'Architettura, Facoltà di Architettura, Università degli Studi di Napoli "Federico II"

Alessandra Bianchi

Centro Interdipartimentale Ricerca Ambiente (CIRAM), Università degli Studi di Napoli "Federico II"

Stefania De Medici

Dipartimento di Analisi, Rappresentazione e Progetto nelle Aree del Mediterraneo, Facoltà di Architettura di Siracusa, Università degli Studi di Catania

Pasquale De Toro

Dipartimento di Conservazione dei Beni Architettonici e Ambientali, Facoltà di Architettura, Università degli Studi di Napoli "Federico II"

Abstract

The reuse of historic buildings can be a main strategy to assure the efficiency in growth of our cities. The choice of a new function can produce relevant effects on both the durability of components of the building, and the social and economical dynamics in the area.

The "Real Albergo de' Poveri" was an alms house promoted by Carlo III Borbone at the beginning of the eighteenth century, and realized in Naples under Ferdinando Fuga's direction since 1752. The considerable physical consistency of the building, its complex morphological articulation, the strategic roles covered within the urban contest, require the examination of functional systems, more than the choice of a single function.

The proposal identifies the activities that guarantee the financial and economic sustainability of the project (driving functions) and it also points out those functions that satisfy the local needs, that alone would not be able to support themselves (driven functions). The attended result is to recognize the best system of functions among different alternatives, analyzing the physical, economic and social system. This strategy should favour the conservation of the building in time, also in consideration of the evolution of the function. The project of reuse should select flexible and reversible technological solutions in order to obtain lasting performances of new functions, both to guarantee changes of the activities in time and to bring the building back to its initial status. This kind of strategy could rise a process that guarantees the good management of maintenance of the building thanks to the economic sustainability of the new activities.

Keywords: building management; compatibility evaluation; maintainability; reuse; sustainability

BACKGROUND

In the last years, the interventions realized have been mainly reusing disused or obsolete buildings. These buildings need new uses in order to protract their life cycle.

The primary objective of the reuse is the quality of intervention choices, that help to guarantee the more general aim of urban and land quality. Today it is necessary to investigate, to evaluate and to propose decision criteria, aimed at the governance of the intervention process on the buildings, while guaranteeing quality of results.

The organization and management process of the built heritage, the control of steps, the coordination of competencies aim to design verifiable solutions, that can be evaluated in the decision stage. In this perspective, the reuse intervention has to identify the bonds to be respected and the qualities offered by the building in relation with the requirements of the users.

The compatibility between building and new use has to be intended as an operative detail, which will aid on one hand the conservation of characters and "values" of built, and on the other hand the economic and social sustainability of future interventions, according to the whole settled context. This perspective is based on the fact that the building's use guarantees its conservation and the development and enhancement processes of the context.

The rehabilitation project can be identified as an iterative process, in which the decision stage is always oriented by information, according to an open model in which the decision is enriched in according with available information. The program can guarantee efficiency and validity of the entire building process through the control of made previsions regarding times, costs and quality of future interventions. This control, necessary for public financed works, becomes indispensable if privates invest financial resources and take decisions about projects regarding the entire community.

In this point of view, the compatibility evaluation for the reuse carries a strategic role, aimed at application of sustainable development policies at an urban as well as land scale. The "sustainable development" connects the idea of "development", that implies a change, a transformation and thus instability, and the one of "sustainability", that recalls the conservation upon time of existing conditions guaranteeing a sustain, without producing decay. This dichotomy recalls the dialogue between transformation and conservation of the buildings: improvement and modification, maintaining upon time those conditions that allow this improvement. The sustainable principle of rehabilitation operated within an urban environment, thus, is strictly correlated with interactions between the physical system, the economic system and the social system.

This goal reclaims the principle of "active safeguard", according to which the building is intended as a "resource" to be safeguarded. It is moreover needed to enhance potential interfaces with settlement context, activating socio-economical re-qualification processes on a larger scale, through compatible use towards more general sustainable development aims.

The conflict among conservation and transformation, that's generated in the intervention phase, can produce the modification or the loss of the plurality of values of the buildings or, on the contrary, it can create new values or increase the existing ones.

Only through an adequate control of choices and impacts which the reuse produces it will be possible to ensure conservation and maintainability of the building. In fact continuation of fruition for buildings guarantees the preservation of their historical and artistic values, increasing common heritage.

METHODOLOGY

In rehabilitation some valuable features of the buildings can be lost and some can be increased. New functions or new modalities for carrying out the activities already settled can affect the conservation of these features. A first strategic activity is the selection, among various alternatives, of the function which can better activate the preservation and the enhancement for both the building and its context. Therefore, the choice of the new use should take into account the settlement and development lines of land. In this point of view the building is considered as a "resource", that has to be enabled not only to express its historical and artistic values, but also to activate virtuous process of environmental re-qualification at a larger scale, within a strategic drawing.

In order to optimize the building management, in each step of the reuse process we have to control the results of the intervention choices. In the programming step, the main strategy to guarantee the building management should be focused on the sustainability evaluation of the new function to be settled. In the design step, the choices should be pointed out to guarantee, on one hand, the flexibility of the building, to allow the changing of the settled activities in time, and on the other hand, its durability and maintainability, to minimize the interventions aimed to preserve the performances required by the use.

The elaborated method for evaluation of compatibility between existing buildings and new intended purpose (Fig. 1) comes from the need to identify, in the programming phase of intervention, the suited activities to be settled in the building. The choice of the intended purpose to be inducted in an existing building in the programming phase of reuse becomes indispensable in order to optimize the available resources in the following phases of the process. In this way, the different choices compared in the elaboration of the preliminary project will be alternative project solutions for the redesign of one single function, already chosen in a previous level of the process. This aim imposes to adopt a comparison method that guarantees reliable evaluations, founded on an accurate selection of information to be lifted from the alternative functions. Therefore, the primary objective of the analysis and evaluation method elaborated is to verify the compatibility of alternative functions, optimizing the resources used in the analysis of information that has to be compared.

The proposal identified the functions, in order to promote a strategy orientated, on one hand, on the allocation of those functions guaranteeing the financial and economic sustainability of the project (driving functions) and, on the other hand, those functions that satisfy local needs (driven functions), that alone would not be able to support themselves. The strategic model that represents this development idea is made up of a joining nucleus, that co-ordinates the two complementary functional sectors: driving functions, economic profile; driven functions, to permit and satisfy local needs.

The evaluation of reuse compatibility is aimed to the achievement of a balance between needed requirements for carrying out activities and performance levels the building can offer, through application of various interventions which will previously indicated bonds. In the reuse intervention the goal is not to obtain optimization of building response to all the new function's requirements, but to verify, primarily, that the building will guarantee al least minimal benchmark respect.

The information that guides control activities of the conflict conservation/transformation is the synthesis of two different knowledge spheres: the requirement frame and the building knowledge.

The normative complex, which includes mandatory and voluntary standards, creates an articulate restriction system and is part of the building's requirements. Prefiguring new functions requires definition of demands regarding new alternative functions to be settled and a number of ranges within which existing building performance levels could be considered acceptable.

The analysis of the requirements has to be carried out starting from the examination of the activities for each function. Activity requirements will be extracted by handbooks, by standards, by optional and mandatory laws, and by design experiences carried out in both new constructions and rehabilitation sectors.

In a synchronic way with this activity, another one should be developed, aimed to the prefiguration of physical impacts following new uses. The building's performances will be analyzed through a study of the usability that includes all functionality conditions: the surface and the volume of the spaces, the dimensions of horizontal and vertical system of distribution. Performance of comfort includes: the amount of natural light, the percentages of humidity, the conditions of ventilation, the number of changes of air in each room. For each class of performance there are appropriate "representative parameters" which allow to confront those with the requirements of new use.

To each alternative function the definition of morphological as well as material bonds for the building rehabilitation should be associated. This means verifying at any time the transformations towards which leading the building for new uses. The definition of the restriction system created by the building supports the intervention choices. The restrictions which the building expresses, either of morphological and dimensional, either of constructive and material, either of perceptive and cultural kind, has to be associated with each function alternative.

CASE-STUDY: THE REAL ALBERGO DE' POVERI IN NAPLES

The method has been tested through the analysis of a case-study, the "Real Albergo de' Poveri" of Naples, a huge building for the city's poor people (Fig. 2). The idea was of Carlo III Borbone

and it was implemented by Ferdinando Fuga in 1752. The alms house was built in the eastern part of the city, at the foot of the Capodimonte hill.

The building is articulated in a main volume facing Carlo III square (five flats high), and other minor bodies surrounding the first and forming internal courts (two flats high) and is developed along a longitudinal axe. The main front is 300 m long and the internal courts have arms 70 m long. The considerable physical consistency of the building, its complex morphological articulation (with split level dislocated areas around many inner courtyards), the strategic roles covered within the urban context, caused the necessary examination of the functional systems.

The acknowledgement of the proposal pointed out the necessity to allocate, in the area of the "Real Albergo de'Poveri", new activities in the economic and vocational training sectors. Beginning from this demand, two distinctive functional systems were hypothesized (Fig. 3). The main idea is to set in each of the intended purposes, a pole, that constitutes a central engine that fuels and transforms the induced deriving from the grouping of the functions. The first (hypothesis A) has as a "driving function" the activities constituted by training and refresher courses in the scientific-technological sectors, orientated in the encouragement of new youth ventures, while the driven functions are constituted by an auditorium and music halls, a scientific-didactic museum and laboratories for scientific and technological research.

In the second function system (hypothesis B), the "driving function" is constituted by training and refresher courses of companies in tourism and craft sectors, even in this case with areas dedicated to the rise and development of youth ventures in the sector, with crafts laboratories and schools for vocational training. The driven functions are the auditorium and music halls, a museum for tourism orientation and laboratories for historical-archaeological research.

The "driving functions" have to guarantee the lasting of the use in time: this management has to take into account the features of the new driving activities, in relation with the social and economic context. "Driving functions" could be managed in two different ways: more activities that will draw large audience or a main attractor with a wide, strong influence.

To verify compatibility for re-use, a procedure was developed, created through a path that defines the successive steps of comparison (building / new use) and allows constant adjusting operations to the functions through feedback. In each step of the procedure input data are inserted, related to the intended purpose. For each function system tested, two distributive hypothesis were considered. In particular, the hypothesis A1 and B1 are characterized by a block function articulation in the building based on the subdivision of the courtyards, while the hypothesis A2 and B2 present a distribution of functions per floor.

In the case of the "Real Albergo de' Poveri", the multi-criteria evaluation was carried out by applying the "Regime" method, which proved to be suited for the specific problem of decision making, permitting the use of synthetic quantitative and qualitative indicators, attributing the right ordinal weight to the different criteria of evaluations. The first step was to make up the evaluation matrix, that organizes the evaluation criteria for lines and the four alternative intended purposes for columns; the element of the matrix identifies, through the right indicator, the way in which a certain alternative follows a particular criteria. Besides the different evaluation criteria, different weights were also assigned, and particularly a priority list was recognized for the ordinal criteria (Fig. 3). The "Regime" evaluation recognized in the B1 system (tourism museum, handcrafts, historical-archeological research labs, based on the subdivision of the courtyards) the best new use.

Therefore, the compatibility control of the singled out new uses, carried out in the programming phase, showed critical points that need to be considered in the planning of the reuse intervention. This can be done comparing each functional nucleus that forms this new use with the rooms in which it fits. In fact, the re-use project can save, improve and integrate the building's performance levels respecting the existing bonds, and can support the building's maintainability.

The research compared the dimensions required by the function and the dimensions of the spaces assigned to them. With these results it was possible to identify the compatibility degree between dimension data of each function and the compatibility of rooms. For this aim the compared parameters were: the dimensioning (number of required rooms, maximum number of users, area/person required, total area required, minimum required dimensions) and the capability (number of rooms assigned to the analyzed function, total area required, minimum dimensions for rooms assigned to the function it was possible to define). On the basis of these

controls the goals to achieve to optimize correspondence between function dimensioning and its space capability were defined (Fig. 4).

After the dimensional/compatibility check, a comparison between the activities requirements and the performance levels of the spaces in which they will take place has been performed: the outcome of this comparison requirement/performance showed how suitable the offered performance levels are in relation to the required ones. Comparisons with a negative outcome underline the need to operate an adjustment of the room, when possible, or of the function. The selected requirements and performances bring back to lead to a usability need: space adaptability in terms of division, aggregation and facilities creation; the lighting conditions required and the ones actually given by spaces, in terms of control of the light flow and darkening; relations between activities that require direct connection and connections between rooms related to them, in terms of horizontal and vertical connections.

With comparisons requirements/performances, the "adequacy" degree of building's spaces and their function was recognized. It's possible to rise performance levels, respecting the features of rooms by means of morphological–dimensional bonds, material–constructive bonds, perceptive–cultural bonds. With the comparison between these bonds, considered as resources able to help planning decisions, and the actions needed for the adjustment of spaces to the building, it was possible to define the trend to follow during the planning stage. In detail, the evaluation of building's performance levels showed: the need to divide spaces, the need to join together spaces, the need to control light flow in spaces. The existence of non-used space in the "preferable" system of functions was considered as a resource in terms of building's flexibility that, in the future, could increase the already settled functions or fit in new ones, connected or not to the existing ones.

According to this scenario, the design of technological elements has to be pointed out to increase the building's performances and to satisfy new requirements needed by the new settled function. The design process should start from the analysis of these requirements, singling out the performance levels needed to an easily and safely carry on of the activities. In order to ensure the efficiency of the intervention, the technical solutions designed should guarantee the durability and the maintainability. Therefore, it is necessary to design the efficiency of each element, in order to ensure the efficiency of the whole building system. This care in design is strategic to minimize the interventions required to limit the damages due to the use and to maintain the performance levels in time, producing positive effects in the building management.

To find solutions for recurring problems (division, aggregation, light flow control, darkening, integration of vertical connections) planning guide lines for new technical elements were singled out through: a comparison between a necessary requirement for the function and the building's offered performance; a comparison between the interventions to be designed and the building's bonds.

For the noticed problems, we performed the recognition of planning interventions guide lines in order to select compatible solutions with preservation finalities of the existing building (Fig. 5). The aim is to preserve, improve and integrate usability and maintainability performances of the building, intending the bonds as resources, that can guide planning choices.

CONCLUSIONS

The chance to assign "new uses" to buildings guarantees an increasing building value – not only on economical point of view – according to the conceptual format of "active safeguard", inverting the traditional idea of considering bonds as obstacles. This logic is aimed to the optimization and enhancement of existing resources, to delay the "life-cycle" of the built heritage through actions which can preserve its morphological, material and constructive features, recognizing its value as an evidence of material culture.

Therefore, the compatibility evaluation to reuse is an indispensable tool to carry out sustainable development policies. The choices should be the result of evaluations of the impacts due to reuse in the economical, social and physical-environmental field.

A project for enhancing and re-employing the built heritage, besides retrofitting existing buildings, could lead to positive changes of cities' full parts, when a new function is defined. The reuse operation for a single building should be inserted into a larger frame, which includes urban net
where other buildings are located, on which is necessary to establish choices due to temporal projection of demand linked with new function to be applied. The aim of this procedure is to produce a change of direction within the reuse policy. Today, in fact, the choice of new uses for existing buildings is founded on the major economic convenience or on the opportunity for employing public funds, connected to a specified sector. On the contrary this paper proposes an orientation of the reuse project towards a new dimension that builds a network between cultural, environmental and social values with the economical and technical aspects.

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Figure 1



Figure 2



Figure 3



PROVIDE THE ENVIRONMENTAL UNIT WITH ADJUSTABLE DARKENING DEVICES



PRESERVATION OF "CHARACTERISTICS" (constraints/resources)

Material-constructive bonds Rehabilitation of the existing fixtures preserving materials and features

Perceptive-cultural bonds Preservation of rhythm and design of windowspaces

Morphological-dimensional bonds Preservation of dimensions and shape of the fixtures

Figure 4

CONSERVATION CONDITION OF THE EXISTING WINDOW FRAMES SIGN



MANAGEMENT REQUIREM	MANAGEMENT REQUIREMENTS FOR THE DESIGN OF THE TECHNICAL ELEMENTS						
CLASSES OF REQUIREMENTS REQUIREMENTS							
RELIABILITY	Reliability of the technical elements Weatherability Usability and maneuverability Safety to intrusions						
DURABILITY	Durability of the materials Durability of the maintenance interventions						
MAINTAINABILITY	Practicability Easiness of cleaning Easiness of inspection/control Easiness of assembling/disassembling Easiness of repairing/replacing						

PRESERVATION OF THE PERFORMANCE LEVELS ACHIEVED BY THE INTERVENTION

Frequent damages of the traditional window frames

- Decay of the finishing
- Decay of the weather strips
- Decay of the dopes
- Oxidation and corrosion of metallic parts
- Decay/break of the window pulls, hinges, etc.
- Damages due to impact
- Flatting of the glasses
- Spots
- Lack of parts
- Deposit of coating

Control for the prevention of the frequent damages

- Control of the drifting duty
- Control of the conservation condition of the metallic elements
- Control of the conservation condition of the dopes and weather strips
- Control of the efficiency of the movable parts
- Control of the conservation condition of the glasses
- Figure 5

BENCHMARKING FACILITY MANAGEMENT BY RELATIVE EFFICIENCY

Yat L. P. Wong

The Department of Building Services Engineering, The Hong Kong Polytechnic University

Abstract:

Benchmarking is often claimed to be a powerful means of continuous improvement for facility managers but benchmarking tools in facility management are less developed than for other services businesses. The most common information which Facility Managers can get from benchmarking results is their positions of performance. Rankings on performance, without further analysis, cannot help much for the achievement of continuous improvement. A new approach, called Data Envelopment Analysis (DEA), is proposed in this article to evaluate and improve the efficiency of facility management operation units. By applying DEA in two cases with collected and computer generated facility management data respectively, we showed facility managers not only could identify inefficiencies but also be given hints on the ways to catch up with their efficient peers. Based on the cases, it was illustrated that DEA could work with facility management quantitative data with clear indications for improvements. One of the cases demonstrated how DEA could be applied with Excel formulae. Further research is suggested with more collected data to test the sensitivity and reliability of DEA application on facility management and whether DEA can produce satisfactory results with qualitative data in Facility Management.

Keywords: Benchmarking; DEA; Facility Management

INTRODUCTION

Facility managers in the Hong Kong property market must recognize that efficiency and competitiveness are the keys for survival these years: Since 2000, office property market has experienced a significant downward adjustment. Based on the average rental rate, the rental premium in Central fell 59 per cent from HK\$17 per square foot in 2000 to HK\$7 per square foot in the second quarter, 2003. The overall occupancy rate of Grade A office has fallen from more than 91 per cent in 2000 to about 87 per cent in the second quarter of 2003.⁵ Competition for tenants is intensive.

Property developers in Hong Kong, via their facility management divisions, are trying their best to create more values for their leassees and the end users of their facilities. These can often be achieved through facility management benchmarking with goals, like reducing costs, enhancing the willingness of customers to pay higher price or improving efficiency of the operation units. The facility manager then decides the benchmark metrics which are usually easy to be identified and compared against those of one's counterparts. The main problem, as pointed out by Massheder & Finch (1998)⁶, lies in the process of comparison and the analysis of comparison results. Some systematic benchmarking methodologies which can improve the quality of comparison analysis are necessary.

A mathematical tool called Data Envelopment Analysis (DEA) has been applied in the benchmarking of financial services, police service and regulated services and proved to be useful, especially when inputs and outputs within the operation unit are not easy to define.

This paper is intended to introduce the application of DEA to assist in evaluating the efficiency of facility management units. After a brief discussion on the trends of benchmarking, a simplified example with graphical description will present the basics of DEA. A facility management case then demonstrates how to set up and use DEA method in Excel spreadsheet to better facilitate facility management benchmarking. Before conclusion, guidelines will be given on how facility

managers can apply DEA and interpret the results. Mathematical formulations of DEA model are listed in Appendix.

A TREND OF BENCHMARKING: MULTIPLE MEASUREMENTS

In 1979, after realizing increasing competition, Xerox started investigating the cause of their lagging by comparing the unit manufacturing cost of their copying machines with that of their main competitors: They identified performance gaps relative to its competitors; then analyzed how the performance gap could be narrowed and ultimately eliminated. Since the success of Xerox in applying benchmarking, significant developments have been seen by applying benchmarking.

During the Xerox era of benchmarking, single-measure based gap analyses were common. The benchmarking subjects were confined to costs, profits in monetary terms and energy consumed. Organization performances are now often evaluated in terms of more complicated measures, like return on investment (ROI) and return on sales (ROS). Apart from completeness of comparison and better consideration of subjects' interactions and tradeoffs, Camp (1995)² pointed out another advantage of benchmarking by multiple measurements: Absolute values are not revealed in the benchmarking report.

Multiple measures can take account of the integration of interactive data but require techniques that are more sensitive. For example, in facility management benchmarking, energy costs, maintenance and number of users are all interactive and their relationships are difficult to define. A better management tool is necessary for accurate facility management benchmarking results.

Benchmarking facility management operation units by DEA

A facility management operation may be considered by the end-users as competent when the qualities of security and cleaning services provided to them exceeded their expectation. However end-users' satisfaction cannot reflect the complete picture whether the facility management services are managed efficiently. The executive needs to know whether the resources are utilized productively. Conventional single measures ignore the interactions and tradeoffs among various performances.

In the financial field, return on investment or other ratios are well recognized as a good measure of performance. In some unique service organizations, operations have been standardized: Quality and quantity of product outputs per labor and time inputs are clearly described, like some large fast food restaurant chains. Where the standardization of facility management services is not yet achieved (if possible), benchmarking tools which can measure outputs versus inputs in an empirical sense are required.

Data Envelopment Analysis(DEA), a linear programming based technique, can measure the relative performance of organizational units where multiple inputs and outputs make comparisons difficult. This was first introduced by Charnes, Cooper and Rhodes in 1978.³ It can combine many performance measures into an indicator of efficiency and help the facility management units achieve their goals with checking during the improvement process. It is commonly applied for assessing efficiencies of operational units. The efficiencies assessed are relative in the sense that they reflect scope for resource conservation and output augmentation at one unit relative to other comparable units. The following hypothetical example with adjusted real data illustrates the basics of DEA.

Mr. Chan is a facility manager of a property investment company in Hong Kong. The property investment company owned two office buildings, Building A and Building B, in the same region with comparable services and leassees compositions. Mr. Chan was given a duty "to present to the company executive how efficient the two facility management units of the two buildings among their peers are".

Mr. Chan can only collect the following two types of data for benchmarking Buildings A and B with the other 14 comparable buildings in the same region:

1. Building services (BS) cost per square feet: BS cost includes costs of electrical service, air conditioning service, plumbing and drainage, sea water system (if applicable), fire services, vertical transport services and general cleaning.

2. Rent per square feet.

Despite the lack of other conventional facility management data for benchmarking, Mr. Chan is convinced that meaningful information can still be drawn from the benchmarking study with the use of DEA because:

- 1. The BS cost represents a substantial operation cost of the whole building's facilities.
- 2. Though rent is largely determined by demand and supply within its owned market sector, it does reflect the competitiveness of the quality of facility management service, assuming the property market has reasonably perfectness with respect to information, market competition and completeness.
- 3. When assessing organizations' efficiency with DEA, financial evaluations are not necessary. DEA just requires activity information (Homburg (2001)⁴).

The usual measure of efficiency, i.e. units of output per unit of input, cannot be applied in Mr. Chan's case since BS cost and rent are not the only input and output of the facility management unit though they may be the main ones.

Some statements concerning the relative efficiency of the buildings can be made:

- 1. BS cost of Building A is lower while rent per feet charged is higher than Building B. Clearly if the input and output are representative, Building A's facility management unit is more efficient than Building B's.
- 2. From Table 1, we see that Building A and Building 4 are with the lowest cost in building services. The two buildings may be considered as the most productive from this limited aspect. However, from the same table, it is noted that the rent per square feet of Building 3 is the highest among the 16 buildings.

Table 1: Building services cost and rent per square feet of 16 buildings of the y	/ear 2001.
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Building	BS cost per square feet (HKD)	Rent per square feet (HKD)				
A	59	19				
В	74	18				
1	65	17				
2	76	17				
3	75	20				
4	55	16				
5	63	18				
6	58	19				
7	76	17				
8	72	19				
9	65	18				
10	75	19				
11	59	16				
12	67	18				
13	69	18				
14	63	19				

The cost on building services per square feet and the rent per square feet are plotted for each building in Figure 1: Buildings A, 3, 4, 6 and 14 form an "efficiency frontier". It was named so because they produce the most outputs in closed cases for a reported amount of costs. Buildings closed to the frontier are relatively efficient and those inside the frontier are inefficient. The facility manager of Building B may either become as efficient as A by decreasing its cost on building services or become Building 3 by increasing the rent charged. These possible transformations of Building B's facility management unit to those efficient ones near the frontier show the basic idea of DEA.

As shown, facility managers can develop an empirical efficient frontier based on their own observation as a benchmark with limited data. However, DEA users are always suggested to collect more data of representative performance measures and incorporate them to refine the model and check any breakthroughs on the frontier with up-dated data. In the paper by Schaffnit *et al.,* it is shown that DEA can deal with 291 benchmarking participants with 5 inputs and 8 outputs.⁷



Figure 1: An Efficient Frontier identifies the Benchmarks.

In this case, DEA can indicate the exact targets for the inefficient units with reference to the efficient ones diagrammatically. Facility Managers can check the improvement progress against time from the diagram. Benchmarks may be given in terms of inputs or outputs:

	Observed measure (HKD)	Benchmark (HKD)	Potential improvement (HKD)
Output: rent per square feet	18	20	2 (increase)
Input: BS cost per square feet	74	55	19 (reduction)

Table 2:	Efficiency	report for	Buildina	В.
		100011101	Bananig	<u> </u>

APPLICATION OF DEA MODEL WITH EXCEL SPREADSHEET

Referring to Mr. Chan's case, after his presentation, Mr. Chan is requested to carry out a more macro benchmarking study of Buildings A and B with 13 buildings. These total 15 buildings' locations and client/ user compositions are not completely known and cannot be assumed similar. The available information includes:

- 1. Salaries, maintenance and energy costs as input data;
- 2. Number of visitors; lessees and its staff as output data. (as shown in Table 3)

Table 3.Inputs and outputs as benchmarking data.(Source: Computer generated figures based on real data)

Building	Salaries (HKD)	Energy cost (HKD)	Maintenance cost (HKD)
A (Ref: 1)	85412	15478	159752
B (Ref: 2)	345621	50950	124563
ONE (Ref: 3)	159740	45411	95142
TWO (Ref: 4)	65478	23346	709000
THREE (Ref: 5)	50269	45632	86245
FOUR (Ref: 6)	71439	85214	15973
FIVE (Ref: 7)	243283	24547	346990
SIX (Ref: 8)	106004	49692	146855
SEVEN (Ref: 9)	91296	40436	82000
EIGHT (Ref: 10)	118012	58986	104000
NINE (Ref: 11)	67871	14762	91921
TEN (Ref: 12)	71621	19907	68771
ELEVEN (Ref: 13)	364763	12547	65709
TWELVE (Ref: 14)	127077	42240	217123
THIRTEEN (Ref: 15)	88884	17274	299300

Number of lessee and its staff	Number of visitors
9512	408
15100	200
158815	168
75412	7878
45214	652
25896	158
24156	450
85214	3500
12654	6201
15429	5212
96321	2841
84589	7542
95142	2462
15472	1844
12548	504

Mr. Chan is also asked to recommend definite benchmarks for buildings A and B. The objective of the company is to control the operation costs of buildings A and B assuming the existing current outputs unchanged.

Given 3 types of input data and 2 types of output, Mr. Chan notes that comparing the efficiency of these 15 buildings' facility management units is not easy as the previous case, different patterns of output levels are supported by different amounts of resources making efficiency comparisons difficult and this is generally the case of facility management benchmarking.

Mr. Chan starts by arranging the data in table 3 in a spreadsheet as shown below (The following presentation is based on Zhu $(2003)^{9}$):

	A	В	С	D	Е	F		G	H		J			K
1	Building	Salaries	Energy cost	Maintenance cost		Lessee and its staff		isitors		λ	char	naina		A (Ref
2	A (Ref. 1)	85412	15478	159752		9512		408	0	.0000	char	nainr	I Cell	0.000
3	B (Ref. 2)	345621	50950	124563		15100		200	0	.0000	J.49	1365		ng cel
4	ONE (Ref: 3)	159740	45411	95142		158815		168	0	.0000	1.00	100-	changi	ing ce ing ce
5	TWO (Ref: 4)	65478	23346	709000		75412		7878	0	.0000	1.00	iperi	changi	ng cel
6	THREE (Ref: 5)	50269	45632	86245		45214		652	0	.0000	1.00	199	hangin	a cell
7	FOUR (Ref. 6)	71439	85214	15973		25896		158	0	.1184	1.00	108	hangin	a cell
8	FIVE (Ref: 7)	243283	24547	346990		24156		450	0	.0000	0.57	82 6	hangin	ig cell
9	SIX (Ref. 8)	106004	49692	146855		85214		3500	0	.0000	0.61	99		0.000
10	SEVEN (Ref. 9)	91296	40436	82000		12654		6201	0	.0000	. 077	93	chang	ing ce
11	EIGHT (Ref. 10)	118012	58986	104000		15429		5212	0	.0000	0.58	69-	chang	ina ce
12	NINE (Ref. 11)	67871	14762	91921		96321		2841	0	.0000	<u>1.00</u>	_ــم	chang	ing co
13	TEN (Ref: 12)	71621	19907	68771		84589		7542	0	.5439	<u>1.00</u>	00-	changi	ing ce
14	ELEVEN (Ref: 13)	364763	12547	65709		95142		2462	0	.3378	1.00	00	Linany	ing ce
15	TWELVE (Ref: 14)	127077	42240	217123		15472		1844	0	.0000	0.50	47	changi	ng ce
16	THIRTEEN (Ref. 15)	88884	17274	299300		12548		504	0	.0000	0.85	12	hangir	ng cell
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21	Energy cost	25150.431	<u><</u>	25150.43073		the D	MUt	Inder						
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35									-				Help	

Figure 2: DEA model with Excel spreadsheet.

The DEA model in the Excel spreadsheet comprises of the following 4 elements:

- Scalar variables for the adjustments of the evaluated object's inputs in cells I2: I16.
- > Target function, i.e. the efficiency, in cell F19. It is also a scalar variable.
- Reference set of inputs and outputs as benchmark in cells B20: B24.
- The object set under evaluation in cells D20: D24.

The following are the entries in cells of the reference set:

Table 4: Entries in spreadsheet for cells of the reference set.

Cell	Entries
B20	=SUMPRODUCT(B2:B16,\$I\$2:\$I\$16)
B21	=SUMPRODUCT(C2:C16,\$I\$2:\$I\$16)
B22	=SUMPRODUCT(D2:D16,\$I\$2:\$I\$16)
B23	=SUMPRODUCT(F2:F16,\$I\$2:\$I\$16)
B24	=SUMPRODUCT(G2:G16,\$I\$2:\$I\$16)

The entries for object set under evaluation (cells D20: D24) are:

Table 5: Entries in spreadsheet for cells of the set under evaluation.

Cell	Entries
D20	=\$F\$19*INDEX(B2:B16,E18,1)
D21	=\$F\$19*INDEX(C2:C16,E18,1)
D22	=\$F\$19*INDEX(D2:D16,E18,1)
D23	=INDEX(F2:F16,E18,1)
D24	=INDEX(G2;G16,E18,1)

(See Appendix for the formulations of the DEA model)

Note that the outputs are kept at the original level by cells D23 & D24; while the inputs are minimized by the DEA model and given in cells D20, D21 & D22. The inputs are minimized with reference to all buildings within the benchmarking group, by cell B25 with entries: =SUM (I2:I16) in the spreadsheet.

Remember that when applying DEA with the Excel Solver function (under <u>T</u>ool in the Excel menu bar; if Solver function is not found, use Add-Ins function under <u>T</u>ool menu), we should check scalar variables are non-negative and linear model is chosen by clicking the Option buttons. As indicated in Figure 2, set Target Cell and other solver parameters in the Solver Parameters dialog box and click the <u>S</u>olve' button, the efficiency of the building specified in 'Cell E18' will appear in 'Cell F19'.

The DEA results are summarized below and Column J in Figure 2:

Table 6: Benchmarking results.

Building	A	В	One	Two	Three	Four	Five	Six
Efficiency	0.9474	0.4936	1	1	1	1	0.5792	0.6199
Building	Seven	Eight	Nine	Ten	Eleven	Twelve	Thirteen	
Efficioney	0 7703	0 5860	1	1	1	0 5047	0.9512	

Mr. Chan can also extract the following information for Buildings A and B as benchmarks:

Building	DEA efficiency	Efficiency	Pote	ential improvements (HKD)			
rating		Reference Set	Salaries	Energy cost	Maintenance		
A (Ref 1)	94.74%	NINE, ELEVEN	4489 (Reduction)	813 (Reduction)	8395 (Reduction)		
B (Ref 2)	49.36%	FOUR, TEN, ELEVEN	175012 (Reduction)	25800 (Reduction)	63075 (Reduction)		

Table 7: Recommendations for Buildings A and B.

A distinctive output of DEA is the generation of Efficiency Reference Set. With the reference set, facility managers of inefficient buildings can locate the sources of inefficiencies by making comparison within the narrowed set. This distinguishes DEA from the other gap analysis management tools, like Spider charts and AHP. This special character of DEA is especially useful in facility management benchmarking because efficient target peers can be located objectively.

DISCUSSION ON APPLICATION OF DEA IN BENCHMARKING

As a general practice of benchmarking, when applying DEA facility managers should first identify similar peers for evaluation. Common criteria are:

- Similar location;
- Similar client composition;
- Similar levels of services, etc.

Relevant inputs and outputs should then be determined. Facility managers must also note when the measurements are taken . Sherman (1984) proposed the following guidelines to decide the relevant inputs and outputs:

- Relevant outputs are generally those services that operation units is responsible for in order to achieve its business purpose.
- Relevant inputs are those resources which are necessary for the production of the relevant outputs.

Facility managers should also consider the core businesses or activities of their serving organizations.

Missing, lack or indetermination of <u>relevant</u> data is often a limitation on DEA models. A recommended safeguard is that: An efficient unit should respond to an increase or decrease in outputs with a corresponding increase or decrease in inputs, Sherman (1984).

DEA compares each unit within the benchmarking group only. The 'efficient' units ('Efficiency' = 100% in the DEA model) are efficient relative to its peers. The 'efficient' units, as rated by DEA, may be interpreted as the best in the benchmarking study but not the optimum one. A breakthrough, i.e. >'100%', is possible by many means, e.g. new technology. If so, DEA model should be adjusted.

Finally, DEA results should be analyzed to locate and improve the inefficiencies. A benchmarking study with DEA is only completed when inefficient units can catch up with their efficient peers. However, as other benchmarking study, facility managers should not be surprised if the causes of inefficiencies are not under their control.

CONCLUSIONS

All facility management units operate with multiple outputs and inputs. The process of turning inputs to outputs within facility management units is difficult to be identified. DEA is a useful method for facility management units to locate ways of improvement where a complete map of operation system cannot be drawn. It can give facility managers guidelines on investigating the source of inefficiencies with reference to the efficiency reference set. In the other words, with DEA, facility managers can allocate time and other resources more effectively to areas where weaknesses have been identified objectively for improvements. Results of the two case studies showed DEA operated satisfactorily with facility management hard data. DEA was proved being able to strengthen the two steps of benchmarking: analysis and adaptation. Further research is suggested to investigate whether DEA can work if facility management soft and hard data are considered under a single DEA umbrella. The problems related to inherent dependency of DEA efficiency scores should also be addressed.

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Appendix

S

The original formulation of DEA for maximization of outputs is

Maximize
$$u_r$$
, v_i

$$\frac{\sum_{r=1}^{m} u_r Y_{r_0}}{\sum_{i=1}^{m} v_i X_{i_0}}$$
Subject to

$$\frac{\sum_{r=1}^{s} u_r Y_{r_j}}{\sum_{i=1}^{m} v_i X_{ij}} \leq 1$$

where j=1, ..., n; $v_i \ge 0$; r=1, ..., s; l = 1, ..., m.

 Y_{rj} and X_{ij} are observed values of outputs and inputs of the j^{th} units (e.g. a facility management department's inputs: salaries, energy and maintenances costs; outputs: rent, services charge and number of end users). u_r and v_i are the weights.

DEA formulations in forms of linear programming are deduced by Charnes et al. in 1978³:

Maximize
$$\sum_{r=1}^{S} u_r Y_{r_o}$$
Subject to
$$\sum_{r=1}^{S} u_r Y_{rj} - \sum_{i=1}^{m} v_i X_{ij} \leq 0$$

$$\sum_{i=1}^{m} v_i X_{i0} = 1$$

where u_r , $v_i > \epsilon$; j = 1, ..., n; r = 1, ..., s; i = 1, ..., m. In 1984, Banker , Charnes and Cooper¹ modified the above and proposed a new version of DEA program:

$$\begin{array}{rll} \text{Maximize} & \sum_{r=1}^{S} u_r \; Y_{r_o} \; + \; \mathsf{w}_0 \\ \text{Subject to} & \sum_{r=1}^{S} u_r \; Y_{rj} - \sum_{i=1}^{m} v_i \; X_{ij} \; \; + \; \; w_0 \leq \; 0 \\ & \sum_{i=1}^{m} v_i \; X_{i0} = 1 \end{array}$$

where u_r , $v_i > \varepsilon$; j = 1, ..., n; r = 1, ..., s; i = 1, ..., m; w_0 represents input / output slack (s).

BUILDING SAFETY AND CONDITIONS INDEX: A BENCHMARKING TOOL FOR MAINTENANCE MANAGERS

Daniel C.W. HO and Y. YAU

Department of Real Estate and Construction The University of Hong Kong

Abstract

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. There is increasing pressure on maintenance managers to inspect and assess the level of safety performance in buildings. Being an abstract notion, 'safety' presents different perceptions to people with different backgrounds. There is a need to standardize a benchmarking tool to measure and compare building performance in terms of safety and conditions.

The Building Safety and Conditions Index (BSCI), developed by the Faculty of Architecture of the University of Hong Kong, 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. Besides, the BSCI can be used as a key performance indicator for maintenance services providers. For organizations with large property portfolios, the BSCI can serve as a priority setting tool to facilitate resource allocation to repair or upgrade buildings with the most urgent needs.

Keywords: benchmarking, building classification, building labeling, safety and conditions

BACKGROUND

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 of building disrepair and unauthorized building works (UBW) have long been the eyesores of the cityscape in Hong Kong, like many other developed cities. According to the Housing, Planning and Lands Bureau (2004), there are around 42,000 private buildings territory-wide. About 11,400 are 20 to 40 years old and are more susceptible to maintenance problems, particularly those without proper management.¹ The dire consequences of building neglect have been reflected in fatal accidents of fallen external renderings, spalling concrete pieces, and collapsed misused canopies. From 1990 to 2002, accidents related to UBW resulted in at least 21 deaths and 135 injuries (Leung and Yiu, 2004). Thus, the pitfalls in our living environment threatening the occupants and the public have been revealed. Requests for addressing the prolonged problems of inadequate building management and maintenance in Hong Kong have become more frequent than ever.

As a response, the government initiated a public consultation on ways for the proper upkeep of private buildings throughout the territory in 2004. Among the suggestions proposed by the authority, such as mandatory building safety inspection and building management, one of particular interest was the formulation of a voluntary building classification scheme. It was believed that the classification scheme would give positive recognition and encouragement to well-designed and properly managed buildings.

As a matter of fact, cries for a building classification system to address the problem of building neglect in Hong Kong were first recorded in 2000. The former Planning and Lands Bureau suggested classifying private buildings by their standards of safety, management, and

¹ According to Team Clean (2003), there are still some 8,000 private buildings without any form of management either by the owners or management companies.

maintenance. A task force was then set up to study the viability of the proposal. In January 2001, the task force considered a voluntary building classification scheme viable. However, there has not been any concrete implementation plan so far. Recently, a consultancy study on a broad framework of building classification based on safety and conditions, which was commissioned by the Buildings Department, has been completed. Details have yet to be released.

The Building Safety and Conditions Index (BSCI)

In view of the need to enhance the living environment of our city, the Faculty of Architecture of the University of Hong Kong in mid-2003 launched a series of research projects that focused on formulating a vigorous, yet simple, building classification framework on building performance on various aspects. In particular, vast emphasis has been cast on the safety of multi-storey residential buildings. Therefore, a Building Safety and Conditions Index (BSCI) was developed as a benchmarking tool for classifying buildings in respect of their safety and physical conditions, while serving to indicate the level of achievement of individual buildings in enhancing the safety of both occupants and the general public. The BSCI assessment scheme is backed up by rigorous and sound theoretical foundation. Thus, the creditability and practicality of the BSCI can be achieved. Besides, what makes the BSCI distinguishable is that its assessment framework is tailored to the mass assessment of buildings.²

DEVELOPMENT OF AN ASSESSMENT FRAMEWORK

The assessment framework of the BSCI is divided into three levels. The first level is a vision, which sets the assessment principles and delimits the scope of the assessment. The second level assumes a strategic role, which defines the safety attributes that contribute to building safety and conditions. The third level deals with operational issues by transforming the safety attributes into a hierarchy of building factors for devising a location and time-specific assessment scheme.

Level 1: <u>Assessment Principles</u>

The assessment framework is intended for the first-tier screening of building safety and physical conditions. For this purpose, it must allow for a wide coverage of buildings within a short period of time at a reasonable low cost. Accordingly, the framework is designed with respect to the principles of generality, objectivity, practicability, and relevance to safety. Generality entails the applicability of the assessment framework to most residential buildings, be they low-rise or high-rise. To achieve objectivity, the factors to be assessed should be measurable and verifiable. If subjective judgments cannot be avoided, they should be validated by documentary evidence such as record photos.

The assessment methods should be practicable and simple, and the factors to be assessed should be easily acquired. Whenever possible, a building is assessed with reference to its basic configurations and conditions without the need to inspect individual flats. A site visit may be required, but generally is confined to common areas and the external environment only. In general, only characteristics of buildings easily assessable by the public are acquired, measured, and assessed. Furthermore, the factors to be considered should be directly related to building safety and conditions that pose hazards to occupants and the public.

Level 2: Identifying Safety Attributes

Based on the above principles, a number of safety attributes that affect the safety of occupants and the public have been identified through literature reviews and workshops with relevant professionals and experts. Intuitively, fire hazard is regarded as the most threatening to the occupants of a building. Lo (1999) developed a fire safety ranking system apt for Hong Kong's situation, and the findings are valuable guidance for identifying fire safety attributes. Yet, building safety embraces not only fire safety, but also many other factors. Structural integrity and external finishes are also problematic areas identified by the Buildings Department (1997).

² There exist other building classification systems, but building safety is seldom their main focus. Notable examples are the Leadership in Energy and Environmental Design (LEED) scheme, the Building Research Establishment Environmental Assessment Method (BREEAM), the Hong Kong Building Environmental Assessment Method (HK-BEAM), and the Intelligent Building Index (IBI).

For the BSCI, several key safety attributes, namely fire resistant construction, means of escape, means of access for fire-fighting, fire services installations, internal defects, external defects, 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. For an illustration, the building factors relevant to the safety attributes are shown in Table 1

Safety Attributes	Building Factors
1. Fire Resistant Construction	compartment volume staircase opening fire-resisting doors
2. Means of Escape	travel distance direct distance discharge value obstacles exit and directional signs
3. Means of Access for Fire-fighting	emergency vehicular access fireman's lifts distance between fire services access point and fireman's lift
4. Fire Services Installations	fire extinguishers hose reels and fire hydrants emergency lighting
5. Hazards	incompatible uses electrical installations gas installations
6. Density	population per floor number of flat per floor
7. External Defects	canopies detached elements finishes
8. Internal Defects	debonded tiles cracks spalled concrete

Table 1: List of Building Factors that Affect Safety Attributes.

Note: Some strategic building management factors apply to all safety attributes and are not shown in the table. They include 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 evaluation systems (e.g. occupant survey).

Level 3: <u>Developing a Hierarchy of Building Factors</u>

The relationship between the safety attributes and various aspects of building factors is then mapped together to develop a hierarchy of building factors. Van Erdewijk (1988) stipulated that there were different categories of architectural elements, each of which was involved in accidents in a particular way. Heimplaetzer and Goossens (1991) confirmed the role of architectural features in the causation of accidents in the built environment. Therefore, building design should play an important role in building safety. Echoed by Al-Homoud and Khan (2004), apart from misuse and the lack of maintenance, poor design is one of the causes of building-related accidents. In this regard, building factors are grouped into two main categories, namely *Design* and *Management* at the top level, as shown in Figure 1.



Figure 1: Hierarchy of Building Factors for Safety and Conditions Assessment

The Design factors include three categories (*Architecture*, *Building Services*, and *External Environment*), which are further divided into 11 sub-categories. *Architecture* deals with the fire risk of buildings and the provision of the means of escape and means of access for fire-fighting and rescue in case of fire. Also, this category is assessed in respect of the measures against falling objects. For example, the provision of utility platforms and covered walkways at the street level can reduce the risk caused by falling objects. The design of *Building Services*, such as fire services, electrical installations, and fuel supply, also has a direct influence on the safety of users or occupants of buildings. As for the *External Environment*, hazards like the presence of a petrol filling station in the neighbourhood will be highlighted. Also, the location of buildings relative to certain civil services, like a fire station, is considered in this category. With regard to these design aspects, the safety issues of buildings can be addressed at the outset of a project.

Likewise, building factors under *Management* are grouped into two categories (*Operations & Maintenance* and *Building Management*), which in turn are sub-divided into seven sub-categories. *Maintenance* is the inspection and upkeep of various building fabrics and services; *Operations* refers to the tidiness and integrity of the exit routes and appendages to 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.

Each of the building factors at the bottom level was assessed in accordance with a scoring table, which was designed after a thorough consultation with experts in the relevant fields. The hierarchal representation facilitates the assessment of the relative importance of the building factors using the Analytical Hierarchy Process (AHP) (Saaty, 1982), which is essential for the construction of a single measure of the performance of building safety in the next stage.

CONSTRUCTION OF THE BSCI

The assessment framework presented above allows for the assessment of the conditions and safety performance of individual building factors in a building. It is often useful, especially for the public, to aggregate the performance of these individual building factors into a simple and user-friendly index for each building, which in this case is the BSCI. The BSCI is essentially an aggregate figure of ratings and weightings of all building factors:

$$BSCI = g(w_1, w_2, ..., w_n; F_1, F_2, ..., F_n)$$
(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 a 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:

$$BSCI = \sum_{i=1}^{n} w_i F_i \tag{2}$$

Multiple decision criteria systems, such as the AHP developed by Saaty (1982), will be adopted to calculate the weighting w_i. 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. This is a relatively expensive way of collecting information, but it would greatly improve the reliability of the weightings, which is one of the most crucial aspects of the assessment framework of this study. When all w_is and F_is are found, the overall index BSCI can be computed. For the easy consumption of ordinary people, the index can be presented in forms of 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.

What are the Benefits?

What is 'safety'? Perhaps one can find out some quite universally accepted definitions in the literature. However, nearly all of these come from the regime of occupational safety. There has not yet been any widely accepted definition of 'building safety'. Being a loosely defined term, 'safety' presents different perceptions to different people. Since the BSCI is the integration of people's perception with different background in a scientific manner, it can help fill in the gap. The primary function of the BSCI is to provide an objective *inter*-building comparison for distinguishing the good from the bad. It is believed that a well-publicized and well-received BSCI can serve as a benchmarking tool to measure and compare building performance in terms of safety and conditions.

Revelation of Hidden Information

Apart from the absence of a universal definition, 'safety' is not apparent and easily compared. For building users or occupants, the BSCI provides a useful tool for evaluating different aspects of a building that are not easily observable. By grading every building, such an index serves to inform people on how each building performs in terms of safety. For example, owners, potential buyers, and potential tenants can refer to the grading to decide whether or not to make a property transaction. It is of paramount importance to these parties, because other than lethal or injurious effects, the failure to observe building safety brings about indirect costs to property owners and investors. Leung (2003), by means of court cases, exemplified the effects of the claims and compensations in building-related accidents on individual unit owners and on their investment returns. In general, a large amount of damages, ranging from approximately HK\$60,000 to HK\$350,000 per unit, had to be borne by the unit owners of relevant buildings, and this amount constituted quite a substantial portion of the average value of the units.

Reward or Punishment by Property Prices

Another advantage of the BSCI is to distinguish buildings of similar ages with different safety performances. At present, without information for the hidden attributes of buildings, the public places a high emphasis on the age of a building. In fact, buildings with a better safety record should be valued higher. Through the BSCI, positive recognition is awarded to well-managed and maintained buildings. The labeling effect on those better-performed buildings will be translated into higher property values, and accordingly for worse-performed ones.

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. In particular, owners of buildings with excellent intrinsic properties, such as locality, do not want these advantages blemished by the poor hygiene and safety performance of their buildings. Chau, *et al.* (2003 and 2004) empirically showed that improvement works brought about a 9 percent increase in the market value of properties in large housing estates, which far exceeded the cost of upgrading. Also, well-maintained buildings may attract more favourable mortgage terms and rental income. Eventually, the desire of owners for enhanced property

values and lower insurance premiums will bring market forces into play to encourage most owners to exercise their management and maintenance responsibilities.

Promotion of Good Practices in Maintenance Management

With the incorporation of design factors in the BSCI assessment scheme, developers will pay closer attention to their products and services. 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 maintenance and management practices. Maintenance services providers can cross-check their practices with the criteria set for the scheme, and follow the practices to improve their services. Although the use of the BSCI for *inter*-building comparison of the maintenance performance is limited by the incorporation of design factors in the assessment scheme, the BSCI itself does serve as a useful performance evaluation tool for the maintenance managers. The continual maintenance performance can be evaluated by tracking the BSCI of the relevant buildings periodically. Furthermore, the BSCI can be used as a key performance indicator for maintenance services providers.

Better Allocation of Resources for Maintenance

It is not uncommon for building maintenance budgets to hardly meet the ever-increasing maintenance needs of their buildings (Shen and Spedding, 1998). Hence, it is essential to ensure that the best solution in terms of 'value for money' is achieved in a planned maintenance programme. The BSCI can be used as a priority setting tool for budget planning, providing a basis for allocating and directing funding to specific building problems. The value of the BSCI becomes more apparent when owners have a large portfolio of investment assets, and fiscal resources for maintenance are limited and must be spread out over extended periods. Needless to say, this priority setting function of the BSCI can help the government efficiently allocate resources to the areas where action is most needed.

CONCLUDING REMARKS

The problems associated with building hygiene and safety do not only affect property occupants or users. The problematic results and their costs are spread across the society. Undoubtedly, these problems should be properly addressed without further delay. Instead of resorting to the problems of intolerable incremental remedies, a long-term view should be taken. The implementation of the BSCI is beneficial to all parties. For building occupants and users, the assessment scheme provides a useful tool for building performance evaluation. For developers, building owners, and maintenance and management services providers, the information provided by the assessment scheme encourages better construction and maintenance of their buildings. The BSCI can be used to evaluate maintenance performance and help set priorities. For the government, the results of the BSCI can be used as a policy tool. As a result, the BSCI assessment scheme will serve to foster a culture of constructing and maintaining good quality buildings.

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THE EFFECTS OF DEPRECIATION AND OBSOLESCENCE ON FACILITIES AS PROPERTY ASSETS

Jon Robinson The University of Melbourne, Victoria, Australia Richard Reed The University of Melbourne, Victoria, Australia

Abstract

The position of real property assets in the corporate balance sheet is discussed in the context of the currently popular move for corporate entities to divest these assets. This has the potential to contribute to some significant savings and investment issues. Companies are institutionalising real property assets through sale and leaseback to create long-term liabilities. Investment returns and property values may be overstated by entities that ignore depreciation and obsolescence of buildings. Significant dilution of corporate returns and investment and superannuation funds may be required for capital expenditure on rectification works to overcome depreciation and obsolescence. The enormity of the problem is illustrated using property market data recorded over the past three decades.

Keywords: Asset, depreciation, facilities, obsolescence, property

INTRODUCTION

It has become increasingly popular in recent years for business entities to move their property assets "off balance sheet". This is particularly relevant where businesses want to concentrate on owning productive assets such as plant and stock in order to avoid tying up capital in property and absorbing its risks. Those entities that own property and wish to divest often enter into a sale and leaseback transaction where a decision is made to sell the property fully leased back to the vendor to release funds for business expansion. Some organisations acquire and modify a property, or acquire land and build suitable premises, take occupation and then sell and lease back.

The sale and leaseback or outright disposal has become very effective as a result of the seemingly insatiable demand for non-residential investment property across the investment quality spectrum. Two main groups of investors have dominated the market, namely, the superannuation funds and the listed property trusts (real estate investment trusts). In order to overcome the negative effects of illiquidity facing investors in real estate, many different approaches have been used to enable investors to have access to property by creating smaller parcels of property. This has included physical subdivision as well as the creation of indirect ownership through securitisation. Physical subdivision enables buildings to be subdivided into separate elements including company shares, stratum titles, strata titles and cluster titles. Securitisation enables real estate to be subdivided into much smaller components through debt and equity investments also including syndication, company shares as well as trust units. In the context of facilities management, the decision is about retaining properties and absorbing the risks associated with depreciation and obsolescence on the one hand or divesting of the properties to another entity which in theory takes on the risks of depreciation and obsolescence but in practice may ignore these effects such that they impinge on the property occupants. If the other entity is a trust, then this may be a very real problem.

Residential and office units in large scale multi-unit developments are managed by bodies corporate that levy annual charges on unit owners, but they are usually only a fraction of the contributions required to establish a realistic sinking fund that will enable replacement of the asset. Returns on company shares and, in particular, trust units appear to be overstated because of the failure to properly allow for depreciation and obsolescence. In either case, a proper sinking fund allowance would reduce net operating income and therefore value. If nothing

is done to correct this shortfall resulting from depreciation and obsolescence, then asset vales will diminish over time.

The phenomenon of overstatement of returns and values is investigated and the reducing returns from and increasing operating costs of investment property are illustrated. This phenomenon may explain why property trust units and shares appear to produce a higher return than the underlying property and why a parcel of units appears to have a higher value than the underlying property portfolio. The market data provide a guide to the timing and costs of rectifying depreciation and obsolescence as well as a guide to property returns and values. Depreciation and obsolescence needs to be reflected in statements about property returns and values.

Depreciation and obsolescence are outlined in the next section. The property investment market is discussed in Part 3 and the effects of depreciation and obsolescence on investment returns and values are discussed in Part 4. Part 5 applies the recorded market data to illustrate the main points and the paper closes with some concluding comments.

Property has always been viewed to be one of the major asset classes in a balanced portfolio. However, it has always been considered to have a number of disadvantages when compared with other asset classes, the major ones being illiquidity and management. In the context of property investment, illiquidity is a major deterrent to investment and divestment because of the time required to complete a transaction in a market in which there are either few buyers and/or few sellers. The hands-on management required to operate an investment property and maintain it in a satisfactory market position is another deterrent to investment in property. These property management activities are increasingly outsourced by facilities managers to specialist firms. If companies retain real properties on the balance sheet, their earnings records may be affected by poorly performing assets. If they divest, they may be faced with an alternative though smaller balance sheet liability in the lease. Either way, the effects of depreciation and obsolescence will affect the corporate occupier of real property.

DEPRECIATION AND OBSOLESCENCE

Depreciation and investment property has been analysed in only a few situations (see for example, Baum, 1991). A key issue in property investment is the wasting asset in the building component that depreciates over time and requires constant upgrading to maintain market position. It has been postulated that one fifth of the income from investment property would need to be set aside for depreciation (Bowie, 1982). This may have resulted in property being overpriced in the market. Most companies make provision for building refurbishment (as well as expansion, new products and so on) by setting aside part of the net income in reserves. The illustration of this is the difference between the yield and the earnings/price ratio (the reciprocal of the price/earnings ratio) which is a measure of the retained earnings. However, trusts are unable to keep reserves as all income is required to be distributed. Therefore, it is difficult to retain reserves or sinking funds out of income. In direct contrast, investments in property companies generate profits out of which dividends are distributed to shareholders and funds are usually retained as reserves. Accordingly, this appears to lead to an overstatement of the yields from property trusts.

Given that the typical property trust returns 6.75%, a depreciation allowance of 1.35% (one fifth) would be required. Ten year bonds currently (September 2004) yield 5.4% (5.415% Australian Financial Review, 30 September 2004), so the margin covering the risks associated with property investment is NIL (6.75% - 1.35% - 5.4%). There is a view expressed that all of the risks can be reflected in the cash flow so that the discount rate can be a risk free rate such as long term government bonds (gilts) (Purvis, 1995, p. 19). But it is not deemed possible to reduce the internal rate of return to a risk free yield due to the traditionally listed real property factors including immobility, fashion, tenant risk, legislation and regulation standards.

Many trusts are obtaining funds by the sale of trust units for development purposes as distinct from investment and trusts which are also able to borrow finance for development purposes. In order to obtain funds for refurbishment, trusts need to raise capital through borrowings, through divesting of some of the assets, through distribution of additional units or through retaining some of its assets in cash. In all of these cases, the investor's holdings are diluted. Thus it appears that some of the returns from listed property trusts appear to include an element of capital. Thus it is up to the individual investors to set aside some of their own returns in a sinking fund.

In addition to the investor class, entities of all types that once owned and occupied their premises are selling to and leasing back from the investment vehicles discussed above. Many past owners have become managers of the trusts into which their properties were sold, and many entities have effectively sold their properties to their employees by transferring the assets into superannuation funds.

The divestment of real assets by many entities has the effect of major balance sheet changes. Fixed assets have been reduced and replaced by substantial lease liabilities so that asset backing may not have the strength, which it had in the past. In order to balance their portfolios, investors would need to consider vehicles that own these fixed assets. As discussed earlier, unitised property has demonstrated a closer relationship with stocks and shares than with direct property, so the diversification benefits may be illusory in asset class terms.

THE INVESTMENT MARKET

Investment strategies associated with property have changed to keep up to the competitive returns demanded by investors. However serious issues are now being raised that question the increasing divergence between managerial and shareholder interests in property (Howton, Howton & Friday, 2000). Property has typically been viewed as 'bricks and mortar', being a relatively long term and low risk vehicle and suitable for superannuation and retirement funds. It has been viewed in this manner by those interested in both direct and indirect investment. In addition property is viewed as a 'growth stock', having returns to shareholders from two sources, first, lease payments on a regular basis e.g. lease payments from tenants and second, the growth in value of the property, realised on sale. Both of these income sources are a function of net operating income where all income-producing expenses are deducted from total income received from the property. The onset of depreciation and obsolescence over time tends to reduce both income and value. Capital investment is required to reverse this situation. An increase in expenses bought about by the costs of refurbishment required to overcome obsolescence causes a substantial decrease in regular income just to maintain capital value. This paper focuses upon these expenses, which may be kept from investors and unit holders until after the expenditure is made. Unfortunately most of this information is hidden from investors, with access denied to everyone outside the REIT (or property trust) management (Graff, 2001). This is a common characteristic of the industry, and prevents potential problems from being highlighted in management practices before the situation becomes irreversible.

The inevitable effect of depreciation and obsolescence in property has recently been acknowledged in the U.S.A. leading to new trust legislation in 2001. REITs or property trusts must now distribute no more than 90% of their earnings to shareholders, recognising the long-term need for reserves that provide for re-investment and refurbishment (Graff, 2001).

A large proportion of these investment vehicles hold substantial properties that form a significant proportion of their total assets. However with the trend away from traditional property investment and into indirect ownership vehicles, such as property trusts and company entities, little consideration appears to have been given to the inherent characteristics of property. These vehicles are being managed not by traditional property managers but by financial market managers. This relationship has placed undue pressure on property trust managers who compete in the open marketplace. This gives rise to the potential for the incorrect management of property and the lack of understanding by the typical individual investor.

In recent times there have been a continually increasing number of individual Australian investors acquiring property. This includes small investors purchasing residential real estate, and large investors buying commercial and retail property. In addition, there are numerous investment funds with large interests in both direct and indirect real estate although the heterogeneous nature of property should affect how each of these funds operates (Gyourko & Keim, 1992). There is little evidence to prove they differ, with all appearing to follow a 'herd mentality' with their management practices in both good and bad times (Robinson, 2002).

Historically, investment in property has provided a safe haven for savings and retirement funds. There has always been a perceived level of protection against typical risks commonly associated with other forms of investment, such as sudden decreases in the value from a sudden sharemarket crash. Property has traditionally been promoted as a 'hedge against inflation' over the long term, although accompanied by illiquidity problems. However, low levels of risk are no longer valid in real estate due to the changing nature of property and the management of real

estate assets. This applies to a broad range of property, from relatively small housing allotments to multi-tenanted high rise buildings. Consequently serious flaws are emerging and only now becoming apparent in this particularly low inflation investment environment. Unless this situation is rectified with proactive management, the increased risk could potentially result in widespread losses to a large cross-section of individuals in society. The main tasks that this project endeavours to accomplish are to:

- highlight and identify these issues;
- quantify the number of individual investors currently exposed to this risk;
- examine the potential for future losses;
- list and detail specific remedies and policy recommendations to avert this loss of income.

This paper highlights a potential loss resulting from specific management practices with regard to property investment. For example, a number of trends have developed with the partial transfer of fixed assets from a company and into long term liabilities (i.e. selling the property on a leaseback arrangement). In this scenario a company may sell its freehold property holdings and enter into a long-term leaseback arrangement that might be undertaken in order to solve short-term cash flow problems. Another example is the often large discrepancy between the financial market valuation (via the sharemarket) of a property trust and the actual market value of the property. It has been suggested that both prices should be identical, but reference to any financial market dispels this notion. Transactions occur as a result of differing opinions about price and worth, and this is of significant relevance to property (Peto, et al., 1996). It has been argued that the valuation of property trusts is as much a function of consumer expectations as it is of understanding their underlying properties (Dowd, 1993). Therefore critical information is not disseminated to the investing public regarding long-term costs and management styles, a potential mismatch in values could occur. Clearly this future shortfall would be drawn from investors' pockets to make up the difference, directly as a result of decisions made by today's financial management.

EFFECTS ON RETURNS AND VALUES

The effects on asset and income value of the wasting asset in the improvements on the land have been dealt with in only a summary fashion. As real estate has always been considered to be a growth asset, it has been assumed that inflation would amortise the wasting component of the asset. This appeared to be true in the low inflation economies of times past where the depreciation and obsolescence associated with buildings proceeded at a slow rate. For example, a property has been analysed to show a yield of 7%. Growth in value in a low inflation environment is forecast at 3% per annum and the property is forecast to have an investment life of 50 years (thus is depreciating at 2% per annum). The overall picture is that there is a real yield of 8% and the growth in value offsets the depreciation. The assumption in freehold real estate is that the appreciation in value of the land component at least offsets the depreciation in value of the improvements.

Amortisation of the wasting asset also appeared to be true in the high inflation economies of the recent past even though the rate of depreciation and obsolescence had substantially increased. Using the same property, growth is now forecast at 10% and the real yield has increased to 15%. Even with a shorter investment life of 20 years (depreciation being 5% per annum) the real yield is 12%. Thus depreciation is masked by high inflation. However, it is now evident that the return to a period of low inflation coupled with the continuing acceleration in change reflected in rapidly increasing depreciation and obsolescence is leading to a situation in which there is insufficient allowance for amortising the wasting asset. Returning to the example, growth is 3% per annum but investment life remains at 20 years (depreciation 5% as before). The real yield has now reduced to 5% showing that growth in value no longer offsets the depreciation.

Using a simple discounted cash flow spreadsheet, a broad assessment of the effectiveness of overcoming depreciation and obsolescence by capital expenditure during the investment period can be illustrated. Using the same property outlined above, the effects of ignoring depreciation and obsolescence are shown in Table 1 whilst the benefits of ongoing capital expenditure are shown in Table 2.

Table 1: Property scenario with no capital expenditure

Year	0	1	2	3	4	5	6	7	8	9	10	1
Growth		3.00%	3.00%	3.00%	3.00%	3.00%	2.50%	2.50%	2.50%	2.50%	2.50%	
Gross income		100,000	103,000	106,090	109,273	112,551	115,927	118,826	121,796	124,841	127,962	131,16
		3.00%	3.00%	3.00%	3.00%	3.00%	3.50%	3.50%	3.50%	3.50%	3.50%	
Outgoings		25,000	25,750	26,523	27,318	28,138	28,982	29,996	31,046	32,133	33,257	34,42
Net Income		75,000	77,250	79,568	81,955	84,413	86,946	88,829	90,750	92,708	94,705	96,74
Yield	7.00%					7.50%					8.00%	
Value	\$1,071,429										1,209,248	
Capital Expenditure						0					0	
Net cash flow	-\$1,071,429	75,000	77,250	79,568	81,955	84,413	86,946	88,829	90,750	92,708	1,303,953	
Discount rate	11.00%											
Present Value	\$916,649											
	8.67%											

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Year	0	1	2	3	4	5	6	7	8	9	10	11
Growth		3.00%	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%	
Gross income		100,000	103,000	106,090	109,273	112,551	115,927	119,405	122,987	126,677	130,477	134,392
		3.00%	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%	
Outgoings		25,000	25,750	26,523	27,318	28,138	28,982	29,851	30,747	31,669	32,619	33,598
Net Income		75,000	77,250	79,568	81,955	84,413	86,946	89,554	92,241	95,008	97,858	100,794
Yield	7.00%					7.00%					7.00%	
Value	\$1,071,429										1,439,910	
Capital Expenditure						50,000					100,000	
Net cash flow	-\$1,071,429	75,000	77,250	79,568	81,955	34,413	86,946	89,554	92,241	95,008	1,437,768	
Discount rate	10.00%											
Present Value	\$1,001,828											
IRR	9.03%											

If depreciation is ignored (Table 1), rental growth is reduced, outgoings growth increases and the capitalisation rate at the end of the investment period increases to reflect the risks of depreciation and obsolescence. The present value of the forecast cash flow in these conditions is much lower than the market value (capitalised initial net income). The difference between the two is an illustration of the hidden costs of depreciation and obsolescence to the unwary investor. If depreciation is rectified by capital expenditure, all projections remain the same. Although the illustration (Table 2) shows a present value that is lower than market value, the differential is much smaller.

APPLICATION OF MARKET DATA

The broad underlying goal of this illustration is to conduct an investigation into the role and longterm viability of property improvements as a viable investment medium. The emphasis will also be placed on the unique characteristics of these assets and the potential effect of incorrect management upon the investments of individual investors.

The context of this illustration is a multi-level commercial office building located in the CBD of Melbourne, Australia. This case study examines the exposure of the individual investor/owner to potential future risk due to the internal management of the property.

The primary aim is to determine whether the effect of obsolescence and depreciation is adequately accounted for in the financial management of a building.

This part of the study examines to what extent (if any) property asset managers are adequately factoring an allowance into their cash flow projections for dealing with the inevitable onset of obsolescence and the associated cost of refurbishment at a later date. This can become a substantial outlay in excess of the original capital cost of the project (Bowie, 1982). The

construction cost of the case study in Melbourne was \$AUD57million in the early 1970s and a refurbishment was undertaken in the early 1990s for \$AUD120million (these sums are not indexed). If the monetary provision for the refurbishment during the life of the investment is inadequate, this additional and substantial sum must be found when the effects of depreciation and obsolescence are reflected by falling rents or vacancies (which were exacerbated in the case study by the property cycle of the early 1990s). This may be borne by relatively new investors who may have purchased equity in the property at a later date, but were unaware of this unavoidable and somewhat 'hidden' financial liability. All property improvements, and in particular all office buildings, are subject to lifecycle characteristics which result in inevitable obsolescence and subsequent depreciation. The rate of obsolescence has altered substantially in recent times, partly due to rapid changes in technology, telecommunications and general work practices. Demands by tenants for office accommodation have also varied significantly and these have increased the rate of obsolescence dramatically. No longer is it possible to construct a building that will meet the demands of tenants well into the future. It is guite common for tenants to relocate to another newer building, showing little loyalty to the existing building as it may not meet their needs completely due to partial obsolescence.

An analysis has been conducted of a city office building and it considers a number of aspects from a historical perspective over the last 30 years:

- The initial cost of designing and constructing the building to lease-up stage;
- The characteristics of the building through its lifecycle, with emphasis placed on the variations between buildings in each lifecycle stage;
- The requirement for refurbishment to combat obsolescence, including when it is undertaken and the optimal time for refurbishment;
- Occupancy record;
- Rental income record;
- Details of the economic cycle.

Falling rents and vacancies over the lifecycle are addressed in the overall management of the property asset. With the rate of obsolescence depending on factors such as design, construction and location, the question to be asked is: Are adequate allowances for depreciation being reflected in the investment returns and incorporated in the day-to-day operation of this investment property?

Expenses of this nature would not necessarily be apparent on the company balance sheet and not completely understood by those without a property asset management background. The corporate or fund investor is likely to understand the problem. But the "small" investor could cause substantial hardship and financial burden to a wide cross-section of the community.

When the property was developed, it had a projected life of 60 years. In the event, this building was stripped back to its structure and façade and all building contents were renewed and this process commenced within 18 years of its completion date. It is appropriate to look specifically at three portions of the overall 18-year period, namely:

- 1973 to 1979 (Table 3);
- 1976 to 1982 (Table 4);
- 1987 to 1993 (Table 5).

Tables 3 to 5 rely on data recorded by one of the authors including inflation, interest rates, rental rates and capitalisation rates. They provide calculations of market value year to year. They also provide IRR calculations before and after a sinking fund allowance which, with the benefit of hindsight, replaces the \$120 million refurbishment cost over the 18-year period at the interest rates applying year to year.

The three scenarios in Tables 3 to 5 reflect not only the depreciation and obsolescence of the subject property but also the cyclical nature of the property market. Table 3 assumes a development scenario. Table 4 is an investment scenario where the investor has acquired the property "counter-cyclically" (ie, in a recession) and Table 5 is another investment scenario where the investor has acquired the property "cyclically" (ie, in a boom). These are hypotheticals used to illustrate the argument about depreciation and obsolescence. In the two investment scenarios, the purchase price is taken to be the calculated market value at the time. In the event, the developer is along-term investor who still owns the property (some 30 years later). The IRR for this investor for the period from 1973 to 1993 (covering the refurbishment period and even

allowing for the depressed market of 1993) is 7% (and 8.5% with a sinking fund to replace the refurbishment cost at the interest rates applying through the 1970s and 1980s) (not illustrated).

Year	0	1973	1974	1975	1976	1977	1978	1979
Inflation		10.60%	26.60%	16.50%	12.20%	9.00%	6.00%	9.90%
Interest rate		12.00%	16.00%	10.00%	10.50%	10.50%	10.50%	10.00%
Rental rate per m2		\$60	\$65	\$45	\$50	\$55	\$60	\$70
Initial cost	-57,000,000							
Net Income		2,400,000	2,600,000	1,800,000	2,000,000	2,200,000	2,400,000	2,800,000
Yield		6.50%	6.50%	7.50%	7.50%	7.25%	7.50%	6.75%
Present Value		36,923,077	40,000,000	24,000,000	26,666,667	30,344,828	32,000,000	41,481,481
Capital Expenditure								
Net income	-57,000,000	2,400,000	2,600,000	1,800,000	2,000,000	2,200,000	2,400,000	44,281,481
IRR	0.19%							
Sinking Fund		2,152,477	1,426,182	2,631,627	2,503,562	2,503,562	2,503,562	2,631,627
Net cash flow	-57,000,000	247,523	1,173,818	-831,627	-503,562	-303,562	-103,562	41,649,855
IRR	-4.51%							

Table 3: Returns to developer as investor

The period covering the development of the property and the leasing-up phase is shown in Table 3. This timeframe is characterised by a substantial initial investment of \$57,000,000 which turned out to be an over-capitalisation of the land. It demonstrates poor development returns as rentals and values were insufficient in the falling market. The result is an internal rate of return close to zero. Notably there was a constant yield with no capital expenditure required due to the 'as new' state of the building. Any expenses associated with the inevitable need for future refurbishment are factored into the alternative net cash flow by way of the sinking fund which leads to the inevitable negative return.

Table 4: Countercyclical investor

Year		1976	1977	1978	1979	1980	1981	1982
Inflation		12.20%	9.00%	6.00%	9.90%	10.00%	11.50%	12.00%
Interest rate		10.50%	10.50%	10.50%	10.00%	10.50%	12.50%	14.50%
Rental rate per m2		\$50	\$55	\$60	\$70	\$80	\$110	\$14
Initial cost	-24,000,000							
Net Income		2,000,000	2,200,000	2,400,000	2,800,000	3,200,000	4,400,000	5,600,00
Yield		7.50%	7.25%	7.50%	6.75%	5.50%	5.00%	5.50%
Present Value		26,666,667	30,344,828	32,000,000	41,481,481	58,181,818	88,000,000	101,818,18
Capital Expenditure								
Net income	-24,000,000	2,000,000	2,200,000	2,400,000	2,800,000	3,200,000	4,400,000	107,418,18
IRR	29.82%							
Sinking Fund		2,503,562	2,503,562	2,503,562	2,631,627	2,503,562	2,045,847	1,666,36
Net cash flow	-24,000,000	-503,562	-303,562	-103,562	168,373	696,438	2,354,153	105,751,82
IRR	23.82%							

Table 4 details another seven-year period that is also without any capital expenditure. It reflects the counter-cyclical investment and the benefits of the improving market (note that yields have already started to decline over this period). The IRR is almost 30%. The building would have been showing signs of ageing due to the inherent depreciation and obsolescence factors, but the returns are still quite high even after allowing for the sinking fund.

Finally, Table 5 shows the effect of ageing on the property over a later seven year time frame before and after an allowance from earlier years is built into the cash flow. Although Tables 3 and 4 benefited significantly from the newly constructed building, the period identified in Table 5 was adversely affected by the substantial cash outflow required for refurbishment, resulting in substantial negative returns exacerbated by the market collapse of the late 1990s. The outlay of \$120,000,000 over 1991 and 1992.

Table 5: Cyclical investor

Year		1987	1988	1989	1990	1991	1992	1993
Inflation		94.00%	8.00%	9.40%	0.70%	-6.90%	-2.60%	2.80%
Interest rate		17.00%	15.00%	19.50%	18.50%	14.00%	11.00%	9.50%
Rental rate per m2		\$310	\$350	\$315	\$275	\$220	\$150	\$70
Initial cost	-157,142,857							
Net Income		12,400,000	14,000,000	12,600,000	11,000,000	0	0	2,800,000
Yield		7.00%	7.00%	5.90%	6.60%	7.50%	7.80%	7.00%
Present Value		177,142,857	200,000,000	213,559,322	166,666,667	0	0	40,000,000
Capital Expenditure						-60,000,000	-60,000,000	
Net income	-157,142,857	12,400,000	14,000,000	12,600,000	11,000,000	-60,000,000	-60,000,000	42,800,000
IRR	-50.55%							
Sinking Fund		1,284,719	1,582,354	987,519	1,097,432			
Net cash flow	-157,142,857	11,115,281	12,417,646	11,612,481	9,902,568	0	0	42,800,000
IRR	-11.00%							

Exceeded the net income, necessitating a cash injection from existing shareholders. This contrasting scenario highlights the dilemma facing potential property investors who are unfamiliar with management styles regarding depreciation and obsolescence. If they are fortunate and choose to invest in the period covered by Table 3 or 4, they will benefit from a relatively secure cashflow with minimal or no capital expenditure. However, if they invest during the period covered in Table 5 there is a distinct need for huge cash injections, emphasising the difference between these three time periods even though they pertain to the identical property.

CONCLUSIONS

Taking into account the various factors identified above, it has been demonstrated that current and/or future owners/investors may sustain monetary losses unless the issue of cost allocation for future expenditure is clearly acknowledged and addressed. This dilemma can be traced to the inevitable and unavoidable effect of depreciation and obsolescence, an inherent characteristic of property along with illiquidity and indivisibility. These factors have serious ramifications for the REIT and superannuation industry. They are also significant for facilities managers who are responsible for owner-occupied property. They provide a reason for corporate entities to divest, namely, the doubtful continuance of retaining a high management cost and potentially poorly performing asset on the balance sheet. They also provide a reason for corporate entities to retain property, namely, to ensure that the facilities remain in good condition and that the depredations of depreciation and obsolescence are offset by the necessary periodic capital expenditure.

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USERS' DEMAND FOR FUNCTIONALITY AND ADAPTABILITY OF BUILDINGS - A model and a tool for evaluation of buildings

Larssen, Anne Kathrine

Bjørberg, Svein

Norwegian University of Science and Technology, Trondheim and Multiconsult AS, Oslo, Norway

Abstract

Multiconsult has developed a model and a tool to evaluate the functionality, adaptability and technical condition of facilities/buildings. This tool can be used in planning new buildings and to evaluate existing ones. The tool consists of three main scales:

Functionality: reflects the users' demands and needs in order to gain good productivity. For existing facilities/buildings we need an answer to the question "How well is the facility/building suited for the activities of the user". Functions, space, design and internal and global logistics are key issues in this evaluation.

Adaptability (flexibility, generality and elasticity): The evaluation of adaptability is technical, where the construction systems, capacities, modularity, floor-to-ceiling heights etc. are registered. We want an answer to the question "How easy/difficult is it to change this building to meet different demands from the user".

Technical condition and indoor environment: Mapping method based on the Norwegian Standard NS 3454 Condition Survey of Construction Works (NS3454, 1995).

The following basic questions are raised by the methodology:

- 1. What is the building's technical condition, and hence its technical value and need for upgrades?
- 2. How well is the building suited for the core business?
- 3. What kind of future use is the building suited for?

This paper describes the methodology to answer questions 2 and 3.

Keywords: adaptability; facilities; flexibility; functionality; usability

INTRODUCTION

There is a growing understanding that space and place means a lot to productivity. When we are planning new buildings today issues like flexibility, adaptability and agility are in focus. The approach and solutions to the issues however, differs a lot from project to project. And what about all the existing buildings? How well do they fit the users' needs and demands today, not to mention future demands? How is the logistics and effectiveness when the school, hospital etc. consists of a conglomerate of different buildings from different time periods? How well can these buildings adapt to meet the demands and needs of tomorrow's users?

In this paper we will describe a methodology that can be adapted to different types of buildings and core activities. Examples from health care and schools will be used to illustrate the development of this model. The rate of change in health care deliveries seems to be accelerating, driven by medical and technical development, epidemiologic development, varying political signals etc. The consequences for health care quality and economy is extensive. Education is also an area facing substantial changes with new teaching methods, new technology etc. The term "class" does not exist in the Norwegian educational system anymore, hence the oldfashioned 'corridor-and-classroom' schools is no longer suited for modern education. The Danish architect, Finn Sørensen, has estimated that effective hospital buildings can have an effect on health care production and economy of approximately 10% (Andersen, 2004). There is substantial uncertainty related to such estimates, but in our opinion there is no doubt that the effect on core activity is considerable, and so is the potential for improvements. In Norway 50-60 billion NOK (6-7 billion euro) is spent every year on somatic health care. 10% would represent 600 – 700 mill euro more each year to health care, and only 1% would represent 60-70 million euro each year.

EVALUATION MODEL

Over the last few years Multiconsult has been developing models for evaluating building's technical condition as a requirement for assessing technical upgrades of building portfolios. So far, the models have been used to evaluate about 17 million m^2 of buildings or about 42 % of Norway's public sector buildings.

The models have now been further developed to include evaluations of buildings' functionality and adaptability. Buildings functionality is a measure of to what extent the space supports the core business. Functionality can be viewed as:

- building properties compared to the needs of the core business
- building properties in regard to its technical operations

A building's properties regarding ability to change according to changes in demand is determined by its adaptability. Possibilities for building changes are determined by technical parameters.

The methodology for evaluating technical condition, functionality and adaptability is based on the principles of condition surveys specified in Norwegian standard 3424 (NS3424, 1995). NS 3424 assesses buildings according to the grades 0, 1, 2 and 3, where grade 3 indicates poor technical condition and grade 0 indicates high technical condition.

What are the consequences of poor functionality?

Ineffective or unsuitable (non-functional) buildings will cause a reduction in core business productivity. Hence, there will be a desire to improve the building's functionality by carrying out appropriate building changes. If the adaptability of the building is poor as well, the building will probably stay inefficient and non-functional throughout the building's lifetime, for this specific type of core business. In such situations, the core business organisation should consider finding other facilities and abandon the existing ones. The building should be considered for alternative use or demolished.

What questions does the methodology answer?

The following basic questions are raised by the methodology:

- 1. What is the building's technical condition, and hence its technical value and need for upgrades?
- 2. How well is the building suited for the core business?
- 3. What kind of future use is the building suited for?

The methodology is currently being used for:

- Current building status surveys (technical condition, functionality, adaptability)
- Development plans and strategies (what use is the building suited for)
- Value auditing
- Rent calculations
- Input demands to the building programming process

In this paper we will present the methodology that will answer the latter questions 2 and 3. Before that, we will examine the terms functionality and adaptability, and the process of quantifying them.

Adaptability

In Norwegian literature *adaptability* is often defined as a function of flexibility, generality and elasticity (Arge, 2002). We experience little consistency in the use of the terms adaptability, flexibility and generality. Multiconsult has defined the terms as follows:

Flexibility: Freedom of changes within the same space function. (i.e. change from cell offices to open landscape).

Generality: Freedom of change of function. (i.e. from school to dwellings, or from storage building to workshop/factory) A building's ability to fulfil changing demands in loads, fire safety, etc.

Elasticity: Ability to make changes in building scale. Possibilities of attaching parts to, or detaching parts from, a building.

Properties describing flexibility, generality and elasticity can be graded in matrices. Figure 1 shows a simplified illustration of the grading. Adaptability grade 0 is describing buildings satisfying high demands to dynamism, like a hospital building. Buildings of a more static nature, like churches, are described by grade 3.



Figure 1: Grading of Adaptability. (Ref. Multiconsult AS)

The same methodology can be used to analyse existing buildings, evaluating how a building meets demands of flexibility, generality and elasticity. Figure 2 illustrates a building from 1930 satisfying the demands of Grade 2. Refurbishment of a building for use as a hospital, where the demands are grade 0, is hardly practical or economically feasible. A building not meeting the core business' demands for building services may cause the business extra costs due to lack of functionality. The health production will hence be less effective as in an optimal building.





Table 1 shows a section of a mapping matrix used for grading adaptability. The use of the matrix demands technical knowledge, and must therefore be carried out by qualified personnel. Dialog with technical personnel who know the properties of the building is also essential.
	Parameters	Grade 0	Grade 1	Grade 2	Grade 3			
BUILDING	r arameters	Glade U	Grade i	Grade 2	Grade 5			
Loads/capasity	Vertical loads/capasity	Extra loadcapasity. Possibility for extra floors and/or extra loads due to new functions. Founded to solid rock.	Most probably some extra loadcapasity. Possible to add some extra loads. Founded to solid rock or piles.		Extra loads not possible. Founded			
ADAPTABILITY Parameters Grade 0 Grade 1 Grade 2 BUILDING Extra loadcapasity. Possibility for extra floads due to new functions. Founded to solid rock. Most probably some extra loadcapasity. Possibile to add some extra loads. Founded to solid rock. Stabs Extra loadcapasity. New work loads possible Most probably some extra loadcapasity. Possibile to add some extra loads. Founded to solid rock. Structure Span Deer spans, large open spaces, gives room form2. Large free spans, integrated beams, few posts. Medium large open spaces. Gives room form2. Structure Floor (construction) Floor to ceiling height Interior walls EXXAMPLE Restrictions against foringer and technical installations EXXAMPLE User equipment/inventory Innfesting/montasje Hose sanitary services. Hust Capasity Availability Availability ELECTRISITY SUPPLY Capasity Availability Availability TELECOM AND AUTOMATION Capasity Availability Availability Site Size, localisation Size, localisation	Extra loads not possible							
	Span	Large free spans, large open spaces, gives room form2.	Large free spans, integrated beams, few posts. Medium large open spaces. Gives room form2.		Small spans. Many indoors loadbearing walls. Small open spaces, many vertical			
Structure	Floor (construction)							
	Floor to ceiling height							
	Interior walls							
	Restrictions against føringer and technical installations		CAAIVIPL					
User equipment/inventory	Innfesting/montasje							
HVS								
Heating, ventilation and	Capasity							
sanitary services.	Availablity							
ELECTRISITY SUPPLY								
	Capasity							
	Availability							
TELECOM AND AUTOMATION								
	Capasity							
	Availability							
Site								
Site conditions	Size, localisation							

Table 1: Section of a mapping matrix used for grading adaptability (Ref. Multiconsult AS).

The matrix consists of a series of physical parameters like ceiling heights, loads and spans etc. which are relevant to the building's adaptability. Under each grade in the matrix, there is a description, to simplify the building mapping. Grading a building, or a section of a building, the grades for the various topics of the matrices are weighted, in order to summarise the total score.

Functionality

Building functionality is mainly related to:

- how the building meets core business demands regarding space functions
- how the space and the rooms are suited for the various functions (size, shape, effectiveness)
- the internal and external logistics nearness of close related function within a building (internal logistics) and within a group of buildings (global logistics)
- how the building is suited for co-use, lease etc.

Table 2 is a section of an unrefined functionality-mapping matrix. A more refined/detailed matrix has been developed and tested for mapping school buildings. The school-matrices specify functions like theory studies, chemistry and physics labs, teachers' restrooms etc., and also consider their flexibility in use (how they are suited for co-use, lease?, etc.). We will not present the school matrices in detail here.

Table 2: Internal logistics: The matrix gives a brief general description of elements characterising function, scale and shape of areas, graded from 0 to 3. (Ref. Multiconsult AS).

	FUNCTIONALITY - INTERNAL LOGISTICS							
Parameters	Grade 0	Grade 1	Grade 2	Grade 3				
Functions	The facilities contains the functions the organisation (user) needs, now and in the known future. No complaints from users.	The facilities contains to a high extent all necessary functions the users need in todays situation Only small amount of functions located in other facilities/building.	The facilities lack some essential functions, resulting in regularly use of other fasilities/buildings.	The facilities does not give room for necessary functions. Large amount of essential functions located in other facilities/buildings. High amount of complaints/dissatisfaction from users.				
Area/space	Suffisient area (m2) to support necessary functions satisfactorily, now and in the known future.	Suffisient area for todays functions.	Amount of space (m2) is little. The spaces is small and well suited for the different functions. Low space/area efficiensy.	Acute need of more space in order to perform necessary functions.				
Design and shape	Design and technical solutions is a very good support to the core activity, today and in the known future. The internal logistics is good and the core activity can operate effectively.	Design and technical solutions is a good support to todays core activity. The internal logistics is good and does not hinder effective operation for the core activity.	Design, shape and technical soluions is inexpedient. Essential functions is ineffecively located.	Design and technical solutions is inexpedient. Internal logistics is bad and results in ineffective operation of the core activity.				

Table 3: Global Logistics: The matrix is similar to the matrix for internal logistics, but describes nearness to other functions, as well as the resources needed for the use of other main functions. (Ref. Multiconsult AS).

FUNCTIONALITY - GLOBAL LOGISTICS							
Parameters	Grade 0	Grade 1	Grade 2	Grade 3			
Distance/closeness	The distance to closely related/essential functions that is often used is short, so that the core business effectivity not is affected negatively.			The distance to closely related functions that is often used is long, and this affects the core business effectivity negatively.			
Need of/use of resources when using other closely related/important functions (separate units).	Internal transportation between core activity and closely related/essential functions is performed with effective use of recourses and is acceptable for the operation of the core activity.(Ex. effective transportation of patients, employees, medical results etc.)			Internal transport between core activity and closely related/essential functions (separate units) is resoursedemanding and works very bad. Contributes to very ineffective operation of the core activity.			

Both matrices can be used for a building as a whole, or for a specific floor or section. Grading a building, or a section of a building, the grades for the various topics of both matrices are weighted, in order to summarise the total score. The weightings given to the different factors may vary, depending on type of core business etc.

Site and location

Issues like transportation to/from the site, transportation within the area, the site's strategic location, the size (area), image, aesthetics etc. and the outdoor environments effect on the users and the core business is often also considered in an analysis of functionality, using the same methodology.

HOW WELL DO THE BUILDINGS SERVE TODAY'S CORE BUSINESS? (QUESTION 2)

Functionality and adaptability have to be considered in connection with each other. In most cases the buildings have to be both functional and adaptable, but not always. Long time and short time needs have to be evaluated in order to make the most useful choices. Figure 3 shows the connection between functionality and adaptability.



Figure 3: The connection between functionality and adaptability.(Ref. Multiconsult AS).

Previous experiences with the model – Case Schools

In 2002 Multiconsult conducted a wide ranging study of the functionality and adaptability for 159 schools, which comprised a total of 687 buildings. The schools were facing a reorganization regarding internal/in-house property rent, and needed a basis to determine technical value and rent.

According to the developed methodology, engineers mapped the technical condition and adaptability. The parameters describing functionality were developed in cooperation with representatives of the educational staff and a reference group mainly composed of principals of some of the schools. This ensured that the educational issues relevant to the project were considered. The schools' principals were then able to assess the functionality of their respective school. The responses were quality checked by the educational staff in the school administration. This quality check was important to shed light on possible hidden agendas, political motives etc. amongst the schools (principals) and to ensure that "similar" schools were given the same grades and evaluation.

In 30% of the schools the functionality was assessed as Grade 2 or 3, which is on the bad (less good) side of the scale. These schools do not have the opportunity to run the school as cost effective as those with Grade 0 or 1. This may lead to the need for more personnel, more equipment and/or transportation costs to external facilities (i.e. gymnastics facilities etc.). The schools with a functionality Grade of 2 and 3 received a rent reduction as a (symbolic) compensation in comparison to those with Grade 0 or 1.



Some of the results of the study are illustrated in figure 4.

Figure 4: Results from mapping of functionality and adaptability of 159 schools.

The schools with poor functionality but good adaptability may, with relative ease and without high expenses, adapt the buildings to ensure a higher degree of functionality. The costs of future reconstruction/building changes will be covered through higher rent. Preferably the rent after reconstruction/building changes should equal the rent levels of schools with a functionality degree of 1.

The schools where the functionality and adaptability are both graded as poor (2 or 3), a closer examination is needed. Poor functionality may indicate that there is a need for refurbishment/changes; lease contracts for these schools should be short-term. Because of the poor adaptability, refurbishment of these buildings may not be practical or economically feasible. The buildings should therefore be considered for other uses/ purposes, or abandoned. The buildings in this category should have their economic values reduced to reflect their future scenarios and risks.

At the time of writing, the methodology is being used in a new study of 19 schools, final results are not available at the moment.

WHAT KIND OF FUTURE USE IS THE BUILDING SUITED FOR? (QUESTION 3)



Figure 5: Step 1 Potential Demand - The diagram illustrates the flow of an introductory analysis of space/building suitability. (Ref. Multiconsult AS)

Most property managers question the future use of their buildings. To answer the question, one needs to compare the different possible functions' space demands to the physical properties of the building.

(1) Grades of Demand. The base of the analysis consists of a set of grades of demand. The grades of demand include a clear specification of the technical properties, like ceiling heights, loads and spans, which are connected to each grade. The specifications may vary for different type of core activity, ex. hospitals and schools will not necessarily have the same descriptions/demands. The matrix is adapted to the specific core activity in workshops with the customer. Table 4 shows a section of the grades of demand matrix.

	GRADES OF DEMAND								
	Parameters	Grade 0 Grade 1		Grade 3	Grade 4				
Step 1 Absol	ute demands								
Building	Ceiling height	> 3,9 m (3,6) Flat ceiling	> 3,6 m (3,3) Feww beams in one direction	> 3,3 m (3,0 m)	> 3,0 m (2,7 m) beams and crossing secondary girders				
	Span	> 18 m	> 16 m	> 14 m	> 12 m				
		free space> 50 m2 (cc > 7 m)	free space >40 m2	free space > 30 m2	free space > 20 m2				
	Loads	4-10 kN/m2, Y kN point load	3,0-4,0 kN/m2, Y kN point load	2,0-3,0 kN/m2, Y kN point load	1,5-2,0 kN/m2, Y kN point load				
	Space for installations								
	Space/area								
	Availability/elevator								
	etc.								
Location	Possibility for expansions								

Table 4: Section of the grades of demand matrix. (Ref. Multiconsult AS, Locum AB)

(2) Demand Profile. A demand profile is set up for each of the various functions/fields of use. The demand profile shows the technical demands of each function/field of use, regarding ceiling heights, loads, spans, etc. Demand profiles are adapted in workshops with the customer. Table 5 shows an example demand profile for a specific function.

Table 5: Example: Part of a Demand Profile for surgery (operation) and laboratory.(Ref. Multiconsult AS, Locum AB)

	DEMAND PROFILE						
	Operasjon (high class) Operasjon (low class)						
Step 1 Abso	lute demands						
Building	Ceiling height	0	> 3,9 m (3,6) Flat ceiling	1	> 3,6 m (3,3) Feww beams in one direction	1	> 3,6 m (3,3) Feww beams in one direction
	Span	1	> 16 m	1	> 16 m	1	> 16 m
		0	free space> 50 m2 (cc > 7 m)	1	free space >40 m2	1	free space >40 m2
	Loads	0	4-10 kN/m2, Y kN point load	0	4-10 kN/m2, Y kN point load	1	3,0-4,0 kN/m2, Y kN point load
	Space for installations	0		0		0	
	Space/area	0		0		1	
	Availability/elevator	0		0		2	
	etc.	0		1		1	
Location	Possibility for expansions	0		1		1	

(3) Building/space mapping. Each building /space unit is evaluated with regard to its physical properties, and the location is evaluated according to the grades of demand.

(4) Matching. One then compare the building mapping results to the functions' demand profiles, in order to find areas matching the various functions' demands.



Figure 6: An example comparison of the physical properties of a building to the demand profile of laboratory. (Ref. Muliconsult AS)

Figure 6 shows an example of a comparison of the physical properties of a building to the demand profile of a laboratory. Building A matches or exceeds the demands, apart from two areas: free space for building services, and possibilities for expansions. If these areas are important, the building should be housing a function that matches better than laboratory. If the building does not match any of the relevant functions, the building should be considered as unsuitable and abandoned.

Full match for all demands for all functions is unlikely, without any major or minor adjustments. The next step is therefore to examine the costs of adjusting the buildings to the probable future use. The adjustment costs must then be compared to the relevant costs of upgrade/refurbishment based on technical condition etc. In some cases the adjustment costs will be so high that the building should be considered not feasible and should be used for something else or demolished.

Case Sabbatsberg, Stockholm, Sweden

A pilot study together with Locum AB, Stockholm, Sweden, was started in spring 2004. The pilot is a further development of the methodology and focuses on possible future use of hospital buildings at Sabbatsberg, Stockholm. At the present time (September 2004) evaluation of the model has started and will be summarised in late 2004.

Results and discussion

The methodology presented in this paper is a systematic and effective process to evaluate buildings, especially for larger portfolios, with regard to time, costs and resources. As a first step analysis for strategy and development plans the results of the studies conducted so far is positive. Results give a good overview of the portfolio and show what areas/buildings need further and more detailed analysis.

The matrices must be adapted to the relevant core activities and functions (functionality, adaptability grades of demand and demand profiles) in close cooperation with representatives from the core activity and owner. An essential part of the first steps of the process is that workshops should be led by experienced process-leaders with good knowledge of the methodology.

The functionality matrices for schools have been received positively by educational staff and by the principals responding to them. The feedback from most principals is that the parameters are considered relevant for the evaluation of functionality of schools and that they are easy to respond to.

One has to be aware of the subjectivity of respondents and of possible hidden agendas, political motives etc. while evaluating the functionality responses. Quality check is therefore important to ensure that "similar" facilities with similar users is given the same grades, and should be performed by persons with solid knowledge of the user organisation and of the facilities. Failing to perform quality check or lack of knowledge by the persons who perform it is an obvious source of uncertainty. The information (about the mapping and how the data will be used) that is given to the respondents in advanced may also affect the responses since tactics and politics may colour their answers.

The general functionality matrices shown in Table 2 and 3 is brief and further development for different core activities, especially health, is being discussed for future use of the method. For different school types we already have a set of more detailed mapping matrices that seem to be working well. Hospitals is of a much more complex nature than schools, and finding good, relevant parameters for functionality is a challenge.

The matrices for assessing technical condition, indoor climate and adaptability is of a more technical and "objective" nature, performed by technical experts. The risks of biased answers here are related to how the persons performing the mapping interpret the different definitions of the parameters. To ensure a common understanding, workshops are arranged with all the technical experts where the methodology is presented and one or several example buildings is assessed.

Weighing of the different parameters of the adaptability matrix is another issue requiring attention. Different parameters may have different weightings depending on the type of use/core activity.

Conclusions

The method presented has shown to be an expedient approach for larger building portfolios or as a first scan of single building, and is currently being used for:

- Current building status surveys (technical and indoor climate condition, functionality, adaptability)
- Development plans and portfolio/facility strategies
- Value auditing
- Rent calculations
- Input demands to the building programming process

The method is general with regard to types of building and use, and flexible when it comes to level of detailing depending on purpose.

Functionality is a complex area that we want to develop further. Especially with regard to health care/hospitals the assessment has uncertainties regarding core activity complexity that has to be handled. Finding an expedient level of general and specified description of functionality is a challenge.

The methodology presented in this paper has shown to be a systematic and effective process to evaluate buildings, especially for larger portfolios, with regard to time, costs and resources. As a first step analysis for strategy and development plans, the results of the studies have been positive so far. The results gave a good overview of the portfolio and indicated what areas/buildings needed further and more detailed analysis.

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IMPROVING FACILITIES MANAGEMENT: A PUBLIC SECTOR CASE STUDY

Teng Hee Tan

Manager, Asset Management Research and Development, Department of Public Works, Queensland

Abstract

Building Facilities Management (FM) within Queensland Government Departments is the responsibility of individual Departments. A broad range of FM services is outsourced to the Department of Public Works and private sector providers. In some instances, there is in-house provision of selected FM services. The Department of Public Works, in collaboration with Treasury Department, has embarked on an ambitious program to improve FM across Queensland Government Departments. This program is part of a wider program of reform across the public sector aimed at sharing the provision of non-core services like finance and HRM to remove duplication and drive efficiencies. Departments are placed in "clusters" which are serviced by a "Shared Services Provider" in each cluster for non-core services.

The paper describes the development of the FM Improvement Initiative, its fundamental thrust and objectives and the strategy for implementation. The Department of Public Works is sensitive to the very broad scope of FM and the need to be focussed on high benefit but realistic and achievable targets. Gaining the support and commitment of the various Departments is critical for success. The program has focussed on six (6) Priority Project Areas described in the paper and a selection of projects, some of which are pilots for wider adoption if successful. The paper also describes some of the governance arrangements established to ensure that such a large-scale improvement program is successfully managed.

Key words: Building; Facilities; Management; Improvement; Shared; Services

BACKGROUND

Queensland is one of the six States of Australia that, with two other Territories, make up the Commonwealth of Australia. This paper describes the Facilities Management Improvement Initiative driven by the Queensland State Government. The Facilities Management Improvement Initiative (FMII) had its genesis in another Queensland State Government reform program known as the Shared Services Initiative (SSI) that was aimed at introducing the concept of Government Departments sharing common services such as finance and human resource management. With over twenty departments making up the mainstream Government machinery, there are efficiencies to be gained by sharing systems and people undertaking financial management and human resource management (HRM).

With shared services, the resources across Departments could be rationalised, systems consolidated and processes standardised and made more efficient. Experience in other jurisdictions indicated that there was potential for significant savings. In pursuit of this objective, Shared Services Providers (SSP) were created to service "clusters" of "client" Departments. These SSP were selected Departments who extended their HRM and finance services to serve other Departments within their cluster. A number of other "generic" functions like fleet management, facilities management (FM) and information and communications technology (ICT) were obvious targets for such an arrangement but were put in a queue for implementation due to the sheer scale and complexity of the reform agenda. There was some initial confusion with the term FM because of the use of similar terminology in ICT. In the context of the FMII, the term facilities management was therefore limited to refer to building facilities management. A number of definitions of FM were also considered for potential adoption. Among them the following definitions were considered particularly relevant:

Facilities Management: "A business practice that optimises people, process, assets and the work environment to support delivery of the organisation's business objectives." (Facility Management Association of Australia)

Facilities Management: *"Facilities Management is the integration of multi-disciplinary activities within the built environment and the management of their impact upon people and the workplace."* (British Institute of Facilities Management)

Facilities Management: "Facility Management is the process by which an organisation integrates its people, work process and physical assets to serve its strategic objectives. As a discipline, facility management is the science and art of managing this integrative process from operational to strategic levels for promoting the competitiveness of organisations." (Hong Kong Institute of Facility Management)

In order to provide a definition that was relevant to the public sector, the following definition was developed for the purpose of the FMII:

"Facilities Management (at facility and portfolio levels) is defined as the ongoing process of aligning building or facility resource requirements to Department service delivery outcomes and Government priorities through planning and managing the cost effective:

- Acquisition, maintenance, renewal and retirement of building facilities; and
- Servicing and operating the built facilities in accordance with functional requirements and performance specifications."

In addition to this definition a detailed list of FM functions was also developed.

In considering the potential for adoption of the Shared Services model for FM, it was necessary to acknowledge the situation in terms of the FM functions in Departments. In the majority of cases, Departments outsourced a significant part of their FM functions from DPW itself. In essence, a Shared Services arrangement already existed for FM. The role of DPW is a significant factor in any consideration for a changed model. Government policy is to maintain a significant internal capability in building FM services provision and policy. Until such time as this policy changes, DPW is a resource that needs to be effectively and efficiently deployed and used for maximum benefit to Departments and Government. FM is also inherently much more complex than HRM or financial management in terms of processes, systems, people and the wide variety of the "hardware" involved – the physical facilities themselves (schools, prisons, office buildings, laboratories, police facilities, residences, etc.).

Nevertheless, the Department of Public Works (DPW) took on the task of examining whether FM had a similar potential as HRM and finance management to be migrated to a shared services model. A small, dedicated team spent some weeks on the task and concluded that while there was significant potential for improvement that would result in financial and non-financial benefits, there was only limited potential for applying the shared services model. Thus improvements to existing arrangements were more appropriate and attractive than wholesale adoption of the financial management and HRM shared services model.

CONTEXT – FM AND THE QUEENSLAND PUBLIC SECTOR

In general, Departments own, operate and manage purpose-built building facilities such as schools, police stations, correctional facilities and hospitals. General office buildings are leased from DPW or in some isolated cases directly from the private sector. DPW meets the demand for office space through a combination of its own portfolio of buildings and leased buildings. DPW provides FM services such as maintenance, cleaning and security services to most Departments. It also provides engineering and architectural design services and project management of construction projects. A policy division provides policy and best practice support, industry liaison and risk management services to Government. Apart from policy services all other services are provided on a commercial fee-for-service arrangement. For maintenance, the majority of Departments have to use DPW services as Government policy. This internal outsourcing model provides the environment for Departments to focus on their core business and for DPW to focus

on delivering market-competitive FM services. However, the model has also spawned inconsistent business arrangements and processes, Departments operating in "silos", a high level of intra-Government transactions and a lack of standardisation in systems and data leading to poor inter-operability and duplication.

The fundamental concept of Government in Queensland is the autonomy of Departments in pursuing their designated roles and functions, undertaking procurement of non-core support services such as FM and generally operating as independent entities. In contrast, there are obvious benefits in Government operating as a single enterprise and achieving benefits from economies of scale, shared services and other collaborative effort between Departments. For example, Government can collectively pay less for a licence to use standard FM software across Departments compared to individual Departments paying separate software licences. Similarly, instead of Government Departments (essentially divisions of the same business entity) competing for building sites in an overheated property market they can opt for a more collaborative approach such as co-locating in a shared facility. Maintenance personnel travelling to remote areas can undertake maintenance work on building facilities of various Departments in the same locality in one trip rather than making separate trips for individual Departments' work programs. This is a significant issue due to the large geographical size of Queensland.

THE FACILITIES MANAGEMENT IMPROVEMENT INITIATIVE

The Facilities Management Improvement Initiative (FMII) was introduced out of the desire to pursue improvements in FM as part of the Shared Services Initiative. The financial incentives for pursuing improvements are compelling. The approximate value of the Government's building estate of 72,000 buildings is estimated at AUD\$14.8 billion spread across twenty-six Departments. The annual projected growth rate of this estate is estimated at AUD\$1 billion. It is further estimated that the total annual FM expenditure across Departments is of the order of AUD\$1.5 billion while the costs to manage the estate and FM activities is AUD\$49.8 million annually. (Source: *Facilities Management – Project Synopsis 2004*). A small percentage improvement in the above areas could yield savings measured in millions of dollars.

Building facilities are part of the broader pool of infrastructure assets that are necessary to "support and sustain" life in a nation or state (Hudson et al, 1997). Most Government Departments rely heavily on building facilities to deliver a wide range of services to the community and to support the economic growth of the State of Queensland. They are subject to deterioration, susceptible to natural disasters, catastrophic failure and require proper management, maintenance and renewal throughout their lives in order to perform their desired functions. The need to improve FM has also been recognised by the Facility Management Association of Australia through its document, "A Proposal for an Action Agenda for the Facility Management Industry" which states "The effectiveness of our built assets is fundamental to the productivity and competitiveness of the economy and our impact on the environment."

One of the challenges faced in trying to improve FM in the Queensland public sector is the sheer scale and complexity of the situation. Thousands of buildings are spread throughout the metropolitan south-east of the State and small, medium and large regional town centres across the State including some very remote communities. People of varying competencies and interests in FM manage facilities across the State. They report to and are accountable to different entities within a large corporate enterprise. The different climatic and other geographical factors that affect facilities and their management add further complexity.

The current building ownership and FM service delivery models also added to the challenge of defining the scope and thrust of the FMII. There are demographic and management issues involved. What improvements could be pursued in regional areas and in the larger metropolitan centres? Should the improvements be driven at improving FM at facility level, e.g. schools, office buildings, prisons, etc.? Should they be targeted at portfolio level where senior managers can drive improvements within their portfolios? Or, should improvements be targeted at addressing issues at the enterprise level, seeking efficiencies and better outcomes from better inter-portfolio collaboration, improved policy, consolidation of systems, sharing of expertise and where relevant, even facilities? Can building ownership models be challenged – for example, would Departments

with small building portfolios consider leasing their purpose-built facilities from the DPW in the same manner as office buildings?

Management Levels	Possible Improvement Targets
Enterprise level – Government as one entity (across all Departmental building portfolios) Geographical area: State-wide	Shared services and accommodation, bulk procurement, coordinated service delivery, standards and policies. Pursuing improvements through whole-of-Government coordination.
Portfolio level – Departments as autonomous entities (individual Departmental portfolios) Geographical area: Specific parts of the State where the department has a presence	FM business arrangements, FM practices, processes. Pursuing improvements through a number of departments working together or in an individual Department and extending them sector-wide.
Facility level – Individual facilities within a Departmental portfolio Geographical area: Individual locations	FM services, practices, processes. Pursuing improvements in an individual facility and extending to other facilities.

Table	1.	Finding	im	provement	targets
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Early analysis of the scope of the FMII resulted in a conceptual view that improvements needed to be driven from a whole-of-Government or "enterprise" perspective. The basis for this view is that "we are all part of Government and surely we can do things better if we work together." There was also recognition that improvements would be pursued over the asset life cycle since there were opportunities for improvement at each stage of the life cycle.

It was also recognised that drawing the boundaries as outlined above meant that the scope of FMII is broad and that any improvement initiatives had to be clearly focussed on specific areas which were not too large or ill-defined. Some projects might be pilots to test improvement propositions and models while others might be more wide-ranging. The scope was confined to building facilities only. A functional definition of FM was developed, resulting in a checklist of all the FM functions considered as being "in scope". Fleet management and ICT were excluded.

The FMII focus for improvement was aimed at four key areas:

FM Demand Management – managing the demand for facilities and the recurrent costs of sustaining existing and future facilities

FM Services – improving the efficiency and effectiveness of FM services

FM Management Resources – improving the efficiency and effectiveness of managing facilities and the associated FM services

FM Governance Framework – taking a whole-of-Government (enterprise) approach to FM through improved governance arrangements

An alternative view of the FMII is one of pursuing opportunities for whole-of-Government improvements in FM to achieve improved outcomes in:

- **Sustainability** of current and future building facilities in economic and environmental terms
- Value for Money in the procurement and delivery of FM services
- **Productivity** of resources and systems to manage building facilities and FM activities
- Good Governance in FM practices and processes.

In the context of this paper, "Value for money" can be considered as a way of assessing whether or not the maximum benefit has been obtained from the goods and services acquired or provided compared to the resources expended. It is often also measured in terms of:

- Economy minimising the cost of resources for an activity ("doing things at a low price")
- Efficiency performing tasks with reasonable effort ("doing things the right way")
- Effectiveness the extent to which objectives are met ("doing the right things").

(Source: "The Concept of VFM"- www.hefce.ac.uk)

Improvement objectives were identified for each of these high-level improvement focus areas as shown in Table 2 below. While these are broad and high level, they were useful in guiding the thinking towards the specific actions necessary for initiating improvements. These actions could then be translated into improvement projects for implementation within a framework that had a high level focus.

The team established to develop the FMII spent considerable time in defining these improvement projects in terms of their scope, benefits, deliverables and milestones. A business process review method was also identified as being a useful tool to apply in each of the improvement projects. This business process review method entails a "discovery" process, an "envisioning" process, a "business case" process and "implementation" phase.

FM Demand Management	FM Services	FM Management Resources	FM Governance Framework
Optimal life cycle costs through improved design and management	Standardised and improved FM processes	Consolidation of small portfolios	FM policies on sustainability
Improved asset performance	Improved FM delivery models	Sharing FM management resources	Improved Capital Planning
Rationalisation of asset holdings	Reduced volume and costs of FM transactions	Improved inter- operability of FM systems	Improved Governance
Improved integration of FM services	Productivity and performance improvements	Standardised and efficient management processes	Improved accounting and financial policies

Table 2: Improvement objectives of each improvement focus area

PRIORITY AREAS

As noted above significant work was done in identifying worthwhile projects that could be implemented in pursuit of these objectives but their scope, complexity, diversity and interrelationships and dependencies between them made some prioritisation essential if the FMII was not to flounder in a tangle of projects. At the same time it was also recognised that high level commitment was critical for the FMII to succeed. An agreement was reached between the Director-General of DPW and the Under-Treasurer of Queensland Treasury to commit to the FMII as a joint initiative of DPW and Queensland Treasury. This provided the high level stakeholder impetus for the FMII to advance towards implementation.

Further effort was thrown into prioritisation of objectives and the relevant projects to achieve these objectives. There was also executive anxiety to demonstrate early successes without losing sight of the longer term objectives. Therefore effort was also put into identifying potential pilot projects that could be extended for wider application either on a regional or whole-of-Government basis.

Six priority areas were agreed upon based on the improvement objectives. These were:

- **Capital Planning** Improving the capital investment planning process for building facilities
- **FM processes** Improving selected FM processes in terms of efficiency and effectiveness

- FM Management Resources Seeking opportunities for achieving the most appropriate distribution of FM management resources between Departments, their shared services providers and DPW
- FM Systems Improving the connectivity and inter-operability of FM systems
- **Asset Performance** Improving the measurement and monitoring of building asset performance as a tool for demand and risk management
- Business Arrangements Improving business arrangements to reduce the volume and costs of FM transactions

Within these priority areas individual "priority projects" were identified for implementation.

PRIORITY PROJECTS

The following list provides some indication of the scope and variety of the priority projects:

- Asset Performance Framework- Establishment of a whole-of-Government framework for consistent measurement and reporting of building asset performance;
- Coordinated Regional Service Planning and Delivery Coordination of maintenance services across portfolios instead of responding to individual portfolio demands to reduce travel and other costs in remote areas;
- Asset Strategic Planning Improving the process of strategic planning for asset acquisition and management to meet service needs;
- *Reducing transactions* Reducing transactions between DPW and Departments through performance-based business arrangement for FM services outsourced from DPW;
- Data standardisation Standardisation of data for building asset registration across Government;
- *Building Capital Planning* Improving the planning, budgeting and approval processes for building projects to reduce cost premiums through compressed project delivery times, overheated markets and other factors;
- *Condition Assessment* Improving the process for assessing the condition of building facilities including data collection for other asset management purposes; and
- Optimal Life Cycle Costs Developing processes for improving the life cycle cost of building facilities through input at the early design phase.

As mentioned above a number of pilot projects will be implemented to test propositions and models as solutions for wider application. These would be managed to ensure that they align with high-level objectives. There are also some Case Study types of exemplar projects selected because of their unique characteristics. The implementation timeframes could vary from 6 months to potentially 12-18 months or more depending on the project.

GOVERNANCE ARRANGEMENTS AND SUCCESS FACTORS

As expected with such a large and ambitious agenda, relatively formal governance arrangements at steering committee and project management levels are necessary to drive implementation. Other critical success factors identified include:

- A strong communication and consultation strategy to ensure commitment and support from Departments at corporate and regional levels;
- Alignment and where relevant integration with other Government agendas such the review of Government information and communication technology infrastructure, shared services arrangements for finance and human resource management;
- Competent multi-disciplinary and multi-Department project teams with effective leadership;
- Clear accountabilities for project delivery and reporting;
- Early risk identification and intervention;
- A clear focus on project scope and objectives;
- Alignment of short-term projects with longer-term objectives;

- Willingness to challenge some long established mindsets (eg the need to own assets compared to leasing from another Department, using alternative procurement models like Public Private Partnerships and Alliance Contracting arrangements); and
- Managing expectations of the wide range of key stakeholders.

One other critical success factor that is often not articulated is that of executive stamina. There is no doubt that while there are short-term projects, there are also others that take a longer time frame. The patience and endurance necessary to pursue long term benefits in Government are often distracted by emerging issues and political agendas. Whether the FMII will enjoy the long term drive and stamina of senior executive management is yet to be seen.

CONTEXTUAL DYNAMICS

There are some contextual dynamics that will challenge the ingenuity and strength of purpose of those involved in the project. Departments are protective of their autonomy and respective roles and are understandably cautious about committing to any whole-of-Government agenda for improvement. Therefore, the value of the FMII to them needs to be demonstrated and used to allay any fears that may cause barriers to rise. DPW as an internal-to-Government provider of FM services must clearly demonstrate its sincerity and commitment to change since many of the projects involve the improvement of DPW systems, processes and business arrangements in order to deliver value for money services.

The FMII is unfunded and expected to be delivered from existing resources. This will be a challenge given the current workloads and level of resources that can be diverted from current functions to undertake a major initiative such as the FMII.

Is the project too ambitious? What are the risks? Does it address critical issues and have "silver bullet" strategies that will strike at the heart of FM and make quantum improvements possible? Is enduring change possible or are the projects "Mickey Mouse" and will pass into oblivion in a short time? What are the hard dollar savings achievable? These are issues that will engage the attention of those involved for some time yet as the FMII unfolds.

Another key factor that underpins all of the projects is the ability to determine baselines and performance measures for measuring any future improvement benefits. It has already been recognised that benefits from the FMII would fall into:

- Productivity gains through improved processes and better utilisation of e-business and asset management systems;
- Avoidance of consequential cost (eg cost premiums due to compressed delivery time frames);
- Better FM outcomes; and
- Direct cash benefits through savings in recurrent costs or reduced capital investments.

The establishment of baselines and ongoing monitoring of performance in most cases involve significant data gathering and qualitative evaluations based on objective and subjective evidence. There is some nervousness about this and a hesitance to commit to data gathering due to the cost and effort that may be incurred. Nevertheless baselines do need to be established if improvements are to be measured and reported on. At the time of writing this paper it is not clear what alternative means of establishing baselines and performance evaluation can be devised to overcome the barriers to data collection.

Are there other areas of potential improvement that should be addressed as a priority? The FMII agenda is broad but not all inclusive. There are other areas that can be targeted for improvement. One possible area is continuing professional development and training. Continuing professional development and training could perhaps be divided into two streams. One stream would be for FM practitioners in Departments and DPW to enhance their skills and competencies in FM. The other stream would be for the senior executives and managers who are not FM practitioners. These senior departmental executives and managers are responsible for the stewardship of building estates worth many millions of dollars and have functional responsibilities that depend and impact on building facility decisions. Many are also from non-FM professional disciplines.

Tobin (1998, pp 48-51) holds the view that employees should have "generic skills" in addition to "function-specific" skills. For those senior executives with no direct line responsibility for facilities,

their generic skills should include an appropriate level of knowledge and understanding of FM. Those senior executives with a more direct functional responsibility for strategic decisions on building facilities should have an appropriate level of FM knowledge as a "function-specific" skill. Successful improvement programs in FM and other business practices depend on senior executive support and drive. In the author's view, an enhanced FM skill level in the upper echelons of public sector management would be a significant advantage in improving the stewardship of public assets.

CONCLUSION

The FMII is at the cusp of the implementation slope at the time of writing this paper and whether it will roll forward gathering momentum as it progresses or languish as other priorities emerge is difficult to forecast at this stage. It is still too early to tell. However, the FMII has merit in being pursued with vigour and given the current commitment and support available from the various key stakeholders there is room for optimism that it will prosper. A review in 12-18 months' time would be very interesting.

The impact of successful implementation of the FMII can be significant and lead to further reform in future. At the very least it will highlight and promote:

- The benefits of working collaboratively across portfolios as part of a whole enterprise;
- The need to continually identify areas of potential improvement and actively seek solutions on a whole-of-Government basis;
- The benefits of challenging mindsets and forging new ways of doing business;
- The need for a balance between the autonomy of Departments and centralised management; and
- The collective responsibility to be accountable for the efficient and effective acquisition and management of valuable public assets.

This paper has provided a brief background to the FMII, its operating environment and broad scope and thrust as a Government initiative to improve building facilities management. Future developments in the FMII will determine the lessons that may be drawn from it in terms of successes and failures.

[The views expressed in this paper are the author's views and not necessarily those of the Department of Public Works.]

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FACILITY MANAGEMENT AND PLANNING IN THE VICTORIAN CORRECTIONAL SYSTEM

Joburt Betadam Director, Architektonic Pty Ltd, Melbourne, Australia Tim Cave Director, Major Projects Delivery Services, Department of Justice, Victoria

Abstract

This paper describes the development of an innovative and unique facility management program across the Victorian prison system - a system characterised by a low tolerance of defective infrastructure and unscheduled repair work - in a joint effort by Architektonic Pty Ltd and Corrections Victoria. This case study highlights effective knowledge mapping in Asset and Facilities Management.

Keywords: Asset audits; innovation; life cycle

INTRODUCTION

This paper describes the dynamic state of the Victorian correction system, based on a major funding commitment by the Victorian Government to combat rising demand for prison capacity, being delivered through a Corrections Long Term Management Strategy (CLTMS) (Office of the Correctional Services Commissioner (OCSC), 2002). Aligned to this Strategy, Corrections Victoria of the Department of Justice Victoria, the State agency responsible for correctional management, has also undertaken the initial stages of facility management planning, using innovative technology, with a view to its potential progressive introduction into the Victorian prison system. This paper provides an overview of Victoria's strategic approach.

The Victorian correctional system represents an atypical facility management environment, due to its substantial security and safety requirements. The prison system has a low tolerance for defective infrastructure and/or unscheduled repair work. These unusual facility management conditions are described.

The final part of the paper outlines a coordinated facility management approach which has now been piloted in Victorian prisons in partnership with Architektonic Pty Ltd, an Architectural and Facility Management firm specialising in these services. In selecting the particular technology solution utilised in this study, the main criteria as specified by Corrections Victoria were:

Data Collection:	electronic format including: digital photograph:; CAD drawings: database (e.g. Access, SQL): single point of entry device					
Information Presentation:	browser based visual front-end: Executive Summary reporting					
Facility Management Capacity: multiple user selective reporting: dynamic interface adaptable to new FM initiatives:						
Future Application:	capacity for trending: pattern identification: benchmarking: funding submissions					

VICTORIAN CORRECTIONAL SYSTEM

The Victorian Government is committed to improving the safety of Victorian communities and families and the extent to which people feel confident about their safety; and building supportive, connected and creative communities.

Through the efforts of government agencies and local communities, Victoria continues to remain a relatively low crime State. The Report on Government Services 2001 (Steering Committee for

the Review of Commonwealth/State Service Provision Productivity Commission, 2001), indicated that in 1999-2000, for the second year in a row, Victoria had the lowest proportion of all States of victims recorded crime against both property (5,135 victims per 100,000 persons) and against the person (497 victims per 100 000 persons). This compares to national levels of 6,095 victims and 908 victims respectively.

The Victorian Government has continued its crime prevention focus, by directing more resources to the corrections system, particularly focused on offender diversion from prison rehabilitation to reduce recidivism. For those offenders who enter the court and corrections systems, the Victorian Government is committed in 2001 to a significant long-term strategy aimed at breaking the cycle of re-offending, known as the Corrections Long-Term Management Strategy (CLTMS) (Office of the Correctional Services Commissioner (OCSC), 2002).

Victoria's total prison population had significantly increased over the previous decade (the 1990's), to the extent that prisoner numbers have reached or exceeded prison accommodation capacity. Over the period June 1996 to June 2000, Victoria's total prison population increased from 2,440 to 3,153 - an increase of 713 prisoners or almost 30 per cent.

This increase in prisoner numbers is despite Victoria having low rates of reported crime (see above) and the lowest incarceration rate of all Australian States, as shown in Table 1. following.

State	June 1995	June 2000	% Change
Vic	71.8	85.7	19.4
NSW	138.8	150.7	8.6
Qld	117.4	179.1	52.6
WA	167.2	221.3	32.4
SA	123.0	114.0	-7.3
NT	397.1	455.3	14.7
Tas	68.0	117.8	73.2
Australia	117.7	143.5	21.9

Table 1: Australian	Prison Population	per 100.000 adults

Source: Australian Bureau of Statistics (Australian Census 2001)

Based on the modelling of these trends into the future, total prisoner numbers were projected, in the early 2000s, to increase to 4,169 by June 2005.

Assuming a 90 per cent total prison system utilisation rate (consistent with national and international benchmarks), accommodating 4,169 prisoners would require a prison with accommodation capacity of just over 4,540 beds. Victoria's prison system at that time had a permanent funded design capacity of 3,232, around 1,300 beds short of expected prisoner demand.

The projected increase in prisoner numbers was considered due to factors including the growing influence of drugs on offender behaviour, as well as a high proportion of offenders returning to the corrections system after their release. Around 44 per cent of sentenced male prisoners and 60 per cent of sentenced females reported their offence was committed under the influence of drugs and/or to support a drug habit in 2000. At the same time, 43 per cent of offenders had returned to the corrections system within two years of their release.

The challenge for the Victorian Government was not only meet current demand pressures, but also develop a long-term corrections management strategy that addressed underlying causes of the problem. It responded by implementing the CLTMS, managed by Corrections Victoria, a business unit of Department of Justice.

In the face of continuing growth in prisoner numbers, in 2002, the Victorian Government committed to the CLTMS. The CLTMS provides a balance between programs that seek to reduce the number of offenders entering the system, by addressing the underlying causes of the problem, and by ensuring that appropriate accommodation is available to meet projected long term prisoner demand growth. The CLTMS includes a range of programs to provide alternatives to imprisonment and to assist in the rehabilitation of prisoners, all with a view to reducing demand for prison beds.

At the same time, the existing demand pressures necessitated a funding of almost \$300M, in a 10 Year Facilities Master Plan to provide new prison facilities, including:

- 1. A 300 Bed Correctional Programs Centre and a 600 Bed Remand Centre delivered under a public private partnership delivery model;
- 2. A net increase in 716 permanent beds under traditional procurement, including a 120 bed minimum-security prison in a regional setting; and
- 3. Other specialised accommodation for parolees, indigenous offenders and sex offenders.

With the introduction of these new facilities, a number of existing outdated prisons, which require extensive refurbishment and upgrade are planned to close in 2005/06.

The Major Projects Delivery Services of the Department has undertaken the project management of the infrastructure development components of this Strategy.

CORRECTIONS VICTORIA ASSET BASE

Corrections Victoria is responsible for the operations and facilities management of 11 prison facilities in Victoria, comprising approximately 160,000 m2 (FECA) of prison buildings including infrastructure and an additional 80,000 m2 (UCA) of physical assets.

Current asset values have been estimated at a total of \$340 million total stock with an overall effective age of 17.3 years, viz:

- \$170 million or 50% of the stock by value is used for prisoner accommodation;
- \$60 million or 16% of the stock is for education and industries;
- The remaining \$120 million or 35% is used for visitor areas, amenities & health, administration and staff, and ancillary & support areas;
- \$100 million of buildings are in Rural & Regional Victoria (average age 19.3 years);
- The remaining \$240 million of buildings are in the Melbourne region (average 12.2 years);
- \$270 million of single storey (average age 17.7 years) and \$70 million of 2 to 4 storey stock (average age 15.7 years);
- Maximum security prisons are valued at \$180 million or 52% (average age 13.7 years);
- Medium security prisons are valued at \$120 million or 37% (average age 21.1 years); and
- Minimum-security prisons are valued at \$40 million or 11% (average age 21.1 years).

Of the stock, 82% is in the 1984 to 2003 effective age bracket, and 15% is pre-1974. Much of the renewals falling due reflect low investment activity from the mid-1970's to mid 1980's.

The average age will drop considerably when the current strategy for three new prisons to come on line by end 2005 and the closure of three "gold-rush" buildings at the same time, is implemented.

CORRECTIONS VICTORIA FACILITY MANAGEMENT

Despite its large asset base and the age of the buildings, Corrections Victoria until recently did not have a coordinated facility management plan and relied on prison-specific reactive response to the upkeep of prison facilities. This has been linked to an inevitable deterioration in the existing infrastructure, a problem common with public infrastructure throughout Australia. Examples of this problem are:

- 1. The decline in facility replacement during the 70's and 80's;
- 2. An historic lack of recognition of the importance of suitable funding in public infrastructure (notwithstanding that there are signs of a whole-of-government strategic facility development planning emerging in Victoria);
- 3. Until recently, no central coordination of facility management with the Victorian Corrections system;
- 4. The inclusion of maintenance/refurbishment funding in the current allocation for each prison, with the prison manager controlling the use of the allocation. As a result maintenance was often "foregone" to allow additional staffing;
- 5. The use of prisoner labour to cover up emerging structure problems "with a coat of paint" rather than addressing the problem; and
- 6. Prison plans are still partly paper-based disallowing comprehensive asset mapping and condition audits this is rapidly being rectified under the new facility management approach.

Another phenomenon, which adds to the complexity of FM planning, is the continual upgrade, taking place to existing prison facilities. It is safe to say that every prison facility in Victoria has been altered, upgraded or re-designed in some way, shape of form over the past five years. This continuous "evolution" of facilities, often resulting from the need to increase facility capacity or modify facility functionality, both allows (funding permitting) some broader refurbishment to the facility, but also often:

- increases the strain on existing infrastructure and building services, which must cope with increased accommodation within existing service specifications; and
- creates an uncoordinated rather than planned development of facilities, which adds to facility management problems.

The above issues have been addressed in the Corrections Victoria Facility Management Plan as described in the second part of this paper.

FACILITY MANAGEMENT PRINCIPLES IN THE PRISON ENVIRONMENT

In the Prison environment, facility management (FM) activities must be carried out in strict adherence to quality management principles because:

- Unscheduled FM activities often require that prisoner areas be decommissioned, to ensure the safety of the FM service provider - this has operational consequences;
- FM providers must usually be escorted by a prison officer, which uses staff resources and adds to costs;
- Unscheduled or unprogrammed FM activities can be disruptive to prisoners and staff (through noise, dust etc.); and
- Prisons are often located in out of the way places, requiring longer response times and travel times for FM providers.

To this effect, quality management is critical to the successful management of FM in correctional infrastructure because:

- Design and build quality is a high priority best practice operational standards can only be maintained in well-constructed facilities, built and maintained for the long-term;
- Delays to completion of maintenance / refurbishment works are unacceptable because of the highly structured prison environment; and
- Quality Assurance is essential construction defects (delaying completion or requiring return visits to the facility to repair or rectify faults) are very disruptive to prison operations.

Within the quality management context, it is noted that, while prisons cause constraints on access to FM providers and require a high degree of rigor, the structured prison environment does lend itself to programmed facility management because:

- The prisoner daily regime is routine and FM can be programmed around it in consultation with the prison operator; and
- Prison facilities are highly specified for security reasons and usually constructed of higher quality materials so that maintenance, refurbishment and repairs are expedited.

Noting the above context, the remainder of this paper describes aspects of a coordinated facility management approach, using innovative technology, which is being progressively introduced into the Victorian prison system. A pilot study undertaken by Architektonic has recently been completed at Victoria's two women's correctional facilities - Dame Phyllis Frost Centre (maximum and medium security for 250 prisoners) and Tarrengower Prison (minimum security for 35 prisoners). This pilot has allowed an "a priori" evaluation of a planned staged rollout of a facility management plan, over the remaining 9 publicly owned facilities over the next five years. The FM approach adopted will have as a final output, a Corrections Victoria Facility Management Plan, which will:

- Provide Minimum Design Standards for Victorian Prisons, based on lifecycle repair and replacement assumptions for the difference asset classes in the facilities;
- Identify critical essential works to bring the facilities up to the Minimum Design Standards;
- Provide a detailed cost estimate of the proactive lifecycle replacement of asset classes within the correctional facilities, including the building fabric over the next 20 years;

• Act as an underlay, by maintaining facility integrity, to the strategic upgrade and development of correctional facilities to meet the continuing demand growth for prison infrastructure in Victoria.

SETTING UP THE FACILITY MANAGEMENT PLAN (Betadam, 2000)

Architektonic Pty Ltd were engaged by Corrections Victoria to conduct a Facilities Asset Condition Audit of the two women's prisons (Dame Phyllis Frost Centre, 260 prisoners and Tarrengower Prison, 38 prisoners) with a view to generating Facilities Management Strategies which would take into consideration the long-term objectives of Corrections Victoria. The processes and methodology undertaken in the execution of this project were adopted as a prototype for future implementation across the whole Victorian prison system.

The innovative utilisation of technology with which the audits were conducted included P@ImActive[™] for data collection (hand-held PDA used for integrating CAD – Digital Photographs – Database) and Intr@Active[™] (Web-based browser reporting interface – CAD / Digital Photographs / Database).

This part of the paper will look at how Corrections Victoria's vision, was translated into a tangible outcome. It investigates the underlying paradigms, which were drivers of the current facilities and how an audit of this nature has allowed Facility Management to take the lead in demonstrating efficiencies and cost benefits proactively and not reactively within the correctional environment. The criticality of correlation between CAD, digital photographs and databases is demonstrated in the reporting tool that is the visual Facility Management System. Life Cycle Analysis is integrated within the project for long-term planning and audit outcomes are discussed.

The objective of the Facilities Asset Condition Audits at DPFC (Dame Phyllis Frost Centre) and Tarrengower Prison was to assess the viability of a Facilities Management System with respect to its capability to provide Corrections Victoria with a tool and resource that would enable the adequate preparation and implementation of Strategic Facilities Management initiatives over an extended period of time.

The emphasis was focused on how the asset detail supported the implementation of new Facilities Management protocols, which were being formulated and created through the establishment of new benchmarks and standards specifically for a correctional environment. The range of processes required to be undertaken leading to the final methodology, included extensive consultation with the numerous stakeholders (including prisoners), thus ensuring that as far as is practicable, all relevant variables were considered at the commencement of the project.

The Facilities Asset Condition Audit task was formulated through the input of a wide-ranging group of specialist consultants including Architects, Facility Management Consultants, Facility Planners, Engineers (services and structural), Building Surveyors, Quantity Surveyors, Graphic Designers and Computer Programmers. The objective of collecting data with a portable handheld device P@ImActive™ PDA (Personal Digital Assistant) capable of integrating digital photographs, CAD (Computer Aided Design) drawings and databases, ensured an efficient and effective methodology capable of broad application at multiple levels of data collection. The integrity and accuracy of the collected data is therefore both consistent and dynamic. This ability to have dynamic data ensures that information is extracted in countless outputs by the end user at their discretion utilising the Intr@Active™ software.

The CAD drawing in its utilisation within P@ImActive[™] is the common denominator that enables data to have significant value beyond its simple drawing representation. Objects in the drawing contain imbedded information that can be linked to, during the exercise of the audits and then extracted into a database for future manipulation. The range of possibilities for data manipulation in CAD drawings is extensive and whilst this audit did not have the scope to investigate these completely, the potential has been built into the system ensuring that future implementation will take complete advantage of the integrated data within.

The Minimum Standards proposed and subsequently utilised in this audit set new benchmarks to which future prison audits will be conducted and potentially new prisons designed. These new benchmarks reflect an outlook focused on how data and information is inextricably linked in the process of data collection, and information presentation, with a view to maximising the significance of the collaboration achieved.

The collective objective (across all disciplines) achieved minimum 95% coverage of all possible asset conditional outcomes in predefined formats. This type of data consistency provided a sound platform for confident translation of data and information for Strategic Facility Management thinking. It also served to eliminate the possibility of multiple translations of the same condition, which then require subsequent downstream reinterpretation. The actual calculated time benefits of using P@ImActive™ for data collection in the field were in the order of 40%. The savings generated for Corrections Victoria were not only significant in dollar terms but also with respect to the generation of paper waste, and field time in prisons where security concerns require these to be minimised.

The drivers for the creation of Facility Minimum Standards arose from a thorough understanding of the many and varied regulations and other statutory documents that specifically impact correctional facilities. These included Government and Departmental Policies and Frameworks which dictate prison specific codes and physical construction requirement in addition to The Building Code of Australia, The Disability Discrimination Act, various Australian Standards and the regulations which commonly apply to all construction types.

For the first time in Victoria, benchmarking of countless correctional assets can now be reported on with a view to assisting the Facility Planning and Management of both current assets and future infrastructure developments. The Facilities Asset Condition Audit became a blueprint for the future realisation of the Facility Management possibilities inherent to the audit task, in setting and achieving significant long-term cost and efficiency benefits for the Department of Justice.

IMPLEMENTATION OF THE FACILITY MANAGEMENT PLAN

The purpose of this paper is to demonstrate the inherent value of the Facilities Management System for prison infrastructure. Intr@Active™ provides Corrections Victoria with a platform through which Strategic Facilities Management can be undertaken more effectively over an extended period of time. The complexities inherent to the corrections environment have been taken into account. The value of the auditing task that includes the CAD updating of drawings illustrates an appreciation of outcomes as synthesized in and through Intr@Active™. The amalgamation of data and information from a range of sources into a Facilities Management System was therefore a crucial first step in establishing a primary base from which significant Strategic Facilities Management decisions can now be undertaken for implementation. The synergies arising from the correlation of data, drawings, databases and digital photographs provides an unparalleled opportunity to explore progressive and new outcomes for Corrections Victoria.

The primary objectives of this audit, leading to a Facilities Management System were to:

- Establish accommodation building condition Minimum Standards by which prison buildings and whole prisons can be measured and assessed
- Using the Standards, formulate benchmarks by which buildings within prisons can be compared both internally within a prison and externally with other prisons and even across the country
- Help Corrections Victoria to identify and define facilities related building problems (by exception) in order to progress the appropriation of both physical and funding solutions
- Aid Corrections Victoria in defining a Facilities Management Model in which important questions are asked and critical information collected as an intrinsic component of the auditing task
- Encourage the transfer of data and information between prison infrastructure elements in consideration of the Facilities Management and Planning issues to be formulated
- Improve operational alignment with Life Cycle processes while demonstrating cost benefits and efficiencies
- Simplify and help organize the Facilities Management processing of data and information for Corrections Victoria
- Minimise the potential for costly oversights within prison infrastructure planning and construction

- Create an accessible Facilities Management System capable of growth and able to demonstrate longevity for the term of the Life Cycle periods
- Integrate with GIMS (Government Information Management System) for substantial mutual benefit across multiple government departments
- Learn from the past and present, for the future improvement and application of infrastructure facilities in prisons

OVERVIEW OF FACILITIES MANAGEMENT ISSUES

To gain an appreciation of the Facilities Management Issues addressed by this paper, it is important to understand the correctional imperatives that were the drivers for the current state of prison facilities and therefore prisons. As an overview, it does not attempt to address every issue, but it does suggest which elements might be seen to specifically impact on prison Facilities Management.

The elements that impact on Facilities Management in a correctional environment include:

- The policies which are the drivers for the justice system
- The legal requirements which are obligated on prison facilities and the management of these facilities (Building Code of Australia etc)
- Correctional accommodation standards which define not only the quality of the facilities but also their ability to satisfy the ultimate objectives associated with rehabilitative and other outcomes
- The special demands placed on correctional facilities by prisoners
- The need to ensure prisoner safety as a primary point of consideration (well understood through the BDRP- Building Design Review Project but not assessed as part of this audit exercise)
- The ability to capture the intent of recent trends in correctional operations and facility design
- The desire to implement strategies which will help to reduce the significant costs associated with building and operating correctional facilities (particularly in regard to benchmarking)
- Seeking sources of information to ensure that knowledge leading to wisdom is sometimes derived from the disparate connection of a multitude of both similar and differing facility types
- An ability to access information in a timely manner so that the generation of dynamic reports ensures confidence in Strategic Facilities Management initiatives

In anticipation of the potential outcomes it was necessary to review the history of the buildings (through the prison maintenance staff and records) so that the identification of current problems is noted as a reference point. The ability to collate this type of historical data represents a significant transfer of knowledge from the prison staff to the Facilities Management System. The established goals and objectives for this project were articulated to all participants leading to the preparation of 'action' plans for the implementation of the audit task. The task of evaluating the condition of existing facilities commenced with a view to extracting the maximum amount of information possible from all sources, and consolidating it into the proposed Facilities Management System. One of the major components of the audit task, leading to opportunities for strategic assessment for the short, medium and the long-term, is Life Cycle Analysis.

LIFE CYCLE ANALYSIS

As part of the audit exercise, Life Cycle Analysis, which includes costing by a Quantity Surveyor, was incorporated into the building components under review. Life Cycle costing is a technique that takes into account all of the costs incurred during the various stages of a building in its operation, or building element during its utilisation. It is the analysis of costs spread over a period of time that corresponds to the economic Life Cycle of the building or building elements.

Life Cycles differ from one building type to another and also change with time and technological advances. The value of Life Cycle costing and analysis is in that it allows for the 'weighting' of trade-offs in building construction, improvement or operation. The inclusion of Life Cycle analysis provides Corrections Victoria with a tool for balancing the short, medium and long-term economic consequences of decisions.

The Life Cycle analysis illustrates how the weighting of both economic and non-economic factors have ramifications in the decision making process for Corrections Victoria. The Strategic Facilities Management outcomes arising from these decisions help to establish a framework for future direction in design, construction and operation of correctional facilities in Victoria.

Life Cycle costing and analysis depends on a large number of variables, which suggests that 'standard' Life Cycle costs are generally not applicable to the bulk of scenarios common to many correctional facilities. Rather, Life Cycle analysis provides a technique for comparing alternatives or assessing the feasibility of an option. A Quantity Surveyor was crucial to the application of costs to each and every item listed within P@ImActive™ with a potential for identification within this audit.

Some of the typical areas under consideration for this audit were limited to the following:

- Repair and replacement costs
- Alterations and improvement costs (where itemised as a defined fabric element requiring review)

As a component of Life Cycle analysis, some costs are non-recurring costs, while others can be ongoing or recurring costs. It is the recurring costs that provide the largest scope for analysis and Strategic Facilities Management decisions, which in turn may alter the cost consequences.

The Asset Management Strategy¹ required the creation of accurate baseline information for existing building condition assets under consideration including:

- Type, location, capacity, value of existing assets (limited application); .
- Existing condition of assets: •
- Functionality of existing assets (degree of obsolescence);
- Current output versus service capacity (limited application).

Note: limited application is a direct aspect of the audit brief and is focused on existing visible assets and building fabric elements noting Life Cycle analysis for items more by exception than an assumption that every item has been considered.

AUDIT OUTCOMES

As a result of the audit of the two Women's Correctional Facilities, the Intr@Active™ reporting tool intrinsic to the Facilities Management System, serves to enhance and supplement the Strategic Facilities Management initiatives to be formulated by Corrections Victoria. To this end the reporting component of the system is crucial to achieving the set objectives because an infinite number of reports to be generated dynamically by any authorised user on any computer with a Web-browser without the need for specific training or licensing. The web-browser interface ensures that it is familiar to anyone who has used the Internet with an emphasis on the visual presentation of information. The emphasis on visual presentation is deliberate because it assures utilisation through the simple and intuitive front-end (created with the aid of a Graphic Designer). It also ensures the practical life of the data and tool is extended, by virtue of its adoption by users as an effective and practical tool for filtering information simply, and without the necessity for understanding databases.

The ability for Corrections Victoria - Facilities Management to generate dynamic reports on a multitude of facilities components is limitless because of the filter arrays available. Reports will capture and group information to achieve potential support for outcomes on a number of levels including:

- Trend analysis
- Budget forecasting
- Problem identification
- Works scheduling
- Facility Management
 GIMS (Government Information Management System) integration
 - Life Cycle projections
 - Policy generation
 - Facility Planning
 - Cost analysis

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FM DELIVERABLES

The Facility Management deliverables arising from this condition audit can be grouped broadly under 3 categories.

- 1. The Strategic FM (1 5) Year Plan which briefly describes the implications of the audit outcomes on Corrections Victoria planning initiatives.
- 2. The Minimum Standards were generated as a result of redefining the criteria by which assessments of the building condition and utilisation could be undertaken.
- 3. The methodology implemented for the collection, correlation and reporting of the condition audits in response to the Facility Management objectives outlined by Corrections Victoria (already discussed above).

Strategic FM (1 – 5) Years

The strategic Facility Management outcomes sought by Corrections Victoria relate directly to the 1-5 year plan, generated in part through the audit process. This plan is formulated to achieve consistency in delivery of prioritised tasks as a primary driver for improvements within the asset base over the plan period. Remedial and other activities are prioritised according to a set of imperatives that include both operational and functional objectives. The underlying principle is to provide safe, efficient and functionally appropriate prison facilities for an extended period of time, while balancing ongoing maintenance and capital expenditure. The competing elements, which would typically demand immediate attention, are blended into the plan to ensure that factors contributing to the natural attrition of the building stock and asset base have been accounted for both financially and in terms of maintenance requirements in a prioritised regime. The plan has enabled Corrections Victoria to programme for short-term and long-term outcomes with confidence in the knowledge that the life cycle anlaysis and conditional audit represents an accurate snapshot of the assets.

Minimum Standards

The formulation of minimum standards, by which assessments of the building condition have been generated, has been a significant factor in determining the criteria by which the 1-5 year plan may be implemented both consistently and effectively. The standards represent an outlook which is cognoscente of the necessity for the building stock to meet and where possible exceed the regulatory requirements typically applied to buildings. These minimum standards reflect a commitment on the part of Corrections Victoria to provide a safe environment for both prisoners and staff in the first instance. The implementation of these minimum standards has revealed some inconsistencies of design expression and led to reviews of several existing design parameters. The minimum standards have set in motion a process of checks and balances that take into account a larger number of variables then have been previously considered in the design and construction of prison building facilities. These standards also represent an independent assessment of the longevity and appropriateness of design elements through 'real world' utilisation, post occupancy. These minimum standards have initiated a rethinking of the briefing process and its interpretation for prison facilities by highlighting where implementation of minimum standards affects the construction and maintenance of prison building assets from inception to demolition and in particular the life cycle assessment and analysis of the built form. The minimum standards include all regulatory requirements but also extend into specific areas of OH&S, DDA implementation and non-regulatory areas such as appropriateness to function for finishes and even appliances (eg. Boiling water units etc).

CONCLUSION

The project outcomes as stated by Corrections Victoria were not only achieved but also exceeded through the depth of information available for interrogation through the Facility Management System. They were also exceeded because in facilitating this project, Corrections Victoria had the vision for the integration and consolidation of a number of disparate avenues of information and data for the purpose of formulating Facility Management Strategies. These strategies will ultimately create structural improvements within the whole of the prison

correctional environment by providing facilities with longevity and sensitivity to the changing needs of prisoners for an extended period of time. Corrections Victoria is also able to generate vital benchmarking statistics that had previously been unavailable and which serve to consolidate and resource new initiatives throughout the correctional environment. The Life Cycle Analysis confirms the cost implications over the life of the assets ensuring that the audit outcomes represent a prioritised methodology for implementing the Facility Management initiatives.

With the adaptation of P@ImActive[™] and Intr@Active[™] for Corrections Victoria, Architektonic was able to support the vision challenge of Corrections Victoria and make it tangible. Together, the collaborative work has resulted in a new endeavour which will not only see Facilities and Facilities Management in a new light, but will also create an environment which will ultimately enhance the rehabilitation of prisoners and those charged with the responsibility of Facilities Management.



Process diagram showing main stages of the FM Plan for Corrections Victoria

The development of the Strategic Facility Management Plan and the Minimum Standards established represents the beginning of a new approach to Facility Management within the correctional environment in Victoria. Corrections Victoria has adopted a revitalised holistic approach to Facility Management and is reaping the rewards for the benefit of the prison population, the staff, prison officers and the community as a whole.

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THE USE OF LIFE-CYCLE COSTS DATA IN FACILITIES MANAGEMENT – SOME COMPARATIVE ANALYSIS OF COSTS IN JAPAN AND USA

Takayoshi Sato Sato Facilities Consultants, Inc. Hiroshi Sugita Saburo Murakawa Graduate School of Engineering, Hiroshima Univ., Japan Teruyuki Fujikami Architecture and Building Engineering, Shibaura Institute of Technology, Japan

Abstract

This paper shows the prospect of Facilities Management (FM) in Japan in using life-cycle cost (LCC) data in a comparative study with similar data from the USA. The study considers the practical issues in applying the concept LCC by utilizing case studies of commercial office buildings in Japan and USA. The results from the comparative study indicate that there are opportunities to minimize costs during the operational and maintenance phase of overall LCC in office facilities in Japan.

Keywords: Facilities Management, Life-Cycle Cost, Operating Cost, Maintenance Cost

INTRODUCTION

For the last two decades in Japan, the growing recognition of facilities management as a management process that embrace the whole life of an asset, has had the impact of raising the awareness to the need to consider the operational period of building assets. There is a growing recognition of a need for a financial management method that gives proper evaluation to overall cost a facility including operational and maintenance expenses throughout its life-cycle. Various studies seemed to indicate that the standard of the overall life-cycle cost of building facilities in Japan is higher comparing to those in other countries.

The aim of this study is to cast a new light on potential means to cut down LCC of commercial office buildings. In this paper we have shown the current situation of operational and maintenance costs of a sample of typical government office buildings in Japan, and analyzed such costs by comparing with similar building in the USA.

THE ACTUAL CONDITION OF FM FOR GOVERNMENT OFFICE BUILDINGS IN JAPAN

The drive to control LCC is a direct result of the analysis for life-cycle costs of existing office facilities. Its objective is better understood the costs associated with a facility under each phase of its life-cycle and, as a result to promote cost effective FM.

The total cost during the operational phase of a building takes up more than half of its overall LCC cost, In order to find out which to be reviewed and cut down among those operational costs, we take advantage of a comparative analysis among similar facilities. We have made a survey of operational and maintenance costs in typical government office buildings, and its result is shown hereinafter.

Outline of Government Buildings

Our survey was carried on eighteen(18) government office buildings and details of them are shown in Table 1. The range of years after the completion is from 14 to 44 years. In terms of total floor area, the majority of buildings are around $7,000m^2$ and its range is from $4,500m^2$ to $30,000m^2$.

Building Model	W1	W2	W3	W4	W5	W6	W7	P1	P2
Structure	SRC	RC	RC	RC	RC	SRC	SRC	RC	RC
No. of Storey	7FL, 1BF, 1PH	5FL, 1BF	4FL, 1BF	4FL, 1BF, 1PH	4FL, 1BF	6FL, 1BF, 6PH	6FL, 1BF, 1PH	6FL, 1BF, 3PH	4FL, 1BF
Completion Date	1982, January	1980, March	1980, March	1979, April	1978, June	1985, March	1982, July	1956, February	1956, February
Gross Floor Area	11,652	6,580	6,333	7,150	7,203	7,758	7,732	19,198	7,096
Contract Sum (¥Thousands)						233,000	207,094	998 (Total of P1,	,000 P2, P3, P4)
Building Model	P3	P4	P5	P6	P7	G1	G2	G3	G4
Structure	RC	RC	RC	RC	SRC	RC	SRC	SRC	S, SRC
No. of Storey	3FL, 1BF	3FL, 1BF, 1PH	6FL, 1BF	6FL, 1BF, 2PH	20FL	6FL, 1BF	11FL, 1BF	4FL, 1BF	15FL, 2BL, 2PH
Completion Date	1956, February	1956, February	1966, July	1970, October	1984, September	1960, November	1972, March	1972, March	1987, September
Gross Floor	5,390	4,811	7,510	11,163	30,630	4,626	15,383	7,641	33,965
Area (m2)						(Annex block 543)			(Annex block 1,231)
Contract Sum	998	,000	532,500	970,000	10,000,000	291,813	734,707	317,380	5,274,021
(¥rnousands)	(Total of P1,	P2, P3, P4)							

Table 1: Outline of government office buildings

Note: SRC (Steel Reinforced Concrete)

Collection of Data

In our survey, operational and maintenance costs are broken down as show in Figure 1. Table 2 shows the cost breakdown in terms of Operational costs and Repairs and Renovation costs for the 18 chosen government office buildings.



Figure 1: Breakdown of operational and maintenance costs

Buildings G1 to G4 are being managed as one group. In this group, the Operational costs are grouped together. Therefore, in the following analysis, these 4 buildings (G1 to G4) are being treated as one unit, referred as group G.

Similar, the seven buildings P1 to P7, are also being managed as one group. However, the Periodical Maintenance costs and Security & Cleaning costs for P7 are separated from the others in the group due to a special administrative organisation. Therefore, this group of buildings is being treated as two separate units, referred as group P1-6 and P7.

Further, Repair and Renovation costs in G2 and G3 are grouped together. This is also treated as one unit, referred as group G2-3.

In the following analysis, singular unit of building and a group of buildings are generically being addressed as 'Building'.

In the analysis of secular change processed in next section, a sequence of data from the same Building in a certain period is required. Prior to our analysis, we examined all data and particulars of Buildings, and excluded from the analysis, some of buildings that are without available data over certain period or without data over an adequate period. These missing data are shown as shaded cells in Table 2.

Duilding	Group		Operational costs						
model			Periodical Maintenance costs / Security and Cleaning costs		Energy / Water Costs		Repair and Renovation costs		
W1		-	As from 1994	(6 years)	As from 1993	(7 years) *	As from 1984	(16 years)	
W2	-		-		As from 1999	(1 years)	As from 1999	(1 years)	
W3	-		As from 1996	(4 years)	As from 1996	(4 years) *	As from 1996	(4 years)	
W4	-		As from 1999	(1 years)	As from 1996	(4 years) *	As from 1999	(1 years)	
W5	-		As from 1999	(1 years)	As from 1996	(4 years)	As from 1999	(1 years)	
W6	-		As from 1997	(3 years)	As from 1996	(4 years) *	As from 1997	(3 years)	
W7	-		-		As from 1996	(4 years) *	As from 1999	(1 years)	
P1			As from 1995	(5 years)	As from 1994	(6 years)	After completion	(44 years)	
P2	1						After completion	(44 years)	
P3							After completion	(44 years)	
P4	P1-0	Р					After completion	(44 years)	
P5								After completion	(34 years)
P6							After completion	(30 years)	
P7	-	1	As from 1995	(5 years)	-		After completion	(16 years)	
G1		-	As from 1990	(10 years)	As from 1996	(4 years)	After completion	(40 years)	
G2		00.0	1				After completion	(28 years)	
G3	G	G2-3							
G4	1	-					After completion	(13 years)	

Table 2: Building models and available data

Note: * mark in Energy / Water Cost column, refers to 'not recognize fuel costs'

THE ACTUAL CONDITION OF OPERATIONAL AND MAINTENANCE COSTS

In the computation of present net value of operational and maintenance costs, we used two types of indices produced by statistics from the government. One is the "Construction Cost Deflators (CCD)" for wooden & non-wooden structured building, prepared by the Policy Bureau, Ministry of Land, Infrastructure and Transport. The other is the "Consumer Price Index (CPI)" prepared by the Statistic Bureau, Ministry of Public Management, Home Affairs, Posts and Telecommunications. We used the CCD index in our analysis as our analysis revealed no great differences between the CCD and CPI indices. All cost data for Operational and Maintenance costs have been adjusted to the base year of 1999 using the CCD index.

In order to uniform the cost scale, all costs are divided by total floor area and presented as per unit floor area, JPY/m².

Periodical Maintenance costs / Security and Cleaning costs



The profile of Periodical Maintenance costs, Security & Cleaning costs for the 4 Buildings, group G, group P1-6, P7 and W1 over the last 5 years is shown in Figure 2 respectively.

Figure 2: Profile of Periodical Maintenance costs, Security & Cleaning costs

Periodical Maintenance costs are approximately JPY 1,500/m² in group P1-6 and W1, approximately JPY 2,000/m² in group G and P7, more or less. Both of them are steady in this

5-years-period and showing no great variation.

Security & Cleaning costs in group P1-6 shows a slight rise in 1998. It is considered that the reason of this rise is caused by the expense for waste disposal that was changed from incinerating at the own lot to the engagement with waste disposal contractor due to the issue of Dioxin. However, in 1999, it came back to the same level as in 1997. It means that Security & Cleaning costs is considered as steady at approximately JPY 1,300/m² in group G, and within the range from JPY 1,500/m² to JPY 2,000/m² in other Buildings.

Therefore, it is found that the total of Periodical Maintenance costs and Security & Cleaning costs is steady within the range from JPY $3,500/m^2$ to JPY $4,000/m^2$ in P7 which is slightly higher than the level of approximately JPY $3,000/m^2$ in other Buildings.

The following is the analysis of the composition of Periodical Maintenance costs and Security & Cleaning costs. In all Buildings, compositions of both costs do not showing great variation. Thus, in this paper, we show group G as a typical model and proceed with our analysis.

Figure 3 shows the breakdown of Periodical Maintenance costs at group G over the last 5 years, while Figure 4 shows the same for Security & Cleaning costs.







Figure 4: Breakdown of Security & Cleaning costs in group G

For the Periodical Maintenance costs (Figure 3), it is obvious that expenditures on four systems account for its major part, i.e. Mechanical & Electrical (M&E) system, Elevators, Air-conditioning system and Chilled & Hot water supply system. The sum of these expenditures account for more than 70% of overall cost.

Viewing the trend over the last 5 years, although expenditure to fire fighting system shows a slight rise, others are steady without great variation.

As regards to Security & Cleaning costs, Cleaning costs take up 70% of the overall cost. Similar for Periodical Maintenance costs, no great change is found over the last 5 years.

Energy & Water costs

To analyze the change in Energy & Water costs, the trend of expenditure for four items, viz. Electricity, Gas, Water and Fuel for W1, W5, group G and group P during the last 4 years are shown separately in Figure 5.



Figure 5: Transition of Energy & Water costs in W1, W5, group G and group P

In all the buildings, there is no great variation in the overall costs and in its composition during the period.

Taking Energy & Water costs in 1999 as the exemplary and comparing the four buildings, W3, W4, W6 and W7; the overall cost at W1 is slightly higher as shown in Figure 5. It is considered that this is due to the large computer room in W1. In the other buildings, Energy & Water costs are within the range from JPY $3,500/m^2$ to JPY $4,000/m^2$ annually. And in all buildings, it is found that the ratio of expenditure to Electricity is high while to Fuel is low.

INTERNATIONAL COMPARISON OF LCC MODEL

In the previous section, we have shown the result of our survey conducted on typical government office buildings in Japan concerning to costs in the operational phase of facilities, which accounts for more than half of its overall LCC.

In this section, a comparative study for Operational and Maintenance costs was conducted on similar type of office buildings in Japan and the USA. The results of the analysis are shown in Figure 6 and 7.

For the purpose of this comparative study, Table 3 shows the common parameters use the sample selection. For this study, we conducted our questionnaire survey on facilities' owners in Japan, and on consultants in USA. Cost data obtained from both countries are, same as in the previous section, were converted to the base year of 1999.

It is clear from the analysis that the LCC of typical office buildings in Japan is generally higher and almost 150% of the same in the USA at the current exchange rate.



	(Hundreds million JPY)			
Country	Japan model	USA model		
Construction cost	¥11.7	¥7.1		
Maintenance & security/clea	¥14.4	¥8.8		
Energy cost	¥14.6	¥10.4		

Figure 6: Comparison of LCC between USA and Japan



Figure 7: Comparison of wages between USA and Japan

Items	Descriptions		
1. Use of facility	Office		
2. Total floor area	6,494m2		
3. Type of main structure	Reinforced concrete		
4. Items for comparison study	Construction cost, Operational and Maintenance cost, Energy & Water cost		
5. Life-cycle period of facility	60 years		
6. Interest	Due to the comparison study, interest is not considered		
7. Others	Expenses for Design, renewal, refurbishment, demolition and overhead are not included.		

Table 3: Conditions in comparison of LCC models between USA and Japan

Periodical maintenance cost and security/cleaning cost

As For Periodical Maintenance costs and Security & Cleaning costs, although wage levels of maintenance labor in Japan is about the same level as that in the USA, the cost to typical building in Japan is as high as 160% of the same in USA.

In Japan, in order to secure the safety of facilities, various laws prescribe the procedure for Periodical Maintenance services for Electrical system, Elevators, Fire-fighting system, Sanitary system in detail, such as required maintenance engineer's qualification, frequency of maintenance services, report to authorities and so on. This sort of services requires maintenance labor two to three times of that in USA.

Energy & Water cost

It appears that there is no great difference in Energy consumption between USA and Japan. However, Energy cost to typical building in Japan is 160 % of the same in USA. It is considered that the higher energy price in Japan is the cause of such situation. Table 4 shows the comparison of Utility rate between Japan and USA prepared by Cabinet office.

Itoms	Index (assume 100 in Japan)			
liens	In Japan (Tokyo)	In USA (LA)		
Electricity (consumption of 290kwh)	100	65		
Gas (consumption of 550,000kcal)	100	36		
Water (consumption of 20m ³)	100	47		

Table 4: Com	parison of	Utilitv ra	ate between	Japan	and	USA
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CONCLUSION

In this paper, based on the analysis to actual data on Operational and Maintenance costs of typical government office buildings, we have shown its overview. Further, concerning the Operational and Maintenance costs to facilities during the operational phase of its LCC, we have studied and analyzed those elements that show higher cost comparing to in USA.

Due to the recession and lack of funds for new projects, there are indications in Japanese construction market that the trend is changing from Flow to Stocks. Over the next 10 years, the amount of investments on new facilities will be getting smaller while that for existing building stock is projected to rise. We need to maintain and keep the existing building stock in good condition. Therefore, it will become more important to control the Operations and Maintenance costs of facilities.

The Operations and Maintenance costs to existing facilities will grow significantly in the near future and it will affect the construction investments across the nation. As a result studies in the curtailment of maintenance costs will become more important. The control of maintenance costs and energy costs will be important focuses of research. The development of maintenance-free-system is also important. In addition to the above, it is important that tools and aids are well prepared in order for facilities owners to draw a proper maintenance plan. And further, we have to set criteria for the evaluation of existing facilities for the sake of adequate maintenance plan.

LINKING WORKPLACE DESIGN TO BUSINESS OBJECTIVES: A MACRO-ERGONOMIC APPROACH

Dr. Michael J. O'Neill

Herman Miller, Inc. Mike_oneill@hermanmiller.com

Abstract

In some workplace architecture and interior design projects today, organizational and business objectives are only indirectly addressed. Once implemented, there is rarely a systematic assessment of the benefits of the design response.

This paper describes a "macro ergonomic" approach to support decision-making in design. This approach includes consideration of architecture and work environment features, technology and work practices, and the linkage between these elements and the business mission. Part of this approach is a measurement model that can be used as a tool to maintain focus on the direction of the design during development, and as a framework for assessing the success of the design after implementation.

This paper describes two Case Studies of recent architectural planning projects with clients in the energy and financial services industries. These Case Studies describe the decision-making process and the measurement framework. The first Case Study involved the development of a logical model guiding decisions pertaining to consolidation and re-design of facilities for an Energy utility company. The second Case Study involved the creation of a facility performance model to evaluate the performance of a group of Call Center facilities. The model was used to provide strategic decision-making support for the redeployment and balancing of capital resources across the facilities.

Keywords: Design, architecture, decision-making, macro ergonomics, measurement, organizational effectiveness

INTRODUCTION

In some workplace architecture and interior design projects today, organizational and business objectives are only indirectly addressed. Once implemented, there is rarely a systematic assessment of the benefits of the design response. Given the increasing pressure on organizations to leverage all capital investments (including buildings) in pursuit of business goals, we argue that workspace design is playing an ever more critical role in the success of companies.

This paper describes a "macro ergonomic" approach to support decision-making in design. This approach includes consideration of architecture and work environment features, technology and work practices, and the linkage between these elements and the business mission. Part of this approach is a measurement model that can be used as a tool to maintain focus on the direction of the design during development, and as a framework for assessing the success of the design after implementation.

This paper describes two Case Studies of recent architectural planning projects with clients in the energy and financial services industries. These Case Studies describe the decision-making process and the measurement framework.

THE MACRO ERGONOMIC MODEL

In this section, we discuss a "Macro Ergonomic" model for understanding the relationship between the physical work environment and business objectives. Traditional ergonomics is concerned with the "micro" work environment - the fit of people to their workstations, for instance
(Hendrick, 1986; 1995). Macro ergonomics is an emerging field in which the overall physical work environment is aligned with the business objectives of the organization (Hendrick and Kleiner, 2001; O'Neill, 1998). Based on a systems approach, we take a broad view of all elements of the business (DeGreen, 1973; Taylor and Felton, 1993). The model itself is composed of three major subsystems: the social subsystem, the technical subsystem, and the environmental subsystem (O'Neill, 1998).

Elements of the Model

The components and processes of the macro ergonomic model are graphically depicted in Figure 1. In this model, the input (in knowledge work, typically data, information, or ideas) is transformed into a knowledge product that has value to a customer or market. Ultimately, this product (or output) of the system furthers the business mission of the organization. This model is purposefully somewhat abstract, because it can be applied at the level of an entire organization, or at some much smaller subpart of an entire company. These include: the technological subsystem (information technology, tools and processes), the people subsystem (human resource issues, work styles, performance), the physical work environment (spatial dispersion of facilities, work environment design, facilities and real estate issues), and external factors that may affect the business (see Figure 1). The environment forms the context within which the activities of the social and technical systems occur, as well as the act of transformation (work).

a. - Purpose

The first element that must be considered is the purpose, or business mission of the organization (see Figure 1). The work environment can be designed as a tool to be used in support of achieving the purpose of the organization. The design of the work environment itself must align with the organizational mission, and both must be viewed as being open to continuous change. Change will surely appear from one of a number of business change drivers (see Figure 1).

b. - Objectives

Business objectives must relate to the purpose of the organization, and may contain concrete statements such as yearly production targets, number of new products developed in a given time period, and the like (see Figure 1). Objectives are measurable, and longer term in nature, and can be stated as goals such as: "increase rate of communication between marketing and Research and Development by 50 percent."



Figure 1: Macro ergonomic model

c. - Output

System output should be consistent with the business objectives (see Figure 1). The output can be a physical product or service activities that create value for both the customer and

organization. We view the overall work environment as a means of supporting the other work subsystems through which the output is achieved. Decision-making about aligning the Work Environment with system output should be integrated with overall architectural design concept development and planning.

d. - Throughput

The process of throughput of input through the system is complex, and includes a consideration of "input," "transformation," and "output" elements. The input enters the social, technical, and environmental subsystems, in which some series of transformation (work) events, through individual, group, or organization-wide efforts, act on that input (see Figure 1). To be successful, this output must meet two criteria: 1) it has created additional economic value for the organization, and 2) it is congruent with meeting the purpose of the organization. Note that in this model, the technical and social subsystems reside within the environmental subsystem. In most organizations, the technical and social processes of work take place in the context of the physical environment. Thus, depending upon the organization, the physical subsystem can also form the system boundary for the other two subsystems. The boundaries of the physical subsystem will vary with emerging work styles that include greater choice of work location and technology options.

e. - Boundaries

There are four types of boundaries in our systems model, including: throughput, physical, social, and time. We will limit our discussion here to the physical boundary. This boundary is defined by the space occupied by the people and technology involved in work. The activities of the entire work system occur within the physical space. This space may occupy one floor within a large building, a campus of buildings, or a far-flung network of facilities and offices located around the world.

f. - External Environment: Change Drivers

The macro ergonomics framework also considers external drivers of change that may affect the growth of a business, and the systems or processes within a business. The model in Figure 1 illustrates some external drivers of organizational change, such as: competition through growth, demographics of the employee population, and technology that can force an organization to change its' subsystems or face problems. The physical work environment, because of cost and other factors, often lags behind technical and people subsystems in terms of responding to external change.

The Measurement Model

Because of its emphasis on understanding specific goals and outputs of the work system and work environment, the macro ergonomic framework (Figure 1) permits the creation of a measurement approach that can link changes to the work system to impacts on behaviors and goals at various levels of the organization. The Measurement Model illustrates an approach that allows business objectives to guide design decisions. The model supports the creation of measures to assess the impact of design decisions on financial and non-financial business The model considers organizational goals at three different levels: mission of metrics organization, business unit objectives, and group/individual goals (see triangle at left of Figure 2). At each of these levels, it is possible to articulate objectives and measures, (see "Objectives and Measures" column, Figure 2) potential work system design responses (see "Process/Technology/Workplace Re-design and Implementation" column, Figure 2), and measures to assess the impact of the design intervention on those goals or objectives (see "Audit Business Impacts" column, right side of Figure 2). This framework permits us to formulate design responses that are strategically linked to business and behavioral goals, and then test the success of the design response against those goals.

CASE STUDIES

In this paper, we present two Case Studies that describe the design decision-making process at the "Organizational Mission" and "Business Unit Objectives" levels (see Figure 2).



Figure 2: Measurement Model

Case Study 1: Strategic Decision Model for Design of Energy Utility Facilities

a. Client Background and Need

The company, in the energy industry, had employees in multiple locations around a large metropolitan area. Key organizational functions were spread out across 10 sites. Department and Project team members located across these sites were required to coordinate their activities from these dispersed locations. Employees scattered across multiple locations resulted in "organizational silos" in which people had trouble sharing a common vision the objectives and mission of the organization. This situation affected work processes, interaction, and communication between departments and teams, which impacted the ability of the organization to achieve its mission.

b. Creating a Strategic Decision Model

We created a model for decision-making focused at the "Organizational Mission" level (see Figure 2). The purpose of this model was to:

- 1. Create an underlying, agreed upon rationale for the development of the space that is driven by the business mission of the company,
- 2. Keep the process "on track" in terms of design intent so that the results align with the original goals of the project, and to
- 3. Lay the groundwork for a systematic program of measurement that will result in a "proof statement" of financial and non-financial outcomes related to the implementation of the project.

c. Logic of the Model

The decision model (see Figure 3) considered the linkages between four factors, including:

- 1. The Value Drivers for the organization
- 2. Organizational Objectives
- 3. Work Practices and Business Processes
- 4. Work environment design

Strategic Decision Model:

Consolidation and Workplace Design Improves Business Process and Organizational Effectiveness



Figure 3: Strategic Decision Model

i. Value Drivers

Value Drivers (see leftmost column, Figure 3) refer to mission-level objectives of the organization. These are shared organizational values, that in turn help the company create long term value for its' shareholders and customers.

ii. Organizational Objectives

In this model, there are four organizational objectives (see second column from the left, Figure 3), including: Flexibility, Communication, Operational Efficiency and Image.

iii. Work Practices/Business Process

This factor refers to key work practices and processes that are critical to supporting the Organizational Objectives (see second column from right, Figure 3).

iv. Work Environment

This factor contains the key features of the work environment thought to drive change in Work Practices and Business Processes (see rightmost column, Figure 3).

v. Dynamics of the Decision Model

This model (see Figure 3) predicts that if Organizational Objectives are attained, they will in turn create value for the customer, shareholders, and the organization, as described within the "Value Drivers" factor. In order to attain these Value Drivers, the work practices and business process must be aligned with Organizational Objectives. Thus, once the value drivers and organizational objectives of the organization (rightmost column) are understood, the Work Practices and Work Environment can be designed to support these strategic elements – thus the "right pointing" arrows in Figure 3.

d. Implementation of the Model

As a result of developing the strategic decision model, the team concluded that consolidation and work environment re-design would be the appropriate strategy to meet the identified business goals. The strategic decision model indicated that cost reductions, improved work and business processes would directly impact key value drivers to the company. Once implemented, the project moved 750 employees in 17 departments, from ten separate locations into two new, build-to-suit structures with different space standards and a layout utilizing new furniture.

e. Summary of Business Results

Once the project was complete, we gathered feedback pertaining to the impact of the new work environment on the four key Organizational Objectives within the Strategic Decision Model (see Figure 3).

i. Flexibility in Response to Business Changes

The company wanted the ability to rapidly adapt to changing market conditions, opportunities and customer needs. Thus, the design of a flexible environment that could change with conditions was critical. Standard office layouts were developed that enabled changes to be made easily. The layout allows people to be moved around without requiring a reconfiguration, resulting in lower costs and reduced change cycle times. The user can adjust the work surface and facilities can quickly change heights. This allows a workstation to support organizational flexibility and be correctly fitted a greater number of employees as they move in and out of these spaces.

ii. Communication

The strategic decision model (see Figure 3) identified a key organizational objective of "Communication," which is defined as: access to, and timely information from leadership, and interaction between individuals and groups within the company.

Access to Leadership. After the consolidation, the management team was able to improve their response time in making business decisions due to less travel requirements and the availability of all the information needed being in one location. Leaders are also able to interact face to face with their teams more, and observe interaction among their employees.

Interaction between individuals and groups. The design of the new space promotes a teaming environment, with lower walls and planned adjacencies to other departments. This has enhanced communication and increased interaction between departments.

iii. Operational Efficiency

When asked about the impacts on the facilities project process, the client team reported that each department was able to increase operational efficiencies through easier, quicker, and more effective business processes. By having all functions together, business approvals are taking place in less time and project management functions have become easier.

iv. Image

The location of the new facility has made the company more visible and promotes a positive image to the community. The facility itself features large external signage, which reinforces the company message. External signage was not used prior to the consolidation.

v. Retention and attraction.

Anecdotal conversations with employees also reveal that the new facility has contributed to a higher level of employee satisfaction. After the move, executives reported a "different feeling" from the employees, and received complimentary letters regarding the new space. These feelings were also captured in recent employee surveys, showing increased satisfaction and morale.

<u>Case Study 2</u>: A Facility Performance Model for Resource Allocation

a. Client Background and Need

This Case Study involved the analysis of the performance of a group of six Call Center buildings by generating a set of performance criteria based on the employee needs and objectives of the Business Unit. The decision-making process for this project was targeted at objectives at the level of the Business Unit (see Measurement Model, Figure 2). The resulting data was used to build a strategic planning model to guide decision-making around the redeployment and balancing of capital resources across the six facilities.

b. Process Overview

The process we used for gathering and analyzing data to build the decision-making model is based in part on Land and Jarman's (1993) future-oriented approach to system design. This process creates an environment in which people at different levels and roles within a company can freely express their ideas in a group setting, and privately "vote" on the issues according to their opinions (O'Neill, 1998). In this study, 12 groups of 20 employees each (two groups from each of the six facilities) participated. The groups included a representative sample of Business Unit leads, their direct reports, work team leaders, and call center operators. Prior to these sessions, we used the macro ergonomic approach (see Figure 1) to develop a set of issues representing needs around the technology, work process, and work environment subsystems of the business. These issues (see Table 1) can be thought of as performance criteria, reflecting a

broader view of the work system, and are related to solutions that can be supported by workplace design.

Once the performance criteria were reviewed, participants evaluated these characteristics on two dimensions: importance of each characteristic to future success of the organization, and current performance of the existing work environment on each issue. Evaluation of "current performance" was then compared to assessment of "importance to the future" for each issue, to create a strategic planning model.

This evaluation was conducted through a voting system using proprietary software that permits the instant display of the group's level of consensus on those issues. The results were immediately displayed to each group in the form of a graphic "Strategic Planning Model" (see Figure 4). This allowed for additional discussion and elaboration by the group.

i. Work Environment Issues List

Table 1 lists the "Work Environment Issues" that were generated prior to the sessions. In the list that follows, information about each issue is provided: an identifying issue number and keyword, and definitions for that issue. The issue number, and keyword are used in the analyses later in this paper.

Issue	Definition	Issue	Definition
1. Aesthetics	Quality of finishes, materials of work spaces	8. Storage	Storage supports job needs in the work space
2. Workspace designed for function	Workspace is designed to support job function	9. Workspace supports teams	Workspace supports team work
3. Visual Privacy	Workspace supports visual privacy	10. Flexible Work Style	Alternative Officing Strategies Flexible shifts work anytime/anyplace
4. Acoustical Privacy	Workspace supports confidential conversations Control over hearing unwanted noise or conversations	11. Adaptable facility	Support space for vendors, consultants
5. Ergonomics	Adjustability, healthy work space, appropriate fit of workspace to worker	12. "Best in Class" environments	Industry leader in provision of work environments Environments used in recruitment and retention
6. Amenities	Convenient physical access to Ice, vending, coffee, dry cleaning, other needs	13. Cost efficient work environments	Minimize churn costs Minimize operating expenses
7. Convenient access to technology	Convenient physical access to copiers, printers, fax, etc. within the work place	14. Consistency in standards across sites	Consistent application of work space standards across the company
		15. Status	Design and materials of work space reflect the worker's status in the organization

Table	1.	Work	Environment	Issues
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c. The Strategic Planning Model

The Strategic Planning Model is divided into 4 quadrants (see Figure 4). These quadrants include "Ideal Zone," (upper right quadrant) "Immediate Opportunities," (upper left quadrant) "Long Term Opportunities," (lower left quadrant) and "Over Performance," (lower right quadrant). Issues can fall into any of these quadrants. The Upper Right Quadrant contains issues that are currently performing well, and are also important to future work success. These issues are known as "maintainers," since they are items that the organization should continue to support and "do well." The Upper Left Quadrant contains issues that are not currently performing well, but that are of near term importance to future work effectiveness. The Lower Left Quadrant contains issues that are not currently performing well and are viewed as being important to future work success - but over a longer time frame. The Lower Right Quadrant contains issues that are currently performing well, but are low in importance to future work success. These can be thought of as "over-performing" issues because their performance is greater than their overall importance warrants.

i. A Dynamic Model for Predicting Change

This model is dynamic, that is; it predicts that the issues will move through the quadrants of the profile over time (see circular arrow, Figure 4). This characteristic makes our approach quite useful for strategic planning. This model predicts that issues enter the profile in the lower left quadrant, as long term opportunities, until internal needs and/or external events compel them to rise in importance within the organization, until they become "immediate opportunities" (see Figure 4, upper left quadrant).

If appropriate resources are applied to these needs, the model predicts they will move into the Ideal Zone of high performing issues (see Figure 4, upper right quadrant). Over time, issues in the Ideal Zone can "drop down" in importance to the future, into the lower right quadrant (Over Performing Zone). These may be issues that originally were in the upper right quadrant (high performing, high importance zone) but because they have been doing well for so long, they fall in importance in the organization.

d. The Model: Identifying Strategic Opportunities

Figure 5 shows the matrix of the issues along two axes: "Future Importance" to the company's success (vertical axis), and "Current Performance" of each issue (horizontal axis). The numbered boxes within the model indicate the location of each issue, resulting from the analysis. Each number is keyed to the definition found in the Work Environment Issues list (see Table 1). In addition, the short descriptive phrases used to identify each issue are adjacent to each numbered box.

We found that two issues; "Ergonomics" and "Convenient physical access to technology," fall into the upper right quadrant (see Figure 5). Four issues ("Acoustic privacy," "Flexible work style," "Adaptable facility," and "Work spaces designed to support job function") fell in the upper left quadrant (see Figure 5). Five issues ("Best in Class" environments, "Workspaces support teaming," "Cost efficient work environments," "Consistent standards across the company," and "Visual Privacy") fell in the lower left quadrant (see Figure 5). Four issues ("Aesthetics," "Storage," "Access to Amenities," and "Workspace reflects employees' status") fall into the lower right quadrant and are thus are that are performing well, but are not viewed as relatively less important to the future success of the company (see Figure 5). The issues residing in the upper left and upper right areas of the matrix – the "Ideal Zone" and "Near term opportunities" (see Figures 4 and 5) include: ergonomics, access to technology, flexible, adaptable, functional and acoustically private space.



Figure 4: How to Interpret the Strategic Planning Model

These issues represent a fundamental shift away from a need for amenities, status symbols and aesthetic concerns, (see Figure 5, lower right quadrant – "over-performers") and towards a flexible, adaptable approach to the provision of workspace that is related to effective work and the objectives of the business unit.



Figure 5: Strategic Planning Model: Response on each Issue (All Sites)

e. Analysis of Facility Performance Across Sites

We then used the data derived from the model to create a comparison of overall facility performance on the Workplace Issues across the six sites within which the research was conducted (see Figure 6). For this analysis, we combined the means of each of the 15 issues on measures of Importance to Future, and the measures of Current Performance, into an index for each measure for each location. Figure 6 shows the average "Importance to Future scores "across the sites (dark bars, rear of chart).

From these results, we recommended that tactics to enhance workspace acoustic privacy, functionality of workstation design, flexibility in support of different work styles, and adaptable facilities be implemented. In addition, we suggested that design to support confidentiality of work and work materials should be made a criterion for individual workspaces and group space design.



Figure 6: Analysis of Facility Performance Across Sites

This analysis suggests that the population of respondents across all sites is in general agreement about the relative importance to the future, of this set of issues to the organization.

When the Current Performance index is compared across sites, it shows that the Ft. Lauderdale, Greensboro, New York, and Phoenix sites are somewhat under-performing on the strategic issues, relative to the Salt lake and Minneapolis sites (see light colored bars, front of chart, Figure 6).

When "Current Performance" scores are compared to "Importance to Future" scores, it reveals that the Salt Lake and Minneapolis sites are slightly over-performing on the issues. The "Current Performance" scores for those sites are actually slightly higher than the scores for those sites on "Importance to Future." Thus, the opportunity is available to shift resources from the over-performing locations to benefit the under-performing locations. We suggested that this recommendation could be implemented by reallocating resources away from issues such as: Aesthetics, Storage, Amenities, and Status, which are "over-performing" issues, (see Figure 5) and no longer represent the strategic direction that facilities need to take to enhance effective work.

f. Implementation of the Model

As a result of developing and using the data from the model to analyze facility performance across sites, the team concluded that a re-allocation of capital investment between the sites was necessary. In addition, the team decided to revamp the corporate-wide facility design standards to reflect the shift in Business Unit priorities revealed by the model. This data-driven model proved so convincing to management that the team used it to drive the design guidelines for a new corporate headquarters that was planned for the following year.

CONCLUSIONS

These Case Studies employ a "macro ergonomic" perspective, which includes examining work process, organizational and management issues, technology and the physical elements of architecture and workplace design. With such an approach, the interactions between all elements of the work system are considered in creating the solution. Another key theme in these Case Studies is the use of participatory processes, which involve employees in sharing their understanding of issues relating to their work and the workplace.

The Case Studies incorporate the use of a broader, macro ergonomic perspective that supports the creation of a model for decision-making to guide design (Case Study 1) or a strategic assessment of facility performance based on user input to business criteria (Case Study 2). In both Case Studies, the macroergonomics approach, and measurement model permit a framework from which assessment can be made based on data instead of opinion. Both case studies provide the framework for a before-and-after measurement program to illustrate the actual effects of an intervention that can be related to salient management issues. While combining a program measurement strategy with an intervention does increase the cost of implementation slightly, it allows the case to be made for additional investment, and it can be used to align the goals of the architectural design or facility strategy with issues that are important to management, such as employee retention, customer satisfaction, and financial performance.

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USABLE WORKPLACES – INVESTIGATING THE CONCEPT

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 of Technology, Gothenburg, Sweden **Professor Tore Haugen** Norwegian University of Science and Technology, Trondheim, Norway **Kari Vissanen** VTT Building and Transport, Finland

Abstract

Conventional approaches to building performance focus on technical, functional and operational aspects of their use. More recently, building performance appraisal has focused on functionality, serviceability and accessibility in an attempt to assess buildings-in-use. On the other hand, post occupancy evaluation seeks to relate building performance to the design intentions. However, occupying organisations consider buildings from a different perspective, as workplace settings, and need appropriate concepts and techniques to assess their value.

In contrast, usability is one of the most important, but most often neglected, aspects in the assessment of buildings and workplaces. Work to apply concepts of usability, widely used in appraisal of other consumer products, to 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 and workplaces.

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 key concepts and discusses some of the theoretical 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 four European countries, presents the case study framework and raises methodological issues arising out of the work. The case studies consider the use of particular tools and techniques for assessing usability - community-based planning, universal design and design quality indicators – in the context of facilities management. Results of the two-year programme of work will be presented at the congress.

The paper will be appropriate for a mixed audience of practitioners, researchers and academics and will highlight the opportunities for collaboration in 'new knowledge production'.

Keywords: Usability, building performance, workplace appraisal, 'new knowledge production'

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:

- 1. Laboratoire Espace de Travail, La Villette, Paris, France
- 2. Norwegian University of Science and Technology (NTNU), Trondheim, Norway
- 3. Chalmers University of Technology, Gothenburg, Sweden
- 4. University of Salford, Greater Manchester, UK
- 5. 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.

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.

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.

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.

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.

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.

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.

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.

Four case studies have been selected and are being prepared, one each in the United Kingdom, Sweden, Finland and France and a fifth is planned in Norway. All five case studies and associated workshops will be completed by May 2005.

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 and radiology centres, 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 French case study took place in Technocentre Renault in Guyancourt. Renault has shifted its focus in the production chain from defining its core business as manufacturing of car to design of cars. This has been the underlying idea when designing the Technocentre. The studied La Ruche Building is housing those design projects that are supposed to go into production. The case contributed to the understanding of usability in many ways. The importance of a well articulated business strategy was clear and need to balance the productivity aspects with the cost aspects in the use of buildings was obvious and above all the importance of managing 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.

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).

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).

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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USABILITY OF BUILDINGS - THEORETICAL FRAMEWORK FOR UNDERSTANDING AND EXPLORING USABILITY OF BUILDINGS

Monica Jensø Geir K. Hansen Tore I. Haugen Norwegian University of Science and Technology, Norway Faculty of Architecture and Fine Art, Department of Architectural Design and Management

Abstract

Usability, with focus on the user perspective, is one of the most important, but often most neglected, aspects of building performance. A new CIB Task Group (TG51) has been created to apply concepts of usability, to provide a better understanding of the user experience of buildings and workplaces. 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" (ISO9241, 1998).

The work of the task group proceeds through a program of action research, comprising an intensive series of case studies and workshops, in association with occupying organizations, 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 program of work will centre on the user experience of buildings and research on buildings-in-use, and will focus on concepts of usability.

NTNU/SINTEF are a part of this Task Group, and we are going to do a research and case study together with our research partner The Norwegian Directorate of Public Construction and Property. The paper introduces the theoretical discussion related to the area of "usability of buildings"; how to do the term "usability" operational, and how important are surroundings compared to user's effectiveness, efficiency and satisfaction?

This paper is also presenting our case study. The case study object is Nord-Trøndelag University College at Levanger.

Keywords: Building performance; educational buildings; usability; workplace.

INTRODUCTION

Public legislations are regulating several parameters describing building functions. Some decisive qualities of a building can however not be directly regulated through legislation. This is the matter of question for qualities like usability.

Legislations and standards are mainly concerning two aspects of buildings:

- they are defining minimum performance and qualities of the completed building
- they are describing how to measure that we have received the desired quality of a building.

Despite of present legislations, standards and measuring methods, many buildings are still struggling with serious failures and weaknesses in performance and function, and the potential for improvements are still comprehensive.

WHAT IS DEFINING USABILITY OF BUILDINGS?

The organization

Various organizations are characterized by different types of work, objectives and organizational structures. According to buildings, organizations have individual objectives and intentions related to what they want to achieve by using a specific building, or by developing or rebuilding a building. The intention of developing a new building may be a contribution to a desired change or development of the organization. The organizational characteristics are in this way contributing to the concept of usability in a building. A specific building can be usable for one organization, while another organization finds it unsuitable related to their needs.

The organizations criterions related to a new building is stated during the programming phase; "Programming is the fundamental activity in planning of buildings. The objectives and desired qualities of using the building is expressed and stated during the programming"¹. The programming work is in a high degree affecting usability of the building.

One of the major challenges in the programming phase is the translation of the organizations criterions into a programming document, and further on into a design. This is work mostly done by hired advisors and architects, not knowing the organization very well. Due to this it may be a challenge to achieve a program document and a design reflecting the criterions of the user organization. These criterions are also dependent on the context and setting that the organization is operating in.

Standardization and legislation

The purpose of legislation and standards is to define a building in advance of the completed building, during the planning and design phase. Demands for function and performance of a building, usually stated in the building program, is an expression of the proprietors objectives and purposes, activities and functions. In addition to this the program states the conditions and frames that must be present for the building project. The programming phase is a process of systematical collection, documentation and specifying criterions affecting the expected performance of the building.

In the Norwegian standardization system different standards affect usability of buildings in different ways and areas, and we will mention some of the most important ones. Usability of buildings, focusing on functionality of buildings, is influenced by the "Table for building functions"². These standards have a structure and classification that enable a complete description of a building to be assembled from information concerning a building's functional characteristics. These standards are used in relation to programming of functional demands, based on defined user functions, control of the design related to functional demands, planning of maintenance, life cycle analysis, independent evaluations and testing of buildings functional characteristics, databases for functional demands and so on. In addition, there are several other standards³ considering available technical solutions in building projects. We also have several standards regulating how a project specification is to be built up and what it should contain, and the different elements and technical installations for the purpose of classification of information, to develop qualities in use and other qualities. We also have regulations⁴ for measuring building area, and stating technical demands and labeling for building products.

Norwegian building projects and the building trade also observe international standards. The ISO 9000's are a series of international standards dealing with the quality perspective, making demands on activities and processes in different organizations regarding quality. Quality⁵ is defined as "the ability to satisfy the customer demands and needs." This means that the quality

http://www.standard.no/imaker.exe?id=4959&visdybde=2&aktiv=4959

¹ Statens byggeforskningsinstitut, "Programmering"

 ² Standards Norway, "NS 3455 Table for building functions".
 ³ Standards Norway, "NS 3420 Specification texts for building, construction and installations", "NS 3450 Project documents for buildings and civil engineering works", "NS 3451 Table for building elements", "NS 3940 Areas and volumes of buildings"

⁴ The Ministry of Local Government and Regional Development, The Ministry of the Environment,

[&]quot;Norwegian Regulations for demands of buildings and building products"

experienced by users depends on the end product being in accordance with the customer expectations and needs.

Measuring methods – Different approaches to the concept of usability

Until lately little has been written or research done on 'usability in buildings.' The terms are vague and little tangible. The concept of "usability" is widely known in relation to applications within product design and in information technology and web-design, related to user friendliness and user interface related to the system.

Different companies are measuring features related to usability and building performance in different ways. In accordance with The Working Environment Act⁶ it has become more and more common among the largest companies to do regular examinations or investigations related to health, working environment, safety, user satisfaction and well-being. However, these investigations are difficult or not related directly to the physical surroundings and the building's features. It is therefore a necessity to do a further development of measuring methods for this use.

Several terms are in use that are related to different measuring methods for buildings. To give an example of this we can mention building-in-use-studies, building diagnostics, building pathology, building evaluation. The problem with these terms is that they are focusing on the building as a product, and do not include the process-oriented evaluation of the building process as a totality. It is essential to develop a measuring method that includes other perspectives like the life cycle perspective and the relation between the organization and the physical surroundings serving the organization.

Post Occupancy Evaluation (POE)⁷ was introduced as a measuring method in the 1960's, as a reaction to considerable problems related to buildings functionality, especially from the users' point of view. POE can be translated as *"evaluation of buildings-in-use"*, and is a method identifying and evaluating several aspects of building performance from the users' needs, and identifies ways to improve building design, performance and fitness for purpose. POE is representing the opposite process of programming, as it is comparing actual performance with expected criteria and users' demands. Programming is a transformation of the proprietor's objectives and purposes into a program by systematic collection, documentation and specification of criteria in relation to expected building performance.

According to Granath⁸, Wolfgang Preiser⁹, who is the pioneer in developing Post Occupancy Evaluation techniques, is an important contributor to this field. Granath says in his note that POE is a technique strongly tied to performance, and is traditionally a technique that is used after a building is in use.

Granath also says that "The Serviceability Tool", developed by Gerald Davis et al.¹⁰, is one of the most wisely used practical and theoretical tools or methods used to evaluate building performance. Davis distinguishes between performance and serviceability. He argues that "Serviceability is about whether a building or facility is capable of performing as required. (...) Performance means actual behaviour in service at a given moment." Granath says that Davis defines serviceability as a broader term than performance, which indicate that his interpretation of satisfaction has a general meaning and is not connected to individual values dependant on situation, context and time.

In accordance with this, Granath expresses that POE and Davis's Serviceability Tool are two competing methods to evaluate and rate buildings in relation to their intended use, because both

⁶ The Ministry of Labour and Government Administration, *"The Working Environment Act"*

⁷ NTNU, Department of Building Technology, Faculty of Architecture, Planning and Fine Arts. "EEU-course, Facilities Management."

⁸ Granath, J., Å., Note concerning usability of buildings, written for the usability workshop in Turku.

⁹ Preiser, W.F.E., et al., "Post-Occupancy Evaluation".

¹⁰ Davis, G. et al., "Serviceability Tool, vol 1 – 5".

are focusing on observing and measuring certain physical aspects of the building or the facility, and evaluated in relation to intended and/or actual use.

Ongoing research related to measuring of usability

There are currently several ongoing research projects that are investigating the relationship between physical surroundings and buildings-in-use. In this paper we are mentioning some of the relevant projects related to the theme, involving interesting approaches to usability of buildings and measurement of building performance. The projects are cover different building categories, but the challenges concerning the relationship between users and physical surroundings are mainly the same.

The project "The Knowledge Workplace"¹¹, undertaken by SINTEF Technology and Society, is focusing on the relationship between physical surroundings, organizational aspects and information and communication technology (ICT). The background for the initiative is the attention that has been given to new office solutions in recent years. The emphasis has been on flexible office solutions, mobile technologies, communication, knowledge creation, identity creation and aesthetics. Much of this development has been driven by consultants and suppliers, without asking questions about what is to be achieved and whether the organizations actually reached the goals they have set for themselves. The project is working on developing methods for measuring how the surroundings are affecting organizations effectiveness, efficiency and user satisfaction.

A similar project, "The Nordic Knowledge Workplace"¹², is conducted under the direction of the Nordic Innovation Centre. The primary objective of the project is how to use workplace design as a strategic mean to promote innovation, knowledge sharing and cooperation in Nordic organizations. This project is, among other things, focusing on measurable relationships between design of workplaces and performance.

There were various other research projects that have been evaluating building performance related to health buildings. SINTEF, on several occasions, has been evaluating the relationship between new physical surroundings, efficiency and cost in use, and well-being and satisfaction among inhabitants.¹³ During these projects they have developed comprehensive knowledge of different models for dwellings and how these are functioning for different categories of users. Guidelines and handbooks for physical design are being developed from such research projects.

There are also research carried out that investigate the relationship between the organization, operation and building in the planning and building process for the new university hospital in Trondheim, St. Olavs Hospital. SINTEF Civil and Environmental Engineering and SINTEF Health Research have completed several projects¹⁴ in cooperation with the development organization. These projects have mainly been focusing on the relationship between the organization and operation of the hospital, and how the new hospital should be designed to satisfy the user organization.

Another project studying physical surroundings and measuring methods is the project "Kontorbyggets arkitektur. Opplevelse og betydning"¹⁵, which is a thesis in the area of environmental psychology. This project is focusing on the physical surroundings of workplaces as one of many elements affecting the well-being and growth in an organization. The study includes a methodology using questionnaire with a semantic differential. The most important finding of the project is that the importance of physical surroundings can be described at three different fields; functional, aesthetic and symbolic. In terms of the functional aspects, the project

- ¹³ Høyland, K., "Ny sykehjemsmodell et bedre tilbud." SINTEF- report STF22 A02500 (des.2001)
- ¹⁴ Hansen, G., Jensø, M., Berg, T., Jordanger, I., Røhme, K., Paulsen, B., "Evaluering av plan- og
- utviklingsprosessen i Helsebygg Midt-Norge. Oppstartrapport." SINTEF-report STF22 F02518. Hansen, G., Jensø, M., Berg, T., Jordanger, I., Røhme, K., Paulsen, B., "Plan- og utviklingsprosessen i Helsebygg Midt-Norge. Læring og erfaringer fra byggefase 1 og innledende fase av byggefase 2". SINTEFreport STF22 A03502

¹¹ The Knowledge Workplace, <u>www.kunne.no</u>

¹² The Nordic Knowledge Workplace, <u>http://www.nordicinnovation.net/article.cfm?id=1-834-308</u>

⁵ Hauge, Å., L., "Kontorbyggets arkitektur. Opplevelse og betydning"

concludes that the physical surroundings can be shaped and developed to fit the nature of the work being performed.

The CIB Task Group 51 "Usability of buildings"

According to the above mentioned national and international standardization and legislation, and the ongoing research in the area, it is clear that there is a need for a better understanding of the concept of usability in relation to buildings and users of the buildings.

The CIB Task Group 51 "Usability of buildings" is established to apply concepts of usability, to provide a better understanding of user experiences of buildings. The objectives of the Task Group 51 are to carry out a series of case studies and associated workshops under a program of action research, to develop concepts of usability for application in practice, and to promote, develop and share methods, processes and techniques for the evaluation of buildings-in-use. The group consists of five international research institutions, Norway (NTNU/SINTEF) being one of them.

The case studies are carried out in cooperation with industrial partners who fund the research and actively participated in the case studies and the international workshops. Four of the participating countries meet in September 2004 to discuss their case studies, and have presented results from these case studies in workshops. The CIB Task Group is working for a period of two years, ending its work in 2005.

The aim of the case evaluation and the workshops is to define aspects of the usability concept. As every case is different and belonging to different contexts, new aspects of the concept are highlighted in every national study. A preliminary understanding of the concept is developing and become more and more elaborate with every workshop.

In the paper "Usable workplaces"¹⁶, the UK case study¹⁷ focuses on the development of R&D facilities for NCR in Dundee, Scotland. The UK contribution to the Task Group is demonstrated through the use of novel planning process. The case study is focusing user participation in the planning process, a feature still quite unusual in UK building projects.

Örebro University Hospital was chosen as the Swedish case study¹⁸, and focuses on the user's experience of functionality and usability of the surgery centre, built in 1997. Their contribution to the 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 and layout.

The case study from Turku¹⁹ is studying "The Old Mill" in Turku Science Park in Finland. The Old Mill is an old factory building, now offering office facilities to several IT companies. The purpose of the case study is to understand the elements of usability in refurbished environments, and secondly to produce elements of use in the planning process of Old Mill 2, which is representing an enlargement of the building.

The French case study²⁰ is studying the vehicle design and development centre of Renault, outside of Paris, and focuses on the occupation of The Ruche Building. The management of the company considered the implementation and use of this project to be an essential part of its change strategy in vehicle design and development. This led to a very ambitious approach, both in the architectural and landscape treatment of the site, and in the way the building has to support ongoing change and improvement of the organizations processes.

¹⁶ Alexander, K., Fenker, M., Granath, J. Å., Haugen, T., Vissanen, K., "Usable workplaces"

¹⁷ Alexander, K., Huovala, R., Kaya, S., "Case study: NCR, Discovery Centre, Dundee. Draft report. CIB Task group 51, Usability of workplaces."

Lindahl, G. A., Hinnerson, J., Granath, J., Å., "Case study: Örebro University Hospital: The O-building. Draft report. CIB Task Group 51, Usability of workplaces."

¹⁹ Nenonen, S., Nissinen, K., Porkka, J., Huovala, R., "Case study: The Old Mill. Draft report. CIB Task group 51 Usability of workplaces." ²⁰ Fenker, M., "Case study: Technocentre Renault in Guyancourt: The Building La Ruche. Draft report. CIB

Task group 51 Usability of workplaces."

Only the Norwegian case study is now remaining, and this will be accomplished over the next four months. As part of our participation in the CIB Task Group we are doing a case study of the Nord-Trøndelag University College at Levanger.

This paper discusses the theoretical framework for understanding and exploring the concept of usability of buildings, and points at different aspects influencing and affecting the usability of buildings. In accordance to this we will describe the focus of our case study, as a supplement to the four case studies already completed, and to bring further the discussion of usability of buildings.

THEORETICAL FRAMEWORK

Usability²¹ 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".

According to this ISO-definition, 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

According to Jensen²² the English language is better than other languages in distinguishes between nuances within the term 'usability'. In this way efficiency means "to do things better", while effectiveness means "to do better things". The Norwegian vocabulary does not permit describing the difference in these terms, and the word "effektivitet" is a common denominator for both. Due to this, the above described differentiation is lost. There is clearly a need to define and describe the different terms and the connection between them, in order to gain a better understanding of the meaning of the terms, and the significance of the words.

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 concept of 'usability of buildings' can be approached in four ways;

- 1. Criteria and parameters affecting usability
- 2. Usability from different stockholder's point of view
- 3. The time perspective
- 4. Workplace and context

Criteria and parameters affecting usability

Several elements influence a building's usability and whether a building is fit for a specific purpose. In an internal workshop²³ at NTNU, researchers and academics tried to develop a common understanding of the term "usability", to define the content and different aspects of the term, and to discuss the most important criteria for usability, and methods and tools relevant for measuring this aspect of a building. As a common understanding, the term 'usability' describes whether or not a product is fit for a specific purpose 24 . Usability, or functionality in use, is concerning the buildings ability of supporting the user organization's economical and professional objectives. The quality of use for a building or a product means that it is efficient in use (use of resources, productivity, effectiveness, rationality), offer the desired effect in use (increasing the value), and to offer the desired quality in use (user satisfaction).

The Ishikawa-diagram in Figure 1 is a result from the workshop that visualizes a simplified picture of this reality. Other relations and solutions may be another answer just as correct as this picture.

²¹ ISO 9241, "Ergonomics of human system interaction."

 ²² Jensen, P., A., "Håndbog i Facilities Management."
 ²³ Hansen, G., "Usability of workplaces. Innhold, begreper, kriterier. Workshop 18. mai 2004."

²⁴ Arge, K., "Forprosjekt. Effektiv bruk av arealer".



Figure 1: Ishikawa diagram - Criteria and parameters affecting usability of buildings.

The international case studies accomplished as a part of the work in CIB TG 51 have given various contributions to the theoretical framework and the discussion related to terms and definitions.

In the British case study²⁵ the concept of usability is investigated by discussing the terms usefulness, adaptability, flexibility, functionality that is used, accessibility and ease of use, and their contribution to achieving usability, in terms of efficiency, effectiveness and satisfaction. The case study is defining the workplace need by discussing culture, organization, communication, collaboration, work processes, innovation, learning, attract and retain, technology, change management and trust.

Serviceability – the supply perspective of the building

According to Alexander²⁶ usability focuses on user perceptions of the ease and efficiency with which they can use the building. Serviceability, on the other hand, describes the capability of a building to provide a range of performances for which it is designed, used or required to be used, over time. While usability states a demand perspective, serviceability states a supply perspective.

Accordance to Davis and Ventre²⁷ the term *performance* describes the performed service in a particular situation, context and time, while serviceability means whether the building is capable of offering satisfying functionality for the users. According to Granath²⁸, Davis defines serviceability as a broader term than performance, which indicates that his interpretation of satisfaction has a general meaning and is not connected to individual values dependent on situation, context and time.

Granath also says "The characteristics of the concept serviceability, as it is defined by Davis et al., (...) is that serviceability and hence performance is causally tied to functionality. In Davis' reasoning serviceability is synonymous to usability in the meaning it has in ISO 9241 – 11."

²⁵ Alexander, K., Huovala, R., Kaya, S., "Case study: NCR, Discovery Centre, Dundee. Draft report. CIB Task Group 51, Usability of workplaces".

²⁶ Alexander, K., Fenker, M., Granath, J., Å., Haugen, T., Vissanen, K., "Usable workplaces".

²⁷ Davis and Ventre, "Performance of buildings and serviceability of facilities".

²⁸ Granath, J., Å., Note concerning usability of buildings, written for the usability workshop in Turku.

Serviceable buildings are buildings of a long lasting technical, functional and economical life time. Buildings functional and economical life time is usually much shorter than their technical life time. High adaptability (generality, flexibility and elasticity) contributes, according to Arge²⁹, to prolong buildings functional and economical lifetime, and accordingly buildings *serviceability*.

This shows that a building performance means the service offered in a specific situation, context and time. A building's serviceability describes whether the building is capable of functioning as necessary, and is reflecting the user satisfaction.

Functionality – might result in usability?

In the Swedish case, functionality is discussed as a category beneath usability. According to Warell ³⁰ the term functionality can be described as *technical functionality* and *interactive functionality*. Technical functionality can be divided into *operational* and *structural functionality*. Interactive functionality defines those characteristics of an artifact that interacts with the users of the artifact, and this functionality can be divided into *ergonomic* and *communicative functionality*. Operational functionality means characteristics or qualities of an object functioning as a part of the totality. Ergonomic functionality means characteristics of an object functioning together with the users of the object. Communicative functionality means those characteristics of an object dealing with how shape and design expresses value and identification.

It is essential to focus on the interdependence and connection between the terms usability and functionality. Will functional buildings automatically be usable buildings, or can a building be usable without being functional? In the theoretical framework for the Örebro case study it is said: "We all know that functionality alone does not make a certain artifact usable. The technical and physical properties of the artifact and its theoretical potential to deliver a certain effect do not automatically make it usable in the real world. As a result of the definition of usability it also depends on the **context** the artifact is designed and used in and the **values** of the designers and users. Both context and values change with **time** and **place**." The Swedish case study concludes that "We can define **functionality** as a property given to an artifact in order to create a **practical effect**. An important effect can be described as **usability."**

In accordance to Warell, functionality defines whether the product offers functions and features that users need to complete tasks. Usability, on the other hand describes whether these features will be used easily and efficiently during task completion.

Usability, branding and image

The Finnish case study focused on "the Old Mill"- building in the context of creating a brand. The brand includes usability, and it offers a way to describe the quality of the building; "*The intangible nature of brand includes the usability. (...) The brand can also be used as a framework for classifying the usability – the brand is a concept, a mindset, which have tangible artifacts like logo, slogans, buildings etc.*"

The case study is presented under four elements as the basics of real estate brand;

- location
- functionality (includes usability)
- services
- associations and image

The perspective of change

The French case study focused the Ruche building as a mean to support the organizational change and product development and improvement of the organizations processes. The project also discussed the necessity of parallel management of the company's human and spatial resources; "The building's margin of manoeuvre>experience>new interpretation of the margin of manoeuvre>new organisational behaviour/modification of the margin of manoeuvre."

²⁹ Arge, K., Landstad, K. "Generalitet, fleksibilitet og elastisitet i bygninger."

³⁰ Warell, A., "Design Syntactics: A Functional Approach to Visual Product Form. Theory, models and methods."

Some branches of the Ishikawa diagram are more comprehensively discussed than others, and it is necessary to do further discussions especially in relation to "processes, time and conditions" and "adaptability". The different terms and interdependence between them will be further investigated in a doctoral study.

Usability from different stockholders' point of view

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. The top level of a company mostly emphasizes pr oductivity and effectiveness, while the individual workers are concerned with user satisfaction and practical aspects due to their daily situation at work. This is caused by different competence, function and role in the organization, responsibility, authority and goals. According to this perspective there are several ways to divide an organization into levels. We are suggesting a classification of five levels, ranging from the company in total to the individual workstation;

- The company
- The Facilities Management (FM)/property
- The project/department/division
- The team
- The individual workstation

The above international case studies have used different approaches to investigate stakeholders' perspectives. While the British case study has focused on usability related to teams and individual workstations, the Finnish case study has focused their main areas in the building and the usability perspective from the FM/property and project point of view. The French case study has focused on usability in relation to the company in total, FM/property and project/division.

The time perspective

The third approach to the concept of usability is discussing the time perspective in a building process. It is useful to consider the different phases in the building process, and to discuss how the usability perspective is changing during these phases.

The perspective on usability changes during the building process due to the character of the tasks and work done by the different actors (See Figure 2). The functional qualities of a building are emphasized in the early planning phase, and it is a general focus of technical structures and functionality. In the later phases, when the building is almost completed, the emphasis is on usability and the user perspective. This is also visualized in the Ishikawa diagram above (Figure 1), where the tail of the "fish" is emphasizing the qualities related to the building, while the head of the "fish" is emphasizing qualities related to use of the building.



Figure 2: The building process (simplified)³¹.

Few of the international case studies have so far offered much attention to the time perspective due to usability, and has not evaluated to what degree the concept of usability is changing during the different phases in the building process.

³¹ Hegge, K., From a lecture related to a course in Building Design Management, NTNU.

The perspective of change in a time period, and adaptability and functionality related to this perspective is another aspect not offered much attention. The term adaptability is concerning functionality of buildings in use over a life time perspective. Functionality over a time period is assuming buildings are adaptable due to continual changes in the user's demands and needs and new ways of using the building. Accordance to Blakstad³² adaptability is described as "*the ability to change as a result of internal or external influence, and is regarded as a strategic "from the top" approach".* The term *physical adaptability* is used in terms of the structure and technical system of the building. Adaptability is a common term for the aspects flexibility, generality and elasticity³³;

Workspace and context

The traditional CIB approach has been focusing on architecture and buildings related to technical and structural aspects. The usability initiative has however shifted the focus to the organization and the user. As described above, the project "The Knowledge Workplace" is focusing the relationship between physical surroundings, organizational aspects and information and communication technology (ICT) at the workplace. In her book "Workspace", Mosbech³⁴ similarly describes *"the four elements of balance"*; organization, workplace, IT and knowledge, and how these elements must be in balance for an office environment to function optimally. The original triangular figure, developed as part of "The Knowledge Workplace" project, is showed with 'context' as an added dimension (See figure 3). This is done to show how the three aspects architecture, organization and ICT are operating in a contextual situation. In this way the setting of a building is included, and cultural differences in different countries are embraced.



Figure 3: The balancing elements of a workplace in a contextual situation.

FURTHER STEPS - CASE STUDY: NORD-TRØNDELAG UNIVERSITY COLLEGE, LEVANGER

Introduction to the Norwegian case study

The University College at Levanger was founded in its current state in 1994, and the main areas of study at the university college are health care, teacher training and engineering. The owner is The Norwegian Directorate of Public Construction and Property, and the user is The University College at Levanger and The National Support System for Special Education. The school is situated in an area called Røstad, close to the north of the town centre of Levanger, in the middle of Norway. The Campus has an area of 500 decare (a quarter of an acre) cultivated land, and consists of a composed and complex group of buildings, totally 28 000 sqm, of varying age and use. Today totally 2 500 students and employees have their daily work at the campus.

This case study is limited to a building completed in 1999, called "The New Pile" ("Nylåna" in Norwegian). This building contains offices for the administration and teaching facilities, with a total area of 10,800 sqm. The planning process was initiated in 1992 by an open architectural

³² Blakstad, S., H., "A Strategic Approach to Adaptability in Office Buildings"

³³ Arge, K., Landstad, K., "Generalitet, fleksibilitet og elastisitet i bygninger."

³⁴ Mosbech, K., "Workspace"

competition. The winning project was developed by HUS Architects from Trondheim. A long and difficult planning process arose, because of a lack of funding from the National Budget. In 1997 the project received the necessary funding. During the planning and building period of "The New Pile" there was a 50% increase in the number of students and employees (at 600 students and 60 employees), and before completion of this building there was a need for further expansion on the campus, in terms of a new building for to support teaching and administrative offices.

This project was chosen as the case study object because the building has been in use for some years, and the user organization has some experiences related to evaluating the building performance and usability.

Research topics and focus area – our contribution to TG 51

The other case studies have been focusing on different aspects of building usability and functionality. We want to contribute to a further development to the theoretical framework related to usability of buildings. Our case study will study the area of usability, and the different perspectives related to usability, during the different phases in the building process over a life time perspective. We will use the case study to discuss challenges in the framework from such a perspective. An important feature is also to discuss 'loops of knowledge' due to this time perspective in order to improve the programming phase as a result of the knowledge and experience gained during the evaluation of building in use.

The case study will be discussing the different stakeholders' perspective related to usability, with a special emphasis on the user perspective. The case study will also focus on the relationship between the planned process and building and the actual process and building. In our case study we are going to do evaluations and measurements between the planned and completed building, and between the completed building and the building as it is today, five years after completion. The study will investigate the validity of the planned building in relation to the situation today, and to discuss the perspective of change. Challenges in the case study will be how to handle the perspective of change.

We are planning to conduct the study as a combination of a descriptive and a normative approach. The descriptive approach will be done as an examination of how the process and the different procedures are accomplished. We will examine documents, conduct a walk-through of the project, and do interviews and conversations with central actors of the process. The normative approach will be carried out by organizing a workshop with different users who will be invited to evaluating criteria for usability of buildings. Using the four approaches outlined above, we are going to discuss what criteria can be used for evaluating usability of buildings. Criteria of usability, developed and discussed in the earlier international Task Group Workshops will be discussed, in light of validity in the Levanger project. Do the users recognize the situation? What criteria are most important to choose? How can this be evaluated in relation to their situation?

CONCLUSIONS

This paper outlined how the usability concept can be approached in four ways from the Norwegian case study. The discussion relating to the theoretical framework for usability of buildings will be continued as an important part of a PhD study at NTNU on hospital buildings.

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AN INTEGRATED ASSET PERFORMANCE FRAMEWORK FOR OPERATIONAL BUILDINGS - Preliminary results of focus group validations in Hong Kong and Australia.

Danny Shiem-shin Then The Hong Kong Polytechnic University Teng-hee Tan Building Division, Department of Public Works, Queensland Chi-kwan Chau The Hong Kong Polytechnic University

Abstract

Business performance is contingent upon effective use and management of all resources to enhance competitive advantage. However, whilst the resource value of finance, human resources and technology is widely recognized, that of the supporting physical asset (i.e. building or real estate) that houses these resources is not obvious to many corporate managers who see building-related expenses as a drain on profit. 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 in relation to 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 paper will explain the conceptual basis of an integrated asset performance framework and the preliminary results of two validation workshops conducted in Hong Kong and Australia.

Keywords: Asset Performance, Integrated Framework, Operational Buildings.

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 ICT, people and business capital. In many cases, investment in building assets ranks closely in value to the investment in people. 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 business performance. They also drive the need to explore with a more searching attitude, the performance of other aspects of the business, including the key resources supporting the business - people, property and technology (Then, 1994).

The need and desire to monitor the performance of operational building 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 also a key driver in the search for an effective performance measurement regime for building assets (Amaratunga & Baldry, 2002). However, the practical implementation of a performance measurement regime that delivers the desired management outcomes efficiently and effectively is more problematic. (Tan, Then and Barton, 2000). A wide range of methods and frameworks for performance measurement of building assets have been proposed (McDougall, et al. 2002). 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 expectations.

This paper proposes an integrated framework for assessing building performance (Then & Tan, 2004) and reports on the preliminary results of two validation workshops held in Hong Kong and Australia.

AN INTEGRATED ASSET PERFORMANCE MODEL

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

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.

The Need

The development of a conceptual framework for evaluation of performance 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 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 - 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 – 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.

The EPFS Model

Taking the above constraints into consideration, Then and Tan (1998, 2000, 2002, 2004) proposed that asset performance indicators used by organisations from both the public and private sectors can be grouped under five broad categories or 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.

• 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.



Figure 2: Integrated Asset Performance Reporting (Then & Tan, 2002)

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 categories of performance measures form the cornerstones of our 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 basic structure for considering the many dimensions of built assets performance and critically reviewing the suitability of currently available measures.

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	

Table 1: Asset performance facets and management focus

Then, S.S. & Tan T.H. (2002)

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.



Figure 3: Factors influencing the Practice of Asset Performance Management

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 (Then, S.S. & Tan T.H., 2000, 2002). 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. (modified from Then & Tan, 2004).

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 95 Key Performance Indicators (KPIs) were selected for validated in two focus groups workshops held in Hong Kong (July 2004) and Brisbane (August 2004). Table 4 lists the 69 validated KPIs.



Figure 4: EPFS Model showing Facets and associated Variables

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 will be provided as feedback to participants of the validation workshops.

RESULTS FROM ANALYSIS OF RESPONSES FROM VALIDATION WORKSHOPS

1. Concept Evaluation of EPFS Model

The concept evaluation comprises a two-part analysis. Table 1 shows the results of the attributes evaluation 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.

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

Table1: Concept Evaluation of EPFS Model

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 (Sataay, 1977; Xu, 2000).



The individual respondents' results on each individual pairwise question are 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.

Asset Performance Facet	Relative Importance Weight
Economic	0.236
Physical	0.182
Functional	0.319
Service	0.262

Table 2: Relative Importance Weightings of Four Different Asset Performance Facets

2. Validation of Asset Performance Variables

For each of the asset performance facets, their corresponding asset performance variables were identified via brain storming sessions by the research collaborators. The degree of perceived relevance of each of the asset performance variables were evaluated using a. 5-point Likert scale type questions with '1' indicating not relevant and '5' indicating very relevant. An asset variable is considered to be relevant if it has a mean value greater than 3.5. Table 3 shows those variables that are identified to be relevant under each of the four asset performance facets.

ECONOMIC Performance	Perceived Relevance (1- not relevant, 5 – very relevant)			
Variables	Mean (Standard Deviation)			
Location	3.93(1.17)			
Capital Value	3.61(1.36)			
Size	3.59(1.14)			
*Return on Investment	3.18(1.45)			
*Benefits Return	3.95(0.88)			
Utilisation	4.27(0.87)			
*Image	3.73(0.99)			
Portfolio Strategy	4.12(0.81)			
Business Turnover	3.17(1.34)			

Mean<3.5 N=41 *N=40

Table 3: Mean Relevance Values for Different Asset Performance Variables	Table 3: Mean Relevance	Values for Different Asset	Performance Variables
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PHYSICAL Performance	Perceived Relevance (1- not relevant, 5 – very relevant)
Variables	Mean (Standard Deviation)
FM Cost	4.44(0.87)
Utilities Costs	4.27(1.05)
*FM Management Costs	3.98(0.97)
Condition	4.29(0.78)
Risk	4.56(0.87)
Age	3.54(0.95)
Refurbishment History	3.68(0.88)
Maintenance History	3.98(0.88)
*Initial Capital Cost	3.20(1.11)
Replacement Value	3.78(1.11)
Deferred Maintenance	4.02(0.94)
Environmental Impact	3.95(0.89)
Remaining Life	3.98(1.06)

<i>FUNCTIONAL</i> Performance	Perceived Relevance (1- not relevant, 5 – very relevant)		
Variables	Mean (Standard Deviation)		
*Internal configuration & Services	4.53(0.78)		
Adaptability	4.07(1.08)		
Statutory Compliance	4.59(0.87)		
Policy Compliance	4.24(0.86)		
Production Facilities	4.22(0.99)		
External Infrastructure	4.10(0.89)		

SERVICE Performance	Perceived Relevance (1- not relevant, 5 – very relevant)
Variables	Mean (Standard Deviation)
FM Service Response	4.39(0.92)
FM Service Price	4.15(0.85)
FM Service Interface	4.24(0.97)
Building Service	4.20(0.98)
Internal Ambient	4.32(0.85)
External Ambient	3.66(0.94)
Local Serviceability	3.88(0.90)

3. Validation of Asset Performance Indicators

For each of the asset performance facets, and their corresponding asset performance variables, Key Performance Indicators (KPIs) were selected via 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%.

Facet	Asset Variable	Key Performance Indicators	Mean (Standard Deviation)	Number of KPIs
Location		Customers / tenants / visitors / clients	95.1% (0.218)	
		Access to essential business services	85.4% (0.358)	
Щ	Size	Floor space	92.7% (0.264)	
	Benefit Return	*Business	80.0% (0.405)	
NON NON		Community	80.5% (0.401)	a
ECO	Utilisation	Space (% of space/capacity used compared with available space/capacity)	97.6% (0.156)	
B	Image	Customers	95.1% (0.218)	
	Portfolio	Different types of assets	85.4% (0.358)	
	Strategy	Location of assets 90.2% (0.300)		
	FM Services Cost	per unit area (sq m)	92.7% (0.264)	
	Utilities Cost	per unit area (sq m)	92.7% (0.264)	
	FM Management Costs	per unit area (sq m)	82.9% (0.381)	
	Condition	Component / Element	82.9% (0.381)	
		Asset overall	82.9% (0.381)	-
	Risk	Exposure to security issues	100.0%	
		Exposure to contamination & health issues	100.0%	
		Exposure to legislative changes	78.0% (0.419)	
	Age	*Building level	80.0% (0.405)	
щ		*Component level	85.0% (0.362)	
AL	Refurbishment	Date of last refurbishment	80.5% (0.401)	
SIC.	History	Nature of last refurbishment	80.5% (0.401)	-
НОН	Maintenance	*\$ expenditure (total)	92.5% (0.267)	23
L L L L L L L L L L L L L L L L L L L	History	\$ per annum as % of replacement value	87.8% (0.331)	
		Major replacements (dates and costs)	95.1% (0.218)	
	Initial Capital Cost	Similar asset	90.2% (0.300)	
		Industry standards 80.5% (0.401)		
	Replacement Value	*Depreciated book value	75.0% (0.439)	
	Deferred Maintenance	*Total Value of Deferred Maintenance	77.5% (0.423)	
	Environmental Impact	Compliance with Environmental legislation	97.6% (0.156)	
		Appropriate environmental rating system (e.g. HKBEAM)	82.9% (0.381)	
	Remaining Life	Physical and functional conditions	90.2% (0.300)	
		Economic viability	80.5% (0.401)	

Table 4: Relevant Key Performance Indicators

Facet	Asset Variable	Key Performance Indicators Mean (Standard Deviation)			
	Internal Configuration	Layout	95.1% (0.218)		
	and Services	Services	92.7% (0.264)		
		Amenities	92.7% (0.264)		
	Adaptability	Major changes	85.4% (0.358)		
ш	Statutory	Building codes and regulations	100.0%		
NC	Compliance	Workplace Health and Safety	97.6% (0.156)		
NOI N	Policy	Space allocation	95.1% (0.218)	14	
L D H O H O H	Compliance	Quality of fit-out and furnishings	87.8% (0.331)		
LE CONTRACTOR		Security	100.0%		
<u>م</u>	Production	Capacity	78.0% (0.419)		
	Facilities	Efficiency	85.4% (0.358)		
		Quality of outputs/outcomes	85.4% (0.358)		
	External	Capacity	80.5% (0.401)		
	Infrastructure	Function	90.2% (0.300)		
	FM Service	Response time to request	97.6% (0.156)		
	Response	Time to resolve problems	97.6% (0.156)		
	FM Service Price	Fit with budget	95.1% (0.218)		
		Comprehensiveness of services	87.8% (0.331)		
	FM Service	Communication	90.2% (0.300)		
	Interface	Resolution of issues	100.0%		
	Building Services	Range of services available	75.6% (0.435)		
		Quality (meeting prescribed parameters)	97.6% (0.156)		
		Reliability	97.6% (0.156)		
	Internal Ambient	Statutory compliance	92.7% (0.264)		
MA		Comfort	97.6% (0.156)	23	
N N N		Ambience	87.8% (0.331)		
SI		Work environment (e.g. noise, safety, etc.)	100.0%		
-	External Ambient	Appearance	82.9% (0.381)		
		Amenities	82.9% (0.381)		
		Clean air	87.8% (0.331)		
		Noise	87.8% (0.331)		
	Local	Range of services available	82.9% (0.381)		
	Serviceability	Quality	95.1% (0.218)		
		Reliability	92.7% (0.264)		
		Responsiveness	92.7% (0.264)		
		Cost	82.9% (0.381)		

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Table 4 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).

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. Through a thorough literature review and follow-up brain storming sessions, the research collaborators identified possible variables corresponding to each of the four facets. For each of the variables identified, potential relevant performance measures or indicators were listed. Two workshops [in Hong Kong (N=20) and Australia (N=21)], comprising of professional practitioners in the field of property/asset/facility management, were conducted to test the validity of the EPFS model. The workshops comprised a combination of explanatory presentations followed by respondents completing three separate sets of questionnaires.

In the main, the EPFS model was statistically validated in term of the following attributes: completeness, robustness, usefulness, importance and practical relevance. In terms of the ranking of the four facets; the Functional facet was ranked as most important, followed closely by both Service and Economic facets, with Physical facet rated the lowest. The statistical analysis of the chosen performance indicators for the four facets confirmed 69 of 95 possible indicators as important measures.

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.

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CAPTURING KNOWLEDGE FROM FACILITIES MANAGEMENT PRACTICES – Issues and Possibilities

Danny Shiem-Shin Then

Hong Kong Polytechnic University, Hung Hom, Kowloon, Hong Kong SAR, China Andrew McEwan Visiting Lecturer, Team Leader, Government Asset Management Unit, Queensland Treasury, Brisbane, Queensland, Australia

Abstract

This is an exploratory paper that looks at issues and possibilities in relation to capturing experience and knowledge from facilities management practice. The underlying premise is that hitherto, current facilities management practice is largely unstructured leading to tremendous waste of facilities managers' time (a critical resource) in day-to-day problems solving. If facilities managers' 'attention resource' is to be optimized, then a structured way of capturing their experience should optimize waste associated with 're-inventing the wheel' within the organization concerned. The possibilities of linking recurring problems to specific or related knowledge content within the scope of activities of facilities management (FM) can potentially provide a fruitful path for exploring and managing the capture, analysis and classification of emerging core knowledge areas as corporate knowledge unique to the particular business and portfolio setting.

This paper begins with a critical analysis of the concepts behind 'knowledge management' and other management tools like business process reengineering, total quality management, project and risk management; as they currently appear in published literature. This analysis considers the notion of knowledge and how it is able to be managed as well as providing context to the emergence of knowledge management as a "new wave" management technique. Issues surrounding current definitions of knowledge management will form the basis of the derivation of a working definition that will be used to propose a knowledge management model for facilities management practice.

The proposed knowledge mapping model will combined knowledge captured from FM practice and content matching against commonly accepted FM core activities/areas or competences. The paper will explore issues and consider possibilities of structuring a proposed knowledge content that reflects the realities of practice.

Keywords: knowledge mapping, facilities management practice, knowledge management, management tools

INTRODUCTION

Knowledge Management is one of the more recent business management disciplines which has attracted a great deal of interest, particularly over the last decade. Along with quality management, value management, risk management, change management, performance management and the list goes on; it presents, within the business context, another emerging area of management considerations that purports to enhance value to the corporate bottom line performance over time.

It is important, from a facilities management perspective, that practitioners understand the thrust of this new management approach to build broader business management proficiency and be able to determine if, where and how such an approach could impact on or even taken advantage of, within the practice of facilities management within a corporate setting.

This paper is an attempt to understand how the knowledge management concept can be harnessed to benefit FM practice, an area of management that is often typified by reactive problems solving in a constantly changing environment. The paper also explores issues and

possibilities of capturing the experience of facilities managers and relating these to emerging core FM knowledge areas as defined by major professional FM institutions around the world. A preliminary framework linking FM practice to FM knowledge areas is proposed as a sustainable facilities management knowledge management model. A primary aim of the paper is to break the constant cycle of 'reinventing the wheel' in FM practice.

KNOWLEDGE MANAGEMENT IN A BUSINESS MANAGEMENT ENVIRONMENT

What is Knowledge Management?

"I don't believe knowledge can be managed. Knowledge Management is a poor term, but we are stuck with it, I suppose. "Knowledge Focus" or "Knowledge Creation" (Nonaka and Takeuchi, 1995) are better terms, because they describe the mindset which sees knowledge as an activity not an object" (Svieby, 2001).

It is interesting to note one of the founders of "knowledge management", Karl Erik Sveiby, who wrote the first book on knowledge management in 1990, is now uncomfortable with the term. Svieby's views are supported by the fact that there are a myriad of definitions for knowledge management, many with a common theme of knowledge management ensuring or being a potential source of competitive advantage and achieving the mission of the organisation (Sarriegi Dominguez J. M. et al., 2003; Zhao and Byar, 2002; Ram, 2002; Pierce, 2002; Grey, 1999; Barclay and Murray, 1997; Malhotra, 1998; KM Forum, 1996;). Knowledge management can take the form of transformation of individual knowledge to organisational knowledge, sharing and applying knowledge, managing and developing personal competencies, managing information, measuring the intellectual capital and organisational learning (Sarriegi Dominguez J. M. et al, 2003).

Equally common in published literature on knowledge management is an information technology focus, which is reflected in the following definition:

"In information technology, knowledge is, to an enterprise or an individual, the possession of <u>information</u> or the ability to quickly locate it" (<u>http://searchcio.techtarget.com/sDefinition/0,,sid19_gci212448,00.html</u>).

Pierce J (2002) states that *"technology is a key enabler of managing knowledge"*, which suggests knowledge can be captured.

The concept of knowledge and knowledge management needs to be carefully examined. As part of knowledge management, knowledge is generally considered to be either explicit or tacit. Explicit knowledge being knowledge that is formalised knowledge, while tacit is knowledge that is "hidden" in our consciousness; it is contained in the human mind (Nonanka and Takeuchi, 1995; Kucza, 2001; Wilson, 2002; Mezel, 2003). Wilson (2002) argues that the use of the term tacit knowledge has been applied incorrectly and the correct term is implicit knowledge as this refers to previously unexpressed but expressible knowledge, while *tacit knowledge* is inexpressible. This view is then consistent with the position that knowledge is a product of the human mind and is not able to be captured. However, if the concept of knowledge is unpacked from the broader jargonistic term of knowledge management, it usually is defined as a state of mental apprehension, perception or cognisance and is generated only in people's minds (Nonaka and Takeuchi, 1995; Wilson, 2002; Barclay and Murray, 1997). The KM Forum (1996) quoting Karl M Wiig (1996), defines knowledge as "the insights, understandings, and practical know-how that we all possess and is the fundamental resource that allows us to function intelligently." This is in distinct contrast to the above views on the management of knowledge in that knowledge is an intrinsic human function relating to the mind and how the mind is able to learn and understand. As mentioned by Wilson (2002) the notion of managing the mind and capturing and documenting the content of the mind is fanciful, however he suggests that if information practitioners need to be referred to as Knowledge Managers then this may not be harmful. If this is the approach in practice, it may be a misrepresentation of the deliverable and may embed a complacency within an organisation that the knowledge needs to sustain competitive advantage are now captured and any loss of personnel will not impact on the corporate knowledge bank. The notion of corporate knowledge is complicated even more when considering an organisation is merely:

"A consciously coordinated social unit, composed of two or more people, that functions on a relatively continuous basis to achieve a common goal or set of goals" (Robbins et al, 1994).

However, knowledge can be classified as being corporate or enterprise; strategic or business; tactical or management; and operational or hands-on (KM Forum, 1996). Fundamentally the context needs to be clearly defined in the first instance and then a "knowledge management" approach can be considered.

Based on the above discussion, the general problem encountered with the definitions examined is that there is a notional separation between knowledge and people. The transformation of data to information, to knowledge, to wisdom; is depicted as a mechanical process that can occur so long as there are tools that enable this transformation to happen. There has been criticism in the past relating to this overly simplistic approach to knowledge creation particularly, the model by Nonaka and Takeuchi (1995).

Business Drivers, the Emergence of Knowledge Management and the Cost of Knowledge

In broad terms, key business drivers that influence the strategic direction and performance of a business and ultimately its value are:

- > Maintaining or increasing market share:
 - Changes in market or community demand for existing products and services.
 - Demand for new products and services.
- > Seeking more cost effective production or delivery of services.
- > Introducing more modern and efficient equipment.
- Implementing changes in regulations requiring modifications to the facility or plant and equipment.
- > The dynamics of the market place, which may result in mergers or acquisitions.

Getting the above correct are often reflected in reduction of cycle times, operating with minimum fixed assets and overheads, shortening product development time, improving customer services, empowering employees, innovation and delivering high quality products, enhancing flexibility and adaptation, avoiding costly mistakes, reducing risks, capturing information, creating knowledge and sharing and learning and improving profitability. (Barclay and Murray, 1997; Van 'T Hof, 2003; Grey, 1999; Sarriegi Dominguez J. M. et al. 2003). The knowledge content associated with the above initiatives can be broadly grouped under the following:

- > Knowledge as a product: It is generated packaged and sold.
- Transfer of knowledge and best practices: Identification of best practices and transferred to other parts of the company.
- Customer-focused knowledge: Capturing customer needs, preferences and business to increase sales.
- Personal responsibility for knowledge: Support every single person in identifying, maintaining and expanding their knowledge.
- Intellectual asset management: Corporate-level management of specific intellectual assets such as patents, technologies ands operational and management practices (Kucza, 2001).

Considering these drivers and suggested knowledge classes, fundamentally a key component to enable the development of responses to the drivers and to have the knowledge available to be classified is the capability or capacity of the business. This will have a direct relationship to the business' profitability, growth and survival, and future direction. It also has a direct relationship to the skills and competencies of the human resources of the business. The skills and competencies of the human resources have a foundation in the knowledge that these human resources have and how they are applied. In recent times, however, there may have been an undervaluing of the knowledge contained in these human resources. As Lurie (1999) indicates in the United States:

"From 1993 to 1996, there was a sentiment in the market that smaller up-start companies were going to overtake the larger, blue chip corporations, which were perceived to be bloated with superfluous workers and internal red tape. Although these

rumours of diseconomies of scale were widely exaggerated, many large corporations slashed their labour force in a move to maintain an aura of competitiveness."

This period saw the emergence of the "downsizing" management vogue. It was sparked by a view, as alluded to by Lurie, that cutting costs to improve the market's perception of the organisations' value and to be able to better compete with other businesses would provide immediate results to the bottom line. This was not only an approach adopted by the private sector. The public sector, facing ongoing pressures relating to the costs of providing services and the political sensitivities relating to increasing revenues through higher taxes and charges, saw downsizing and outsourcing as measures to reduce costs and defer the pressures for a short period – hopeful to the next government or next term of office.

While Lurie's view is more concerned with the value of the organisation's market value i.e. share price, and not non-economic issues relating to the operational performance of the business, such as loss of corporate knowledge, an article in Business Review Weekly (Knowledge in action, by David James, 23 Feb 2001, BRW) said "if knowledge is 'owned' by the worker, staff turnover represents the loss of an asset for the enterprise. Cronin (Bernard Cronin, chief executive of the Australian Institute of Management) estimates the cost of losing an employee to be between \$150,000 and \$340,000." Pierce (2002) proposes that the annual avoidable cost for an organisation of 10,000 with a 15% attrition rate is \$225M.

Stephen Roach, Chief Economist at Morgan Stanley, who was a strong protagonist for downsizing, changed his strong views in 1997 stating that it was a recipe for disaster (Wilson, 2002). This is reinforced by Jenkins (1997), as reported by Wilson (2002), that downsizing was the most pervasive yet unsuccessful change effort in the business world. Certainly the notional costing above reflect that the "downsizing" euphoria had some dire consequences to organisational knowledge. While this may be a notional cost, the retrenchment of significant numbers of staff represents a potentially important loss of corporate knowledge – this point reinforces the previous assertion that knowledge resides in the person not the organisation. Taking this further in terms of recognising knowledge as an asset from an accounting perspective i.e. it provides further economic benefits, there is the view that it should be recognised as part of the intangible assets that often make up to 50% of an organisation's value.

(http://www.cibasolutions.com.au/Resources/res_news_article.htm) In so doing, retrenching staff will then affect the bottom line because of flow on implications to the operating result due to asset disposal and reducing the financial position of the business. However, this leads to further discussions on intellectual property and knowledge and the key accounting issues of relevance and reliability of measurement etc., which are outside the realms of discussion for this paper.

The timing issue relating to the downsizing period as mentioned above is worthy of a closely examination. Wilson's research (2002) indicates that an exponential growth in knowledge management activity in the years commencing 1997. It would appear that, from a business management perspective, knowledge management emerged as a response to the consequences of the downsizing activity of the late 1980s to mid 1990s, and is taken as a panacea to the knowledge loss experienced by businesses that embraced the downsizing strategy to reduce costs and improve the market's perception of the value of the business. (Figure 1)



Figure 1: Literature search results of the "Web of Science", Wilson (2002)

The Use of Knowledge Management

Notwithstanding the issues pertaining to the validity of the knowledge management concept, there is value in understanding the flow of information within and between organisations to determine when and where information is needed to assist is improving the manufacture of a product or the delivery of a service.

Grey (1991) and Van 'T Hof (2003) suggest that knowledge management complements, enhances and builds on other organisational initiatives such as total quality management (TQM), business process re-engineering (BPR) and organisational learning (Senge,1990), providing a new a urgent focus to sustain competitive position. Again, while BPR has been another management vogue enthusiastically grasped as another panacea to streamline processes, discarding non-value-adding processes and thus reduce costs, two-thirds of BPR exercises have said to have failed (Wilson, 2002; Malhotra, 1998).

The concept of the learning organisation is probably closer to the intent of what knowledge management is aiming at achieving. A learning organisation generally focuses on the continual learning of individuals and integration of knowledge to organisational routines and actions; effective knowledge sharing among the people in the organisation and eventually also outside the organisation (it may be embodied in products or services); critical, systemic thinking allowing the questioning of established procedures; a culture of learning, where new ideas are honoured and rewarded; a spirit of flexibility and experimentation including the possibility to take risks in order to innovate; and a people-centred environment that cares about the development and well-being of people (Liebowitz, 1999).

For both Business Process Reenginering (BPR) and knowledge management a mapping exercise forms part of the process to identify processes and information flows and broadly speaking a mapping exercise is a part of most of the practices, though taking various forms. The main aim of knowledge mapping is to give managers enough information about their knowledge resource to allow them to make informed decisions.. Knowledge mapping is therefore aimed at explicit knowledge management by managers rather than providing a computer based document management capability. The use of knowledge mapping can lead to managers taking informed decisions about the use of other knowledge management approaches (Gordon, 2002).

BPR is a recognised management tool used by organisations to improve their performance across a range of indicators. The purpose of reviewing an organisation's business processes is to gain a comprehensive understanding of the way the organisation currently operates, to identify bottlenecks and difficulties in the current system and to redesign those systems to produce an improved outcome for the organisation and its stakeholders.

Close examination of the BPR and knowledge mapping approaches indicates very similar information being gathered as part of the mapping processes, though there is a different focus in terms of how the information is to be used e.g. for BPR to identify the actual process flow while the knowledge map is identify information flow and information access points. It could be argued that the same process map could be used for both purposes with the specific requirements being gathered as a secondary output of the process mapping exercise.

While knowledge mapping may not be a synonym for business process mapping, the above illustrations suggest that the same process could be used for both management practices with particular outputs being derived as a result. It further illustrates that as these management practices emerge the general thrust remains the same in terms of overall approach, a particular focus is taken based on the nature of events that have necessitated the development of a management approach e.g. reduce costs through streamlining process and reduce costs though maximising the knowledge-base of the individual in the organisation.

What has been learned?

As suggested earlier, the timing of the growth of interest in knowledge management in the late 1990s and early 2000s would appear to have some relationship to the downsizing and outsourcing turbulence of the late 1980s and early 1990s, of which loss of corporate knowledge was seen as a major detrimental consequence. Certainly, based on the information from Wilson's research (2002), knowledge management was embraced with vigour at this time and it could be argued that the reason for this was that the concept was lauded as a response strategy, though

superficial as the concept has been ill-defined, to the loss of corporate knowledge resulting from downsizing and outsourcing.

The literature reviewed so far appears to support Wilson's findings (2002) that "there is absolutely no agreement on what constitutes "knowledge management". Certainly the concept has been embraced, but as Wilson (2002) surmises, this seems to be driven more from the consultancy arena rather than being philosophically driven by organisational management. This view is supported by a survey undertaken by Bain and Company in 2000, which indicated that only 35% of their world-wide sample of 451 companies was using "knowledge management", reporting a satisfaction rating of 3.5 on a five-point scale, compared with 70% of companies using benchmarking and 80% using strategic planning. Knowledge management was in 19th position out of 25 management tools.

A MODEL OF A FACILITIES MANAGEMENT APPROACH TO KNOWLEDGE MANAGEMENT

Current Facilities Management deficiencies

Facilities Management, as a management discipline, has not been able to establish a clear identity as has its close business management relations in human resources, finance and information technology. One primary obstacle is that most activities undertaken by the facilities management function are seen as a business cost and not seen as contributing to maximising shareholder and business value – unlike human resources, finance and information technology which are seen to be directly contributing to improve business performance through:

- recruitment of the right resources and skills;
- > making the right investment and financial decisions; and
- establishing the right operational infrastructure to ensure that the business operates efficiently and effectively and to enable information to be readily accessible for financial and human resource management requirements.

Facilities management identity is also obscured by the various disguises that it can operate under. As facilities management is multidisciplinary, its identity can be lost through a specific discipline focus within a business whether that be architectural, engineering, property management or maintenance. This apparent lack of focus further erodes the ability of a facilities management function to grow internally through building internal capability. The multidisciplinary nature of facilities management also can obstruct its functional ability to adapt quickly to business dynamics.

As a result, the general perception remains of facilities management being a non-value adding cost to the business and potentially being loosely defined as "non-core". This view generally results in facilities management support services being identified as part of any downsizing and/or outsourcing initiatives to reduce the cost to the business.

Outsourcing Impacts

The above review appears to support the notion that the downsizing and outsourcing activity of the late 1980s to mid 1990s created a major corporate knowledge vacuum. Knowledge management emerged as a response to the consequences of the downsizing and outsourcing agenda as a panacea to the knowledge loss experienced by businesses that embraced the downsizing approach as the strategy to reduce costs and improve the market's perception of the value of their businesses.

Observations from the outsourcing of facilities management support functions would agree that the risks relate to:

- The outsourcing trend contributing to the loss of internal knowledge;
- The outsourcing trend adding uncertainties to ownership issues in terms of corporate information; and
- Outsourcing placing the onus on the client to effectively manage the suppliers' deliverables, which assumes the existence of adequate internal capabilities if corporate knowledge (culture, processes, core content) is not to be lost forever.

Clearly, there needs to be an adequate level of internal business capability to ensure that the above risks are mitigated and managed over time and that business performance is not compromised.

Building Facilities Management Capabilities

The risks presented by unstructured or ill-conceived outsourcing arrangements can be mitigated or minimised through careful planning. In this instance, the internal capability required to effectively manage an outsourced facilities management supply arrangements is in question.

The business can respond to this knowledge gap by either:

- > Building internal capability through internal learning; or
- > Building internal capability through external education and training.

It is proposed that a primary strategy is to achieve this through a structured, internal knowledgebased approach to building internal capability. Even more mission critical to the business however, is ensuring that strategic and operational facilities management capabilities are sustained and developed over time. It is this overall risk that a knowledge-based facilities management model for building internal capabilities is proposed as a viable risk mitigation measure.

Knowledge Management Definition for Facilities Management

The development of any plan to introduce a new management approach must recognise the business requirements. In general terms, the business will require a return on investment from this new approach, which translates into maximising the wealth of the business and in turn the wealth of shareholders.

The previous discussion relating to business drivers indicates that, as utility theory proposes, the primary business motivator relates to maximising the value of the organisations. For the particular period that has been examined, this was pursued through a strategy of businesses being able to better compete with other businesses through cost reduction to provide immediate results to the bottom line. The new approach needs to "fit" with the strategic business direction and is able to contribute to the achievement of this strategic business direction and maximising the value of the business.

The facilities management linkage to business success is illustrated in Figure 2 below. This aligns facilities management to the four (4) specific business focus areas: strategic direction, resources and capability, governance, maximising the value of the business and shareholder wealth.



Figure 2: Context of Facilities Management in supporting Business Success

The model's four quadrants define how this alignment manifests itself to support the achievement of the four focus areas. The facilities management function is able to contribute to the success of the business by:

- Ensuring that the right governance arrangements are established, through clearly defined accountability structures, processes and practices, to protect the business and provide confidence to prospective investors and shareholders.
- Ensuring that adequate consideration is given to building FM capacity in terms of the skills and knowledge which staff will need to perform and manage the FM functions and having the finance, people and systems which are necessary for FM and the delivery of facilities services.
- Making better business decisions that will contribute to the achievement of growth and survival, and future direction by ensuring the availability and quality of information, which supports decisions, and assessment of outcomes.
- Enabling the FM function to align with and contribute to the achievement of business profitability, growth and survival, and future direction.

Fundamentally the model suggests that the facilities management function requires knowledge of strategic direction, facility risks and contribution to the achievement of strategic direction and the value of the business, corporate, organisational and environmental governance requirements and the resources and capability required to enable all this to be realised.

As concluded earlier, a definitive definition for knowledge management is arguably not available due to the nebulousness of the concept. However the term is recognised as a new management tool and as is not easily discarded. Rather than attempt to argue for a better definition or for a more relevant term to use to replace *knowledge management*, a definition for knowledge management that is relevant for the purpose of use for facilities management is the approach taken for this paper.

For this paper, the issue of knowledge management is not so much about the term but the application of what it means in the context of facilities management. Taking the view that knowledge is a human function and that knowledge has a direct relationship to the ability to perform a function, the knowledge management definition used for this paper, which also gives credence to Svieby's notion of "knowledge focus", is:

"The management of knowledge, which has been gained over time by individuals through their own learnings about the way business is conducted through business processes and practices, and nurturing this knowledge to enable it to be used to its maximum benefit to the business to enable information to be utilised (gathered, captured, stored, retrieved and applied):

- that can be leveraged to inform the business on facility implications resulting from maintaining or increasing market share. Either through:
 - Changes in market or community demand for existing products and services.
 - Demand for new products and services.

that can be further analysed to identify:

- opportunities where facilities can contribute to more cost effective production or delivery of services.
- opportunities where more modern and efficient equipment may be introduced.
- where changes in regulations require modifications to the facility or plant and equipment.
- trends or emerging issues relating to the dynamics of the market place which may result in mergers or acquisitions and development of appropriate facilities management response strategies."

This provides a definition with a focus on knowledge rather than managing knowledge per se. This has a closer relationship to the learning organisation mantra then trying to determine how an information system might try and manage knowledge. This focus on knowledge relates to the building of internal capability to better perform a function, rather than pursuing a management model for knowledge that is illusive.

Relating this back to being a facilities management response to the key business drivers the model's elements enables information to be utilized (gathered, captured, stored, retrieved and applied) for the following purposes:

- To leverage and inform the business on facility implications resulting from maintaining or increasing market share. This may be either through changes in market or community demand for existing products and services or demand for new products and services.
- To analyse business processes in order to identify opportunities where facilities can contribute to more cost effective production or delivery of services.
- > To identify opportunities where more modern and efficient equipment may be introduced.
- > To identify where changes in regulations require modifications to the facility or plant and equipment.
- To support strategic facilities planning by identify trends or emerging issues relating to the dynamics of the market place, which may result in mergers or acquisitions, and development of appropriate facilities management response strategies.

This provides a framework within which a knowledge management approach can be applied within the FM function. On the basis of having a defined focus on how knowledge can be utilised within a FM function to support the achievement of business directions, it is suggested that careful consideration be given on how to maximise this approach within the business to ensure that it **will** add value and contribute to overall business profitability, survival and growth, and future direction.

Defining the Scope and Competencies of Facilities Management

The growing body of academic literature and publication on the nature of FM practice (e.g. Nutt (2000), Grimshaw (2002); McGregor & Then (1999), Atkin & Brookes(2000), Best, Langston & De Valence ,2003) has done little to dispel the impression that there is still diversity in FM practice and that FM in whatever guise, will continue to grow. However, the term "FM" is now recognised in all five continents. The FM profession is developing at a time of rapid change in all the areas that define its practice. The landscape for FM is also increasing global in context rather than national given trends in 'total outsourcing' of physical portfolio and services delivery by large public sector authorities and major international corporations. In short, in its continued evolution, FM must embrace change and allow diversity in the way it defines and manages practice.

The debate on whether FM has claimed the mantel of being a true profession or discipline with its unique core knowledge base will no doubt continue. In reviewing the 'the professional core' of FM of three national institutions of facility or facilities management in North America, Britain and Australia, Then (2004) summarized that Facilities Management is about:

- Understanding the business
- Planning and providing for the business
- > Managing the facility as an asset resource over its functional life cycle
- Managing the facility as functional enablers to support human resource and production processes within affordable occupancy costs
- Managing change
- > Being visible as a value-adding resource for the business
- Being professional

If we accept the above propositions as valid outcomes for the continued development of FM, it will be appropriate to provide a conceptual model that encapsulates the 'professional core competency' as advocated by the above national FM professional bodies. Then (2003) proposes a model that sees FM's involvement spanning from *facilities provision* (strategic components) *to facilities service management* (operational components). The four components of Strategic Facilities Planning, Space Planning and Workplace Strategies, Facilities Support Services Management and Asset Management and Maintenance, reflect the broad, but inter-related resources base (investments, space, assets and people) that the practice of FM must manage effectively to bring about an optimum solution to business demands.

In functional terms, the scoping of facilities management can also be defined to embrace the following:

- Strategic Facility Management (governance and organisational capability)
- > Facility Planning (identification of business need and response)

- Facility Creation/Acquisition
- Facility Operations
- Facility Maintenance
- Facility Replacement and Disposal
- Facility Management Tools
- Environmental Management
- Facility Management Systems
- Business Management
- > Legislation, Codes, Regulations and Standards

A MODEL FOR CAPTURING KNOWLEDGE FROM FACILITIES MANAGEMENT PRACTICE

It is our proposition that in order for corporate facilities managers to perform their intelligent client role effectively, they would benefit from a growing knowledge framework that ensures key learning's are captured from the on-going practice of FM operations through a thorough analysis of problem areas that emerge in the course of strategic evaluation, the procurement process and subsequent service management processes. The phase 'intelligent client role' is used to summarise the professional or managerial activity which regulates decision-making in the facilities function in terms of both facilities provision and delivery of facilities support services which enable the primary business to be conducted.

The notion of a taxonomy as ". . a classification system for improved information management" within a corporate context is central to the accumulated knowledge of real-world problems captured from the experience of operational management. Access to the knowledge-base assembled will contribute to improving the capacity of users and managers to sustain and improve the operations of the business. The key concept relates to how the use of the taxonomy, which should be closely aligned to the business processes, will contribute to corporate learning and continuous improvement through critical internal process analysis and comparison with best known current practices. Figure 3 illustrates the link between problem areas in FM practice and a proposed taxonomy covering FM knowledge areas or functions. The outcomes from practice analysis will form the basis of key corporate learning and innovations.



Figure 3: Facilities Management Practice and Knowledge Capture

It is anticipated that outcomes from the practice analysis will highlight areas/gaps within the FM knowledge taxonomy that will require actions to be taken. Such actions may be in terms of knowledge gaps and inadequate competencies in strategy development and/or operational practice, or lack policy clarity in project brief, inadequate performance measures, training needs, etc.

For many large corporations, the role of facilities managers has evolved into an *intelligent client role* in which the focus has shifted from managing day-to-day service transactions to managing service packages by third party service providers and ensuring that prescribed service performance are met at affordable costs. In addition, knowledge of the supply market and awareness of industry best practices are critical elements in arriving at informed decisions in matters relating to service specification, procurement options, selection and subsequent monitoring of external service providers.

In an outsourced environment, the onus and responsibilities on the facilities manager is more demanding in that the element of control becomes more critical and often more problematic. In such a situation, access to appropriate information becomes a crucial aspect of on-going monitoring of service delivery and identifying changing corporate demands. The situation is often compounded in many clients' organization which choose to or have outsourced.

It is our proposition that in order for corporate facilities managers to perform their intelligent client role effectively, they would benefit from a growing knowledge framework that ensures key learning's are captured from the on-going practice of FM operations through a thorough analysis of problem areas that emerge in the course of strategic evaluation, the procurement process and subsequent service management processes. The phase 'intelligent client role' is used to summarise the professional or managerial activity which regulates decision-making in the facilities function in terms of both facilities provision and delivery of facilities support services which enable the primary business to be conducted.

Conceptually, the steps involved in operationalising the above model include:

- > Identify and classify problem area by establishing the context and cause.
- > Relate problem area to knowledge area(s) or function(s) within taxonomy of FM.
- Analyse the problem area and decide on course of action by determining the information required to remedy the problem.
- Classify and codify problem area in relation to knowledge area(s) within FM taxonomy and identity information needs and tools required to build on internal capability to solve similar and related problems in the future.
- Improve internal FM capability by sharing of practice knowledge through periodic formal/informal training or mentoring, linked to performance evaluation.
- > Review and continuously improve the approach.

As an example, a management decision to consider outsourcing of facilities maintenance may be the trigger to examine the knowledge requirements to manage an outsourced arrangement and how, over time, individuals through their own learnings about the way business is conducted through business processes and practices, and nurturing this knowledge to enable it to be used to its maximum benefit to the business to enable information to be utilized.

CONCLUSION

The paper has critically analysed the knowledge management concept and postulates that there needs to be caution to blindly jumping on the knowledge management bandwagon.

The model for adopting a knowledge management approach, with a knowledge focus foundation, for facilities management that carefully considers how information can be utilised (gathered, captured, stored, retrieved and applied) to build capability and the knowledge of the individual, to add value to the organisation, is the position taken in this paper having considered the broader learnings from organisations jumping on the knowledge management bandwagon without thinking through the issue.

As Einstein stated "Knowledge is experience. Everything else is just information" (Kucza (2001).

The primary issue is how can experience be captured to obviate the wasteful effort of 'reinventing the wheel' when a similar problem is encountered again. The practicality is to optimize the attention resource of hard pressed facilities managers.

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A STUDY OF THE RELATIONSHIP BETWEEN PRIORITIES AND SATISFACTION OF WORKPLACE AND OFFICE WORKER CHARACTERISTICS

Saburo Murakawa

Graduate School of Engineering, Hiroshima Univ., Japan **Hiroshi Sugita** Graduate School of Engineering, Hiroshima Univ., Japan

Abstract

To accommodate an office environment to requirements from an IT system, the demand for renovations of existing offices is growing in the market. This paper shows the study of renovations based on the evaluation of office room environment by asking users to respond to a questionnaire. Further, the relation ship between a user's personal characteristics and his/her evaluation of essential elements in an office environment is being analyzed from the view of the user's health, and the influence of the user's health on his/her evaluation of the office environment is made clear. It is recognized from the result of the questionnaire survey that the demand for renovations related to storage space, temperature and humidity is high, and those improvements are expected. Applying the technique of factor analysis among the results of answers related to users' health, for instance, those users with physical fatigue value a relaxing environment, personal relationships and an efficient working condition.

Keywords: Renovations; Satisfaction; Priority; Workspace; Office Buildings

Introduction

In recent years, changes in the social context with regard to office buildings have especially been significant in the area of providing workspaces that are suited for the use of information technology and computerization of offices. Responding to the demands of office workers, it makes a difference in the value of building. When responding to the needs of office workers by renovation, it is important to determine the priorities and the satisfaction toward workspace. In addition, it is also important for the building owners to understand the effect on the satisfaction toward the needs of office workers by the differences of their characteristics.

In this study, based on a questionnaire survey of office workers regarding the priorities and the satisfaction toward their workspace, we determined how office workers assess their workspace. We also examined the requirements of renovations for the needs of office workers. Furthermore, we analyzed the relationship between the personal health condition and the priorities of workspaces. The purpose of this study is to clarify how the priorities of workspaces are affected by personal health condition.

Outline of Survey

Buildings investigated

We surveyed six office buildings located in the city of Hiroshima. Table 1 outlines the buildings investigated. These buildings ranged in age from 10 to 32 years, and these were larger than 6,000 m2. We brought questionnaire survey forms to specific departments located in those buildings and asked office workers to fill them out. We distributed the questionnaires in each building in late September 2002 and collected them two weeks later, in early October. Requests to fill out the questionnaires were made in the name of the Chugoku Branch Office Survey Research Committee, Research Institute of Environmental Management, Administration and Maintenance (RIEMAM). Table 2 shows the response rates.

Content of questionnaire survey

The questionnaire contained four pages and 138 questions in three categories: general questions, priorities, and satisfaction. The questions were based on Reference 1 (Office Environment Subcommittee, Research Committee on Environmental Engineering, Architectural Institute of Japan).

(1) General questions

This category consisted of questions in five areas: respondent characteristics (gender, age, occupation, job title, years employed), workday (Time length of commute, mode of transportation used for commuting, overtime, etc.), office duties (type of work, frequency of outings, frequency of interaction with customers, frequency of computer work), company characteristics (in-house and external facilities, etc.), and health conditions.

(2) Priorities regarding workspaces

This category consisted of questions in three areas: the area around the respondent's own workspace (14 questions), overall office rooms (20 questions), and the building and surrounding environment (8 questions).

(3) Satisfaction regarding workspaces

This category consisted of the same questions as section (2) above.

	Building 1	Building 2	Building 3	Building 4	Building 5	Building 6
Year completed	1975	1973	1987	1970	1990	1992
Construction	S	RC	SRC	RC	SRC	SRC
Scale:						
Floor area	8,144 m ²	11727 m ²	35790 m ²	6713 m ²	18281 m ²	27183 m ²
Stories above ground	9	12	16	9	10	14
Underground	0	2	2	1	1	1
levels						
Purpose	Office building	Office building	Office building	Office building	Office building	Office building

Table 1. Summary of the buildings investigated

Table 2. Response rates						
Building	Number of	Number of	Response rate (%)			
	questionnaires	questionnaires				
	distributed	collected				
Building 1	50	35	70			
Building 2	59	54	91.5			
Building 3	50	50	100			
Building 4	90	90	100			
Building 5	55	48	87.3			
Building 6	20	20	100			
Total/ (average)	324	297	(91.7)			

Table 3 indicates the questions in each section. For more details on the content of the questions,

Please refer to Reference 1.

Respondent characteristics

Table 4 shows the characteristics of respondents in each building. Building 1 had more female than male respondents, unlike the other buildings. Most respondents were age 30 or above. With regard to occupations, Building 4 had a large proportion of technological workers, unlike the other buildings. The job title of ordinary employee accounted for the largest proportion of respondents. At each building, a large proportion of respondents had been employed there for less than five years.

Office workers' assessment of workspaces

Demands for renovations

To determine the trends in office workers' priorities and satisfaction in each building, we determined the average level of priority and level of satisfaction for each question item in each building and graphed these values with priority levels on the horizontal axis and satisfaction levels on the vertical axis, obtaining values in four quadrants: high priority and high satisfaction, low priority and low satisfaction, and high priority and low satisfaction. Figure 1 shows the results obtained for Building 4 as an example. The shaded numbers indicate questions where all six buildings fell into the same quadrant; numbers in angled brackets indicate questions where five of the six buildings fell into the same quadrant; and underlined numbers indicate questions where four of the six buildings fell into the same quadrant. Respondents were asked to choose from five satisfaction levels and three priority levels. The five satisfaction levels are described as followings; 5 for "Really Satisfaction", 4 for "Satisfied", 3 for "Neutral", 2 for "Not Satisfied", and 1 for "Dissatisfied". The three priority levels are described as followings; 3 for "Neutral", 2 for "Neutral", 2 for "Neutral", and 1 for "Not Necessary". The average scores are calculation by each level number.

For many of the questions, all the buildings fell into the same quadrant. For example, respondents in each building indicated a high priority level but low satisfaction for questions about adequate storage space, clean and fresh air, and comfortable temperature and humidity; so these question items indicate a high level of demand among office workers with regard to renovations.



Fig. 1. Levels of priority and satisfaction by building: Case of Building 4

Table 3: Question content

Healt	n conditions						
E1	I get distracted.	E9 I	run out of patience.				
E2	It's hard to get enthusiastic about a task.	E10 I	t's hard to be neat and orderly.				
E3	I do not like to talk.	E11 I	My shoulders get stiff.				
E4	I can't collect my thoughts.	E12	My back gets sore.				
E5	I feel annoyed.	E13 I	My eyes get tired.				
E6	I get worried about things.	E14 I	feel dull and listless.				
E7	I often make mistakes in the task I'm doing.	E15 I	'm sleepy.				
E8	I have trouble remembering little things.	_					
Priori	ties and satisfaction						
1	My desk is large enough that I can easily spread ou	it all the d	locuments and other things I need.				
2	I can use the space around my seat as I please.						
3	I can lay my hands on the equipment and materials	I need rig	ght away.				
4	I have ample storage space.						
5	I'm not bothered by other people moving past or loo	king into	my workspace.				
6	I'm not bothered by the sounds of people talking, te	lephones	, computers, copy machines, or other equipmen				
7	My desk has sufficient lighting.						
8	I have enough privacy.						
9	The space around my seat is comfortable.						
10	The desks and storage cabinets are easy to use.						
11	The corridors and the space around my seat are wid	de and ea	asy to use.				
12	I can see all around the room from my seat.						
13	I can look out and enjoy the scenery outdoors.						
14	The light is not glaring or too bright.						
15	It's easy to hold a meeting whenever desired.						
16	I can relax with a cup of tea.						
17	My conversations on the phone and discussions are	e not over	heard by outsiders.				
18	Confidential documents for internal use only are not	t visible to	o outsiders.				
19	I can talk with people near my seat about matters other than work.						
20	I can tell what kind of work the people around me ar	re doing,	and whether they're taking a break.				
21	My workspace is neatly organized.						
22	Office equipment (computer, fax, copy machine, etc	.) is locat	ed near my seat.				
23	The entire room is nice and bright.						
24	The room is not dirty (floors, walls, etc.).						
25	It's easy to enter, leave, and move around the room	and ther	e is easy access to other departments.				
26	Information is conveyed smoothly within the compar	ny (circula	ar memos, etc.)				
27	The air is clean and fresh.						
28	The temperature and humidity are comfortable.						
29	I ne interior design (colors, forms, materials, etc.) is attractive.						
30	I nere are natural elements such as plants.						
31	I ne lighting does not cause any glare on computer	or word p	processor screens.				
32	I can smoke without bothering anyone. / I'm not bothered by cigarette smoke.						
33	I can easily change the layout.						
34	I can easily move my seat.						
35	I denti heve te weit leng for the eleveter.						
36	I don't have to wait long for the elevator.						
37	I can relax and enjoy a meal.	ontion					
38	I'm not concerned about measures for original prevention.						
39	The leasting is converting the surplus croude possible						
40	The location is convenient for running errands hear	by.					
41	There are notural actings poor the office (such as a	nork)					
42	mere are natural settings near the unice (such as a	α μαικ).					

Table 4.	Characteristics	of respondents

	RId 1	PId 2	PId 3	PId 4	RId 5	PId 6	Total
O and an	Diu. I	DIQ.2	DIU.5	DIU.4	DIU.J	Diu.0	TULAI
Gender:	40	20	20	00		45	407
Male	16	30	30	68	28	15	187
Female	19	24	20	22	20	5	110
Iotal	35	54	50	90	48	20	297
Age:							
Up to 20 years old	13	6	5	29	8	1	62
30-39 years old	6	18	33	22	12	3	94
49-49 years old	9	9	8	13	13	10	62
50 years and up	7	20	4	26	15	6	78
Total	35	53	50	90	48	20	296
Occupation:							
Technological	2	24	8	69	7	19	129
Clerical	32	30	42	17	35	1	157
Other	1	0	0	2	6	0	9
Total	35	54	50	88	48	20	295
Job title:							
Executive	0	0	0	1	0	1	2
Management	9	6	7	16	18	4	60
Ordinary employee	26	45	41	69	27	13	221
Other	0	3	1	3	2	0	9
Total	35	54	49	89	47	18	292
Years employed:							
Less than 1 year	14	14	27	41	12	8	116
1 to 5 years	12	27	20	27	17	6	109
5 to 10 years	8	5	2	12	12	2	41
10 or more years	1	7	1	8	7	4	28
Total	35	53	50	88	48	20	294

Comparative analysis of priorities and satisfaction in each building

Compare the buildings with regard to the average values for levels of priority and satisfaction, we calculated correlation coefficients for each pair of buildings based on differences in the levels of priority and satisfaction. Table 5 shows the results obtained.

There was higher correlation coefficient for priority levels than satisfaction levels in each case, regardless of differences among the buildings. This suggests that although larger or better-equipped spaces result in higher average satisfaction score, the level of priority is not affected by differences among workspaces to the same extent as satisfaction. Instead, priorities are affected by the content of job duties and by the social context.

Satisfaction					Priorities					
	Building 1	Building 2	Building 3	Building 4	Building 5	Building 1	Building 2	Building 3	Building 4	Building 5
Building 2	0.79					0.83				
Building 3	0.69	0.60				0.80	0.87			
Building 4	0.77	0.74	0.67			0.80	0.87	0.83		
Building 5	0.48	0.65	0.49	0.66		0.81	0.88	0.83	0.92	
Building 6	0.59	0.53	0.51	0.53	0.57	0.75	0.81	0.81	0.90	0.85

 Table 5.
 Correlation of satisfaction and priority levels at each building

Note: number of samples; 42

Correlation of personal characteristics and priorities

By analyzing the correlation of the health conditions and workspaces of office workers with their evaluation of priorities, we checked whether personal characteristics such as health conditions had any effect on the workers' priorities. We have seen in the preceding section that office workers in the buildings surveyed showed similar trends in their priorities, regardless of differences in their workspaces; so we have combined data from office workers in all six buildings for analysis below.

Personal characteristics of office workers

(1) Job duties at the office

Figure 2 shows the response percentages to questions about job duties at the office, including the type of work performed by office workers and how often they go out of the office, interact with customers, and work on computers. Most respondents (over 60%) worked individually, rather than in groups. Most respondents said they often leave the office and interact with customers, rather than hardly ever. Only around a tenth of the total said that they do not often work on computers, reflecting the extent of computerization in the modern working environment.

(2) Health conditions

To determine the health conditions of office workers, we calculated the average responses of all the respondents to 15 questions relating to health conditions. Figure 3 shows the average responses. In the questionnaire, a response of 1 meant "no," 2 meant "no opinion," and 3 meant "yes." Below, these questions will be presented in abbreviated form.

Most of the average responses fall between "no" and "no opinion." However, the respondents indicated greater level of fatigue with regard to their shoulders and eyes than the other question items.



Fig. 2. Responses on office duties



Fig. 3. Average responses on health conditions

Analysis based on health conditions

To determine trends in responses concerning health conditions, we applied factor analysis by the major factor method and varimax rotation with the 15 question items on health conditions as the variables, and obtained three factors. Table 6 shows the results obtained from the factor loading matrix.

The first factor is interpreted as mental fatigue, since it involves higher factor loading for question items such as "I get distracted," "It's hard to get enthusiastic," and "I do not like to talk." The second factor is interpreted as concentration, since it involves higher factor loading for question items such as "I often make mistakes," "I have trouble remembering," and "I run out of patience." And the third factor is interpreted as physical fatigue, since it involves higher factor loading for question guestion items such as "My shoulders get stiff," "My back gets sore," and "My eyes get tired."

Next, to determine the health conditions with regard to personal characteristics for each of the three factors obtained through factor analysis, we calculated the average factor score for each characteristic. Figure 4 shows the distribution of average factor scores.

A detailed examination of the correlations between personal characteristics and health conditions reveals that more men than women and more ordinary employees than executives and managers indicated mental fatigue. In terms of job duties at the office, mental fatigue affected more respondents who do group work than those who do individual work.

Question item	fac1	fac2	fac3
I get distracted.	0.59	0.40	0.21
It's hard to get enthusiastic about a task.	0.56	0.49	0.13
I do not like to talk.	0.55	0.29	0.21
I can't collect my thoughts.	0.53	0.41	0.17
I feel annoyed.	0.52	0.18	0.24
I get worried about things.	0.44	0.36	0.02
I often make mistakes in the task I'm doing.	0.21	0.74	0.17
I have trouble remembering little things.	0.13	0.58	0.14
I run out of patience.	0.40	0.56	0.14
It's hard to be neat and orderly.	0.26	0.51	0.01
My shoulders get stiff.	0.06	0.09	0.70
My back gets sore.	0.03	0.11	0.57
My eyes get tired.	0.18	0.10	0.55
I feel dull and listless.	0.48	0.04	0.51
I'm sleepy.	0.29	0.08	0.50
Contribution ratio(%)	15.76	15.36	12.62

Table 6. Factor analysis of health conditions

° 0.2



Fig. 4. Distribution of personal characteristics by average factor score

Turning to the factor of concentration, more office workers aged 40 or above than those aged 30 or younger, more ordinary employees than executives and managers, and more technological workers than clerical workers indicated diminished concentration. Diminished concentration affected more respondents who do individual work than those who do group work, more respondents who frequently go out of the office, and more respondents who frequently interact with customers than those who do not.

Meanwhile, physical fatigue was reported by more women than men, more workers aged 30 or younger than those aged 40 or above, more clerical workers than technological workers, and more ordinary employees than executives and managers. Physical fatigue affected more respondents who rarely leave the office than those with frequent outings, more respondents who rarely interact with customers than those with frequent interaction, and more respondents who frequently work on computers than those who do not.

Correlation of health conditions and priorities

Last, we studied the correlation between office workers' health conditions and their priorities concerning workspaces in order to determine how the evaluation of priorities is affected by personal characteristics related to health conditions.

We classified the sample into positive and negative factor scores with regard to each of the factors obtained in the preceding section (mental fatigue, concentration, and physical fatigue). For each of these sample classes, we obtained the average responses to 42 questions concerning priorities and examined the differences using t-tests. Taking the example of the third factor, physical fatigue, Fig. 5 (next page) shows the average response profiles on the negative side (no physical fatigue) the and positive side (physical fatigue). The questions concerning priorities are presented in abbreviated form in the figure.

For 12 items of the questions, significant differences in priorities were found according to whether or not physical fatigue was indicated. For instance, respondents who reported physical fatigue placed a higher priority on questions related to relaxation, such as "I can relax with a cup of tea" and "I can relax and enjoy a meal." Similarly, these respondents placed a higher priority on questions relating to smooth and efficient work, such as "Office equipment is located near my seat," "Information is conveyed smoothly within the company," and "I can easily move my seat," and questions about a well-equipped workspace including location, such as "The air is clean and fresh," "The lighting does not cause any glare," "The restrooms and kitchenette are well equipped," "I don't have to wait long for the elevator," and "The location is convenient for running errands nearby." In addition, respondents who reported physical fatigue were more likely to place a high priority on questions related to interpersonal relationships, such as "I have enough privacy" and "I can tell what kind of work the people around me are doing."

Workers who experience physical fatigue because they rarely leave the office or interact with customers inevitably spending long periods of time at their own seats. As a result, they place a higher priority on relaxation, including break time and mealtime, and on matters related to interpersonal relationships within the company, including privacy. Meanwhile, workers who experience physical fatigue because they do a great deal of computer work tend to place higher priority on matters relating to a well-equipped workspace, such as "The lighting does not cause any glare," and matters relating to smooth and efficient work, such as "Office equipment is located near my seat."

Conclusion

In this study, based on a questionnaire survey of office workers with regard to priorities and satisfaction concerning their workspaces, we have determined how office workers assess their workspaces and examined the requirements for renovations with regard to the psychological needs of office workers. We have also analyzed correlations between the health conditions of office workers and their evaluation of priorities concerning workspaces in order to determine how priorities are affected by personal characteristics related to health conditions.



My desk is large enough. I can use the space around my seat as I please I can lay my hands on the things I need right away I have ample storage space. I'm not bothered by other people moving past or looking I'm not bothered by noise. My desk has sufficient lighting. I have enough privacy. The space around my seat is comfortable. The desks and storage cabinets are easy to use The corridors and space around my seat are wide and easy to use I can see all around the room from my seat I can look out and enjoy the scenery outdoors The light is not glaring or too bright. It's easy to hold a meeting whenever desired I can relax with a cup of tea. My conversations are not overheard by outsiders Confidential documents are not visible to outsiders I can talk with people nearby about matters other than work I can tell what kind of work the people around me are doing My workspace is neatly organized Office equipment is located near my seat. The entire room is nice and bright. The room is not dirty. It's easy to enter, leave, and move around the room Information is conveyed smoothly within the company The air is clean and fresh. The temperature and humidity are comfortable. The interior design is attractive. There are natural elements such as plants. The lighting does not cause any glare I'm not bothered by cigarette smoke I can easily change the layout I can easily move my seat. The restrooms and kitchenette are well equipped I don't have to wait long for the elevator I can relax and enjoy a meal. I'm not concerned about disaster prevention. I'm not concerned about crime prevention. The location is convenient for running errands nearby Transportation to the office is convenient. There are natural settings near the office.

O5% significance

Fig. 5: Results of t-test on average response profiles

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Main author presentation

Saburo Murakawa is the Professor at Graduate school of engineering, Hiroshima University. His special fields are building and city environmental engineering, plumbing engineering and environmental psychology.



VALUE FOR MONEY AND PUBLIC PRIVATE PARTNERSHIPS

Michael Pitt Andrew Walls Heriot Watt University, Edinburgh, Scotland

Abstract

The use of public private partnerships or the private finance initiative (PFI) as a method of procuring public assets and services is now in its twelfth year. PFI is a fundamental change to the manner in which government in the United Kingdom procures a significant portion of its capital expenditure, particularly in the fields of transport, health, prisons and schools. The choice of this procurement route has excited much opinion amongst the various stakeholders as to whether or not it provides "value for money" (vfm).

Current opinion on whether or not PFI offers vfm varies. Using examples to illustrate the complexity of the argument this paper will demonstrate and explain how different opinions on the PFI process are formed.

Keywords: partnership, private, public, finance, initiative

Introduction

Under PFI the performance of projects in terms of completion of work within time and budget is a considerable improvement when compared to projects procured in a traditional manner (Comptroller and Auditor General, 2003).

	Traditional	PFI
Projects over budget	73%	22%
Projects late	70%	24%

Construction companies involved in PFI expect to make three to ten times as much money when compared to the money made on traditional contracts. This increase in profits is made because the construction companies are assuming the risks previously retained by the client and not by 'profiteering' (The Guardian, 08/09/04). The fluctuation in margin is attributed to the amount of equity held in the consortium completing the PFI by the construction company.

The public sector comparator (PSC) is flawed – the PSC may also inflate the cost of risks transferred to the private sector. Risks which are transferred to the private sector have to be identified, quantified and costed and these can easily be inflated to make the PFI option appear to provide "Value for Money" (Centre for Public Services, 2001).

A survey of 200 members of the Association of Chartered Certified Accountants found that only 1% strongly agreed that PFI provided value for money (The Guardian, 11/10/02).

In HM Treasury's document on PFI (2003) it states;

"The government aim in procurement decision-making is to secure the maximum improvement in public services from investment through maintaining an unbiased stance on which procurement route will offer value for money in each case."

All stakeholders agree that the fundamental requirement of PFI is that it must offer value for money on a project by project basis. The real difficulty appears to come when stakeholders assess value for money relative to their own positions and interests in the PFI process.

PFI is one of several procurement routes that fall under the general heading of public private partnerships (PPP), the rational of PPP is described as, "the combination of the resources of the public and private sectors, in the quest for more efficient service provision" (Akintoye, 2003). At present PFI is the most frequently used form of PPP. Government publications (Public Private Partnerships, 2000) subdivide the PPP label into 3 different types of "partnership".

- 1. The introduction of private sector ownership into state owned businesses (Strategic Partnering).
- 2. The PFI and other arrangements (Design and Build, Prime Contracting) where the public sector contracts to purchase quality services on a long term basis so as to take advantage of private sector management skills incentivised by having private finance at risk.
- 3. Selling government services into wider markets and other partnership arrangements where private sector expertise and finance are used to exploit the commercial potential of government assets.

The above perhaps explains why the acronym PPP can be used, and is used widely, when authors refer specifically to PFIs. As this paper deals specifically with the private finance initiative and not another procurement route within the PPP stable the acronym PFI will be used in this paper.

The aim of this paper is to review vfm issues that relate to the PFI procurement process and to summarize informed opinion made to date as to whether or nor PFI has indeed delivered vfm. The paper has been structured as follows. Section 2 outlines the PFI background, structure and process. Section 3 discusses the definition and the measurement of vfm. Section 4 reviews the principal creators of vfm and section 5 summarizes the findings of this review.

PFI Background and Structure

The idea that a private company might design, finance, build and manage infrastructure is not new. In the first half of the 19th century canals, railways and the like were undertaken on the basis of private promotion (Winch, 2000). However the financial crash of 1866 took away much of the competitive advantage of the promoters, or contractors, with the result that banks preferred increasingly to lend to governments and established firms rather than finance speculators projects. Thus, from the latter half of the 19th century to 1992 the involvement of a private company in the public infrastructure was largely either as a supplier contracted to provide an asset or service financed and funded by the public authority or as a provider of finances to the public authorities but not both.

PFI was introduced in 1992 by the then chancellor of the exchequer Norman Lamont with the aim of increasing the involvement of the private sector in the provision of public services (Allen, 2003). The reasoning for this was to encourage investment in a fading infrastructure from a source untapped previously and to bring in "private expertise" to the completion of public works.

This initiative superceded the Ryrie Rules that had been retired in 1989. The Ryrie Rules had been introduced in 1981 in order to "establish criteria under which private finance could be introduced into nationalized industries" (Allen, 2003). The principles behind the Ryrie Rules were similar to those behind PFI with the exception that the Ryrie Rules required public expenditure to be reduced, pound for pound, as a consequence of the use of private finance.

The initial impact of PFI was low. However PFI received a substantial boost with the change in government in 1997. The new Labour government did much to increase the use of PPP of which PFI remains the dominant form. Since then much has been done to encourage the use of PFI, however the principles (Grout, 1997) underlying the heart of PFI remain the same as they were in 1992, these are;

- financing is to be predominantly (usually fully) from the private sector and the contractual structures relate to the consumption of services not the asset itself;
- a "substantial" amount of risk must be transferred into the private sector; and,
- the project must be shown to offer value for money to the tax payer.

Thus the selection of PFI as the procurement process of choice must be made on the basis of PFI offering best vfm when compared against other procurement routes – both traditional and other routes from within the PPP set.

A PFI is usually executed by a consortium. The consortium will have been assembled for a particular PFI project and will often be a joint venture by several different types of organisations e.g. Contractors, Facility Management Companies and Financiers (Debt and Equity). The joint ventures are often referred to as Special Purpose Vehicles (SPV). The SPV has 2 principal benefits in the area of risk management. Firstly, it allows the project specific risks to be allocated to the most appropriate consortium member, and secondly, it allows a company to finance a project without putting the entire company at risk.

Prior to starting 'work on site' the PFI will have gone through a clearly defined process that has been developed, and continues to be developed, in order to confirm that the PFI procurement route, for a specific project, represents vfm. At present the primary test of vfm is the comparison of the proposed PFI against a Public Sector Comparator.

Value for Money – Definition and Measurement

PFI is a procurement route that if selected it is deemed to offer the best value for money as measured against alternative procurement routes. The value for money assessment is not an exact science the net result being that opinions on vfm vary from stakeholder to stakeholder. Vfm is defined (HM Treasury, 2003) as "the optimum combination of whole-life costs and quality (or fitness for purpose) to meet the user requirement" In seeking vfm for PFI the Government seeks to ensure that;

- The evaluation of which procurement option to use is undertaken with no inherent preference for one option or another. There should be no dogmatism in this choice. Decisions should be made on the best evidence available;
- Value for money is not taken to be least cost. There is a need to ensure that quality standards are maintained, for example in the design of public infrastructure, and the long-term viability of the PFI contractor is assured;
- The commitment to value for money should not be at the expense of the terms and conditions of the employees transferred or subsequently employed by a PFI contractor; and
- A full evaluation of the costs and benefits on a whole-life basis is always undertaken, including assessment of risk.

"As public procurement involves the expenditure of tax payers money there is a constant need to ensure that the money has been spent economically, efficiently and effectively. Where it can be shown that money has been spent in this manner it is reasonable to conclude that value for money has been achieved."

The process to confirm vfm is gradual. PFI procurement is described, currently, by 14 stages. Justification of the PFI starts at stage 3 with a 'Business case and the Reference Project', this is revisited at stage 9 and then again at stage 12 when the PFI proposition is tested for the last time in terms of risks transferred, value for money and affordability. It is at this stage (stage 12) that the Public Sector Comparator (PSC) is compared with the cost of the preferred bid in order for the PFI project to illustrate vfm.

The PSC is defined (Treasury Taskforce Private Finance, 1997) as a "hypothetical risk-adjusted costing, by the public sector as a supplier, to an output specification produced as part of a PFI procurement exercise"

The PSC has been criticised both in terms of its construction and the manner in which it is used. Construction of the PSC is completed, largely, very early in the procurement process (stage 3) and because of this it may not present a realistic comparison by the time it comes to be used in stage 12 when it is compared against the preferred bidders cost. Inherent in this exercise at stage 12 is the assumption that the comparison is 'real', this may not be so. The public authority may only be able to proceed with the project if they proceed down the PFI procurement route as there is no government funding for the project they wish to procure (Kee and Forer, 2002).
In addition to this the PSC appears to be used as a test that the project either passes or fails. It is argued that (Reference) decisions on PFI deals need to be based on a realistic, systematic and comprehensive analysis of the benefits and risks as well as the costs with the PSC being just one of the factors in this assessment.

Although efforts continue to be made to improve the value of the PSC it is important to note that the PSC will neither ascertain whether or not the consortium will deliver the project on time and within the budget nor will it be able to measure the quality of the bid.

It is worthy of note that as of November 2000 some 16 potential PFI projects had been rejected because either they failed to provide vfm or they were deemed unaffordable (Spoehr et al, 2002).

Clearly construction and use of the PSC is fundamental to the successful implementation of PFI. However, the PSC is seen as a measure of vfm and not a characteristic that can add or subtract value on a specific project.

Principal Factors in creating vfm

What characteristics of the PFI procurement process substantiate the use of PFI and, importantly, allow the PFI to show vfm relative to other procurement routes. A review of informed literature on PFIs would indicate that a variety of the characteristics of the PFI are promoted as key to the creation of vfm. The aspects of the PFI procurement process most frequently mentioned are listed and discussed below.

Many of these are similar to the 'vfm drivers' identified in the report "Value for Money Drivers in the Private Finance Initiative" (Arthur Andersen and Enterprise LSE, 2000). Unfortunately no empirical research to date appears to have identified the principal forces within the PFI dynamics. However there is a strong body of opinion within the literature that would support the characteristics given below.

 <u>Risk allocation - Optimal allocation and valuation of risk</u> – From a financial perspective it is reasonable to suggest that the required rate of return on an investment increases as the riskiness of the investment increases (Brigham 1985). Thus the theory and practice that in PFIs risk should be borne on the basis of the principle that the party best able to control or manage a risk should take responsibility for the risk (Merna, 2000) in order to achieve the optimum (lowest) cost is sound. Additionally, risks that cannot be controlled by either party are normally borne by the public authority.

The allocation and valuation of risk is a complex task that has considerable impact when the costs of the consortium are compared with the PSC. The NAO reported (2003) that for 17 PFIs the savings shown against the PSC were less than the cost of the risks transferred to the public authority in 15 out of the 17 PFIs. The allocation of risk is seen by many as the most crucial element in a PFI being able to achieve vfm. This is illustrated clearly by the statistics quoted above and the comments made by industry.

- 2. <u>A focus on outputs rather than inputs Out-put based specification</u> This type of specification is one of the main technical differences from traditional project procurement. The client describes the outputs they require from the contract rather than describing the inputs they require in order to meet the output they need. Additionally the output specification should provide the bidder the opportunity to prioritise the service by defining the clients required level of criticality (relates to the event impacting on the asset) and functionality (relates to the assets importance).
- 3. <u>Competition</u> A PFI project, like a conventional project, has to go through the tendering process where, normally, several SPVs tender against a common set of parameters, terms and conditions. Where a PFI has been won in open tender it makes the argument for vfm easier to substantiate. The element of competition has additional benefits to the client during negotiations, however this needs to be balanced against the bidding costs as these will more than likely be recovered elsewhere. The use of "competition" as the ultimate illustration of vfm ignores the value of the PSC and the fact that PFI procurement might be inappropriate in certain instances.
- 4. <u>Contract Duration and Scope</u> The duration of the contract and the scope of the contract works are very closely linked. The long duration of PFI contracts and the inclusion of the

facilities management function allow the consortium to consider properly whole life costing issues in order to minimize the contract period costs. Additionally best value, synonymous with vfm, cannot be achieved unless, during initial procurement, bidders grasp the opportunity to integrate design, construction and facilities management issues to minimise life cycle costs and optimise operational efficiency (McDowall, 2002).

Additionally, the manner in which PFIs are structured requires the consortium to construct the asset(s) before it can receive payments. This very often results in the consortium investing more in the initial stages of the contract than would be done under standard procurement arrangements to hasten the completion of the building relative to "traditional" construction. The long duration of the contracts, 25 to 35 years, allows the consortium to recoup the initial outlay, therefore without this time the PFI would be very unlikely to illustrate vfm against a PSC. This is supported by the minutes of evidence taken before the treasury committee that stated, "most PFI projects will not deliver value for money against a public sector comparator without the inclusion of services". Reports by the National Audit Office have confirmed the intrinsic value of services in achieving this in current projects.

- 5. <u>Bid Costs</u> This is really the antithesis of competition. The barriers to entry of new competitors to PFI procurement are high, some would claim that there are benefits (Lenihan, 2002). The bid costs for a PFI are typically in the order of, approximately, 3% of the contract value (ref NAO). The absence of competition from the procurement process can only result in a loss of credibility, and potentially vfm, from the PFI procurement. Bid costs can therefore be seen as having a negative and real impact upon PFI and vfm, particularly so when the number of bidders is reduced to one. The risks associated and the reasons for the number of bidders falling to one are ignored at the Authorities peril. e.g. Libra PFI (VNU Business Publications, 2003)
- Innovation The ability of the SPV to innovate is directly related to the quality of the Output Specification and the element of competition during the initial stages. This has been exemplified in successive rounds of PPP (PFI) prison procurement that showed that a combination of innovation and competition led to reductions in costs at each stage (PWC, 2001)
- 7. Borrowing Costs Financing of the project -- The fact that the Government can borrow more cheaply than the private sector is an accepted fact. It is assumed by many that the differential in the cost of capital between the public and private sectors means that the consortiums higher cost of capital will have a negative impact on the vfm case, but, it is argued determining vfm is not simply about comparing interest rates. This is not correct when the cost of capital is to be considered it should be on the difference between the cost of purchasing the asset traditionally and through PFI. Therefore the cost of capital has a lesser role to play in the vfm argument than many may first appreciate. Additionally, there is always the assumption made that the government would be able to raise the capital if the project were not to proceed as a PFI.
- 8. <u>Private sector management skills</u> For a variety of reasons that no one appears to be able to put their finger on these skills are viewed as essential. Whether or not there is a real difference between management skills of the private sector and the public sector is open to debate. However there is a real difference between the systems and procedures required within the public sector when compared to the private. It could be argued that the levels of accountability, less in the private sector, and delegation of authority, more in the private sector, allow 'things to happen faster' and thus the perceived value of "Private Sector Management Skills".
- 9. <u>Client Management skills</u> Some of these skills have already been identified elsewhere as they relate, directly, to the quality of the output specification and the running of the competition, or tender. These two aspects fall within the remit of PFI procurement a much larger and more complex task and one that places a very high demand on the capability of the public sector team. Additionally it would also appear to be common sense that the overall project success is to a very large determined by the ability of the client to adopt and sustain the Best Value regimes through out the project life (Akintoue et al, 2003)
- 10. <u>Performance measurement and incentives</u> These do not of themselves materially effect the empirical argument for or against vfm however they will increase the confidence of the client

if they are set and apportioned correctly. Recent commentary has stated that the simplistic assumption that there is a necessary and direct relationship between project incentives and performance outcomes is doubtful (Bresnen and Marshall, 2000). This is reinforced by the later comment that incentives, in the main, are not yet used or refined to best effect (PSC, 2001).

11. <u>Contract Flexibility</u> – In recent times the issue of Refinancing has appeared. The trend of interest rates over the last ten years has generally been downward, thus the cost of financing a PFI has fallen and there are large amounts of money to be made by refinancing the project. In order for vfm to be achieved the contract terms and conditions need to provide the appropriate flexibility, particularly in the manner in which gains are to be shared between the customer and the authority.

Conclusion

The PFI is a complicated and protracted method of procuring infrastructure, largely, but not exclusively, roads, schools, hospitals and prisons. In the 12 years that PFIs have been in existence many opinions have been voiced on whether or not the PFI procurement route is one that can provide vfm. Importantly there does not appear to be anyone willing or able to confirm from an objective stance, that PFI offers vfm. This situation is likely to continue for some time.

However, there are some interesting trends developing and slowly but surely more precise and objective information is appearing in the public domain.

Positive messages include;

- PFIs are seen as attractive by large contractors thus the benefits of competition in terms of vfm remain.
- Between 1997 and 2001 the cost of finance (adjusted for the change in interest rates) has reduced and the affordability of the PPPs to the Public Sector Clients (Middleton, 2001) has improved. This change is attributed to a greater understanding of PPP, improved risk management and competition to provide finance (usually in the form of debt). (It is acknowledged that the author refers to PPP rather than PFI but as the subject matter being discussed is 'finance' it is considered reasonable to assume the author is talking about PFI).

Less reassuring messages;

- The selection of PFI can enable the Public Authority to proceed with work they are unable to fund in a conventional manner. This short term view may well distort priorities in favour of projects that can be procured through the PFI route.
- There is an over reliance on the use of the PSC as the sole measure of vfm (NAO, 2003). This is aggravated by the fact that the PSC construction is also the subject of criticism (NAO, 2003).
- The absence of reliable information of PFIs has already been alluded to in the text. A
 recent study (Gosling, 2004) stated that only 50% of the information requested from Public
 Authorities was made available for inspection. Whilst the reasons for withholding some or
 all of this information may well be legitimate this does little to improve the credibility of PFI.

The trends and statements made above plus the review of vfm characteristics in section 4 illustrate that vfm is not an exact science and that it is very hard, if not impossible, to make a categorical statement that PFI does provide vfm.

The benefits of PFI are to a large degree self-evident e.g. certainty of time and expenditure but at what cost, both now and in the future? It is therefore suggested that if PFI is to be continued it needs to continue to develop an openness to the scrutiny of fact, by all parties, and mechanisms that encourage a product of high quality.

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IDENTIFICATION OF CLINICAL AND FACILITIES MANAGEMENT INPUTS IN THE CONTROL OF HEALTHCARE ASSOCIATED INFECTIONS

C. L. Liyanage

C. O. Egbu
School of the Built and Natural Environment, Glasgow Caledonian University, UK
D. Kashiwagi
Performance Based Studies Research Group (PBSRG), Arizona State University, USA

Abstract

Controlling infection is an important issue worldwide both in terms of safety and wellbeing of patients and for the efficiency and effectiveness of the health service. The paper attempts to discuss the risks involved in HAI and clinical and FM services' involvement in the control of Healthcare Associated Infections (HAI). There are many reasons why patients develop infections. The "chain of infection" has evolved as a popular way of describing it. The paper will present the main links of the "chain of infection". It will then attempt to identify the risk factors involved in infections. The crux of the paper will describe the essential areas to be considered during the process of the control of HAI. From an FM point of view, design and maintenance of the building is important to provide a risk-free environment for the patients as well as for the healthcare workers. Design considerations include ventilation requirements, patient accommodation, facilities such as hand wash basins and toilets and materials to be used for the surfaces. There is also a need to focus on soft FM areas such as cleaning, catering, laundry and waste disposal to reduce the risk of transmission of infections. One of the main conclusions of the paper is that there is a need for apt attention on FM services to maintain a safe environment, since FM services have a significant role in the control of HAI. Moreover, infection control is everybody's business, thus, there is a need for better collaboration and coordination among clinical and nonclinical teams to come up with 'seamless' infection control practices.

Keywords: Built environment; Facilities Management; Healthcare Associated Infection (HAI); Infection control.

INTRODUCTION

Studies throughout the world document that Healthcare Associated Infections (HAI) is a major cause of morbidity and mortality (Ayliffe et al, 1992; The Scottish Office, 1998; Damani, 2003; Bennet and Brachman, 1998). Healthcare organisations are searching for new and effective strategies to tackle this issue as it is seen as evidence of poor quality of health service delivery. There are many reasons why patients develop healthcare associated infections. Some of these relate to immunocompetence of the patient, while others reflect the environment in which the patient is nursed or the skills of the surgeon and the team conducting patient care. HAI is predominantly considered as a clinical issue by many researchers (Horton and Parker, 2002; Bennet and Brachman, 1998; Maki, 1989; Mehtar, 1992) and healthcare managers, However, a careful consideration would suggest that FM has a vital role to play in this regard. HAI by definition means 'infection which was neither present nor incubating at the time of admission but has developed during the course of a stay in hospital or other facility' (Haley, 1986 as cited in Horton and Parker 2002; Comptroller and Auditor General - England, 2000; Scottish Executive Health Department, 2002; World Health Organisation, 2002; Amberg, 2003). HAI stands particularly for Healthcare Associated Infections, although it can be described as Hospital Acquired Infections or Healthcare Acquired Infections. HAI could occur in any healthcare setting such as general practice, day surgery centres, residential aged care, long-term care facilities, child care centres, nursing homes, and community services other than hospitals. Besides, infections can manifest themselves during the stay in hospital or in the period following the

hospital stay (Haley, 1986 as cited in Horton and Parker 2002). Therefore the term 'Healthcare Associated Infections' is more pertinent for the term 'HAI'. HAI has been recognized as presenting a significant problem in terms of quality of care and cost for hospitals, governments and consumers in most countries (Department of Human Services, 1998). According to Ayliffe, Babb and Taylor (1999) the acquired infection rate was approximately 10% in the UK and other developed countries. This means that 5-10% of patients in hospitals at any one time have acquired an infection from hospitals (Refer table 1). MacDonald (2002) suggests that, in the UK, twice as many beds are blocked by patients with an HAI than those blocked for social reasons.

Country	Infection rate
USA	5 – 10%
Australia	6%
Norway	7%
England	9%
Denmark	8%
France	6 – 10%
Netherlands	7%
Spain	8%

Table 1: Estimated prevalence of healthcare associated infection

(Source: Thames Valley University, Richard Wells Research Centre and other expert sources as cited in Department of Health, 2003)

HAI directly affects the patient, their carers and employees because of severe or chronic illnesses, pain, anxiety, depression, longer stay in hospital. It also reduces productivity and earnings and sometimes causes death. In addition, it is a major burden to the hospitals. HAI is known to cause unnecessary expenses for the hospital as well as for the patients. Treating HAI imposes an additional burden on hospitals and results in additional costs to healthcare and community services. Ineffective control of HAI has direct and indirect cost implications. The direct cost implications could be increased bed occupancy, increased nursing and medical time, and the extra use of pharmaceuticals and medical equipment. Ayliffe, Babb and Taylor (1999) describes the main costs of HAI as the increase in length of stay and additional specific treatment, service or materials, e.g. antibiotics, disinfectants, protective clothing, dressings, infection control staff. However, the indirect costs of HAI are more difficult to quantify (Damani, 2003). Costs for cleaning, additional clinical waste, microbiology and surveillance can be few of the indirect costs. As aforementioned patients and carers' pain and productivity losses due to the illness are also potential costs which are difficult to quantify.

The National Audit Office estimated the cost of HAI at £1 billion per year (Department of Health, 2003). Similarly, last year the annual cost of HAI to the National Health Service of Scotland (NHSS) was £100M approximately (380,000 bed days per annum) which means the equivalent of a 1000 bed hospital is running continuously just to handle HAI (Hinks et al, 2003). Data available from United States too show that the costs of maintaining one hospital bed for a year would support a full hospital infection control programme in a 250-bedded hospital.

Given these statistics of HAI rates and cost implications, it is not surprising that health care authorities around the world are very concerned about HAI, thus, are continuously seeking new ways of controlling HAI. Unfortunately, many of the HAI are difficult to eradicate, and are often drug resistant (Beggs, 2003). SENIC project, performed in the United States during 1975 to 1985 showed that up to a third of HAIs are preventable (Haley, 1985 as cited in Department of Health, 2003). Similarly, another survey done by the Hospital Infection Working Group of the Department of Health UK (Department of Health, 1993), asserts that:

'about **30 percent** of hospital acquired infection could be prevented by <u>better application of</u> existing knowledge and implementation of realistic infection control policies'

The health service (in any country), therefore, has to effectively adopt appropriate infection control practices in order to protect patients, healthcare workers and other stakeholders from the HAIs which are preventable.

THE CHAIN OF INFECTION

Effective infection control practices call for a sound understanding of the basic concepts of infection and how it occurs. The use of a 'chain of infection' has evolved as a popular way of

describing the sequence of events necessary for an infection to occur. Beggs (2003) explains that it is important to clearly identify and define the chain of infection because it enables future trends in the disease to be predicted. It also enables an effective control strategy to be developed. Literally, Infection results from the interaction between a source and a susceptible host. This interaction is called 'transmission'. These three interrelated factors (refer figure 2), i.e. source, transmission and the host, represent the chain of infection (May, 2000; Bennet and Brachman, 1998; Horton and Parker, 2002; Damani, 2003; Queensland Government, 2001).



Figure 2: Main links of the chain of infection

Herein, the source is the root which releases infectious agents (bacteria, viruses, fungi). It can be either people, water, food or the built environment. According to the Victorian Rural Infection Control Practice Group (2002) the five main routes of transmission of infections are contact transmission, droplet transmission, airborne transmission, common vehicle transmission and vector-borne transmission. The infectious agent transmitted by one of the five ways stated above can enter into a susceptible host through broken skin, mucous membranes or respiratory or urinary tracts. The susceptibility of the host can be varied due to numerous factors such as age. immune system, medical interventions or physical wellbeing. For example, an immunosuppressed patient is more highly susceptible to catch an infection than a person who has a good immune response. For an infection to occur the links of the chain (figure 2) have to remain intact (Horton and Parker, 2002). Therefore, it is the healthcare services' responsibility to break one or more links of the chain which can be manipulated. The process which is adopted to break the links is widely known as infection control, which is either reactive or proactive.

RISKS INVOLVED IN 'HAI'

Identifying risks involved in HAI is important in instigating effective infection control practices. Healthcare organisations strive to maximise their effectiveness by minimising the risk factors which might have an unfavourable effect on outcome. The chance of these factors impacting on an outcome is known as risk. Risk is therefore defined as the chance of something happening that will have an impact on objectives (Carey Group Report, 2001). HAI itself is a risk to the healthcare and to the whole community; hence, effective minimisation of rates of infections is perceived as a major challenge in today's health service.

According to the Carey Group report (2001), in the context of HAI, the principal risk involved is the probability of patients, staff or others being exposed, while in a healthcare setting, to an infectious agent which damages their health. The Department of Human Services (1998) has divided risk factors involved in HAI into 2 groups; *intrinsic and extrinsic*. According to them some patients are at greater risk than others for acquiring HAI due to the presence of certain risk factors which alter their susceptibility to infection. Intrinsic risk factors are the factors which are inherent in patients. It includes the presence of acute medical/surgical disease, and severity of illness. Extrinsic, in contrast, relate to the types of medical practice performed at individual staff or hospital level and the mix of patients within hospitals. Horton and Parker (2002) have categorised the risks of HAI in a similar way, i.e. risks are inherent in patients (intrinsic) as well as associated with treatment and practices (extrinsic). The risk factors identified by Department of Health (2003) are;

- patient related risk factors; e.g. the increase in the number of people with more serious illnesses (such as cancer) which heighten their vulnerability and susceptibility to infection through weakened immunity
- therapeutic risk factors; e.g. the need for indwelling devices that breach normal defence mechanisms
- organisational risk factors; e.g. high bed occupancy, increased movements of patients and poor staff to patient ratios plus the tendency of hospitals to admit patients with a wide range

of serious illnesses from a large geographical area so that different pools of patients are mixing within the care environment

- behavioural risk factors; e.g. poor compliance with hand washing and other hygienic practices by health staff
- structural risk factors; e.g. numbers of single rooms and hand basins
- environmental risk factors; e.g. dirty instruments, floors and walls in clinical areas
- external (to healthcare) risk factors; e.g. profligate and inappropriate use of antibiotics in medicine and agriculture around the globe

However Filetoth (2003) has classified the risk factors in infections into four distinguishable groups according to their source and possible influence (Refer table 2). Herein, endogenous risk factors are those that originate in a patient in whom a disease develops, and such factors contribute to an increased risk of development of the disease of interest whereas exogenous risk factors are those factors originating from a source external to the patient in whom the disease occurs, such factors are often called 'environmental'. Both endogenous and exogenous risk factors either can be objective or subjective. Objective risk factors are mainly independent of humans, and are determined mainly by nature while subjective risk factors mean the factors which are dependent on human decisions and interventions based on human behaviour.

Risk factors	Examples
Endogenous objective	age, severity of underline disease, length of hospitalisation can contribute to an increased susceptibility to infections
Endogenous subjective	behaviour and cooperation of a patient (psychiatric cases, conscious negligence) also influence the occurrence of HAI at the individual level
Exogenous objective	are the structure and technical capability of a health care system, and the development of medicine in general, to prevent and influence the occurrence of diseases which also applies to HAI
Exogenous subjective	are staff practices, attitudes and knowledge which influence the occurrence of HAI

Table 2: Risk factors of HAI (Source: adapted from Filetoth, 2003)

The risk factors provided by the Department of Health (2003) can be categorised under the divisions given by Filetoth (table 2). For examples, patient related factors can either be 'endogenous objective' or 'endogenous subjective' while behavioural factors can be 'exogenous subjective'. Therefore, the risk factors are homogeneous, although categorisation differs from one author to another. Nevertheless, the prevention of HAI is a more difficult task. The difficulties are inherent due to the status of the risk factors mentioned above, e.g. hospital environment, patient's condition, culture of the hospital staff and management staff practices and status of the medical procedures/interventions carried out by the hospitals, etc. Therefore, the main aim of infection control should be to minimise or avoid the aforementioned risks.

CONTROLLABLE AND UNCONTROLLABLE FACTORS OF 'HAI'

Infection control practices are written to reduce the risk for patients and healthcare workers (West, 1995). Filetoth's (2003) division of risk factors of HAI (refer table 2) can be used to identify the factors which could be controlled by the health service to reduce the risks of HAI (refer figure 3). The structure and technical capability of a health care system, the development of medicine in general, staff practices and attitudes and knowledge which influence the occurrence of HAI can be considered as controllable risk factors. Although it is depicted, in figure 3, that all endogenous are uncontrollable and all exogenous are controllable, some exogenous factors could be uncontrollable due to reasons such as antimicrobial resistance and the extent of medical interventions.



Figure 3: Controllable and uncontrollable risk factors (Source: adapted from Filetoth, 2003)

As per figure 3, the risk factors given by Department of Health (2003) can be categorised under controllable factors and uncontrollable factors as shown in table 3. From this the elements of infection control can be regarded as healthcare structure, environment, staff practices and healthcare management. In terms of infection control, the uncontrollable elements are beyond the remit of health service or healthcare management.

Controllable factors by healthcare	Uncontrollable factors
 organisational behavioural structural environmental 	 patient related therapeutic external (to healthcare)

Table 3: Controllable and uncontrollable risk factors

(adapted from Department of Health, 2003)

ESSENTIALS OF INFECTION CONTROL

Importance of hand hygiene practices

Hand hygiene is a critical element in the control of HAI. The hands of healthcare workers are crucial in 'contact spread' as well as in most other cross-infections too. The role of the hands of healthcare workers in the spread of infection has been investigated on numerous occasions since Semmelweis reduced the death rate of women following childbirth in 1847 by improving hand hygiene compliance (Infection Control Nurses' Association - ICNA, 1998). Most crossinfections in healthcare occur by transfer from the hands of staff, primarily due to lack of handwashing or poor practice in the process of handwashing or poor practice in the process of handwashing and drying (Boyle, J, 2001). However, it seems that patients also contribute to infection rates with their own hand hygiene practices. Hygienic hand washing in the hospital or clinic, to remove transient contaminants acquired from patients or the environment and prevents cross-infection to vulnerable patients, is regarded as one of the most fundamental infection control measures, yet it is done infrequently by personnel in most hospitals (Maki, 1989). Many MRSA (Methicillin-Resistant Staphylococcus Aureus) and other infections are spread this way because healthcare workers do not wash their hands effectively, before attending to patients (Ayliffe et al, 1988). Indirect-contact is distinguished from direct-contact by the participation of an intermediate object, which is often inanimate. These inanimate objects are often called 'fomites'.

Importance of management involvement

Even though 'hand hygiene' and healthcare worker practices are considered to play a dominant role; structure, environment and leadership/management also have supremacy over control of infection. The Scottish Office (1998) declares that although the basic principles, such as the

primacy of handwashing and universal precautions remain unchallenged, the field of conflict between healthcare services and an increasingly fickle population of microorganisms becomes ever more diverse and reaches into the community with growing frequency as the duration of hospital stay shortens. Therefore one of the main concerns of this manual was to clarify the roles and responsibilities of Health Boards, General Practitioners (GPs) and other deliverers of care regarding infection control provision and function. This endeavours in implementing a 'seamless' infection control service which pervades all disciplines, without barriers. The emerging concern of HAI, in all countries including UK, has resulted in changes in organisational structures in healthcare. The introduction of infection control teams, infection control committees, infection control doctors and infection control nurses has been a major step towards addressing management and control of infection. Tannahill (2003) asserted that to make infection control practices effective it should be embedded into everyday practice of healthcare whilst supporting it at an organisational level. Leadership and management will be the key aspects of eliminating organisational risk factors. According to Phillips (2001), leadership is essential to influence and persuade staff that infection control has high priority and practices must change. With reference to the Department of Health (2003) management should develop high guality surveillance systems, setting clear standards for infection control and making HAI a key feature of quality and patient safety programmes. In addition, there should be a system in place to monitor progress whist taking corrective actions.

Importance of facilities management services

According to Mehtar (1992) the disinfection, antibiotics, sterile services, waste disposal and handling, sharps disposal, isolation facilities for patients, kitchen and catering, planning and development, purchasing of new equipment and decontamination of equipment servicing are major issues for consideration in infection control. Thus, they can be regarded as the elements of infection control or control measures of infection control (from healthcare point of view). According to Mehtar's (1992) classification 'hand hygiene' falls under sterile services and management responsibilities under planning and development. However, Boyle. B (2001) has presented the infection control measures in a different way (refer table 4).

What to control?	Control measures
Air	Building Ventilation
Water	Design, Temperature, Hypochlorite
Infectious Patients	Isolation
Domestic Equipment	Cleaning
Staff Carriers	Screen tests
Food	Good hygiene and temperature control
Equipment	Sterilisation and disinfection
Staff contact	Handwashing, protective clothing and aseptic techniques

Table 4: Control measure of HAI (Source: Boyle. B, 2001)

Both Boyle. B (2001) and Mehtar (1992) have highlighted many of the areas which can be classified under the category of FM services. It includes building ventilation, water supply, cleaning of domestic equipment and food. Which means, despite organisational and behavioural aspects (e.g. management involvement and hand hygiene practices), structure and environmental aspects too are deemed to be included in the control of HAI. The Department of Health (2003) describes 'structure' as the design of the building, e.g. numbers of single rooms and wash hand basins. It has considered 'environmental issues' as a matter of domestic services, e.g. cleaning of dirty instruments, floors and walls in clinical areas. Although this description does not entirely cover many of the areas to be considered it gives a notion that FM services have a role in HAI. The consideration of the structure and environmental issues together should ensure a 'safe environment'. 'Safe environment' is a broad term used frequently in healthcare settings to signify a secure surrounding within which people are not harmed (Horton and Parker, 2002). The components of a safe environment can be depicted as shown in figure 4.

A 'safe environment' includes a host of things, albeit, in view of infection control, the above are the major elements. According to figure 4, it is apparent that infection control practices constitute a non-clinical component (rather FM component) as well. One might wonder how 'infection control', an area seemingly more akin to clinical practice, has an association with non-clinical aspects. Ayliffe, Babb and Taylor (1999) aver that the healthcare environment includes all the physical surroundings of patients and staff, i.e. structures, fittings, fixtures, furnishings, equipment and supplies. Briefly, it is the 'built environment'; the place where the patient is treated. It has an importance influence on the likelihood of acquiring an infection and on the nature of such infection. A variety of microorganisms is likely to be found in hospitals where many people are aggregated thus one of the main objectives of infection control is to expose patients to an environment at least as free from microbial hazard as that which they would find outside the hospital (Ayliffe et al, 1992). Regular cleaning of the environment including floors, toilets, baths, wash hand basins, beds, locker tops and other furniture plays an important role not only in maintaining the appearance of buildings but also in reducing the dust, dirt and soiling which can harbour microorganisms. The domestic services staff therefore play an important role in maintaining a safe patient and work environment (Ayrshire and Arran Health Board, 2000). Clothing or bed linen used by hospital patients is a possible infection risk to staff handling it on the ward, during transport to, or during processing in the laundry. An inadequately disinfected or decontaminated laundry may also be a risk to subsequent users (Ayliffe et al, 1992). The need for adequate food hygiene facilities is of paramount importance, since the consequences of an outbreak of food poisoning in a healthcare facility can be life threatening to patients. Therefore, particular care must be taken to minimise the risk of infection or intoxication through the food service system (Damani, 2003). An effective waste disposal practice should be carried out by dividing waste into categories and using different methods of disposal for the various categories. Inappropriate handling and disposal of waste can contribute to the spread of disease in and out the hospital (Mehtar, 1992).



Figure 4: The principles of a safe environment – in view of HAI (Source: Horton and Parker, 2002)

Apart from the management of facilities services during the building occupancy stage, **facilities planning and construction** also have a role in the control of HAI. It was identified that healthcare environment is a secondary reservoir for organisms with the potential for infecting patients. If healthcare-associated infection is to be reduced, it is imperative that infection control is 'designed-in' at the planning and design stages of a healthcare-facility (new build or renovation project) (Property and Environment Forum Executive, 2002). Designed-in infection control means that designers, architects, engineers, facilities managers and planners work in collaborative partnership with infection control teams to deliver facilities in which infection control needs have been planned for, anticipated and met. It demands input from healthcare managers and clinical professionals to facilitate identifying HAI related issues and standards of infection control. Their input will be crucial for a design which enhances staff practices such as hand hygiene and domestic cleaning.

The areas of FM services in the control of HAI, inter alia, include:

1. Design, construction and maintenance of facilities: Du Moulin (1989) asserts that the design of wards have a direct effect upon the potential for infection. Engineering and architectural

elements which will ultimately contribute to minimum risks of infection are deemed to be included for hospital designs. Therefore, as aforementioned, if HAI is to be controlled, it is imperative that infection control is "designed-in" at the planning and design stages of a healthcare-facility (new-build or renovation projects). Apart from the need of appropriate facilities planning and design, new-builds and refurbishment projects also need to be managed and controlled. Construction, renovation, repair and demolition activities in existing healthcare facilities require substantial planning and coordination to minimise the risk of airborne infection both during projects and after their completion. In addition to the design and construction stages, during the building occupancy stage there is a need for appropriate maintenance of healthcare facilities to improve the state of the built environment in order to ensure minimum or no rates of infection. Poorly maintained environment will be a pool for microorganisms to grow and multiply. Common infectious diseases such as 'Legionella' can occur through water supply systems while 'Aspergillus' can arise through ventilation systems, which are not maintained properly. The following is a list of the main facilities to be designed, constructed and maintained in the control of HAI:

- water supply systems
- inanimate surfaces
- the space around beds
- heating, ventilation and air-conditioning systems
- sanitary facilities
- 2. Cleaning: Thorough cleaning removes majority of microorganisms present in the environment. As indicated by Ayliffe, Babb and Taylor (1999) regular and efficient cleaning is necessary to maintain the appearance, structure and function of healthcare buildings and their contents. As for the National Health Medical Research Council (Australia) and the Australian National Council on AIDS (1996); toilets, sinks, wash-basins, baths, shower areas, and surrounding areas should be cleaned regularly or as required. Bed pans and urinals should be cleaned with an abrasive cleaner, rinsed in warm water then dried and stored appropriately. The cleaning methods for these items should avoid the generation of aerosols. Overall, regular cleaning and maintenance is necessary to maintain a safe environment.
- 3. Disposal of waste: There are different types of clinical wastes, mainly clinical and domestic; and different classifications of wastes which determine how the waste should be treated. Both domestic and clinical wastes are likely to contain moisture and nutrients which will allow microorganisms to grow to large numbers in the environment (Damani, 2003). As the Auditor General, Scotland (2001) noted, the effective management of hospital waste is essential for the health and safety of patients, staff and the general public.
- 4. Laundry and linen: Linen is a potential source of micro-organisms. Used linen which is soiled and fouled, may be contaminated with potential pathogens. Therefore, used linen should be removed from the patient or bed with care.
- 5. Catering: The hospitalised patients are more susceptible to food-borne infection and more likely to suffer serious consequences from such infection than healthy members of the community (Filetoth, 2003). As noted by the National Health and Medical Research Council (Australia) and Australian National Council on AIDS (1996), food preparation and handling should comply with relevant State and Territory health regulations.

MANAGEMENT, CLINICAL & NON-CLINICAL INPUTS - ELEMENTS OF INFECTION CONTROL



Figure 5: Main elements of Infection Control

The main elements of infection control can be categorised as shown in figure 5. As aforementioned the health service have only a limited control over the risk factors of HAI. According to figure 5, infection control have controllable elements and uncontrollable elements, in view of health service. External or factors which cannot be controlled by the health service will be factors such as susceptibility of the host or severity of illnesses, etc. The factors which can be restrained are named as 'internal' due to their state is being related to healthcare. Since design and construction has a significant contribution over the control of HAI the controllable elements are divided mainly into two phases, i.e. design/construction stage and building occupancy stage.

The two phases consists of 3 main inputs. These are, management input, clinical input, and nonclinical input (construction staff and facilities services staff).

There are some other organisations such as surveillance organisations, professional bodies, suppliers and government bodies that are associated with healthcare who have a marginal role in the control of HAI. However, healthcare managers, clinical staff and non-clinical staff are the major contributors in the process of HAI eradication. Therefore, these three 'main inputs' have been considered to discuss the sub elements of infection control. Several sub-elements are given under the three main inputs. In a generic perspective, the sub-elements given are key considerations which lead to a 'seamless' infection control practice. Different professionals, it would seem, have different perspectives of fundamentals of infection control. Therefore, attention seems to have been levelled more towards clinical practice over non-clinical issues. However, there is a necessity to attend to built environment and facilities management issues (non-clinical issues) as well to implement an effective infection control strategy in hospitals or other healthcare institutions.

CONCLUSIONS & FUTURE WORK

Healthcare Associated Infection (HAI) continues to be a worldwide problem. It causes problems to patients, to the community and to healthcare workers. It is a burden to the health service as well. Through different national prevalence surveys done in UK and other developed countries, the acquired infection rate obtained was about 10%. Hence HAI is a major concern. Now, it is high time that the Health Service came up with new strategies to tackle this issue since it is seen as evidence of poor quality of health service delivery and also leads inevitably to avoidable costs. Although microorganisms are the main cause of nosocomial infections, they are by no means their only determinants. Patient-associated factors play a major role (especially immune status), as well as the therapeutic conditions (personnel behaviour, 'devices') and the patient's environment. Facilities Management (FM) services have a significant input in the process of infection control. It is not only FM services such as cleaning, catering and waste disposal that have a role in HAI but the 'built environment', which embraces facilities design, construction and maintenance of such facilities. The paper draws four main conclusions from the above discussions:

- The hospital infection control team is responsible for implementing and operating an efficient and cost-effective infection control and prevention system. In order to implement an efficient and cost-effective infection control and prevention system, the infection control teams must identify the factors affecting HAI properly.
- Inappropriate measures, e. g. the routine disinfection of floors in wards and hallways place a burden on staff, patients and the environment, and distract staff from other critical measures such as proper hand hygiene. Proper collaboration between hospital staff in implementing infection control measures, and especially hand hygiene is of paramount importance.
- For the reason that support services have a significant role in controlling HAI the healthcare management should give proper attention to FM services to maintain a 'safe environment'
- Infection control is everybody's business, thus, there is a need for better collaboration and coordination among management and staff members to come up with 'seamless' infection control practices
- Most what has been put forward in this paper is based on a literature review done as part of the research which the paper is based. The next step of the research project will be to commence the case study approach. It is divided into two parts. One will explore the context of FM services and challenges associated with measuring and managing performance during the building occupancy stage. It will focus both on in-house and outsourced FM services to recognise any divergence of practices. It was identified from the literature review that the application of infection control standards is comparatively less during the design and construction stages due to the cost of involvement and lack of mandatory and evidence-based guidelines of infection control for contractors and infection control professionals. Therefore, the second part of the case studies will look upon the extent of application of infection control standards during new builds and refurbishment stages.

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'NON-INTEGRATION' OF FACILITIES MANAGEMENT TO THE CORE PROCESSES OF HEALTHCARE – PROBLEMS AND SOLUTIONS

C. O .Egbu

C. L. Liyanage

School of the Built and Natural Environment, Glasgow Caledonian University, UK

D. Kashiwagi

Performance Based Studies Research Group (PBSRG), Arizona State University, USA

Abstract

This paper is based on the issue of Healthcare Associated Infections (HAI). Facilities Management (FM) has a dominant role in the control of HAI. The idea of this paper is to discuss the issues arising through non-integration of facilities management to the core processes of healthcare, in view of HAI. The paper draws evidence from a series of government publications to unveil the reasons for non-integration. Many government reports, published in UK, have given a very diminutive role for the FM function in the process of infection control. Neither has it given core responsibilities nor clear communication to major players of infection control, i.e. infection control teams. The paper also discusses the role of Knowledge Management (KM) towards better integration of FM to the core processes of healthcare in the control of HAI. This paper draws out three main conclusions. First, there is a need to assign properly defined roles and responsibilities and clear authorities to the facilities managers and facilities services staff. Not having properly defined lines of communication can result in ambiguities as well as poor practices through lack of direction. Secondly, whether FM is in-house or outsourced, the healthcare management and infection control practitioners should endeavour to involve facilities managers in the development of guidelines and standards for FM services. This could minimise practical difficulties of FM practices when adhering to infection control standards. Finally, healthcare managers should take steps to create an 'open-culture'. This could encourage clinical and facilities services staff to share their knowledge and could result in minimising errors. The 'open culture' can improve integration. It is however apparent that the integration of FM and the core functions will be crucial not only for infection control but also for achieving the main goals of healthcare delivery.

Keywords: Facilities Management (FM); Infection control; Integration; Knowledge Management (KM).

INTRODUCTION

The effective control of infections in healthcare is imperative in order to protect patients, visitors, healthcare workers and other occupants in hospitals or other healthcare buildings. These infections are commonly known as Healthcare Associated Infections (HAI). Healthcare Associated Infections (HAI) by definition means *'infection was neither present nor incubating at the time of admission but has developed during the course of a stay in hospital or other facility'* (Haley, 1986 as cited in Horton and Parker 2002; Comptroller and Auditor General, 2000; Public Health Laboratory Service, 2000; Scottish Executives Action Plan, 2002a; World Health Organisation, 2002; Amberg, 2003). Infection control, a synonym to the control of HAI, can be either reactive or proactive. There has to be a climate of awareness among healthcare management, healthcare workers and the public about the severity of HAI and the importance of infection control. The control of HAI should be integral with the other processes of healthcare. The processes either can be clinical or non-clinical. It was identified from the research on which this paper is based that non-clinical services, commonly known as support services have a vital role in controlling HAI. Thus, improvements in infection control demand an understanding of the relative importance of FM as a fundamental part of HAI. The idea of this paper is to discuss the

problem of infection control from an FM perspective. Thus far a diminutive role is given to the FM component in the process of infection control. In terms of infection control, a greater deal of attention is given to clinical issues over FM issues. It is evident from a series of government reports published across UK. This 'power crisis' has, *inter alia*, created a cultural barrier between clinical and facilities services staff. The paper describes the importance of integration between clinical and facilities services staff to facilitate best practice in the control of HAI. Finally, the paper attempts to put forward the role of knowledge management as an effective approach in improving integration and awareness among the clinical and non-clinical staff.

INFECTION CONTROL (UK CONTEXT) – WHAT HAS GONE WRONG?

Never has infection control in the UK received so much attention and prominence as it is the case now. This has followed principally from a series of government reports acknowledging and emphasising the importance of infection control as a key indicator of high quality clinical care (Masterton, Mifsud and Rao, 2003). Many books and reports in infection control have regarded HAI as a clinical issue (Bennet and Brachman, 1998). The Medical Research Council (1944) has considered infection control as a nursing issue. However, a recent publication entitled 'Winning Ways', a report of the Department of Health (DoH, 2003), has proposed seven action areas to control infection and has averred to the fact that it should not be left to the clinical staff alone; however, it has not given a particular emphasis to the FM aspect. It appears that the report has overlooked the remit of FM over the control of HAI. The organisational structure developed by the Comptroller and Auditor General (2000) to control infection in England (refer figure 1), also appear not to have given any responsibilities to in-house Facilities managers or Facilities management contractors where the FM service is outsourced.

The research, on which the paper is based, tries to focus on NHS Scotland (NHSS) context in particular. Hence, it is worthwhile considering the priorities given by the NHSS to FM services in the control of infection. HAI emerged as a principal concern in NHSS after the Salmonella outbreak at Victoria Infirmary in the year 2001. The working group led by Dr. Brian Watt (Scottish Executive Health Department, 2002b), which was assigned to oversee the outbreak, came up with several recommendations, in 2002, emphasising the importance of hand hygiene and the spaces around the beds (the bed space for wards recommended by Watt groups is 2.7m from centre to centre of beds). The main cause of Salmonella outbreak was poor food hygiene. Therefore, notably, Watt report highlighted the significant role of non-clinical practices (i.e. FM services) in the control of HAI. However, some recommendations given by the Watt group resulted in controversies due to costly alterations and lack of evidence in terms of recommending numbers, sizes and spaces for facilities arrangements. The Carey Group report (2001), which discusses the need for a comprehensive framework for managing risks in terms of HAI, has also underlined the magnitude of FM services in the control of HAI. Further, it has laid emphasis on a common approach to promote an organisational culture which actively seeks openness and sharing of information on managing risks of HAI. There is a host of facilities services to be managed and controlled in reducing the risks HAI. Such facilities services range from hard issues such as construction and property management and maintenance, to soft issues such as cleaning, waste disposal, catering and laundry and linen. The Scottish Health Plan 'Our National Health' (2000), which has given priority to the setting and monitoring of national clinical standards for NHSS, has extended the remit of CSBS (Clinical Standard Board of Scotland, presently known as Quality Improvement Scotland - QIS) to include service standards on food, cleanliness and other aforementioned facilities services in the control of HAI.

According to the Chief Medical Officer's letter (CMO) of September (2003), a major programme of work was laid out in the Scottish Executive Health Department's (SEHD) ministerial action plan on HAI to improve the prevention and control of HAI across the NHSS. This programme is now being actioned by the Scottish HAI Task force, of which the Chief Medical Officer is the Chair. The HAI Task force is both overseeing existing work in progress and commissioning several new working groups to address the many tasks specified in the action plan. Their target is to achieve reliable, repeatable, and acceptable levels of control over HAI within a minimum of three years. For the task force, multidisciplinary groups which consist of experts who are specialised in particular areas of concern are assigned to govern the HAI issue. This is a major step towards a strategic infection control perspective which fits with wider societal values and expectations. Besides, this has set FM areas including built environment, cleaning and catering as major concerns in the control of HAI. Consequently, the HAI task force prioritised publishing a 'code of practice for cleaning' as one of their main documents. The HAI task force has also highlighted the need for guidance documents on 'infection control in the built environment'. The emphasis is specifically made upon the infection control issues related to procurement, design and construction of new-build and hospital refurbishment projects. Moreover, legionella issue is also a major focus of the HAI task force. Legionella, arises mainly through poor design, construction and maintenance of water supply systems, is one of the common infections occur in hospitals.



Figure 1: Responsibilities in the NHS in relation to HAI (Source: Comptroller and Auditor General, 2000).

HAI is becoming a worldwide concern. Owing to this vital consideration of HAI in all countries including UK, there have been changes in organisational structures in healthcare. Introduction of infection control teams, infection control committees, infection control doctors and infection control nurses has been a major step towards addressing management and control of infection (refer figure 2). Members of all infection control teams (ICTs) and infection control committees (ICCs), in hospitals and NHS trusts, are mainly doctors, microbiologists and nurses. None of the

ICTs or ICCs (refer figure 2) have participants from FM services. It is true that, in healthcare context, FM, per se, is a support service to the core process of healthcare, (i.e. clinical care); however, to tackle HAI, FM has to be given right of way.



Figure 2: The organisation of infection control (Source: Ayliffe, Babb and Taylor, 1999).

As aforementioned, the profile of prevention and control of HAI in the NHS Scotland has been transformed within the past few years. After the Victoria Infirmary 'Salmonella' outbreak, which occurred mainly due to food-borne infections, NHS Scotland's focus on facilities services, in the control of HAI was remarkable. However, it would appear that Scottish Centre for Infection and Environmental Health (SCIEH), the main organisation that executes surveillance on infection control, has not given a clear authority for FM services over prevention and control of infection. This is apparent in the model developed for prevention and control of infection and communicable disease for Scotland by SCIEH (SCIEH, 2002). The idea of developing the model was to ensure that the most effective arrangements and processes are in place to achieve and maintain best practice in infection control and communicable disease control. The model consists of three main elements, namely, core components of the model, national infrastructure and delivering a sustainable model. It has given priority to performance management and has given measures to achieve best practice nationally. For infection control practices to become effective, all NHS organisations and their personnel have to understand how their contribution fits as part of the comprehensive approach. Due to this reason the model has articulated a generic framework of national roles, responsibilities and relationships for infection control. In this generic framework FM services appear to be given a diminutive role in control of HAI. Further, FM services neither have direct relation with the infection control teams nor with the infection control committees.

Overall, although many government documents have averred the significance of FM services in the control of HAI, it would seem that they have not given a prominent role/authority for FM in doing so. It was put forward in a conference held in 2003 in NHS Scotland (organised by the Property and Environment Forum Executive, Scotland) that, controlling HAI is everybody's business; means that 'infection control is a collective effort'. 'Everybody' in this respect is the government/policy makers, healthcare management, participants from both clinical and non-clinical staff services, and the general public. Therefore, if there is to be any major new impact on controlling risks of HAI, there has to be a fundamental change in the thinking of management and staff. There has to be a climate of awareness of the importance of FM services in the control of HAI. Thus, improvements in infection control demands an understanding of the relative importance of FM as a fundamental part in HAI.

INFECTION CONTROL – IMPORTANCE OF 'FM' INTEGRATION

As Berwick (as cited in Woods et al, 2001) asserts, great health professionals do not make great healthcare. Great health professionals inter-acting well with all of the other elements of the healthcare system make great healthcare. As the Department of Human Services (1998) described, infection control requires commitment of adequate resources and clear lines of communication between the major players. As identified in the previous section, one of the major problems in NHS England and NHSS organisation structures, designed specifically for control of HAI, is that they have not defined FM as a key player in the process of infection control. Neither have FM professionals given any clear lines of responsibilities nor clear lines of communications to work with the major players, i.e. infection control committees/infection control teams (refer figure 2). This could lead to a host of issues stated below:

- likely to create unnecessary bureaucracy
- less focus and commitment from facilities managers and facilities services staff in the process of infection control
- little or no involvement of facilities managers in the development of infection control guidance for FM services
- less understanding about the operational issues by the infection control teams when developing guidance for FM services
- practical difficulties when adhering to infection control guidance
- communication barriers between clinical and FM services teams which can ultimately cause cultural barriers
- marginal support from the FM services staff to achieve infection control objectives
- less understanding of the scope and issues of infection control
- less emphasis on a 'team approach' in the control of infection
- less co-ordination during training initiatives for facilities services staff
- segregation of clinical and FM services
- duplication or gaps or work which could ultimately cause time, cost and resource constraints

The availability, utilisation and suitability of facilities can greatly influence healthcare setting in developing and transmitting infectious agents. For examples; lack of handwashing facilities in wards can present staff from washing hands in between patient contacts; improper use of disinfection agents for decontamination can result in cross infection; and unsuitable ventilation systems which do not serve the exact purpose can assist in the growth of infection. All these can occur due to poor planning of healthcare settings, variances of standards or lack of specialist knowledge of FM function. Predominantly, in view of FM, poor integration of FM services to the clinical process will be one of the major factors of causing HAI. In simple terms, 'integration' implies the formation, coordination, or blending of units or components into a unified whole (Environmental Monitoring and Assessment Program, 2002); thus integration between the two parties in achieving infection control goals together. Integration also considers interdependency between the two parties when carrying out practices of infection control.

Clinical staff and support staff (facilities services staff) consider themselves as two separate entities and hence coordination between the two is currently less than ideal. Staff's perception on cleaning of ward beds is an evidence for this. They regard the cleaning of the upper part of the bed (pillows, bed linen, etc.) as a duty of clinical staff and underside cleaning (cleaning of equipment underneath the bed, floor, bed frame, etc) as the duty of the domestic staff. Commodes or ward equipment which are frequently used need frequent cleaning. From discussions with few of the Facilities Managers of NHSS, it was identified that support staff perform thorough cleaning of toilets and ward equipment at least twice-a-day. However in their view, it's the clinical staff's responsibility to clean the equipment or commodes in-between patient use. These reveal the segregation of the tasks related to the same component or same domain. Apart from cleaning, the other FM services, which have significant roles in the control of infections, also exacerbate the issue of non-integration. Examples of this can be cited from areas such as laundry and linen, catering and management of waste (segregation of waste and disposal). Although appropriate handling of all these services is the responsibility of facilities services staff; it requires assistance and guidance from infection control teams or from microbiologists. Clothing or bed linen used by hospital patients is a possible infection risk to staff handling it on the ward, during transport to, or during processing in the laundry. Inadequately

disinfected or decontaminated laundry may also be a risk to subsequent users (Ayliffe et al, 1992). Besides, the need for adequate food hygiene facilities is of paramount importance, since the consequences of an outbreak of food poisoning in a healthcare facility can be life threatening for patients. Therefore, particular care must be taken to minimise the risk of infection or intoxication through the food service system (Damani, 2003). Also, effective waste disposal need to be addressed the issues of appropriate division and handling of waste. Inappropriate handling and disposal of waste otherwise can contribute to spread of disease in an out the hospital (Mehtar, 1992). All the above require guidance from the infection control teams and microbiologists such as suitable temperatures for disinfection of laundry and linen, appropriate temperatures for food storage and correct methods of segregation of wastes in the forms of household waste, clinical waste and sharp objects. It is vital to ensure safety against HAI. However, from informal interviews with experts in infection control revealed that the level of infection of infection control teams is low in FM services; even though they are needed to be involved. The level of involvement is even lower in hospitals where FM services are outsourced; some microbiologists and infection control team members claimed that they are not at all involved in assisting FM contractors (PFI or other private contractors) on infection control matters.

According to the Scottish Executive's Action Plan (2002a) links between clinical and facilities staff are essential to influence many of the factors underlying HAI such as the spacing and configuration of beds, control of bed occupancy, patient movement and delayed discharges. The impact of poor clinical environment on the incidence of HAI can be compounded by patient management factors such as bed occupancy and throughput. Delayed discharges increase the likelihood of patients acquiring infection and HAI can, in turn, lead to delayed discharge. The Action Plan asserts that the responsibility of FM services should be clearly defined between nursing and facilities services staff to avoid any discrepancies in work practices. Facilities managers are responsible for creating a risk free environment in terms of HAI, for the occupants of the particular hospital/healthcare building; especially for patients, as they come to hospitals to get better not to get sick. Thus, there is a need for facilities managers to continually work with the infection control teams. On one hand, it fosters the development of operable (practicable) infection control policies for FM services. On the other hand it facilitates FM staff and managers to regularly inform infection control matters which impinge on their work.

Improved coordination among staff members is needed especially for areas which are high-prone to HAI. These require apt attention to fulfil tasks as and when required. For example, control of infection practices in domestic services, maintenance and waste management require integration of domestic and other facilities services staff and the ward-based clinical teams. Such services should not be the soul responsibility of the facilities services staff; it should be a collective effort. Fundamentally, the following staff members should be aware of the facilities services standards and their practices:

- the facilities managers and staff
- nursing staff (including matrons)
- supervisors
- the purchasing manager
- infection control staff
- staff responsible for supply of central sterilised equipment/ materials
- ward managers
- departmental managers

The absence of integration among the aforementioned participants could usually result in poor performance in FM service. The nationwide audit carried out by Audit Scotland (Audit Scotland, 2003) across the NHSS to review the cleanliness of hospitals, came to the conclusion that the level of cleanliness of some clinical equipment was found to be unacceptable in 10% of wards in hospitals. Their recommendation was that 'cleaning of clinical equipment requires co-ordination between domestic services and nursing staff and the development of operational policies with explicit responsibilities'. Similarly, the same can be recommended for other FM areas as well.

Thus far, the paper was focussing on the importance of integration between clinical and FM teams; integration across the teams. However, integration within the FM teams is also essential in dealing with problems of HAI. The FM services staff should coordinate and communicate, whenever possible, to identify any deficiencies of their work practices. For an example, there should be better linkages between estate management and domestic services since both services' ultimate goal is to upkeep the hospital environment. In some cases, poor maintenance

of equipment can cause difficulties in cleaning. For example, with time, a broken ventilation system which is not fixed can be a reservoir for dust accumulation, thus, can be a threat for the surrounding area in terms of cleanliness. As Audit Scotland (2003) noted, there is a need for better co-ordination of domestic services and estates management to identify and manage areas of risk. There should be better coordination amongst other facilities services staff as well. For a prompt house keeping service, which is part of the domestic service, there should be a close liaison between the house keeping staff and the catering staff. As a whole, better integration of clinical and FM teams (both managers and staff) is required to carry out infection control practices effectively. A great responsibility lies with the healthcare managers to initiate practices which avoid lack of integration between these two functions.

KNOWLEDGE MANAGEMENT (KM) – CAN IT IMPROVE INTEGRATION?

KM – an introduction

The structure, input and process of healthcare should be designed in such a way as to achieve quality delivery in terms of efficiency, effectiveness, safety, timeliness, etc. Technology will be one of the key aspects in this context for hospitals to drive the delivery of care by effectively minimising waste. According to Handy (2002) technology can be used to reinforce the human relations values of confidence, proximity and responsiveness that are very essence of the business. But as he proclaims businesses may be enhanced by the new technology but people/expert's involvement is always essential to ensure the smooth running of functions and to identify errors. Especially in a service sector like healthcare, technology is only an enabler for efficient delivery whereas healthcare workers/professional's skills, experience, ideas and knowledge will be the core input for an effective delivery. Ideas, skills, knowledge of people are the intellectual property, which drives an organisation and is now recognised as the key asset of most organisations (Handy, 2002). Presently many sectors have turned to explicit and systematic knowledge management (KM) to develop the intellectual capital needed to succeed (Wiig, 1999) so as to retain, develop, organise, and utilise their employees' capabilities.

KM is about ensuring that people have the knowledge they need, where they need it, when they need it - the right knowledge, in the right place, at the right time (National Electronic Library for Health, 2003). It is known as the capabilities by which communities within an organisation capture the knowledge that is critical to them, constantly improve it, and make it available in the most effective manner to those people who need it. They can then exploit it creatively to add value as a normal part of their work (Royal Dutch, 2001 as cited in Haines, 2002). It is evident from the literature that FM has a dominant role in HAI control. However, practices of healthcare staff and healthcare management processes also appear to play an important role in the incidence and control of HAI. In this sense KM is significant to retain, develop, organise, and utilise the organisation's capability of managing HAI. The report 'NHS Performance Indicators: A Consultation (2001)' asserts that around 15% of HAI could be avoided through strengthened arrangements for prevention and control, and better application of existing knowledge and good practice. As a knowledge intensive sector, healthcare needs to adopt the latest medical and relevant support service practices. It also has to rely on the skills and expertise (knowledge) of the staff to provide a quality service (Knowledge Management Strategic Advisory Committee. 2002). Although it is largely a public and service sector, it should aim to operate and survive like a profit-oriented organisation in achieving the goals and targets, e.g. providing a better, risk free service to the general public. KM is specifically vital in achieving this due to the fact that it requires prompt attention or quick response on customer needs, i.e. patient care, with the aid of prompt and appropriate knowledge, skills and expertise of staff for excellent delivery of services. Precisely, it needs the employment of the right sets of knowledge at the right time. However, most hospitals are unaware of their acquired knowledge base although healthcare providers and policy makers produce standards, protocols and guidelines from time to time. A workshop for National Health Service in Scotland (NHSS) Estates Directors held in the year 2002 (Hinks et al, 2003) concluded that all the key components of the solution to controlling HAI are already known but the issue lies in their better communication and implementation. Hence the priority should be to coordinate and disseminate existing knowledge in a form that is consistent and accessible to all stakeholders involved in HAI avoidance.

Addressing the big issue – integration

According to Albers and Brewer (2003) KM deals with the creation, acquisition, integration, distribution and application of knowledge to improve the operation effectiveness and competitive advantage of an organisation. KM is providing the right information to the right people at the right time. Most companies that have knowledge management programs emphasise knowledge sharing and integration which is what is referred to as first generation KM.

FM in healthcare context is complex. It becomes more complex when infection control is considered. Hospitals require a high quality service from catering, cleaning, maintenance, portering, laundry services, waste management, etc. due to the risk of HAI. Severely ill patients may need special dietary requirements; cleaning, portering and maintenance should be carried out ensuring less dispersal of microorganisms since patients are highly susceptible to catch an infection; patient's and staff's clothes, uniforms and bed linen should be handled with care for health and safety reasons; house-hold waste and clinical waste should be properly segregated to ensure infection control practices. Because of this Olesen and Hood (2003) confirm it is necessary that cross-fertilisation between specialist groups occurs for mutual recognition and information exchange regarding objectives and planned outcomes that may not be coincidental. The benefit of information exchange will be the provision of an environment within the healthcare setting that is functional, comfortable and safe and that addresses the needs of the people with illness or health concerns. Implied within this is that infection control risks will be addressed or minimised.

Facilities managers and facilities services staff often lack knowledge in infection control. It is not cost effective if they are to be provided training on the control of HAI. Indeed they can be provided with guidelines on the requirements or responsibilities they have over infection control but not the peripheral knowledge of HAI. For example the maintenance staff are provided the guidelines regarding ventilation requirements of wards but it is up to them to achieve the standards considering the other practical issues such as movement of patients and staff during maintenance of ventilation systems, issue of legionella, dust control etc. The role of the infection control practitioners is to provide the necessary support and expertise to motivate the other parties to apply appropriate infection control practices. It is not only 'knowledge transferring' but is 'knowledge sharing'; a two-way process where facilities managers and facilities services staff become well-versed with infection control issues and vice versa. Their integration will enhance knowledge sharing and will subsequently create new knowledge, e.g. come up with good practices in infection control. FM services staff can gain assistance from infection control practitioners or clinical staff. Similarly, clinical staff can receive assistance through the domestic staff to carry out cleaning practices effectively in sanitary and other ward areas, as and when required, in-between patient use. Sharing expertise among staff members gained through experiences can resolve practical difficulties endured by individual staff members when performing the tasks of infection control. This should not only be between different categories of staff but also staff who perform similar tasks can share knowledge and the expertise gained through experiences. This can resolve practical difficulties encountered by individuals when performing the tasks.

Contracting out FM services has often been debated by the healthcare managers and infection control practitioners. Infection control practitioners believe it as a poor practice which could increase the incidence of HAI. Murphy (2002) alleges that 'contracting out of hospital FM services has further contributed toward falling standards'. According to him outsourcing FM services has not improved the quality of service, rather it has created a two-tier workforce, breaking up the healthcare team and creating obstacles to the provision of client-focused integrated services. As to Barrett (1995) improvement is needed in the quality of cleaning 'where direct control has now often been lost to outside organisations'. Similarly, Doctors Corocoran and Kirkwood (as cited in Murphy, 2002) argue that cleaning and other FM services are critical area for infection control and yet in many hospitals its management has been lost to outside organisations, resulting in uncoordinated and inconsistent FM protocols. On the contrary, Rogers (1999) cites two of the main advantages of outsourcing of FM services in hospitals as follows:

- Reduction in functional difficulty: difficulty in managing different functions and tackling span of control
- Reduce risk by spreading the risk to outsourced contractors

According to Smith (1995), outsourcing FM contracts reduce burden of healthcare management; the healthcare manager's role moves towards overall contract monitoring, while the FM contractor focuses on service delivery. In contrast, there are those who subscribe to the view that where services are contracted out they are more likely to have failed' (NHS, 2001). Considering this dilemma of contracting out FM services, it could also be argued that it is not totally the problem of outsourcing which increases the incidences of HAI, but the lack of integration between the FM contractors and healthcare management (both management and operational levels). As Smith (1995) states, FM contractors and healthcare managers should have a better integration to develop, initially, a partnership understanding between the teams, if it is to be outsourced. It is perceptible that FM contractors do not have an in-depth knowledge of HAI. Then again, neither infection control practitioners nor healthcare management are thorough in practical issues of FM services. Hence, whether FM is in-house or outsourced the healthcare management and infection control practitioners should endeavour to involve facilities managers in the development of quidelines and standards for FM services. Simultaneously, clear lines of communication should be developed among them to improve coordination and integration. Not having properly defined communication lines can result in ambiguities as well as poor practices through lack of direction. Therefore, 'integration' is required between FM and the clinical teams. Better integration permits two teams to explore each others' areas. It broadens their views on what is happening around them. It identifies the issues which could exacerbate each others' performances. It could eliminate duplication of work. Ultimately, integration helps them to achieve goals through a coordinated effort. Briefly, integration and coordination rather creates a culture where staff will use a holistic view to execute work.

CONCLUSION

Thus far a diminutive role is given to the FM component in the process of infection control, although FM is significant in infection control. There has to be a climate of awareness of the importance of FM services in the control of HAI. Thus, improvements in infection control demands an understanding of the relative importance of FM as a fundamental part in HAI. Not having clear lines of responsibilities and clear lines of communications to coordinate with the major plays of infection control, i.e. the infection control committees/ infection control teams, could lead to a host of issues such as unnecessary bureaucracy, less focus and commitment from the FM staff, little or non involvement of facilities mangers in the development of infection control guidance for FM service, segregation of clinical and FM services, communication and cultural barriers between facilities services staff and clinical staff and finally gaps or duplication of work. Therefore, there is a need to improve the integration of FM and clinical components of the healthcare service in order to control HAI as well as to achieve high quality health service.

There is a need to assign properly defined roles and responsibilities and clear authorities for the facilities managers and facilities services staff. Not having properly defined lines of communication can result in ambiguities as well as poor practices through lack of direction. Secondly, whether FM is in-house or outsourced, the healthcare management and infection control practitioners should endeavour to involve facilities managers in the development of guidelines and standards for FM services. This could minimise practical difficulties of FM practices when adhering to infection control standards. Finally, healthcare managers should take steps to create an 'open-culture'. This could encourage clinical and facilities services staff to share their knowledge and could result in minimising errors. The 'open culture' can improve integration. It is however apparent that the integration of FM and the core functions will be crucial not only for infection control but also for achieving the main goals of healthcare delivery.

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FM AND PROJECT PROCESSES IN HEALTHCARE FACILITY PLANNING - A CASE STUDY ON USABILITY

Göran A. Lindahl Division of Building Economics and Management, School of Civil Engineering **Josefina Hinnerson, Jan Åke Granath** Division of Space and Place, School of Architecture Chalmers University Of Technology, Gothenburg, Sweden

Abstract

This paper reports on a case study of the planning and use of the O-building, used for radiology and surgery, at Örebro University Hospital. The study has been performed within the work of CIB/TG 51. The ambition of the O-building project was to create "Care for future generations". The project started in 1992 and the building was opened in 1997. The project process was rooted in tradition in the County of Örebro to carry out projects in close co-operation with the users as well as aiming for a high quality building. Traditionally building design projects in the County of Örebro are set up in a close co-operation between core business representatives and the real estate department. The health care units involved organised themselves in design teams to develop useful solutions for their professional activities. The real estate department set up a project organisation to support the building project. Representatives for both these groups meet in a co-operation group to make decisions to deliver to the project steering group. The consulting architects worked closely together with the teams in both core business and the real estate department. The case study shows that the project process was characterized by the tradition of co-operation between real estate and hospital representatives coupled with an emerging FMperspective that resulted in what is considered as a successful project.

Keywords: workspace, usability

INTRODUCTION

Background

The background to the case study presented in this paper is a research and practitioner based network within CIB/TG 51 on Usability. Currently five countries participate; UK represented by Salford University and NCR, Sweden represented by Chalmers University of Technology and Örebro University Hospital, Finland represented by Helsinki TU and Old Mill Oy, Norway represented by NTNU, Trondheim and Statsbygg and France represented by School of Achitecture, La Villette, Paris and Renault Technocentre in Paris. Every country contributes with a design case that is presented and examined in a workshop. The company in co-operation with the local researchers makes the evaluation. The aim of the evaluation is to describe the actions taken, decisions made and gualities included in the project to arrive at a usable solution. The evaluation also includes a review of the usability of the building in use. The sources for this investigation are documents, interviews and observations of the kind that are used in ethnography. The evaluation is documented in a draft report to the whole group. This report is then the basis for a workshop where the evaluation is discussed and challenged by the other participants. The aim of the evaluation and the workshop is to find aspects of the concept of usability. As every case is different and belong to different contexts new aspects of the concept of usability is highlighted in every study. An early provisional and somewhat rudimentary understanding of the concept is developing and will become more and more elaborate with every workshop.

Method

As the aim of the investigation is the understanding of a complicated concept rather than finding common quantitative evidence of a certain phenomenon, we use a qualitative and practice grounded method of which we have long experience. If our aim were to find common knowledge on what properties makes a building usable we would base our investigation on a traditional quantitative point of departure. As we, in this investigation, aim to expand the understanding of the concept usability in order to develop a common understanding that can serve as guidance in as many design and evaluation situations as possible, we have to chose our situations of investigation in another way. From a similar project of investigation of the multiple aspects of "the importance of spatial design to work place performance", we developed a method for this kind of research (Torngvist 2001). The first component [i] of the investigation is to fuse practice and research together in the development of understanding. Theory developed from practice and theoretical reflection on and structuring of practical understanding are the cornerstones of the investigation. The creative process of investigating and reflecting on common situations between research and practice is essential. This method of developing innovative new concept that challenges existing theories, as well as proven practice has been successful in earlier projects. The second component [ii] is the combination of self-evaluation by practice and a selection of quick ethnographical research methods (Massey 1998, Mc Cleverty 1997). During the almost ten years long thematic network "Workspace" a case based method was developed (e.g. Tornqvist 2001). The third important component [iii] is choosing situations from different cultural contexts like countries, companies and industrial branches. Like the thematic network "Workspace" this is a co-operation between a number of countries represented by researchers and companies from different branches.

Theoretical framework

Traditional programming of buildings focuses on the properties of the building itself. It focuses on the functional properties of the building and assumes that usability will follow as a causal effect of a functional design. Traditionally Swedish building research has been very successful in analysing building functionality, often with focus on housing design (Granath & Bergqvist, 1983). One established evaluation method is the *"The Serviceability Tool"* (Davis & Ventre, 1990; Davis 1993) that uses the terms *performance* and *serviceability* where "Serviceability is about whether a building or facility is capable of performing as required" and "Performance means actual behaviour in service at a given moment." Another important method is the Post Occupancy Evaluation – POE – technique developed by Wolfgang Preiser (Preiser et al, 1988). POE is traditionally a technique that is used for buildings in use. Preiser has however in recent writing indicated different types of POE; indicative, investigative and diagnostic (Preiser, 2003). POE and the Serviceability Tool are two methods to evaluate and rate buildings in relation to the intended use, they both focus on observing and measuring certain physical aspects of buildings and facilities in relation to the intended or actual use.

Product designers suggest two categories of functionality; *technical functionality* and *interactive functionality* (Warell, 2001). Technical functionality is defined as those properties given to the artefact that makes it do the job in itself. Interactive functionality is described as those properties of the artefact that interact with users of the artefact.

Functionality as mentioned above is a characteristic given to an artefact in order to achieve a *practical effect* (Warell, 2001). However, the technical and physical properties, the defined functions, of the artefact and its theoretical potential to deliver a certain effect do not automatically make it usable. The definition of usability also depends on the *situation* in which the artefact is used, the *context* the artefact is designed and used in and the *values* of the designers and users. It is also affected by the culture in which the artefact is designed and used (Vatrapu, 2002; Vöhringer-Kuhnt, no date). All of these aspects also change with *time* and *place*.

In ISO standard 9241-11 three factors are described that determine usability. *Efficiency* means that the artefact allows the users to perform with ease and with little use of resources. *Effectiveness* describes the ability of the artefact to deliver a certain effect. The third factor is *satisfaction* that describes the users feelings and attitudes towards the artefact and its effects.

Participation is also related to planning of functions and performance of buildings. A growing awareness of the importance of employee participation in organizational change and workplace design is quite new in countries like US, UK and Germany. At the same time, this has been

legislated and common practice in Scandinavian countries for almost thirty years and in other countries it is not even considered as relevant (Granath et al 1996; Lindahl 2004).

Usability as used in this paper and in the work of TG51 is a complex term that is being developed within the task group. All of the aforementioned aspects are being considered and how they in different ways and to various degrees affect usability. The case presented below utilises some of the aspects covered and contributes to the development of the definition of *usability*. A tentative framework based on only this case would be to acknowledge the aspects of *situation, context, culture* and *participation*.

THE CASE - THE ÖREBRO UNIVERSITY HOSPITAL

The Örebro University Hospital, USÖ, one of nine University hospitals in Sweden, is a development-oriented medical centre located in central Örebro, a medium sized Swedish town. It has extensive basic general medical facilities and provides health care for inhabitants in the region as well as to central parts of Sweden. USÖ is among the leading hospitals in the area of occupational- and environmental medicine, ophthalmic diseases, urology, and cancer treatment. It is one of the leading hospitals in radiology and was the first in the world to link all radiology departments in the county into one virtual department though a shared county network. The European Development Centre for Radiology is located at USÖ. The usable area of the hospital buildings are over 200 000 m². The major development of the hospital was done in 1960:s but an ongoing renovation and investment in new buildings have made USÖ one of the best-maintained hospitals in Sweden today.

Organisation of real estate and services

Like most public health care organisations in Europe, Swedish counties face difficulties financing the core business. In many counties this have resulted in low investments in real estate both in terms of new buildings and maintenance. Many counties have an enormous need for investments in a run down building stock at the same time as the deficit in core business is boosting. In Örebro the investments have historically been high in real estate and the situation, on the contrary to other counties, is not acute. In 2001 a new facilities and service company was created – Landstingsservice. The new concept was to include all support to the core business in one organisation. The former real estate company was now included in the service unit to deliver all services needed to the USÖ.

The purpose of the building and project schedule

The master plan for the hospital from 1983, revised 1990, laid out the detailed plan for development. The O-building was the final stage of that plan. The building was supposed to house two main activities, surgery and radiology. The building houses general, urological, orthopaedic, hand and gynaecological surgery. Late in the process, in 1995, thoracic surgery was added. The units for anaesthesia and ICU (Intensive Care Unit) were also located in the building as support units to surgery. The surgical units should have their own operating theatres, support and administrative spaces. The radiology department is divided into: neuroradiology, gastrointestinal, skeletal, nuclear medicine and emergency radiology. The building is used for three categories of patients for both surgery and radiology, these are: emergency patients, planned in-patients and planned one-day surgery patients.

The ambition of the project was to create "Care for future generations" and the cost estimate for the project was of just over 50 million Euros (\$ 46 million). Decision to start the project was made in 1992. In April 1993 the functional brief was presented and discussed with the County Administrative Board and thus presented to the politicians in the County Council. This was an important step as all decision-makers and politicians were present. The first complete design proposal of the building was presented in 1993. The first design was fairly traditional, but more detailed investigations of the site and the interface with connecting buildings ended up in a building with a triangular form. In 1993 a foundation was made for the O-building. This was done in order to connect installations and underground corridors crossing the site. In 1994 the construction started. In 1995–1996, there were cutbacks in the hospital budget. This had the effect that three surgical units got two instead of three operation theatres and that thoracic surgery was included in the O-building. , The O-building was completed in 1997.

The process

Traditionally, health care is organised in a hierarchical way. Building projects however often fall outside the ordinary relations in an organisation. The real estate unit has since early sixties had established active co-operation between core business and building projects in planning and designing and have developed a culture of participatory design. They also have a long experience as a client and organiser of building projects. From the following case description of the project we find that this participation from core business employees was very detailed and started early enough to affect strategic issues of the building project. The health care units that were affected formed design teams to develop useful solutions for their professional activities. The real estate department set up a project organisation to support the building project. Representatives from both groups met in a co-operation group to make decisions to deliver to the project steering group. The consulting architects worked closely together with the teams in both core business and the real estate department. The process to develop and design the O-building involved a large number of people. Three main groups carried out the process, thus we distinguish between the user project, the building project and the co-operation group.

One user project was set up for each unit. However, the thoracic unit that was added to the project in 1995 did not have a user group. Due to Swedish legislation and praxis, the different unions were represented. One person was responsible for continuity and strategic issues, mostly the head nurse for each unit. The chairman of the department (clinic) participated as well as a representative for the assistant nurses and department of medical engineering. No representatives for services like janitors or cleaners were represented. The project group was well rooted in and chosen out of trust by the rest of the unit. They reported back at unit meetings. A construction project manager from the real estate department led the building project. This group also consisted of the architect, technical consultants and representatives from the hospital management. A co-ordination group was set up as a bridge between the user project and the building project. The head of the unit, the chairman of the department and representatives from medical engineering participated from the user project and the architect, construction project manager and sometimes the hospital management participated from the building project. The coordination group made decisions regarding the development of the project. The architect also worked directly with the different units. The work done in the user project groups was presented regularly at meetings on unit level. There were large papers on the walls were people could comment on drawings and other material that was displayed. The comments were given to the architect.

Co-operation in design

The different surgery units in the user project carried through design activities to investigate alternative solutions and articulate the needs of the units. An important arena that all units could use was a room with a complete mock-up of an operating theatre. This was the arena where nurses, doctors and medical technicians could meet with architects and other representatives of the building project and investigate different solutions. The mock-ups were used for simulation where the degree of truthfulness to reality was extremely high and detailed. Most of the dialogue in the design process took place directly between individuals or groups from the user project and the building project and they often arrived at concrete conclusions and suggestions. Decisions, confirmation and policies were then forwarded to the co-ordinating group that had the formal power to take that role.

The process of the radiology units was somewhat different. The head of the department and the head of medical engineering were at an early stage dedicated to the idea of using new digital technology. The head of the department contacted the radiology department in the county and investigated if they were willing to convert to digital radiology and to connect to a network that could transfer digital x-ray pictures. All five radiology departments concluded that this would be a great advantage to them and agreed to participate. The idea was presented to the head of the hospital and the county politicians and got support as long as they kept the time and cost limits. The first brief for the units however suggested a mixture of traditional technology and digital technology and a step-by-step conversion to the new technology. The manufacturer of digital x-ray equipment – Philips - however took an interest in the developments and was willing to use USÖ as a testing ground for development work. This situation and the parallel development of equipment made it not feasible to use the same method of a common testing arena as was done for surgery. In this case the development of technology was done through innovative work in all

steps of the chain from Phillips laboratories to the actual radiology unit in Örebro with iterations of information and knowledge between radiology nurses, doctors and technicians on one side and engineers and researchers at Phillips in the other end. The result was that USÖ became the first hospital in Sweden that totally depended on and fully utilised digital radiology technology.

Important issues in the design process

In surgery, the main organizational issue was the change from an organization where surgery was a general resource for the whole hospital and located in a central unit. In the new organisation the surgery was divided into units and organizationally belonging to different departments (clinics). This change was however decided beforehand and was a prerequisite for the new building.

In radiology, the main issue was the transition of technology. Many operators and nurses feared the new technology and the risk that their professional knowledge should be obsolete. As the more serious development in this direction took place after the briefing process for the building had started, it was also a problem for the building project. A step-by-step move of units and a thorough educational program was established to meet these problems.

A demand from the users was operating theatres with windows and daylight. This question was raised by the building project as they thought; this could be a problem for certain processes like keyhole surgery and that they would pull the curtains down most of the time anyway. The experiences from the old operating theatres, located in the dark core of a double corridor building from the seventies, was however so definite that no discussion was necessary. The users were also inspired from research in environmental psychology that stressed the importance of pleasing environment for both staff and patients. A question related to this was access to outdoor terraces. This was a trickier question, as it was easy to advocate for the hygienic risks of going outdoors when working in a surgical unit. No real arguments came up that could justify outdoor terraces, but today there are terraces in the building to the pleasure of the staff. However, everyone realized that it was a calculated risk and it is now used with a strong awareness that the hygienic regulations must be followed rigorously. Another important issue in the operating theatres was the high demands of cleanliness that led to the demand for laminar airflow ventilation through the ceiling whereas it could also be satisfied with more traditional displacing ventilation. A decision was made that four units needed such high degree of cleanliness that the investment was justified. The thoracic surgery however, that came in late in the process, also advocated this need but according to the standard used they did not need such high quality ventilation.

From the interviews, it was found that the experiences from the design process are very positive. Most of those who participated or worked in the units that moved into the building remember it as a positive experience. They are also very appreciative of the project leader of the building project who was open and tried to consider all wishes with respect. Interesting enough persons in leading positions does not remember the process being as smooth as the interviewees remember it. The head of the real estate company at the time remember, with some uneasiness, the turmoil that accidents in thoracic surgery caused at the time. The decision to install the less advanced ventilation in the operating theatres led to accusations against the real estate company having caused accidents by not letting thoraic surgery have what they considered appropriate ventilation standard. The head of radiology also remember the tough discussions he had with different professional groups who feared the introduction of digital radiology.

THE OUTCOME

The result is a triangular shaped seven-storey building with a helipad on top. The shape was derived from site constraints and because the new building needed to connect to the adjacent buildings. This applied not only to axis but also to floor levels. It has a cast-in-situ concrete structure built stepwise with the floors first, then the walls. When the building structure was complete, all installations were brought in. All vertical installations run through shafts and all installations on the floor run along the corridors. The operation theatres are fed from the corridors to allow for future changes. The second and fifth floors are installation floors were all ventilation systems are installed. There are five separate ventilation systems taking care of the requirements from the activities and a central hot air system is also installed for local warming of patients post-op as this enhances their recovery.

Organisation and use of the building

In the basement there are underground corridors connecting to the underground communication systems of the hospital. On the ground floor are general hospital communication areas. Emergency entrance of the hospital is placed in a building adjacent to the O-building. From the emergency entrance, there is a direct connection to the ICU and the top-floor with the helipad. The major part of the ground floor is used for the radiology department and it's examination rooms, meeting rooms and offices. The ground floor also has a popular outdoor rest area used by radiology. The third floor houses day-surgery and preparation rooms for this. The day-surgery units carry out surgery where the patient can return home the same day. This floor also has 4 operation theatres for thoracic and 4 for general surgery. The fourth floor has a pre-operation ward and 10 operation theatres. These are orthopaedic surgery 4, urological surgery 2, hand surgery 2 and gynaecological surgery 2.

The type of surgery/radiology that needed to be done affects the daily activities in the building and whether it is an emergency, planned in-patients or planned day surgery. A typical process for surgery starts when the patient arrives at the O-building. If the surgery is day-surgery the patient arrives at day-surgery reception. The patient is then taken to a preparatory unit. After tests and preparations the anaesthetic unit brings the patient to the operation theatre and prepares for the operation. After the surgery the patient is the taken back to the anaesthetic unit. When the treatment is completed the patient leaves the hospital. When the patient comes from another department and it is planned, the patient arrives by the aid of the anaesthetic department to the relevant surgical unit/theatre, where the patient is anaesthetized. Once the surgery is completed, the patient is awakened in the pre surgery room at the O-building. This improves the quality of the preparatory process, as there is more than one nurse available to check on the patients during this phase. This solution was tested during the design process.

A typical process for radiology is firstly affected by whether the patient comes as out-patient or as in-patient. The outpatient is arriving arrives to a reception. The patient is then given an individual space where he/she can change clothes and make preparations for the examination. The patients have their own spaces were they can control light etc. This is important as they can become more relaxed and can adjust the conditions individually. At the radiology department there is incandescent light as opposed to fluorescent light, which gives a warm and comfortable atmosphere. This is important as most radiology examinations imply that clothes are taken off in a more or less public environment. The light character and the small scale with individual spaces enhance the quality for the patient. When the patient comes from department within the hospital they go directly to the relevant examination room.

Experience of use

A number of those interviewed did not work in the hospital at the time of design. The difference in appreciation of the building between those who participated at the time and those who did not is not obvious from our interviews. Most negative comments concern the orientation inside the building. The triangular shape is not intuitively understood. In the interviews, the building is however mainly commented positively. Especially the different colour schemes used to indicate departments are experienced as both "looking nice" as well as supporting orientation. Several interviewees also comment that the colours are positive for the patients. Those that have been temporarily working in other hospitals experience the building as very nice. A comment was that "when I was working in another hospital I understood how great a workplace we got". Another comment concerns the milieu, "it is not only grey, white and with cold light".

The main concern at the surgery department is that the day-surgery workload has increased. This results in a lot more patient transports than expected. This in combination with a shortage of staff and construction of the building with surgery on two floors is considered a significant problem. The handling of sterile goods is a function that is carried out differently in the different surgical units. This resulted in a separate lift for this function and that sterile goods need to be transported to another building in order to get fully sterilized, due to the different views on how sterile goods should be managed. It is an overall logistical difficulty although not experienced as a major problem.

In the radiology department positive comments concerned, the overall work environment design, the decoration and comfortable premises. However, ergonomical issues could be further dealt with, as there are still problems with backs and shoulders. This might be because although major

adjustments for the radiology examination are done automatically the final adjustments have to be done by hand. A new stress factor not present before is stress related to malfunction of the computer-based systems.

A criticism concerning the building is that is not used at its full potential. It is only used to 1/3 of its capacity. This is however, a hospital management and political issue that are related to politics rather than the usability of the O-building. In sum, the building is considered nice and well functioning for both staff and patients. The difficulties encountered concerning ergonomics are similar to other parts of working life but compared to other hospitals lower. The building has unused capacity and has proven flexible during the first 6 years of its use.

DISCUSSION AND CONCLUSION

Functionality

Örebro County Council has long experience as a builder of hospitals and a solid know-how and experience in how to design and furnish buildings for their purposes. The tradition in the organization is not to make detailed and voluminous lists of all equipment and building properties in briefs. The functional brief was more or less developed through work with mock-ups and through the co-operation with Philips. Tacit and explicit knowledge embedded in the minds of the users was an important source of information and knowledge. Visits to other hospitals together with experiences within the building project were also useful.

The strategies were slightly different in radiology and surgery. In surgery, *technical functionality* was secured through working with mock-ups. By doing that it was possible to both investigate the properties of every single piece of equipment, to make sure they functioned well, and how they worked in the context of the operating theatre. In the radiology departments, the functionality was secured through the co-operation with Philips. The equipments used on the patients in radiology do not differ much from analogue radiology, the big difference is that film is not used in digital radiology, which makes a difference in development, handling and storing of the pictures. It also makes a big difference to doctors in terms of diagnostic praxis and effectiveness in operating situations. As the experience of the actual technique was little and not all technology existed at the time of project start one defined functions rather than equipment in the briefing and procurement process.

In surgery, *ergonomic functionality* was secured through extensive use of the mock-up. A number of issues were discovered. As the equipments used on the patients in radiology were rather like traditional equipment, existing expertise could be used. New functions in handling and maintenance of the equipments were dealt with in co-operation with Philips.

Communicative Functionality was important in both the operating theatres and radiology. Partly it was a matter of communicating certain values to the patients, partly of symbolic meaning to the staff. Windows in operating theatres, colours and decoration had this double meaning. In interviews we found how relative these aspects are. It is not before people have been to other hospitals or heard comments from patients they realize what a pleasant work place they have. Having this pointed out to them they feel a certain pride of their working environment.

Efficiency

The process of working with prototyping in the mock-up room safeguarded against non working solutions. A semi-conducting floor that fulfilled the functional specifications had a pattern that made, needles and other small items disappear if dropped, which could have caused serious hazards, is an example of this. The new organization in surgery is well supported by the building. It is today, due to proximity, easier to be flexible and borrow staff from other surgical clinics if needed.

In radiology the decision to change to digital radiology coincided with an independent demand from the hospital management to save money by cutting down staff. The new technology made it possible to analyse the work organization and the competence needed in the department. This led to a new competence structure were more responsibility was given to qualified radiographers and the competence of the radiologists was used in a more efficient way. The new technology made the group of assistant nurses obsolete and allowed less staffing during examination.
Effectiveness

An example of how effectiveness was allowed to rule over what we maybe could argue would have been more efficient is the total transition to digital radiology. It might have been easier to take it slowly and transform the technology in a pace that would have been more in line with the personnel's skills and knowledge. It might also have been less risky not to stand in the frontline of a new technology. However, with a procedure of planned transition combined with education of personnel the hospital has become a very effective unit in radiology. Due to the late introduction of the new technology in the project, there were quite large spaces left empty that originally were designed to be archives.

Satisfaction and dissatisfaction

Staffs in surgery and radiology say their work place is both pleasant and working well and the real estate and service department call the building "the jewel in the crown". In general most users are positive. Nor does people who were involved in the design process remember the doubts and objections that they once had. One of the major conditions to achieve satisfaction with the new building was to involve users in a very early stage of the process, as was the way and culture of doing projects in the Örebro County Council. Already in the late sixties, the first attempts to involve users in the design processes took place and the use of mock-ups as a tool in the design process goes back to the early seventies. The surgical departments had a major impact on the design due to this process.

The absolute demand on daylight in the operating theatres was a qualitative issue that could have been questioned. So was the access to terraces. Both demands were met by the project and in the case of the terraces; there were no other reasons to meet this demand than to satisfy staff. The project group considered it a calculated risk and put many efforts into preventing anything to happen in the use of the balconies by strongly alerting the awareness of hygienic rules.

The thoracic surgery unit was not happy with the decision to give them "ordinary" displacing ventilation as they argued for laminar airflow ceilings. Shortly after moving in there was an increase in infections in the unit and one patient died. Arguments were that it was to be caused by insufficient cleanness of the air. The immediate conclusion from the users was that this was caused by, what they regarded as, an inadequate ventilation system. This attracted attention, not only in the hospital but also in media. Accusations were delivered and the hospital management and politicians had to investigate the cause of these unfortunate accidents. It was a hard time for the real estate and service department that was responsible for the design and functionality of the ventilation system and that also had a part in the suggestion to deny the unit to get what they regarded an absolute minimum standard of ventilation. However, the real estate and service department did not question the relevance of the complaints, but initiated a thorough investigation of the ventilation system and a parallel investigation was done of the procedures of the health care chain in the unit. There was no evidence that anything was wrong with the ventilation system. The investigation of the health care chain, however, proved that the hygienic alertness standard had been less than satisfactory in the unit since they moved into the new building. It was also interesting to note that the unit had for many years operated in premises with displacing ventilation without being aware of it and with no incidents at all. There are some reflections made on the dissatisfaction in the thoracic surgery The unit had joined the design process late and did not have the same possibility to have influence on the solutions and therefore had not the same feeling of ownership of the process as the other units and had one strong demand that was rejected by the project. It could be that the attitude to moving into the new premises was not positive and thus the ventilation system, and indirectly the building project, was blamed when accidents occurred. If this dissatisfaction with the project also was to blame for the temporary of the nursing chain is not possible to know.

The dissatisfaction in the radiology department was of a different nature. There was a substantial risk to push the new technology as fast as one did. Dramatic changes of technology can cause fear and alienation among professionals that find their traditional knowledge and skill becoming obsolete. To make a major change at the same time as a substantial cut down of staff was risky. A very articulated and resourceful group was the orthopaedic surgeons. They traditionally used the x-ray films to sketch on when planning an operation. To have all images on computer screens would mean a change in procedures. They also feared the quality of the pictures would

be lower in the digital format. Other surgeons were however positive as they saw advantages in the new technology for their praxis.

The radiology engineers were strongly affected by the new technology as some of their old knowledge might be obsolete and they had to learn new procedures. Some assisting nurses in the radiology department realized the new technology would make their group obsolete as their work was connected to the handling of film. Radiographers feared the less staff in connection with the new technology. There are also some reflections on the dissatisfaction in the radiology department. The department is today one of the model clinics in the world. The staff is very aware of the fact that they are working in a clinic that is considered to be the state of the art in the area. The new technology has developed in such a way that it is supporting surgery of all kinds. Evidence from interviews shows that despite the serious doubts and fears during the process the persons who pushed the project forward represented a counterforce in the process. The technicians mention the trust in the very skilled colleagues and managers that were involved as a reason why they accepted the solutions despite their fears. The chair of the radiology department, who was the initiator of the new technology, managed to get all hospitals in the region to join in the new technology project and to get approval from hospital managements and the public owners. The fact that staff that remained in the organisation got better and more rewarding job content and larger responsibilities was an additional aspect that made the project successful in the end. A massive education program and a step-by-step moving into the new premises was the strategy for the project. The openness from the building project and the external consultants regarding the actual design of the work place also contributed to the acceptance of the total project.

What do we learn from the design of the O-building?

Studying the process that took part in the O-building case we can clearly see the importance of participation for development of a usable building. By participation in the mock-up room work functions could be tested for real and not only agreed upon based on a functional specification. The gap between definition of function and real use was thus bridged. In radiology the relationship between function and usability developed differently. Based on the trust for the head of the radiology department and technical manager they were allowed to develop a radiology department based on digital technique. If these persons had not had the trust of the staff the new solution would have faced fierce resistance by staff. The trust allowed for an efficient process were few actors pushed the process and the staff participated only in meetings and were not actively involved until the new radiology department was about to get staffed and completed. The trust even allowed for drastic changes like the change of technology in the radiology department. Exampels of the aforementioned are; the thoracic surgery department were we learn that lack of influence and participation can have severe consequences on the acceptance and perhaps on performance. From the radiology department we learn that usability to some extent is a subjective feeling that is affected by one's own role in the process, how other aspects develop with time and how the workplace relates to other experiences of work situations. An overall trust related aspect is also that the county has a long-term experience from participative building design processes and thus the staff, in both surgery and radiology, knew that involvement was a part of the process - it was never something they had to fight for. We conclude that both these aspects, participation and trust, are signinficant in order to achieve a building fuction that have a high degree of usability from the users point of view.

Further research

Considering that this study was performed a few years after the building was completed the issue of how satisfaction and dissatisfaction have changed during the first years of use would relevant to monitor as guidelines for future changes.

In the study of the process two approaches to the co-operation were identified. One trust based process and one participation-based process. As for the USÖ case both worked in the organisation, but further studies will be needed in order to develop knowledge about to what extent the approaches are possible to combine and to what extent they support usability also in other cases.

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RECRUITMENT AND RETENTION OF ESTATES AND FACILITIES STAFF IN THE UK NATIONAL HEALTH SERVICE

Daryl May

Phil Askham, Sheffield Hallam University, England

Abstract

Agenda for Change is set to be the biggest reform of pay since the National Health Service¹ (NHS) began in 1948. As well as introducing a standardised pay structure, it also aims to improve recruitment, retention and morale of staff. Staff groups identified as having recruitment and retention problems include estates/works officers, qualified maintenance craftspersons and qualified maintenance technicians.

The object of this research was to investigate recruitment and retention problems for estates and facilities staff currently experienced by Trusts. Focus groups were used as the primary method of data collection in an attempt to tap into the existing expertise of staff working at strategic and operational supervisory positions in a wide range of Trusts.

Although our findings suggest that the main recruitment and retention issues fall into four main themes: social, financial, environmental and political; recruitment and retention of estates and facilities management staff (Efm) staff is a complex problem involving a wide range of issues and these can vary from location to location. Furthermore this should also be seen as a series of issues that varies across employment groups including: domestic/housekeeping, trades, managers/officers and Facilities Directors; which need to be distinguished.

There is a continuing need to raise the profile of Efm in the NHS to those levels enjoyed by Human Resource and Financial management. Furthermore perceptions surrounding both recruitment and retention issues and the nature of work within Efm in the NHS can lead to a negative and self perpetuating "Cycle of Failure" where there is an assumption of loss of control. However there are some initiatives being undertaken that suggest it is possible to concentrate on internal matters such as more appropriate and flexible recruitment processes, improved support services for staff and greater flexibility within the job and that these can generate "Cycles of Success".

Keywords: Recruitment; retention; NHS; focus groups; facilities & estates.

INTRODUCTION

Agenda for Change looks set to be the biggest reform of NHS pay since it began in 1948 - over a million NHS staff will be affected, with the exception of doctors, dentists and senior managers. By the end of March 2004 most of the Early Implementer (EI) sites will have transferred their staff on to the Agenda for Change pay scales. After a review of the EI sites and a second ballot by some of the unions a national role out is planned for October 2004.

In addition to introducing one standardised pay structure across the NHS, Agenda for Change also aims to *"improve the recruitment, retention and morale of the NHS workforce"*². As part of Agenda for Change, Trusts will be able to incorporate a premium into the pay rates/weighting where market pressures would otherwise prevent them from being able to recruit and retain staff. The staff groups identified as having recruitment and retention problems include estates

¹ Healthcare in the UK is delivered free at point of care. The NHS is the Government funded service in the UK, and is divided into local Trusts which run hospitals and other health facilities.

² From the NHS Modernisation Agency website -http://www.modern.nhs.uk/agendaforchange/Afcplain.pdf

officers/works officers, qualified maintenance craftpersons and qualified maintenance technicians (Department of Health, 2003)

The document "Working for the Future: an invitation to shape a National Workforce Strategy for Efm³" (NHS Estates, 2003) was the result of a NHS Estates⁴ consultation exercise. The document was the first step in an attempt to tackle the recruitment and retention problems currently facing the NHS for it's Efm staff. As outlined in this document:

"over two-thirds of Trusts report problems recruiting and retaining Efm staff, and many Efm staff report skills gaps in Efm management, in areas such as strategic planning and public finance skills. Almost every trust has said the formulation of a national strategic approach to the training and development of Efm staff would be a positive way forward". (NHS Estates, 2003, pg.3)

The objective of this research was to investigate, and highlight recruitment and retention problems for estates and facilities staff that Trusts are currently experiencing. As part of the research Trusts were also asked to discuss initiatives that they have implemented in order to combat problems.

LITERATURE REVIEW

Schlesinger and Heskett (1992) provide a "Cycle of Failure" model which presents a framework where companies or organisations become trapped in a self perpetuating cycle of high staff turnover. The cycle of failure seems to ensure continuing deterioration of service quality, managerial headaches, and long-term decreases in outputs. The starting point on the cycle is when organisations tolerate high staff turnover and expect their employees to be dissatisfied. Service workers are paid low wages, their job is simplified repetitive and boring and requires little training - thus the organisations expect low levels of dedication and loyalty, and they get what they expect.

High staff turnover and motivation becomes worse as management do not want to invest in staff who will not stay with the organisation. The self perpetuating cycle produces poor service and motivation from staff, and customers have a poor perception of the service. Customer dissatisfaction fuels further decreases in employee satisfaction, thus encouraging turnover. The managers Schlesinger and Heskett talk to are often resigned to failure, and that the cycle of failure is beyond their control and inevitable - in fact some organisations build it into their strategic plans - some of the excuses include:

- To get good people would cost too much and you can't pass on these cost increases to customers.
- It's not worth training frontline people when they leave you so quickly.
- High turnover is simply an inevitable part of our business. You've got to learn to live with it.

(Schlesinger and Heskett, 1992, pg. 312)

Clark (1999) reinterprets the Cycle of Failure into the Cycle of Success. This is illustrated in Figure 1.

Clark argues that as staff become more motivated, their confidence increases which further fuels motivation. Motivated workers are less likely to leave the organisation, or be absent on short-term sickness which results in reduced costs. Customer service (or other service levels) increases because staff are motivated which leads to an increase in service deliverables, and this along with reduced costs leads to greater profits - or for the NHS better budget control or further reduced costs/increased services. The reduced costs (or higher profits) become available to provide higher levels of training that contribute to increased worker motivation.

³ As defined by NHS Estates, Efm refers to "Estates & Facilities Management". It is intended to cover the whole range of services which support clinical care - including estates management, "hard FM" such as engineering and maintenance and "soft FM" such as hotel services.

⁴ NHS Estates is a Government executive agency responsible for providing advice and guidance on all aspects of estates and facilities.



Figure 1: Cycle of success or failure (Clark, 1999).

In an interview and questionnaire based study of 28 managers from large London based NHS Trusts; Marali (2003) concluded that altruism was still an important shared core value. This places emphasis on patient care, a commitment to the NHS, the provision of public services to the community, improving health and free healthcare for all. These values survived despite the 'increasing "business-like Emphasis in the NHS.' (pg. 557)

The study also examined managers' perceptions of their public image with the following findings:

- the general public believe that only clinical staff were motivated by altruistic values
- the nature of the management job was low profile and suffered from unfavourable comparison with 'the more glamorous and emotive image attached to the doctors and nurses' public image'
- they also believed that clinicians and politicians propagated a poor image of managers as a means of scapegoating *"for the failures and inadequacies in the NHS"* (pg. 558)

In an investigation into the public library workforce in the UK Usherwood et al (2000) found that salaries generally were low but an important factor attracting staff was "the public service ethos" (pg. 64). However recruitment and retention problems included negative image and limited opportunity as well as low pay.

RESEARCH METHOD

Focus Groups represent a cost-effective way of gathering data. These are distinguished from group interviews in that the researcher's role is to facilitate discussion amongst a group of participants, who share some common interest, rather than simply to direct questions at a group in much the same way as would be the case with an individual structured or semi-structured interview.

Focus Groups seemed the appropriate data collection instrument given time constraints but also given the wealth of experience and knowledge available to the staff who participated that could best be accessed by allowing a relatively free and open discussion. A potential disadvantage in the use of focus groups is the possibility of distortion arising from the group dynamic. Individuals can dominate to the detriment of a balanced contribution from all participants. This risk cannot be eliminated entirely and one of the roles of the facilitator is to moderate this if at all possible.

However the impact of individual dominance can be reduced by participant selection, trying for an optimum number of group members at similar levels in the management hierarchy.

There is considerable theoretical support for the use of focus groups as a means of data collection. The focus group tradition has its roots in market research and politics where there is a danger of seeing participants as passive objects. Johnson (1996) however suggest that it is possible to use group interviews to access tacit uncodified and experiential knowledge, opinions, meanings and the role of the individual as part of a larger organisation. Osteraker (1999) describes the successful use of what she terms 'reference groups' of employees to construct a new motivational survey in the workplace. She found that involving employees generated a sense of ownership but stresses the need in the workplace context to ensure there is no conflict between different levels of management. McDougall (1999) provides further evidence of the use of groups with homogenous membership to encourage coherence and trust.

Two focus group sessions were undertaken, one in the South and one in the North of England. The Southern focus group was attended by seven staff from a range of Trusts⁵ all of whom were in senior management positions within estates and facilities management or other relevant strategic roles. For the Northern focus group the researchers selected staff operating at more operational management levels. It was hoped this would provide contrasting evidence reflecting both strategic and operational concerns.

Both focus groups took place over a working lunch, with a buffet provided, and were scheduled from 11.00 until 2.00. Both sessions were attended by the two researchers, one of whom acted as facilitator with the other as observer. Both sessions were taped with the agreement of all participants and the tapes were transcribed verbatim.

Themes and general questions had been prior agreed between the two researchers based on issues arising from the literature on recruitment and retention and other data sources.

Ethical issues were addressed at the outset of each session by providing and reading a prepared statement setting out the purpose of the research, a full explanation of the methodology, confirmation of the right to withdraw and the principles of anonymity.

The data from both sessions were transcribed and the purpose of the transcription was to produce an accurate written record of what was said during the interviews, word for word. The transcribed data were analysed using thematic content analysis based on coding using computer based techniques. The purpose of this analysis is the generation of units of meaning from the data which can then be classified or categorised and ordered to identify emerging themes and interpretation of the data. This process of analysis started with open 'coding' of the transcripts to produce a list of descriptive codes or labels enabling the data to be broken up. This first analytical stage produced over one hundred codes from the data.

The next stage was to check the coding for accuracy and, at the same time delete, merge and rename codes which where then grouped under higher order and increasingly generic headings or 'categories', producing a hierarchy or tree of codes. The categories were further grouped into emerging themes.

Using coding to categorise data in this way is used to signify more general themes. The first coding stage produces a working set of codes which is largely descriptive. Then, second stage coding marks regularities in the data signalling categories, explanatory threads, leads and commonalties. Coding is about reducing and presenting the data to identify and illustrate themes.

One of the main concerns within this thematic analytical approach is its inherent subjectivity. Bias is built into this type of data which cannot be assumed to be value-free or neutral. However, there is increasing support for the view that bias and subjectivity are an inevitable part of qualitative research and that this subjectivity needs to be acknowledged. However by using the two focus group sessions the researchers hoped to be able to demonstrate convergent results leading to greater confidence in the findings. Furthermore to build validity checks into the analytical process both interviewers undertook initial data coding independently to check for convergence/divergence of initial codes.

RESULTS AND DISCUSSION

⁵ Representatives attended the focus groups from Acute, Mental Health and PCTs.

The case study research findings have been summarised and presented under a number of descriptive categories. The main categories from the research are then listed under one of the four themes:

- Social
- Financial
- Political/Strategic
- Environmental/Building

Social

Application & Recruitment Process

Findings from the research suggested that the application and recruitment process impacted on Trusts' ability to recruit staff. This was partly due to the Trust internal systems and processes, sometimes imposed from HR, resulting in unnecessary delays. For example, the length of the recruitment period resulted in a number of Trusts losing potential recruits to other employers. Accordingly Trusts located in areas with low unemployment found potential recruits, who were actively seeking work, were to gain employment much faster with other organisations - such as supermarkets who could recruit and offer jobs much faster.

Although necessary, the criminal records checking process was also causing delays in appointing staff. Trusts found that if staff references are sought for at the same time as the criminal records check, and consequently come back as a problem, then money has been wasted paying for the checks. The delays in having to check criminal records adds further to the overall recruitment process.

Some Trusts reported that the statutory induction period for staff was too inflexible, particularly for staff who were recruited to evening part time positions. For example, housekeepers or domestics who applied for a 20 hour evening shift (because they had family commitments and these hours were convenient to their family arrangements) were required to attend the Trust induction which was a 2 week period Monday - Friday, 9am to 5pm. This resulted in them not being able to commit to the induction period and therefore take the job.

In addition to standard HR processes causing delays they were also inflexible and several Trusts stated this was a problem when trying to recruit facilities and estates staff. For example, some Trusts had not been authorized to advertise and recruit speculatively, i.e. without an actual position being available - this would allow potential recruits to be held on file until a suitable position becomes available. Before recruiting can proceed the amount of forms that first needed to be signed and/or approved was also found to add to the delays.

Some respondents complained that the actual recruitment and assessment tests for low paid workers were unnecessary and deterred potential recruits from applying. One particular example was during the recruitment of housekeepers, the Trust's HR department wanted a 45 minute interview accompanied by separate aptitude tests. This was felt to be too tough and intimidating.

Standards of recruitment/Quality of staff recruited

Some respondents believed the problem in attracting the required calibre of staff resulted in overall standards dropping and therefore accepting staff who may not be as qualified or competent for the job. Consequently this increased the supervisory and management requirements and also had a damaging effect on the profile of the facilities/estates departments. In addition one Facilities Director felt it caused senior facilities staff to get bogged down by operational issues:

"I believe my role is not to run the operational estates and hotel services, my role is actually to add value to the discussions at our executive group and Trust board, with respect, whether the boiler is wenty years old or twenty five years old, what he wants to know is what am I doing about the choice agenda, the financial flow agenda and the environmental agenda".

Some Trusts even had difficulties getting the required calibre of recruit to attend an interview. Respondents thought this may be either related to the pay and conditions offered or the perception of the job and the type of work.

Economy/Workforce Profile/Demographics

During the research the economy, profile of the national workforce and demographics were discussed. Trusts were reporting it increasingly difficult to recruit to trade positions, as one estate manager pointed out:

"..over the last ten or fifteen years when big (construction) projects finished you used to get people knocking at your door, (asking) 'are there any electrician vacancies'? That has not happened, particularly for the last two and half, three years. I cannot get trained staff, I've got no electricians, and up until very recently had four fitter vacancies".

In the past, some hospitals would have relied on a pool of recruits (for trade staff) from those moving into the later stages of their careers who did not want to continue contracting⁶. These same workers were now being enticed to continue employment in the private sector due to the enhanced pay and conditions on offer. The problem was heightened by the lack of young people entering into trade apprenticeships - although anecdotally respondents believed this may reflect the general decline in actual apprenticeships on offer.

In general across all facilities and estates departments Trusts reported that as staff leave and not replaced it resulted in an aging workforce profile. Consequently key skills are being lost from the organisation and not replaced. In addition, the increasingly fluid workforce, especially amongst the unskilled ancillary staff group resulted in the organisational memory losing skills and knowledge - as one facilities manager pointed out *"we're almost always in a complete state of flux"*.

The impact of the black economy was highlighted as a factor affecting recruitment of facilities and estates staff, in relation to cleaning/domestic staff one estates manager explained, "because there's an awful lot of professional couples both working now and an awful lot have a cleaner in for a couple of hours, and it's cash in hand".

When trying to recruit facilities and estates staff some Trusts identified the lack of affordable housing as major obstacle - this is staff at both management and ancillary levels - and most severe in the South East.

Perceptions of NHS as an employer & Efm careers

Respondents felt that the NHS was only perceived in offering clinical careers and there were three critical issues highlighted. Firstly it was implied that a common misconception from the general public was the NHS only offered clinical careers - i.e. doctors and nurses - therefore potential recruits were unaware of the careers offered in estates and facilities departments.

Secondly it was suggested that (in general) the public is largely unaware of what functions the "facilities" and specifically "hotel services" departments undertake - this adds to the problem that estates and facilities have in raising their profile. In addition, some respondents felt careers in facilities and estates were perceived as unexciting, further affecting the profile of the roles which are seen as lacking the appeal necessary to attract a higher calibre of recruit.

The third issue was that of "aspirations", an example was how difficult it was for NHS estates/facilities representatives to visit schools/colleges and promote careers as porters or domestics. In comparison, a NHS clinical or general management representative would be able to promote careers in their departments.

Respondents felt that the NHS (as an employer) was no longer perceived as a "class A employer". The result was a negative impact on recruiting staff, and as one manager pointed out they can no longer rely on the altruistic nature of people:

"essentially levels of pay and conditions of service from the rest of the employment market has caught the Health Service up, the Health Service is no longer a class A employer, I don't think anymore you get staff going to the NHS because they want to get the feel good factor of being part of healthcare".

Some Trusts reported that staff, particularly those working as domestics and porters, were concerned about being "contracted out" to the private sector. Exit interviews conducted at one

⁶ However not all Trusted shared this same approach, some did not encourage the appointment of recruits who wanted to "retire" into the NHS.

Trust illustrated this, with staff reporting to be insecure about working for a private contractor which is perceived as having a "hire and fire" culture. As one estate manager described "people are quite scared of it,(particularly) those that have never been involved with it".

Local competition

The research indicated that some Trusts believed their reputation as employers, especially the working conditions and the type of work offered to domestic staff, deterred potential recruits. As one manager pointed out:

"why do they want to work in a crappy loony hospital when they can work in a nice new shopping centre where they get perks and the discounts and all the other things that come round";

and in relation to the type of work:

"I can go and work for that book shop or I can clean that school next day, I'm not in the blood and guts there".

The local competition for tradestaff was also cited as a specific problem. Again largely due to the current vibrant construction industry, Trusts reported difficulties in recruiting builders. Some Trusts believed they were also competing with Local Authorities⁷ for tradestaff who were able to offer preferential pay and conditions.

Financial

Agenda for Change

Discussions centred around Agenda for Change featured heavily during the research. Agenda for Change has been positioned under the "Financial" theme - however the category which is also significant for the "Political/Strategic" theme.

In general there was a lot of concern regarding the impact Agenda for Change would have on the current workforce and future recruiting. Respondents felt that re-grading would be a problem, and specifically highlighted the re-grading of tradestaff as an issue. The Trusts that had already graded their estate/trade staff have found that the pay bands were coming out much lower than anticipated - chefs were another staff group singled out as potential losers after re-grading under Agenda for Change.

Rates of Pay

The issue of staff pay and conditions is intrinsically connected to Agenda for Change, particularly with the national deadline for implementation October 2004. However at present some Trusts felt that the low rates of pay offered for Efm positions did have an adverse effect on recruiting staff. Respondents highlighted that the low pay advertised on job adverts meant it was difficult to get good calibre estates and facilities managers to apply and attend interviews. Other staff groups singled out, where low pay was felt to affect recruitment and retention, were the estate/trade staff and domestics. Trusts felt that it was difficult to attract estate/trade staff due to low pay, especially as there is already a national shortage. Low pay also contributed to the difficulty attracting domestics, made worse by other factors already discussed such as cleaning private homes, other competition and the cost of transport/childcare etc.

The low pay offered to directors of estates/facilities was also highlighted, and in some examples it was felt the remuneration packages offered to senior staff did not match the level of responsibility for the job. Consequently questions were raised over the calibre of potential staff attracted to the senior posts and the effect that this had on the overall profile of estates and facilities in the NHS.

Job Security

Although the impact of Private Finance Initiatives⁸ (PFI) wasn't discussed in any detail during the research, respondents felt PFI schemes and private organisations (awarded contracts to operate

⁷ Local Authorities have devolved responsibility from Central Government for delivering social services funded through a local tax.

⁸ PFI schemes are designed to encourage private-sector involvement and finance in capital projects. The NHS is using PFI to build new hospitals.

hospital support services) were contributing to the perceived lack of job security within NHS Efm jobs. Respondents believed that in the past perceived "job security" was a strong incentive to working for the NHS. Now some respondents felt that the perception, regardless of the actual reality, had a negative impact on recruitment and retention. Additionally some respondents argued that the lure of job security in general for society may not hold the same attraction as it once did - there was no such thing as a *"job for life"* anymore.

Impact of clinical resource problems

Some respondents felt the financial problems in their Trust's clinical departments were impacting on their ability to recruit staff. For example, one estate manager felt that the Trust's over-reliance on temporary agency staff to fill clinical posts caused an over spend on labour costs. Consequently, this resulted in the Trust board announcing a block for all departments recruiting new staff.

During the research some managers pointed out that new staff starting in estates and facilities departments, particularly hotel services, viewed them as "a foot in the door" and a route into nursing and clinical careers. While most respondents viewed the progression as a good thing, and agreed it attracted some potential recruits, there was the issue over the cost of recruiting and then replacing staff lost to clinical departments. As one facilities manager stated, *"what better person to recruit than someone who knows the hospital, who knows the ward, who knows the job's not glamorous"*. However the concern for estates and facilities managers was that their best staff were taken by the clinical teams and they were then responsible for finding the resources to replace them.

Political/Strategic

Separated Strategic Approach

Some respondents suggested that at a strategic and national level there needs to be a separate approach to tackle the NHS recruitment and retention issues across Efm staff groups. The logic for this is the specific factors and problems associated with each staff group - which cannot be tackled with a single policy. It was recommended that Efm staff be separated into three groups before any national or local strategy for tackling recruitment and retention issues could be implemented:

- Trade staff
- Manager/Officer level
- Facilities Director

National Strategy

The document 'Working for the Future: an invitation to shape a National Workforce Strategy for *Efm*' was produced by NHS Estates (2003) and developed in consultation to look at the problems in recruiting and retaining Efm staff. Some respondents felt the strategy outlined in the document needs to reflect a separated approach as discussed above and did not go far enough in tackling the current problems faced by Trusts in recruiting and retaining Efm staff.

Graduate Recruitment Schemes

A major concern during the research was a lack of national graduate recruitment scheme for Efm staff, as one manager pointed out "we're the 3rd biggest employer in the world I think, the biggest in Europe and facilities is 25% of that and we don't have any graduates". Some respondents felt that the profile of facilities and estates needed to be raised to the same level as HR & Finance and an appropriate graduate recruitment scheme introduced to reflect this. It was suggested that any graduate recruitment scheme had to take a broad approach in attracting applicants from technical/building backgrounds but also business backgrounds. One respondent felt that the NHS needed closer links with Universities in order for facilities management graduates to feed into professional positions.

Career structure (lack of)

The career path for staff into Facilities Director posts was questioned and it was highlighted that there was no natural route to this position. Similarly it was queried how many facilities directors

had made the move to an NHS Chief Executive, as one manager explained "it's almost saying there is no framework for us, there is no career development, we don't have planning in facilities".

The other staff group singled out for a lack of career structure were estates and trades positions. It was felt in the past there was a career structure which has now been lost, certainly at a national level, meaning that Trusts needed to implement policies at a local level.

Government Initiatives

Respondents identified Government initiatives such as the cleanliness standards and CHI⁹ inspections as adding unrealistic expectations onto staff who would not have such pressures working for alternative organisations. As one facilities manager pointed out:

"a domestic working in a local school is not going to have somebody from CHI coming out and inspecting their work..... the pressure is increasing and the shop floor staff pay and conditions are reducing".

The impact of Trusts merging was discussed during the research and respondents who had recently gone through a merger felt one of the crucial success factors, related to retention of staff, was to level out the pay discrepancies between the merged Trusts. During the merger period another problem some managers experienced was a freeze on recruiting to permanent positions. Only temporary posts could be offered during the restructuring, which made it very difficult to recruit to certain positions - part time cleaners were highlighted as one problem area.

Foundation Trusts

Until the first wave of Foundation Trusts¹⁰ were operational respondents were unclear whether the new organisations would impact on recruitment & retention in the NHS. However some concerns were expressed around Foundation Trusts not constrained by Agenda for Change pay scales and therefore able to offer preferential pay and conditions. The anticipated consequence would mean the first wave of Foundation Trusts able to attract quality recruits from other non-Foundation Status NHS Trusts and the wider pool of potential employees - However the Department of Health states that Foundation Trusts <u>will</u> implement Agenda for Change and they will not be able to use unfair competition to attract staff¹¹. This highlights a communication problem.

Training

Respondents felt that estates and facilities departments needed to advertise the quality of training offered to staff during recruitment. The training programmes offered for difficult to recruit to staff groups, such as catering roles, porters, and domestics, need to be explicitly outlined along with the associated benefits of undertaking such training. One manager pointed out it is a matter of making staff feel valued, wanted and making them aware of the training and career opportunities available.

Environmental/Building

Workplace Conditions & Environment

Respondents felt that the perception of the NHS from the outside was one of a lack of investment in the buildings. The result was that potential estate and facilities management recruits could get jobs with other organisations where resources are less of a problem, as one manager stated:

"a known factor outside is that the estate has always had to save money, people in the profession recognise that if they go into a hospital they're not going to sit around, they're going to work and they can do a lot less for a lot more elsewhere".

The perceived lack of investment was also a factor which contributed to the workplace conditions or the perceived workplace conditions in the NHS. This in turn deterred staff, particularly

⁹ CHI is the now known as the Healthcare Commission. They are the Government body responsible for providing an independent assessment of the standards of services in healthcare - both public and private. ¹⁰ Foundations Trusts are a new type of NHS Hospital run locally that have substantial operational and financial freedom.

¹¹ From the DoH website, Foundation Trust page FAQ -

http://www.dh.gov.uk/PolicyAndGuidance/OrganisationPolicy/SecondaryCare/NHSFoundationTrust/NHSFoundationTrus

domestic staff, who could work in alternative organisations with preferential workplace conditions. However in spite of the perception of the NHS workplace conditions some respondents thought this may actually appeal to potential recruits who were attracted to what they might see as a challenge.

The location of some new healthcare buildings was reported as a factor in recruiting staff. For example, respondents highlighted new mental health units constructed some distance away from town centres which resulted in increased transport costs for staff to reach work. This meant domestic staff, who were generally on lower wages, taking into consideration the transport costs, especially if alternative employment was available with reduced transport costs.

The facilities and estates departments often needed to employ staff who work shift hours, e.g. early morning or during the night. Where Trusts offered services to support their staff, such as inter-site transport or crèche facilities, it meant workers employed on non-standard hours could not access those facilities. As one hotel services manager pointed out *"the crèche doesn't open until half past eight and some of our ancillary staff start at 6am"*.

CONCLUSION

The recruitment and retention of estates and facilities management staff is a complex problem involving a wide range of issues. It is important to recognise that findings are variable from Trust to Trust and there is also evidence of geographical variation. From the data there was at least four different main themes identified; social, financial, political/strategic and environment/building. Within and across these themes there are a number of key areas of focus. One of these inevitably is Agenda for Change whose impact at the moment is unclear. This lack of clarity reflects in part the second focal point which is a lack of communication as illustrated for example by the mixed messages coming through on whether or not Foundation Trusts will have to implement Agenda for Change or whether they will be able to offer preferential rates of pay and thus divert potential staff away from non Foundation Trusts.

There is some evidence around perceptions, both of recruitment problems and the nature of working within the NHS, that suggests attitudes of resignation, inevitability and absence of control in recruitment and retention are leading to a self perpetuating "Cycle of Failure" and there is no doubt that there are external factors such as the state of the economy over which there is no control. At the same time, initiatives within some Trusts do suggest it is possible to begin to generate "Cycles of Success" around recruitment and retention by taking control over internal matters by implementing local policies and dealing with inflexibilities.

On a more positive note one of the things to emerge from the research, in terms of examples of good initiatives on recruitment and retention, is the necessity for drawing out the complexity of the problem and identifying these internal and external factors. External factors are those over which managers can have little or no control. These will include the state of the economy and the buoyancy of competitors. Such factors can only be monitored. It is important to know, for example, that the reason for difficulties in recruiting domestics is that professional couples are offering up to £8.00 an hour cash in hand. Internal factors, on the other hand, can, with a little effort and energy, be addressed. Initiatives emerging from the research show, for example how recruitment processes can be speeded up by removing some of the red tape, and can be made more user friendly and less intimidating by changing application forms and offering more suitable selection processes. Other initiatives demonstrate that is possible to offer staff more of the services they require and greater flexibility within the job.

Separating out internal and external issues is one means of addressing the recruitment and retention problem. Another way in which it is possible to begin to recognise and understand the complexity of the problem is to see it not as a single issue but as a series of problems affecting different staff in different ways. What has emerged from the research report is the need to recognise what was termed a *separated strategic approach* dealing with NHS Efm staff in four distinct groups each with its own distinct recruitment and retention issues:

- Domestic/Housekeeping;
- Trade staff;
- Manager/Officer level;
- Facilities Director Level.

This is seen as one possible way to tackle the complexity of the problem and may help to determine appropriate local and national strategies for tackling the problems can be implemented.

Finally, there is a continuing need to raise the profile of Efm to those levels enjoyed by Human Resource and Financial Management, for example. Given the size of the NHS as an employer, and within that the size of Efm, it is somewhat surprising that there is so little emphasis on graduate recruitment within Efm and that there is such a limited and haphazard career structure for Efm staff. The NHS also needs to place more emphasis on training and staff development for Efm staff.

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MAINTENANCE CONTRACTING IN SOCIAL HOUSING IN THE NETHERLANDS – A STATE OF ART REVIEW AND FUTURE PERSPECTIVE

G.A.M. Vijverberg

OTB Research Institute for Housing, Urban and Mobility Studies, Delft University of Technology, Delft, The Netherlands

Abstract

Together, the housing associations in the Netherlands spend about \in 3 billion per year on the maintenance and minor improvements of their 2.4 million social rental dwellings. By far the greatest share of the maintenance is contracted out to external contractors. Frequently heard justifications for this are that they are better equipped for such work, they work more efficiently and innovatively, and so they are cheaper. However, for day-to-day maintenance tasks, the housing associations draw frequently on their in-house maintenance contractor.

At the present time, in-house maintenance contractors are being put under considerable pressure to work in a manner that better meets market requirements. The housing associations draw up agreements with their in-house contractors with respect to productivity, the quality of the management, and the quality of the service provision to tenants. Automation and data processing support the drive for enhanced professionalism.

In the paper, attention will be paid to the factors housing associations have to weigh up when deciding whether or not to introduce outside maintenance contractors or retain their in-house contractor. There then follows an outline of the important discussion points and dilemmas that in-house maintenance contractors will have to address in the next few years. Consideration is given to the focus of the package of tasks and responsibilities, the organization, and the business assumptions. Finally, the drive for professionalization and the future perspective of the in-house maintenance contractors is outlined.

Keywords: social housing management; maintenance management; (in-house) maintenance contractors; the Netherlands

INTRODUCTION

At the present time there are 523 housing associations active in the Netherlands (Aedes 2003). The number of housing associations has fallen markedly in the last few years as a result of mergers. Together, the housing associations manage 2.4 million dwellings and spend an average of \in 1,263 per dwelling per year on maintenance. The total maintenance expenditures of the housing associations amount to about \in 3 billion per year. Closer analysis reveals that repair and mutation maintenance (necessary maintenance when tenant leaves) account for about one-third of the expenditures (namely \in 448 per dwelling per year). The remaining \in 815 is spent on planned maintenance, minor improvements and major maintenance (Aedes 2003).

	Volume of business per dwelling	Volume of business on housing association property	
Day-to-day maintenance	€ 448	€ 1,075 million	35%
Planned maintenance and minor improvements	€ 815	€ 1,925 million	65%
Total	€ 1,263	€ 3,000 million	100%

Table 1: Volume of maintenance business according to maintenance types.

Source: Aedes 2003

VOLUME OF MAINTENANCE BUSINESS UNDERTAKEN BY IN-HOUSE MAINTENANCE CONTRACTORS

The housing associations' in-house maintenance contractors in the Netherlands account for 9% of the total maintenance expenditures (that is, \in 252 million). More than 90% of maintenance is thus outsourced to external building contractors. When we take a closer look at the underlying maintenance types, we see that the emphasis of the work package lies on day-to-day maintenance. In-house skilled workmen carry out 18% of the day-to-day maintenance work. This share drops to just 4% in the planned maintenance, minor improvements and major maintenance. It is worth noting that the large housing associations undertake relatively more maintenance through their in-house maintenance contractor than the smaller housing associations. Housing associations with more than 10,000 dwellings carry out 14% of the regular systematic maintenance with their own in-house contractor (Aedes 2001).

	Volume of business by in-house maintenance contractor	Volume of business contracted out	Total (in millions €)
Day-to-day maintenance	€ 194 (18%)	€ 881 (82%)	€ 1.075
Planned maintenance and minor improvements	€ 78 (4%)	€ 1,847 (96%)	€ 1,925
Total	€ 272 (9%)	€ 2,728 (91%)	€ 3,000

Table 2: Volume of maintenance business undertaken by in-house maintenance contractor.

Source: Aedes 2003

KEY FIGURES AND CHARACTERISTICS OF MAINTENANCE CONTRACTORS

It appears from research that, in the Netherlands, 61% of the housing associations have their own in-house maintenance contractor (that is to say, they themselves employ skilled craftsman for their maintenance work). That percentage amounts to 320 housing associations. It is noted how much more frequently than average the larger housing associations have their in-house maintenance craftsmen. Of the housing associations larger than 10,000 dwellings, for example, 76% have their own in-house maintenance contractor. On average, that would comprise from 11 to 12 skilled workers, so that in total, about 4,500 people are involved. The emphasis lies (as stated above) on day-to-day maintenance. The focus of the work content is constructional maintenance (carpentry, plumbing, plasterwork, electrical work). It is worthy of note that the level of the sales tax has a direct effect on the decision whether or not to outsource maintenance work. A few years ago, the Dutch government decided to reduce the tax on plasterwork and paintwork in dwellings older than 15 years to 6% (moving from the high -19%to the low -6%- tariff). The Economic Institute for the Building Industry in the Netherlands calculated immediately a shift of several percentage points in favour of outsourcing plasterwork. Thus, following the change in the tax regulation, outsourcing plasterwork became considerably more attractive (EIB 2001). Paintwork was already being almost completely contracted out to third parties before the tax regulation change. It is also worth noting that housing associations almost completely outsource such specialist work as central heating maintenance. lift maintenance, garden maintenance, and cleaning work to third parties.

We can draw on the results of a study carried out in the Netherlands in 2001 by the Maintenance Contractors Platform to investigate a number of business characteristics. About 40, mostly in-house maintenance contractors are registered with the Platform (thus 13% of the target group); fifteen companies assisted in the research. Although this research group was not representative, the results give an indication of the activities of the vanguard of the in-house contractors in the Netherlands (Platform Onderhoudsbedrijven 2001)

A worker in the building industry completes an average of about 1,500 productive hours per year (CBS 2002; EIB 2001). This total includes about 70 hours compensation for time lost through wind and rain. This bad weather compensation hardly applies to those employed in the housing associations' in-house contractors, since most of their maintenance activities are carried out indoors. The number of productive hours worked by a craftsman on in-house maintenance amounts to 1,434 hours. As reported above, this figure applies to 15 forerunners. The average number of productive hours per worker for all 340 in-house maintenance contractors can be expected to be substantially lower.

Figures are also available for the hourly rate. The benchmark of the Platform shows that in 2001 the rate for an all-round craftsman amounted to \in 36.76. If we index that figure, then the 2002 hourly rate comes to about \in 38.50. The hourly rate for the self-employed craftsmen who are members of ZZP [*Zelfstandigen Zonder PersoneeI*] is somewhat lower, namely from \in 30 to \in 32, including VAT. No data is available for the larger external maintenance contractors. The impression is that these companies apply a comparable hourly rate including VAT for all-round activities such as in-house maintenance contractors. Excluding VAT, they are then about 20% cheaper.

In 2001, absenteeism for the building industry as a whole in the Netherlands amounted to 5.6% (EIB 2002). Unfortunately, no data is available for absenteeism for the in-house maintenance contractors. The expectation is that the percentage for them lies substantially higher than 5.6, partly because of the older age of employees concerned.

WEIGHING UP WHETHER OR NOT TO HAVE IN-HOUSE MAINTENANCE CONTRACTOR

What are the reasons for housing associations wanting to have or to keep their own in-house maintenance contractor? This question was investigated by Aedes together with the NVOB at the end of the 1990s (OTB 2000). If we first consider the reasons the housing associations cite as being to the advantage of an in-house contractor, we find that they fall into two groups, namely: client-related reasons (service, image, and so forth.) and business-related reasons (flexibility, costs):

- service to tenants (66%);
- rapid intervention (65%);
- image/ awareness of name (47%);
- flexibility (38%);
- costs (15%);
- quality (11%);
- other (8%).

Client-related reasons were cited most frequently. This helps explain the substantial size of the market share of in-house contractors in day-to-day maintenance. Quite correctly, business reasons were cited somewhat less frequently. In addition to the reasons reported according to Adams, it is possible that the loss of professionalism also played a part (Adams 1998).

A closer look at the reasons cited by the housing associations for maintaining craftsmen of their own reveals that business reasons prevail in planned maintenance and major maintenance. The housing associations find that the number of productive hours and the efficiency with respect to the hourly rate is too low, so that labour costs are too high. Housing associations question whether carrying out maintenance should be considered part of their core business (not to be confused with preparation and supervision, which are less controversial). Franks (1998), Ebleton (1998) and Jashapara and Kisters (2000) also point out how organizations are retracting to their core business. The current merger wave among housing associations renders the use of scale advantages in the market via the outsourcing of maintenance work all the more attractive.

TASKS, ORGANIZATION AND LEGAL CONSTRUCTION

The housing associations and their in-house maintenance contractors are concerned at the present time with several crucial questions with respect to their package of tasks and responsibilities, and the organization, and the business assumptions of the facilities. The most important discussion points and dilemmas are (OTB 2002; Vijverberg et.al 2002):

Maintenance types

For which maintenance types do you wish to play an active part as in-house maintenance contractor? These include (as indicated) repairs maintenance, tenants' maintenance under an annual service subscription, mutation maintenance, planned maintenance and major projects.

> One-stop shop

In that context the important question is whether you also wish to play a part with your own in-house maintenance contractor in the coordination of the maintenance work carried out by external contractors. If the answer to this question is in the affirmative, then as a maintenance contractor you can arrange for a substantial share of for example the day-today maintenance to be passed on to your own in-house facility. The in-house maintenance contractor is responsible for the quality of all work carried out. As a result, the maintenance facility can decide for itself the tasks to outsource and the tasks to be carried out by their own workforce. The in-house contractor is legally responsible in all contacts and dealings with the housing associations. So, for example, on the final delivery of a mutation dwelling (change of tenant) the contractor first hands it over to the in-house maintenance contractor. Only when the delivery on completion has been approved is the dwelling passed on by the in-house facility to the district team of the housing association concerned.

> Organizational structure and personnel administration

Maintenance services are arranged according to the manner in which the in-house maintenance contractor should be organized. For example, the workforce can either be divided over the various districts, or alternatively it can operate from one central facility. A further question is whether it is best to build up a workforce of specialists, all-rounders, or a mixture of both.

Organizational and administrative interlinking

The question to be addressed concerning the organizational interlinking is which services and activities should run via the mother organization, which via the maintenance contractor, and which should involve both together. A recent example is the call centre. Many housing associations are now transferring to a system in which requests for repairs are dealt with as far as possible by a call centre connected directly to the in-house maintenance contractor.

The administrative interlinking is also a point of attention. The benchmark of the Maintenance Contractors Platform reveals that the interlinking is still substantial. Two thirds of the in-house maintenance contractors have no financial administration of their own and as many as 80% are still completely dependent on the automation system and databases of the housing associations (Platform Onderhoudsbedrijven 2001).

Cost centre or profit centre

The issue in choosing between an at cost or a profit based centre is the question whether you would prefer the maintenance contractor to work on a non-profit basis or with a profit objective. This choice is often linked to the question whether the maintenance contractor may work for several client organizations, or only for its own housing association (for example other housing associations, associations of home owners, schools). It can be seen from the benchmark of the Maintenance Contractors Platform that 75% of maintenance contractors work exclusively for their own housing associations. The choice is also linked to the form of legal construction from which the maintenance contractor operates (Platform Onderhoudsbedrijven 2001).

> Forms of cooperation and the legal construction

There are various possible forms of cooperation. Examples that can be considered are cooperation with contractors, with other maintenance contractors, franchise constructions with the self-employed members of ZZP [*Zelfstandigen Zonder Personeel*], and so forth. These cooperative forms can be set in a variety of legal constructions (for example, a foundation, civil law partnership, partnership, private contractor with limited liability, or a public limited contractor). These constructions have highly divergent consequences for fiscal and employment legislation. In addition, the power of control over the housing associations is regulated in the legal constructions in various ways.

DRIVE FOR PROFESSIONALIZATION OF MAINTENANCE CONTRACTORS

In the course of the next few years, in-house maintenance contractors will have to pay considerable attention to the further professionalization of their services. The following points are involved (OTB 2002):

Rise of productive hours

A further rise in the number of productive hours (reducing absenteeism, building up a younger team of employees, reducing travelling times). Target: 1,434 productive hours a year (preferably more, in the range of 1,450-1,475 hours).

Productivity improvement

An increase in either the efficiency or the productivity within the productive hours. This increase can be achieved by well automated work planning and guidance of the workforce, good means of transport, qualitatively well motivated and well trained professional personnel.

Administrative overhead reduction

Currently, there are frequent double registrations, enormous piles of paper (receipts) and thus a great deal of administrative work. The stock administration is frequently inefficient. Stockrooms are located in several places within the area of work. The structuring of work processes and adequate automation can lead to substantial improvements.

> Introduction of a pricing system

At present, accounts are often settled retrospectively. Realistic rates should be introduced, possibly with a differentiation according to maintenance type (applying a different rate for repairs maintenance than for mutation or planned maintenance); introduce a handling fee for activities coordinated for the maintenance contractors; introduce administrative compensation for the intake of requests for repairs, inspections which have to be carried out before work can be undertaken; work much more with unit prices, develop relevant management registers.

Identification of a capacity optimum

A share of the necessary capacity is seasonal. Efforts should be made as far as possible to work from the lowest level of the necessary capacity. Peaks and troughs can be absorbed through horizontal and vertical flexibility. Horizontal flexibility refers to the interchange of the various disciplines in the workforce within the own maintenance contractor. Vertical flexibility refers to sound agreements drawn up with contractors concerning the hiring of external capacity. Another possibility is to work more with the self-employed (ZZP). ZZP members are usually professional carpenters, bricklayers, plasterers, housepainters and all-round building trade workers. The number of ZZP members is growing enormously; it doubled to 35,000 in 2001 in just eight years. The most important reasons for this rise are the relaxation of the Establishment Legislation in the Netherlands (at this moment only an Entrepreneur's Examination in the Building Sector is needed for companies which carry out non constructive activities). Another reason is the flourishing economy of the last seven or eight years. Recently, the Dutch economy has clearly stagnated. Economic growth has fallen to just below zero in 2003. For 2004, a slight recovery is anticipated.

> The establishment of quality standards and performance agreements

Consideration can be given to the KWH hallmark Quality Assurance in Housing Construction in the Rental Sector, the Dutch Safety Checklist Contractors VCA, ISO, and the Dutch Quality Assurance Institute INK. Many housing associations aspire to the KWH hallmark. In 2004, about 165 housing associations (that is, 32% of the total number of housing associations in the Netherlands) embarked on the path towards acquisition of the seal of approval. To date, it has been acquired by more than 100 housing associations (KWH 2004). Some of the requirements relate directly to the service provided for residents. These requirements include telephone accessibility, setting the period of time within which maintenance activities contracted with residents must be completed, and so forth. Meeting these requirements is made obligatory for external contractors as well as, self evidently, for the in-house maintenance contractors. In addition to the KWH hallmark, a housing association may also choose the NEN-ISO 9001 path (translation of an International Standard into a Duch norm). A third, far more comprehensive possibility is through the INK, the Dutch Quality Assurance Institute. The INK trajectory ought not to be chosen by an inhouse maintenance contractor operating independently (see also KWH). Initiating this path in a broader context from the housing association as a whole would be more advisable. A phased approach with part modules can be followed. Finally, the Dutch Safety Checklist Contractors VCA can be mentioned. It concerns person or company certification from the

perspective of safety and the environment. Currently, external contractors are involved; inhouse maintenance services should also explore the opportunities.

> Improvement of the provision of information and automation

At present, many in-house maintenance contractors find it difficult to generate relevant registers, gain insight into profit and loss accounts, acquire information on the cost price of services and products that are offered (and thus the rates of charges to be applied). Currently, in-house maintenance contractors work in an extremely traditional manner. Most companies make use of the primary systems of the housing association. There is a need for custom-made work that can connect to and communicate with the primary systems. Alternatively as a maintenance contractor you may wish to have software developed for you. Self-development of software is however expensive and carries a high risk of failure. Fortunately there is now a reasonable supply of software created through the initiatives of software companies and housing associations in the Netherlands.

OUTLINE OF THE FUTURE FOR MAINTENANCE CONTRACTORS

Our expectation is that there will always be a market for in-house maintenance contractors. For the next few years that market share is likely to remain reasonably stable at 9% of the volume of maintenance business in the Netherlands.

Housing associations will have to deal with their in-house maintenance craftsmen and contractors in a more businesslike manner. As a result, the market share in the planned maintenance and major maintenance will come under pressure. In these types of maintenance activity, business considerations weigh more heavily. In-house maintenance divisions will have to compete with external contractors in open-competition.

However, in the day-to-day maintenance there is market share for in-house maintenance contractors to win. In addition to business arguments, client arguments play a particularly important part. Successful expansion of market share in day-to-day maintenance work would require the implementation of the drive for professionalization referred to above.

The expectation is that automation will take off in the next few years. One can think of reporting requests for repairs via the internet, coupling with work planning, all company cars fitted with board computers, employees travelling directly from home to the first job, following company cars in the city via GIS applications, delivery vans by suppliers, large quantities of supplies discontinuation no longer held in central and decentralized warehouses, reconsideration of workshops, and so forth.

In 2004 OTB Research Institute will organise an inquiry of the approximately 523 housing associations in the Netherlands. The inquiry is going to deal with a wide range of subjects concerning strategic housing policies and technical housing management. In that inquiry we will also pay attention to in-house maintenance contractors and procurement trends. The results will be presented in a separate paper on the CIB W70 symposium in Hong Kong.

This paper generally deals with maintenance contracting in the Netherlands. It's would be interesting to undertake an international comparison in the future on procurement trends in different European countries.

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STRATEGIC HOUSING STOCK POLICY AND MAINTENANCE MANAGEMENT PRACTICE IN DUTCH SOCIAL HOUSING

G.A.M. Vijverberg

OTB Research Institute for Housing, Urban and Mobility Studies, Delft University of Technology, Delft, The Netherlands

Abstract

OTB Research Institute has established a long-term research project on performance-based cooperation in the technical management of Dutch housing stock¹. Stakeholders including housing associations, contractors and the Dutch Building Research Foundation (Stichting Bouwresearch) are directly involved in this research project. Literature reviews, case studies and inquiries are part of our research methods. In 2004 the OTB Research Institute initiated a research project which involves almost all housing associations in the Netherlands (Vijverberg, 2004) about housing management and maintenance management. In this paper we address the question of what the current developments are in strategic housing stock policy, technical management and maintenance management practice in the Netherlands.

Effectiveness of housing management is not proportionally related to the size of housing associations. Medium-sized housing associations (1,800-4,000 dwellings) perform best. The employee/dwellings ratio is 1:108. Small and large housing associations seem less efficient. Strategic housing stock policy is generally accepted within large associations. 71% of the housing associations have formulated a housing stock policy document. For associations with more than 10,000 dwellings the percentage is 89%. More than half of all respondents have formulated guidelines for operational tasks at the level of housing complexes. The housing associations consider housing quality and market perspective as most important in determining their housing stock policy.

71% of the housing associations perform condition assessments to draw up their maintenance planning. Just a third of the housing associations use condition rating to record the technical state of building components. In planned maintenance private tenders with several contractors are most popular in maintenance commissioning. Almost 90% of the associations use this way of tendering. Over 60% of the housing associations use maintenance contracts for responsive maintenance and planned maintenance, especially for the maintenance of central-heating boilers and lifts. More than half of the associations use performance-based maintenance contracts for central heating and lifts; paintwork comes next with one third of the associations. The market share of performance-based contracts for other building components is still very small. The inquiry shows that performance contracts in practice really contain performance characteristics.

Keywords: housing associations, strategic housing stock policy, technical housing management, maintenance performance levels, maintenance planning, contracting maintenance, performance-based contracts

INTRODUCTION

As a result of mergers in recent years, the number of housing associations in the Netherlands is decreasing and the average size of the managed stock has increased. There are currently 579 housing associations in the Netherlands and they manage a total of 2.4 million dwellings. About 530 of the housing associations are members of branch-organisations (Aedes 2003). Together with Aedes and Kovon (an organisation for quality control of maintenance contractors in the

¹ Research project within the research program 'Habiforum Vernieuwend Ruimte gebruik 2004-2009'

Netherlands) we sent them an electronic questionnaire (via internet/e-mail). The response was 24% (125 associations). This is a remarkable lower response than a comparable inquiry amongst housing associations sent in a traditional way (by post) in 1997 (Straub 1997). Still the response is sufficient for reliable statements on housing associations as a whole. The spreading of the response is also sufficient for statements on the underlying size classes.

The average size of the 530 housing associations is 4,335 dwellings. In spite of the mergers, the number of large associations is still modest. Only 10% manages more than 10,000 dwellings. Besides dwellings, housing associations also manage dwellings of third parties and other real estates. The most frequently mentioned types of real estate are business accommodation, shops and studios (almost 64%). This is followed by associations for home owners and other third parties (58%), and parking places and garages (55%). Only one fourth of the associations manage beds or rooms in houses for the elderly and nursing homes. Libraries, art libraries and schools came last (15%). Further investigation shows that larger associations more frequently manage dwellings for third parties and other real estate.

Dutch housing associations are not-for-profit organisations, which are obliged to operate in the interest of social housing, in particular by providing decent, affordable housing to lower-income households. This is reflected in the Housing Act and the Social Rented Sector Management Decree (BBSH), which states the rights and obligations of Dutch housing associations (Nieboer and Gruis 2002; Priemus 2003). In the 1990s, the national government granted social landlords considerably more freedom in policy development but diminished the financial support to social landlords. Furthermore, demand for social housing decreased, partly due to a booming economy and changes in housing preferences towards home-ownership. As a consequence, housing associations which own nearly the entire social rented sector in the Netherlands, began to adopt business-like approaches in their housing management. They had to be more market-driven and client-driven. For technical management just the lower limits have been set. All dwellings have, in any case, to satisfy the minimal requirements of the Dutch Building Decree (Straub, 2004).

In this paper we describe the housing management and maintenance management practice of Dutch housing associations, based on the recently conducted inquiry (Vijverberg, 2004). In the merger of housing associations an often heard argument is that merging leads to a more efficient scale for housing management. We are interested in the effectiveness of housing management in comparison to the size of housing associations. Secondly, we wonder if the business-like approaches in housing management are reflected in the way housing associations consider all aspects in formulating their housing stock policy. Investments and maintenance strategies will be related to the strategic policy. The strategic housing stock policy may determine the desired quality levels of the housing estates and complexes and/or dwelling types and building components. We wonder if housing associations differ in quality levels and which supporting tools they use in their technical management. We are also interested in how management practices have changed between 1997 and 2004. The 1997 survey was conducted to better understanding the way housing associations operated as private organisations and how they related maintenance and improvement to strategic housing stock policies (Straub 1997). At that time the Dutch housing associations had acted independently from the government for some years. The survey revealed some changes towards a business-like approach. In this paper we describe the outcomes of the survey 2004. If applicable we compare the results with the outcomes of the 1997 survey.²

LARGE HOUSING ASSOCIATIONS SEEM LESS EFFICIENT

The 2004 survey shows that the average association employs 51.6 staff members. As earlier mentioned the average size of a housing association in the Netherlands is 4,335 dwellings. This means 1 employee per 84 dwellings. When we itemize this to size categories it is notable that the smallest associations (less than 1,800 dwellings) employ comparatively more staff members to manage the stock (1 employee per 30 dwellings). The most ideal size category in terms of employee/dwellings ratio is 1:108 for a dwelling stock of 1,800-4,000 dwellings. The size

² In 1997 questionnaires were sent to all 382 housing associations, which owned over 2,000 dwellings. In 1996 about 800 housing associations existed. The analyses were based on 181 responses, a response rate of 47.1%. Because of the survey 1997 was just sent to housing associations owning over 2,000 dwellings, a scientific rightly comparison is not possible.

category of 4,000-10,000 dwellings has a ratio of 1:96. The largest housing associations (>10,000 dwellings) is third with a ratio of 1:94.

A conclusion is that the smallest associations employ comparatively more staff and therefore seen as not very efficient in management and maintenance of the stock and possibly, in planning and developing new construction as well. It is also notable that the largest housing associations perform worse than medium-sized associations. In terms of efficiency of scale therefore, the mergers of housing associations did lead to better efficiency of labour. However, it is noted that the large associations more frequently have an in-house maintenance contractor with skilled workers within the organisation. Large associations also more frequently develop a broad package of services and societal activities.

	<1,800	1,800-4,000	4,000-	>10,000	Average
	dwellings		10,000		
Average number of dwellings	925	2,707	6,089	17,266	4,335
Average number of employees	31.2	25.0	63.2	183.0	51.6
Number of dwellings per	1:30	1:108	1:96	1:94	1:84
employee					

Table	1:	Amount of	employees	(in full-tim	e equivalent	permanent	functions)
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Source: OTB inquiry Technical management of housing associations 2004

STRATEGIC HOUSING STOCK POLICY GENERALLY ACCEPTED WITHIN LARGE ASSOCIATIONS

We define strategic housing stock policy as: 'All activities developed by a housing stock manager to achieve the aim of keeping or bringing the stock in accordance with the short and long term market developments and market preferences and the objectives of landlords'.

71% of the housing associations have formulated a housing stock policy in one or more current documents. For associations with more than 10,000 dwellings the percentage is 89%. Most documents are based upon the organization mission statement and its goals.

We have asked all associations with current housing stock policy documents on what scale the documents make pronouncements on investments and exploitation choices. The housing complex level and the Product-Market-Combinations (PMC) are favorites (66% and 56% respectively). The district/neighbourhood level and the type of dwellings come next with 38% and 27% respectively. Least interesting is at the street level (10%).

In determining their housing stock policies, housing associations consider a broad range of aspects. The housings associations were asked to indicate the importance of several aspects and considerations in their housing stock management. (See table 2). The results are very comparable with the results of the same question in the 1997 survey.

The housing associations consider housing quality³ and market perspective (lettability) as most important in determining their housing stock policy. Respectively 89% and 83% approve those aspects to a (very) considerable influence. More detailed research shows that small as well as large associations find housing quality important. Large organisations especially find market perspective important.

³ We define housing quality as: the physical characteristics of a dwelling, which are relevant to the use of that dwelling, including the plan features and facilities provided (Straub and Vijverberg 2004). Plan features are those, which are determined by, or are evident from, the building structure and layout of the floor plan of the dwelling in question, i.e. the volume and floor space, the (number of) rooms, their size and layout in relation to each other; internal and external accessibility (e.g. availability of a lift), outside spaces, such as a balcony, loggia, (roof) terrace or garden and external structures (shed, garage) or off-street parking space. Facilities include the standard of equipment and finishing of the kitchen, bathroom and toilet, heat and noise insulation, security features, etc. and (central) heating and hot water installations, climate control, electrical systems, lighting and communication. The type of dwelling, i.e. single-family and multi-family, as well as its internal and external accessibility largely determines the plan features. Other determinant factors include the year of construction (built before or after the Second World War and built after 1969) and tenure.

Aspects and considerations In %, n = 90	No influence	Some influence	Considerable influence	Very considerable influence	Total
Technical quality	1	32	52	14	100%
Housing quality	1	10	58	31	100%
Environmental quality	26	58	17	-	100%
Urbanistic quality	16	53	31	-	100%
Government regulations	30	49	19	2	100%
Type of dwelling (single/multi–	6	27	58	10	100%
Year of construction or refurbishment	12	43	38	7	100%
Social issues street, neighbourhood, district	10	31	49	10	100%
Market perspective (lettability)	2	16	42	40	100%
Life-styles of occupants	24	47	28	1	100%
Wishes of sitting tenants	9	51	39	1	100%
Exploitation result	10	40	43	7	100%
Book-keeping value and/or	11	49	37	3	100%
going concern value (net					
present value)					
Market value	18	40	37	6	100%
Social return	13	41	39	7	100%
Availability of subsidies	47	47	7	-	100%
Own capital and/or solvency	10	37	44	9	100%

Table 2: The perceived influence of different aspects and considerations on housing stock policy

Source: OTB inquiry Technical management of housing associations 2004

Also being ranked as important factors are the type of dwellings (68%), the technical quality (67%) and the social issues in the street, neighbourhood and district (59%). For type of dwellings and social issues the same goes as market perspective. Small associations attach less importance to this factor than larger housing associations. For technical quality it is the other way round. 83% of the associations with less than 1,800 dwellings approve technical quality to a (very) considerable influence. For associations with less than 4.000 dwellings the percentage is 56%. Also important are own capital and/or solvency (53%) and exploitation result (50%). Smaller associations approve less importance to these financial factors.

In the past few years life-styles of occupants has become an important topic in journals and magazines in the Netherlands. The inquiry shows that life-styles is not (yet) an important factor in housing stock policy. Only 29% state that life-styles is (very) important. The opinion is related to size-categories. Less than 10% of the small associations assign influence to this aspect. Larger associations find it much more important.

The housing associations consider government regulations and the environmental quality and the availability of subsidies as not important in housing stock policy. The first two factors score 20% and subsidies only 7%. For all the three aspects, the larger associations give more weight to these aspects than smaller ones.

It's striking that sustainability still plays a minor role in housing stock policy (Nieboer 2004). Sunnika and Boon reported little progress in the period 1993-2002 (Sunnika and Boon 2002). The 'importance' is low and has even gone done in relation to the results of the inquiry of 1997. New ways have to be found to get sustainability back on the agenda.

GUIDELINES FOR OPERATIONAL TASKS

Next to the fact that housing stock policy is worked out in one or more documents it's also important to know whether the documents are worked out in guidelines for operational tasks on the level of the housing complexes. Guidelines can be specified on subjects as policies for target and client groups (e.g. allocation), rent and rent adjustments, investments, remaining exploitation period, maintenance etc.

80% of the associations housing stock policy plans have been worked out in guidelines for operational tasks. Combined with the earlier mentioned 71% of the associations with policy plans this means that more than half of all housing associations in the Netherlands has developed guidelines on housing complexes level. Important subject for the guidelines are rent price policy and maintenance policy (in 9 out of 10 guidelines). Next comes information on proposed investments (for example refurbishment) in dwellings and guidelines for target and client groups (8 out of 10). Other interesting subjects covered in the guidelines are the remaining exploitation period and investments in environmental quality (7 out of 10 and 5 out of 10 respectively). Services are the least interesting.

QUALITY LEVELS WITHIN TECHNICAL MANAGEMENT AND STRATEGIC COMPANY POLICY GAIN MARKET SHARE

The outcome of the strategic housing stock policy will often be complex and maintenance strategies, including desirable quality levels. In our definition a quality level may include the technical quality, the housing quality, the quality of collective building parts and grounds (multi-family dwellings) and the level of services. 60% of the housing associations apply more than one quality level managing their housing stock. However, that means that 40% of the housing associations do not differ in quality per housing complex or housing estate. The use of quality levels is related to size-classes. For larger associations (>4,000 dwellings) the percentage is 67%.

The housing associations that apply more than one quality level were asked how the maintenance strategies are linked to complex strategies, like demolition, refurbishment and consolidation (continuing exploitation of housing complexes). For the period until demolition 92% of the housing associations apply an adapted maintenance strategy, for the period until refurbishment two third and the period until sale one third.

Implementing quality levels, aspects of housing quality and technical quality are most frequently used, respectively by 92 and 81% of the housing associations. Only one third of the housing associations that say to apply more than one quality level differ in service levels.

Maintenance strategies of housing association depend on anticipated interventions. A housing association can distinguish maintenance performance levels for the different types of maintenance: response maintenance (breakdown services), re-let maintenance and planned preventive maintenance (condition-based maintenance). In 1997 housing associations distinguished in general, three maintenance performance levels: average, above average and below average. A performance level influences the budget for maintenance and the relation between planned maintenance activities, response maintenance activities and re-let maintenance. If a housing complex has been labelled 'above average' over 100% of the average maintenance budget might be spent. The strategic housing stock policy would determine the dwellings for target groups requesting for a higher housing quality and maintenance performance level. The dwellings could be maintained at a higher level when executing planned maintenance and/or reach a higher housing quality level at the time of executing re-let maintenance. Some planned maintenance activities can be executed more frequently or with higher quality materials. A complex can be labelled 'below average' if the strategic policy opts for refurbishment, demolition or sale in the near future. Only response maintenance, minor repairs and no replacements, will be executed for the remaining exploitation period (Straub, 1997).

According to the 2004 survey, 84% of the housing associations that apply more than one quality level uses maintenance performance levels in planned maintenance, 80% in re-let maintenance. Not so surprisingly just 43% differs in the quality of response maintenance. We think that differentiation in response maintenance is applicable in just a few circumstances. If a housing association has formulated a variation in quality levels, they have to implement these in all operational processes. 38% of the housing associations use maintenance budgets to differ in

maintenance performance levels. 64% use admitted maintenance activities to differ in maintenance performance and 58% of the respondents differ in maintenance activities cycles.

MAINTENANCE PLANNING AND CONDITION ASSESSMENT

Maintenance policies related to the strategic housing stock policy have an impact on the form and meaning of long-term mainteance plans, techniques and instruments which support the planning of maintenance, e.g. the data collection and data processing. Data collected during a condition survey on-site and long-term maintenance plans should support policy-making in a variety of ways such as for choosing appropriate maintenance performance levels for housing and/or building components, prioritising maintenance activities and setting budgets.

We supposed that almost all housing associations use long-term maintenance plans. The housing associations were asked if they perform condition assessments to draw up the maintenance planning. 71% of the housing associations say doing that. It means no less than 29% do not perform condition assessments. The frequency of the condition assessments varies enormously. 43% of the housing associations that perform condition assessments are doing that yearly. On the other hand 29% of the housing associations actualise condition assessments ones in every three years.

A condition-dependent approach to planned maintenance leads to a decoupling of quality assessment from the determination of maintenance activities. Table 3 shows the data registered per building components on-site, by building inspectors. Approximately 90% of the inspectors register the type of defects and the extent of these defects. It was expected that a large number of housing associations would express the state of building components in condition marks. We think that the use of condition marks makes the state of maintenance transferable between building inspectors and maintenance managers and the maintenance department and those involved in setting up the strategic housing stock policy. It is also very useful for data processing. We expected that as a result of several research projects, use of the method in the Dutch House Condition Survey (six-point scale), and being a popular subject in trade journals, continuing education, seminars, etc., the process of condition assessment using standard lists of defects and a six-point scale would have become more popular among housing associations. That is not the case. The inquiry shows that just one third of the housing associations use condition marks to record the technical state of building components.

Type of defect	93%
Extent of defect	89%
Intensity of defect	58%
Condition mark building component (six-point scale)	33%
Type of maintenance activity	64%
Extent of maintenance activity	61%
Planning year	67%

Table 3: Data per building component registered on-site by building inspectors

Source: OTB inquiry Technical management of housing associations 2004

A maintenance planning system fulfils a central role in the support of technical management processes. In 1997 almost all housing associations used maintenance management systems. The use of maintenance management systems according tot the survey 2004 is divers. Most of the housing associations use standard software packages provided by the market, sometimes linked to company information systems that support the main processes of the housing associations.

Although the fact that maintenance planning programs are widely used we wonder if those systems underpin the strategic stock policy making process. The maintenance management system must be capable of being used as a policy instrument, e.g. by enabling users to calculate maintenance performance levels based on the condition of building components before and after executing maintenance work. In this approach assessed defects and condition marks before at one side and acceptable defects and conditions marks after executing maintenance work at the other side, are steering instruments in the planning process. It should be pointed that the most of

the programs used in 1997 were inadequate to use as a policy instrument and to translate strategic stock policies into differentiated maintenance policies (Straub 1997).

MAINTENANCE COMMISSIONING AND CONTRACTING

The housing associations' in-house maintenance departments account for 9% (\in 250 million in 2002) of the total maintenance expenditures in the Netherlands (Aedes 2003). The emphasis of the work of in-house contractors lies on response maintenance and re-let maintenance. More than 90% of maintenance (\in 2,730 million in 2002) is outsourced to external building contractors.

In planned maintenance private tenders with several contractors are most popular in maintenance commissioning. 89% of the housing associations use this way of tendering. One fifth of those associations contract out all, and 4/5 a part of the planned maintenance in this way. Private tenders with one contractor are used by 84% of the associations. Public tendering seems not interesting in planned maintenance. Only 12% of the housing associations use this way of contracting out (table 4).

Over 60% of the housing associations use maintenance contracts for responsive maintenance (breakdown services contracts and comprehensive contracts) and planned maintenance, especially for the maintenance of central-heating boilers and lifts. For planned maintenance the picture is comparable with response maintenance. 65% of the associations have sublet all or a part of planned maintenance in contracts. Within re-let maintenance contracts are less popular. Only one third of the associations have concluded contracts for this maintenance type. It's notable that, depending on the type of maintenance, 8 to 9% of the housing associations within the population. Further research showed that this is not true. Depending on the maintenance type it's 7 tot 15% for the associations managing less than 1,800 dwellings.

Aspects and considerations	None	1-10%	11-30%	31-50%	51-80%	81-99%	100%	Total
In %, n = 90								
Private, one contractor	20	35	28	19	9	4	10	125
	(16%)	(28%)	(22%)	(15%)	(7%)	(3%)	(8%)	(100%)
Private, several contractors	14	7	9	18	31	29	17	125
	(11%)	(6%)	(7%)	(14%)	(25%)	(23%)	(14%)	(100%)
Public tender	110	6	2	2	1	1	3	125
	(88%)	(5%)	(2%)	(2%)	(1%)	(1%)	(2%)	(100%)

Table 4: Contracting out planned maintenance

Source: OTB inquiry Technical management of housing associations 2004

If the strategic housing stock policy and maintenance strategies have been formulated clearly and performance requirements have been defined and made measurable, contractors could be made more responsible for the choice and implementation of maintenance activities. So-called performance-based maintenance contracts are being concluded with growing frequency between housing associations and maintenance contractors. Most frequently mentioned are contracts for central heating installations and lifts. More than half of the associations involved in the inquiry concludes these kind of performance contracts. For these components there is a growth of market share in relation to the state of the art in 1996 (Straub, 1997).

Also notable is the market share of paintwork. More than one third (37%) of all associations conclude performance contracts for paintwork. For associations managing more than 4,000 dwelling this percentage rises to 44%. The market share is about the same as in 1996 (a few percentages down). The market share of performance contracts for other 'building components' (outside maintenance, roofs and total maintenance) is very small and has decreased considerably since 1996 (Straub 1997).

Table 5: Market share of performance-based maintenance contracts for different building components

Central heating	58%
Lifts	52%
Paintwork	37%
Outside maintenance (including paintwork)	5%
Roofs	4%
Total maintenance	2%

Source: OTB inquiry Technical management of housing associations 2004

The size of the housing association proves to be a factor in applying (performance-based) maintenance contracts. For large housing associations it is more or less essential to explore alternative means whereby maintenance processes can be managed efficiently and effectively. An additional argument is that the housing associations have chosen to re-focus on their core business, and a number now regard maintenance as a secondary process for which outsourcing, provided it is organized in a responsible manner, is preferable (Straub 2002).

CHARACTERISTICS OF MAINTENANCE PERFORMANCE CONTRACTS

It is interesting to know what factors are involved in the present maintenance performance contracts. In this way it is possible to determine the extent of 'performance'. All respondents were asked to select factors from a list presented to them.

Characteristics	N = 95
Technical performance requirements	62 (65%)
Requirements concerning services	58 (61%)
Maintenance scenarios made by the contractor	24 (25%)
Unit prices coupling standard activities	32 (34%)
Fixed yearly rates	65 (68%)
Term to end life expectancy of building components	11 (12%)
Term to end of exploitation housing complex	3 (3%)
Periodical performance measuring by principals or third parties	35 (37%)
Self control and periodical performance measuring by contractors	20 (21%)
Contractor as supplier of (maintenance) capacity	13 (14%)
Contractor as real estate adviser	21 (22%)

Table 6: Characteristics of maintenance performance contracts

Source: OTB inquiry Technical management of housing associations 2004

Technical performance requirements (condition marks and measurable performances), requirements concerning services (speed things are dealt with etc.) and a fixed rate per year are mentioned most frequently (more than 60%). The first two are interesting characteristics of maintenance performance contracts. Periodical performance measuring by principals or third parties, maintenance scenarios made by third parties and unit prices coupling standard activities come next. The gap with the earlier mentioned factors is wide. 30% of the associations select these factors. The first two are in our view interesting characteristics of performance contracts.

20% of the associations with performance contracts mentions self control/periodical performance measuring by contractors and the contractor as real estate adviser. In our opinion these are both important characteristics of performance contracts and performance-based cooperation. The other listed factors score 10% or lower.

Conclusion is that performance contracts in practice really contain performance characteristics.

CONCLUSIONS, RECOMMENDATIONS AND DISCUSSION

Effectiveness of housing management is not proportional related to the scale of housing associations. Medium-sized housing associations (1,800-4,000 dwellings) perform best. The employee/dwellings ratio is 1:108. Small and large housing associations seem less efficient.

We wondered if the business-like approaches in housing management are reflected in the way housing associations consider all kinds of aspects in formulating their housing stock policy and how the policies are worked out. We expected the implementation of housing stock policy documents and management schemes in almost all organisations and the use and further developments of instruments as condition-assessment and performance-based maintenance contracts. The results of the survey 2004 show that that's not true. 71% of the housing associations have formulated a housing stock policy document and 57% of all respondents have formulated management schemes on the level of housing complexes. The housing associations consider housing quality and market perspective as most important in determining their housing stock policy. It's striking that sustainability still plays a minor role. The progress made from 1993 onwards has stopped. The 'importance' is low and has even gone done in relation to the results of the inquiry of 1997. New ways have to be found to get sustainability back on the agenda.

60% of the housing associations apply more than one quality level managing their housing stock. The results are size-class dependent. Larger housing associations perform better. Next to size we think that market circumstances also play a role in the development of individual Dutch housing associations. This can't be proved in this article because market circumstances were not involved in the inquiry. The survey gives not enough reasons to say that housing stock policies of Dutch housing associations are strategic or not, according to Nieboer and Gruis (2002). The policies are in any way market-oriented.

The strategic housing stock policy-making and maintenance policy-making should be based on objective, reliable information about the performance of housing complexes and building components. Data are required on the technical condition of the building components (e.g. condition marks), the housing quality (e.g. standard of equipment and finishing of the kitchen), the environmental quality (e.g. use of materials, energy-use and kind of heating system), adaptability for changes in housing and environmental guality and the realised costs for maintenance and improvements. Forecasted budgets needed to implement complex and maintenance strategies, should be part of the calculated going-concern value. 71% of the housing associations perform condition assessments to draw up the maintenance planning. Just a third one of the housing associations use condition marks to record the technical state of building components. It seems to be that condition assessments are still used for operational reasons: drawing up yearly activities plans and prioritising maintenance activities. We think that a clear coupling between the strategic stock policy and the technical management with respect to planned maintenance is still lacking in many cases. We also think that a gap between the information needs of managers and management information provided by standard software packages, still exists. New software is needed to facilitate policy-making by easy calculations and comparisons of budgets, quality levels and performance requirements.

In planned maintenance private tenders with several contractors are most popular in maintenance commissioning. Almost 90% of the associations use this way of tendering. Over 60% of the housing associations use maintenance contracts for responsive maintenance and planned maintenance, especially for the maintenance of central-heating boilers and lifts.

More than half of the associations conclude performance-based maintenance contracts for central heating and lifts; paintwork comes next with one third of the associations. The market share of performance-based contracts for other building components is still very small. The total market share of maintenance performance contracts is stable in the period 1996-2004. For a few building components the amount of contracts has gone up, others are more or less stable or going down. The inquiry shows that performance contracts in practice really contain performance characteristics.

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PERFORMANCE-BASED MAINTENANCE PROCUREMENT BY DUTCH HOUSING ASSOCIATIONS

A. Straub

OTB Research Institute for Housing, Urban and Mobility Studies, Delft University of Technology, Delft, The Netherlands

Abstract

OTB Research institute has established a long-term research program to performance-based maintenance procurement in the technical management of housing stock. Stakeholders: housing associations, contractors and the Dutch Building Research Foundation are directly involved in this research program. Literature reviews, case studies, expert meetings and modelling of processes are part of our research methods.

Dutch housing associations contract out most of their maintenance work and improvements. The outsourcing and commissioning of maintenance is becoming less of a commitment to carry out specific works according to a work program, and more of a performance-based co-operation between the client and contractors.

Housing associations have developed performance-based contracts for paintwork including work to the substrates, flat roofing, lifts and central heating systems. The performance has to do with the performance of the elements during time and sometimes also to the service level, e.g. the response time and active maintenance time for breakdown service.

A breakthrough of performance-based maintenance contracts is obstructed by a lack of knowledge of clients and contractors, desired flexibility in maintenance policy by clients and their desired low market prices. In many cases the contract period is restricted to maintenance work cycles of elements. Maintenance contractors want to be kept involved in the maintenance of housing complexes during a long period, for the optimal use of their knowledge.

Keywords: maintenance; outsourcing; performance-based; procurement; technical management

INTRODUCTION

Each year, Dutch housing associations spend in excess of \in 3 billion on maintenance and minor improvements, whether to the fabric of their buildings or the building services. Given the age of the housing stock, this amount is likely to increase in the years ahead. More than 90% of maintenance work is outsourced to external building contractors (Aedes 2003). The housing associations therefore have every reason to ensure that the outsourcing is properly arranged.

The growth in the size of the holdings for which an individual housing association is responsible is an important factor in considering the adoption of performance-based maintenance contracts. There are currently 552 housing associations in the Netherlands, which between them manage 2.4 million dwellings. Growth is not so much due to new construction or the purchase of dwellings. but is further to an ongoing wave of mergers. Over the past decade, the average size of a housing association's managed stock has increased to 4,600 dwellings. Some larger associations have as many as 40,000 dwellings under their management, which renders it more or less essential to explore alternative means whereby maintenance processes can be managed efficiently and effectively. With the ongoing consolidation in the branch of Dutch housing associations, their bargaining power towards maintenance companies generally increases. An additional factor is that the housing associations have chosen to re-focus on their core business, and a number now regard maintenance as a secondary process for which outsourcing, provided it is organized in a responsible manner, is preferable. Another reason for considering performance-based contracts is the emergence of a strategic housing stock policy. This entails a costumer focus, greater differentiation in quality and hence some variation in maintenance performance levels (Straub 2001; Straub 2002a). The interest shown by housing associations in

performance-based agreements is also further to their adoption and development of quality management systems. Many associations have now adopted the INK (Institute of Dutch Quality) management model, comparable to the EFQM Excellence Model (EFQM 1999). While still focusing on direct results and processes, the associations wish to shift the emphasis onto continuous learning, innovation and improvement and to seek out value adding partnerships with other organisations. There is now noticeably greater attention for maintenance processes and partnership in the supply chain for maintenance.

The traditional maintenance approach entails single, detailed contracts and competition based on price, usually by means of a tender process. By contrast, the performance-based approach centres on a set of desired performances or service levels. Maintenance contractors no longer act as suppliers of capacity, but become active participants in the overall maintenance process. They assume certain risks and responsibilities with regard to the quality and costs of maintenance activities, doing so for a long period wherever possible.

The results of a survey by the Economic Institute for the Construction Industry (EIB), together with our own findings, indicate that most professional housing managers still contract out maintenance activities in the traditional manner (EIB 1998; Straub 2002b). Only three per cent of housing associations have granted fabric maintenance work under a performance-based contract. For paintwork this figure is 12%, while for installation maintenance it is 18%.

Despite the low share of performance-bases contracts in the maintenance market, clients and contractors are able to cite a number of advantages attaching to a performance-based approach (Straub 2002b). Clients emphasise the reduction of financial risks at the longer term and steering the maintenance processes on main points. Contractors underline improvements of performance and service and innovations in the whole maintenance process by having continuity in orders and sustainable relationships with clients. They have a common interest in developing performance-based concepts and suitable instruments for performance measurement.

ONGOING RESEARCH

This paper is largely based on two ongoing studies being conducted by the OTB Research Institute for Housing, Urban and Mobility Studies at Delft University of Technology. The first study is into performance-based agreements for several building components and organization's maintenance activities and involves seven large, innovative housing associations and the Dutch Building Research Foundation (SBR). The housing associations involved in the study have entered into performance-based contracts with maintenance companies. The second, parallel, study is into performance-based approaches and involves input from contractors specializing in exterior surfaces, again with the participation of the SBR. Both studies hope to promote mutual learning and to establish guidelines for performance-based maintenance concepts. The first phase involved literature reviews and case studies, together with an analysis of the housing associations' current procurement and outsourcing methods. Performance-based agreements covering the maintenance of central heating systems and lifts, flat roofing and paintwork have been examined and compared. Then, in 2003, various processes were modelled and expert meetings were organized at which housing associations and contractors were invited to discuss the interim results. In 2004, performance-based approaches for various building components will be further elaborated, and the Dutch situation with regard to innovative performance-based concepts will be compared to that in other countries, and that current in the refurbishment and new-build sector. There has been considerable prior research into the performance-based concept in new construction (e.g. Pries 1997). The results of our study indicate that the preconditions that exist here also apply for the most part to maintenance and improvement work. The final component of the study will examine how effectiveness and efficiency can be enhanced throughout the maintenance supply chain.

The housing associations consulted during the current study state that the reduction of financial risks and improvement of quality must be seen as paramount. Fulfilling the needs of final costumers (the tenants) is also important, but not a leading objective. They emphasize new approaches whereby their maintenance processes van be managed effectively and efficiently. They are aware that procurement of maintenance is not just an operational activity, but involves tactical and strategic decisions about outsourcing and differentiation questions. The outcome of the research may assist in discussions around the transition of the building sector from a one-dimensional orientation on costs, to process and value maximization.

WHICH BUILDING COMPONENTS?

The development and use of performance-based agreements will depend on the type of maintenance involved, the costs as a proportion of overall maintenance expenditure, and the opportunities that exist to measure both performance and the level of risk faced by the client. Maintenance contractors are prepared to assume certain risks, but at a price. In the case of performance-based agreements for separate building components, a preventive and/or condition-based maintenance approach forms the basis of all maintenance activities. However, this does not mean that the agreements should not also cover breakdown services by comprehensive contracts, such as those to which flat roofing and various installations. Preventive cyclical maintenance and breakdown service lend themselves particularly well to the performance-based approach. In case of preventive cyclical maintenance regular, fixed contact moments between client and contractor already exist. Preventive activities are carried out to preclude breakdown of the system. Performing breakdown service is not so much a question of performance level of the installation components, but that of the technical service levels, i.e. response time and active maintenance time. Some of the performance requirements can be derived from the requirements of the client's own quality management systems, put in place to ensure customer satisfaction. Indeed, the customers themselves have a part to play in monitoring compliance with such requirements.

Paintwork

Paintwork, with the necessary work to the substrates, accounts for over one third of housing associations' current maintenance expenditure. It is therefore not surprising that the associations should seek new methods of contracting out such work in order to render the procurement process itself more efficient, while also maintaining the ability to control performance on a sustainable basis. The contractors involved in the current study have adapted their working methods accordingly. Most performance requirements involve product performance, e.g. cracking of substrates and degree of blistering of paints.. Both clients and contractors acknowledge that the current high degree of detail of performance requirements is a matter for further attention. Not all possible occurring defects have to be used in performance-based contracts (Straub 2002b). The extensive quantity of requirements indicates that there is insufficient trust, confidence and knowledge available to reduce the number of firm requirements. Clients in particular expect that future agreements will contain far fewer detailed specifications and will rely more on functional requirements. Our ongoing research involves indicative performance criteria deduced from functional requirements for painted building components.

Flat roofing

The housing associations require certainty with regard to the life span of flat roofing and its performance over the long term. Normally, manufactures guarantee the well functioning of their roofing products for 10-15 years, if certified contractors do maintenance. In the case of performance-based agreements for flat roofing, it is clearly appropriate that the responsibility for providing a guarantee on well functioning comes to rest with the maintenance contractor, rather than the manufacturer. Just one of the housing associations has entered into a performance-based agreement with a roofing company, which has in turn entered into a contract with the supplier of the roofing product used.

Central heating systems

In the case of maintenance to central heating systems, the housing association company union Aedes published a model performance agreement in 1998 (Aedes 1998). Individual associations have since produced their own versions of this agreement, sometimes going even further than the 'standard'. Safety requirements play an important role in shifting responsibilities for maintenance activities to contractors. Response times and active maintenance times are the most important performance requirements. One of the housing associations involved in the study has gone so far as contract out all improvements to, and replacements of, central heating systems over the long term. This association simply demands that its residents should have hot water and heating. How this is achieved is not seen as important, as long as it is indeed achieved. Another housing associations wished to have mechanical ventilation systems included in the performance agreements for central heating systems. But, dwelling types, construction years and the habits of the tenants have a major influence on the circulation of fresh air. As yet, it has not
proven possible to establish responsibilities and risks of client and contractor in this regard in any responsible manner.

Lifts

The housing associations emphasize the cost savings and additional performance quality that can be achieved through the introduction of new agreements for lift maintenance. There is currently some general dissatisfaction regarding the performance of lift maintenance contractors. By passing greater responsibility to the contractors themselves, costs can be reduced considerably. Existing maintenance contracts are based on a fixed number of call-outs per year. However, not all lifts require the same amount of maintenance in a year. This will depend on factors such as the type of lift and the intensity of its use. Eventually, they wish to achieve a clear, uniform maintenance approach, with fewer parties involved, and fewer different types of lifts in use. Moreover, those lifts should be of better quality. This is prompted in part by the Safety rules for the construction and installation of existing lifts (CEN 2003), following the European Recommendations (95/216/EC) and the European directive to new lifts (European Council 1995).

DEVELOPMENT PHASES OF PERFORMANCE-BASED PARTNERSHIP FORMS

Despite the fact that model agreements exist for many years, the development of performancebased maintenance agreements is still in its early stages. Progress varies greatly according to the type of maintenance concerned. Both the housing associations and the contractors are striving to achieve continuity of work, improved quality, direct and indirect cost savings, greater certainty with regard to maintenance costs in the long term, optimum process management, and the measurability of performance. In general, the development phases which may now be identified can be described as: (1) the traditional contracting-out (by tender) of maintenance activities; (2) price and performance agreements for maintenance activities and (3) long-term cooperation for maintenance. See Figure 1.

1 Traditional contracting-out (by tender) of maintenance activities

- Detailed description or specification of work to be performed
- Procurement by means of competitive tender
- The role of the maintenance contractor is limited to the actual work
- The objective is to achieve the lowest price or best price-quality ratio

2 Price and performance agreements for maintenance activities

- Performance agreement based on standard activities and unit prices
- · Cooperation with a selected group of maintenance contractors
- Contract is valid for one or two maintenance intervals
- The maintenance contractor contributes to the planning process
- The objectives are improved quality, direct cost reductions, budgetary certainty and the development of sustainable relationships

3 Long-term cooperation for maintenance

- Performance-based contract with agreements covering price and performance for the long term.
- Cooperation with a selected group of maintenance contractors
- Financial risks laid down by maintenance contractors
- The contract duration is until the end of the desired operational life span of the housing complex or several maintenance intervals
- The role of the maintenance contractor is that of advisor
- Objectives are to match quality to the principles of organizational policy, to allow the client to manage the main outline of the process, to improve the process, to achieve indirect cost savings and to promote innovation on the part of maintenance contractors

Figure 1: Development phases of performance-based partnership forms

All the housing associations participating in this study are following the same development path with regard to performance-based maintenance agreements. However, they have reached various stages of development. There are also differences with regard to the individual associations' approach to each of the various types of maintenance, depending on the organizational structure, size and general policy. Many of the performance agreements to date are notable for their inclusion of price and performance agreements between a housing associations intend to achieve more long-term forms of cooperation. In that case contractors are consulted at an early stage of the process, and are therefore able to contribute their ideas concerning the best maintenance strategy within the constraints of the quality requirements, the expected life span, and the financial aspects applying to each housing complex. However, it is important to acknowledge that the client organization's objectives are likely to change over time and external circumstances may change. Therefore any long-term cooperation must incorporate a degree of flexibility.

THE PERFORMANCE-BASED PROCUREMENT PROCESS

Figure 2 presents the six phases of the performance-based procurement process for maintenance, based upon the purchasing process model of Van Weele (2002). The first three phases are called tactical purchasing. Phase 1 (specify) relates to the formulation of the Programme of Requirements for maintenance, according to the type of maintenance or the building components concerned. This Programme of Requirements will set out the general objectives, guiding principles and preconditions for the envisaged partnership form, as well as the functional requirements for the maintenance activities. Based on the Programme of Requirements, contractors are selected in phase 2. A general contract is then entered into with one or more of these contractors in phase 3. This will set out standard activities and unit prices, which will then be used as a basis for the performance-based contracts for each project in phase 4. Phase 3 may be said to include the formulation of performance indicators insofar as these are derived directly from the Programme of Requirements. This is a joint undertaking by both client and contractor. The performance indicators for individual projects are elaborated to form performance requirements (with a clear norm) in phase 4. The client will monitor compliance with the agreements by means of periodic performance measurements in phase 5. Finally, Phase 6 (after-care) involves the evaluation of the process undertaken together with the maintenance contractors, whereupon the contracts will be revised and/or prolonged as appropriate.



Figure 2: Performance-based maintenance procurement process

Process for performance-based planned maintenance

In practice, the performance-based procurement process is not exactly a copy of figure 2. Determining factors are the type of maintenance and the building component covered by the performance-based contract, and the legally binding agreements by which the client and contractor are obliged to observe the performance requirements. Having studied and analysed existing contracts, we have further elaborated this model to cover the planned maintenance

management process. Figure 3 presents an idealized process model for performance-based planned maintenance. The figure shows just the technical management process.

The responsibilities of the client are (shaded in the figure):

- definition of maintenance projects;
- establishment of quality levels for maintenance projects;
- determination of available budgets for maintenance (and improvements);
- tactical purchasing and ordering of maintenance (see the first four phases of figure 2), resulting in a general contract and/or performance-based contracts, together with price and performance agreements;
- the selection of an appropriate maintenance scenario.

The contractor's responsibilities are:

- inventory and inspection ('zero situation');
- planning and budgeting maintenance activities, the production of maintenance scenarios and a schedule of activities based on the client's requirements and conditions;
- actual execution of the maintenance work (first activity plan of the selected maintenance scenario).



Figure 3: Performance-based planned maintenance management process

As shown in the figure the client and contractor often liaise with regard to the maintenance scenario and planning of activities and any subsequent modifications to the schedule. Performance measurements, conducted by the client, contractor and/or a third party consultant will enable the client to ascertain whether the contractor has met the stated requirements. Having entered into agreements, there is a 'one on one' relationship between the client and the contractor throughout the term of the contract. The maintenance contractor must report the maintenance activities conducted and the performance levels attained directly to the client during the entire period. Using information derived from inspections or performance measurements, the client can update his maintenance planning.

CONTRACTUAL ARRANGEMENTS

In our ongoing research we focus on technical arrangements of performance-based contracts. Besides, commercial, organisational and legal arrangements differ from those in traditional maintenance contracts. The performance-based contracts in our study are based upon a fixed price, allowing them to recover additional costs caused by agreed circumstances.

Contract period

Housing associations and maintenance contractors agree that performance-based agreements will be most useful and appropriate if they are long-term in nature. Continuity enables the product and services to be offered at the best level of quality. However, this does not necessarily mean that the agreements should be legally binding for long periods. It must remain possible for the parties to "go their separate ways" should this prove necessary. Nevertheless, there must be a letter of intention to continue the partnership throughout the term of the contract. In order to observe and measure the effects of performance-based arrangements, the ideal situation is to have one contractor perform the maintenance on a building complex for the entire operational life span of the building.

Performance requirements and performance measurement

There should be no room for disagreement between client, maintenance contractor and any external consultant with regard to the measurement of performance or the definition of a building component. Clear and unequivocal agreements are essential. The maintenance of building components often involves several contractors, whereupon it falls to the client to determine the performance measurement method to be used. The contractors themselves should, where possible, monitor the degradation processes by performing performance measurements, further to the agreed performance levels. Performance control by independent third parties, may take the form of a random check rather than a full inspection of every product performance indicator. In the Netherlands most of the performance-based-contracts for paintwork can be characterised as prices and performance agreements for maintenance activities. See figure 1. Performance control is carried out after the execution of initial activities and maintenance work cycles (final acceptance control), at specific intervals (periodic performance measurements) and at the end of the contract period. The final acceptance control involves an examination of performance directly related to the quality of the workmanship.

IMPLEMENTING PERFORMANCE-BASED MAINTENANCE PROCUREMENT

Performance-based maintenance procurement influences the internal organisation of both client as contractor, the selection of contractors and their responsibilities and the appropriate tools and information.

The client organization

In the traditional organization structure, responsibility for procuring maintenance work often falls to the staff of a technical department of the housing association, such as the maintenance project managers. Frequently, a fixed small group of maintenance contractors will be involved, working to a basic standard specification. In fact, this is more a case of 'ordering' maintenance work. By contrast, 'procurement' implies that the choice of maintenance contractors is made at a tactical level within the organization, perhaps within a central procurement department. The selection and evaluation of contractors can be made at this level, based on purely objective criteria. The housing associations participating in this OTB study acknowledge the importance of

an intelligent client role. They realize that they will in future require people with different skills: fewer hands-on technicians and more maintenance process managers, being people with a thorough knowledge of procurement, legal issues and access to high-level technical expertise (even if this has to be brought in from elsewhere). The financial mandate to enter into long-term agreements is probably greater within a procurement department than on the operational level. Moreover, a central department is also likely to have access to the necessary legal expertise.

Selection, assessment and organization of contractors

Within the performance-based procurement system, the selection of maintenance contractors with whom the client wishes to work is extremely important. A housing association performs an appraisal of business risks based on information that allow them quickly to predict a contractor's risk of success or bankruptcy. Besides, the housing associations currently use selection and assessment documents which they have developed themselves and which enable maintenance contractors to be selected objectively and systematically. A positive development in this regard is that maintenance sector organizations are now working on their own system of quality assurance. with a certification system for affiliated members. An example is the development of a scan for performance-based competences of maintenance companies (Hoofdbedrijfschap Afbouw en Onderhoud 2003). Maintenance companies must be able to define and achieve the various performance levels for each type of maintenance and building components. Moreover, the contractors must be able to present and substantiate the (financial) risks attaching to the various maintenance scenarios. For example, they must be able to assess whether the likelihood of damage recurring, or damage being caused to other parts of the fabric, will increase given certain methods of carrying out the planned maintenance work. The financial risks attaching to unforeseen events must be shared between the client and contractor.

Here, it is important that not only the management of the maintenance companies know the implications of such a system, but that the operational staff are also aware exactly what the new working method entails. This applies equally to the clients, among whom we have noticed some disparity between the intentions and practices of management and the manner in which the maintenance project managers wish to work. The traditional manner of thinking and working, with its focus on incidental maintenance interventions, is not simple to abandon in favour of one based on performance requirements. Difficulties in doing so are similar with training building inspectors performing condition surveys (Straub 2003).

Responsibilities and risks

Working according to the performance-based principle entails a shift of responsibilities between the parties as well as a shift of risks. The companies that agree to assume greater risks will charge higher prices. In other words, it costs money to buy off one's risks. However, because responsibilities are also transferred, the maintenance contractors are in a better position to manage the risks.

In the performance-based agreements examined within this study, there is little evidence of financial risks being transferred to the maintenance contractors. The performance-based agreements are of relatively short duration and rely on predetermined performance requirements levels as well as to success or failure in meeting the agreed life expectancy of, say, external paintwork or central heating boilers. Hereupon financial claims are possible, based on penalty clauses. The standpoints of the housing associations with regard to imposing penalties vary significantly. In fact, financial penalties are rare in practice. A penalty is more likely to take the form of a cancelled contract. Most agreements relate to 'short cycle maintenance' and generally do not include major maintenance interventions such as the replacement of building components, which are to be charged separately. Their development phase can be characterised as 2 in figure 1. If the agreements were to be of longer duration, and were indeed to include replacement of building components the contractors would indeed bear more responsibility and greater financial risk. Incentives for better performance are a prolongation or enlarging of contracts.

Information provision

In the case of performance-based agreements relating to specific building components, the contractors must report the activities carried out, the condition of the component in question, and the level of service achieved in terms of response and active maintenance times. The report should be presented in the form requested by the client. The desired exchange of information between clients, contractors and consultants will probably require some modification to existing information systems. Historical data concerning maintenance costs is important in developing

performance-based agreements and in evaluating the tender bids received. An insight into past costs and the performance of building components and maintenance types, and hence the registration of such information, is important when entering into long-term performance-based maintenance agreements.

RESULTS AND DISCUSSION

A breakthrough of performance-based maintenance contracts is obstructed by a lack of knowledge of clients and contractors and distrust. Confidence in each other's working methods is clearly of prime importance.

A long-term partnership will enable both clients and contractors to derive the greatest possible advantage from the performance-based maintenance approach. Dutch housing associations fear a disturbance of price competition using long-term performance-based contracts. Together with their desired flexibility in maintenance policy they restrict the co-operation period to maintenance work cycles of elements. Continuity of work must never be the main objective of the contractor, since this could lead to lassitude. Long-term cooperation with the client must be accompanied by improvements to process and performance, and by cost savings for client and contractor alike. Clients and contractors should be aware that realization of each other's objectives depends more on the process and the manner of working than on the type and duration of the legal contract. Based on the client's starting position, the intended quality level, specific project characteristics and an assessment of the risks, the choice of cooperative structure and contract form can be made with the interests of each party in mind.

Maintenance contactors can match their knowledge of degradation processes, condition-based maintenance and the practical activities involved to the circumstances of each project, such as location and usage, and to the principles and conditions applied by the client. In doing so, they must also make use of the knowledge of suppliers of products and materials. Performance monitoring can take the form of 'self control', as part of the contractors internal quality management system, with occasional random checks by a third party.

The development of performance-based maintenance agreements is, given the financial interests involved, most advanced in the case of fabric maintenance, and in particular for exterior paintwork on various substrates. Clients and contractors require guidelines for an effective, efficient and transparent performance-based procurement system for fabric maintenance. OTB Research Institute is now working alongside the parties concerned in developing appropriate guidelines, with a focus on exterior paintwork on wood, brick, metals and plastics. For the propose content of the contract we follow the elements listed in the European pre-standard ENV 13269 (European Committee for Standardization 2001) The extent to which the working processes can be standardized must now be examined. The guidelines will differ according to the objectives of the parties involved and development phase of the client.

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PRACTICES AND PERFORMANCE OF OUTSOURCED OPERATION AND MAINTENANCE IN COMMERCIAL BUILDINGS

Joseph H K Lai Francis W H Yik The Hong Kong Polytechnic University, Hong Kong SAR, China Phil Jones Cardiff University, Cardiff, United Kingdom

Abstract

There has been an increasing trend in the outsourcing of operation and maintenance (O&M) services for buildings in Hong Kong. Engaging a 'specialist' to do the job should, in theory, yield better services to end-users at lower costs but the contrary has been noted in various cases. There are, as yet, little in-depth investigations reported in the published literature about what would make an outsourcing O&M contract a success or failure.

This paper reports the preliminary findings of an ongoing research, which attempts to: identify the factors that determine contract performance and cost, formulate guidelines to help building owners decide whether to outsource O&M services, and highlight issues that require attention in outsourcing. A key part of the research is a survey, which has recently been completed. It involved face-to-face interviews with building owners, building management companies and O&M contractors. The survey result reveals the practices in the industry, including the outsourcing arrangements, scope of work, cost, and contract work management and supervision. The paper summarizes the key survey findings and conclusions drawn from preliminary analysis of the results.

Keywords: Commercial Building; Operation and Maintenance; Outsourcing; Performance; Practice.

INTRODUCTION

Operation and maintenance (O&M) for buildings has long been regarded as routine and ancillary; few studies have been done on the appropriateness of current practices to enhance performance. Traditionally, O&M works are done primarily in-house with some specialist work outsourced. In the late 90s, the Asian financial turmoil triggered building owners in both the public (ETWB, 2003) and private (e.g. the HSBC (HK IMAIL, 2002)) sectors to outsource more O&M works in order to meet immediate cost reduction targets. Recent research unveiled some areas that require improvement, e.g. the knowledge and skills of practitioners (Lai et al., 2004a) and definition of contractual responsibilities (Lai et al., 2004b). Notwithstanding these, O&M outsourcing is expected to grow if contractors can deliver quality services at lower costs than in-house O&M (Yik & Lai, 2004), which in turn hinges on how well the contract works are managed and the contract performance measured and monitored.

Outsourcing of support services has both merits and demerits (Campbell, 1995; Bragg 1998; Dunn, 2003). A particular mode of outsourcing may work perfectly well in one circumstance but fail in another. The scale of building and complexity of O&M work, end user requirements and O&M service standards, competence of the contractor, coordination between the in-house team and the contractor, the prevalent O&M practices and the service culture are all being influential factors. On the basis of information collected through in-depth face-to-face interviews, this paper reports the common practices and performance of outsourced O&M work for some commercial buildings in Hong Kong, including the common scope of O&M contract work, contract management structures, means for communicating O&M information, and costs for operating and maintaining air-conditioning installations.

THE SURVEY STUDY

The Pilot and Detailed Questionnaire Surveys

To ensure the survey work on this unexplored topic will yield meaningful results, a pilot survey was carried out prior to the full-scale survey with a focused group that comprised one representative from a building owner, another one from a building management company and the third from an O&M contractor. Drawing on the feedback and experience gained, the questionnaire was refined. Face-to-face interviews were preferred to simply sending out the questionnaire to participants to enable confidence building (Fowler, 2002) and hence to facilitate obtaining sensitive, yet essential information; although it sacrifices anonymity of the interviewees (Welman, 2001; Sekeran, 2003).

The detailed questionnaire comprised two parts, each containing four sections. The questions in the first part enquired into general personal information about the participants and background information about their company and building and maintenance practice. Those in the second part focused on detailed information about O&M contracts handled by the participants. Twenty four face-to-face personal interviews were conducted but the results of two had to be discarded due to lack of sufficient knowledge of the interviewees to enable them to provide some essential information about the building under investigation.

Demography of the Samples

The majority of the interviewees were experienced practitioners; with around half having attained undergraduate qualification and worked at managerial level or above. Twenty-six O&M contracts pertaining to twenty selected commercial buildings (6 'office'; 13 'office-retail' and 1 'hotel') were sampled. The aggregate gross floor areas (GFA) of the buildings are: 711,631m² (office); 122,588m² (retail); 23,098m² (hotel) and 67,039m² (car park). The age of the buildings ranged from 6 to 32 years; three wholly occupied by the landlord while the rest were variously occupied by the landlord, multiple-owners and tenants. Table 1 summarises the number of buildings in the sample with outsourced O&M work for various types of services installations, in whole or in part. Among these buildings the two highest counts are respectively for air-conditioning installations, which demand labour-intensive O&M work, and for lifts and escalators, which involve servicing and repair of proprietary components and need to be conducted in compliance with onerous statutory requirements (Lai & Yik, 2004).

Services requiring O&M work	Outsourced	No. building(s) without the installation
Electrical	14	0
Generator	18	1
Air-conditioning	19	0
Building management system	12	4
Fire services	18	0
Lift and escalator	19	0
Plumbing and drainage	11	0
SMATV and CABD system	14	2
Security and access system	14	0
Boiler installation	2	16

Table 1: O&M Work Outsourced for the Sample Buildings

FINDINGS AND DISCUSSIONS

Outsourcing modes and scopes

Two extremes of outsourcing modes and scopes for O&M work were observed: one Grade C^1 office building with gross floor area (GFA) less than 3,000m² had all the preventive O&M works entirely carried out by in-house staff (but those required by legislations to be undertaken by

¹ Grade A – Buildings with effective central air-conditioning; good lift services and professional management available. Grade C – Building without central air-conditioning; barely adequate lift services and minimal management available. See RVD (2004) for detailed classification.

competent or registered professionals were outsourced) whereas one Grade A office building with GFA exceeding 70,000 m^2 had outsourced all its O&M works (Figure 1).

For the rest of the surveyed buildings, one or a combination of partial, selective and bundled outsourcing (Figure 2) was common. Most building owners outsourced the works that have to meet statutory requirements and works that demand large manpower or specialist skills leaving the in-house workforce with the non-statutory and less labour-intensive preventive works. Unlike among public-sector buildings where District Term Maintenance Contracts (HKHA, 2004) are widely used, no cross-boundary outsourcing (Figure 3) was found in the sample. This may be ascribed to the fact that the surveyed private commercial buildings are either owned by single owners who possess a limited number of buildings, which makes economies of scale unavailable; or jointly owned by multiple-owners, which renders costly transactions for apportioning O&M expenses unjustifiable.



Figure 1: Total Outsourcing



Figure 2: Partial, Selective and Bundled Outsourcing

All the surveyed contracts made use of either "centralized" or "partially grouped" contract management structure where a manager looks after all or a mix of O&M trades. None of them adopted a "dispersed" management structure under which the contracts are managed by individual personnel (Atkin & Brooks, 2000). This implies that the sample contained no



organizationally immature companies and the absence of cross-boundary outsourcing did not justify the existence of single-discipline contract managers.

Figure 3: Cross-Boundary Outsourcing

In contrast with the total outsourcing modality where all the O&M works would be executed by a contractor and its subcontractors, building management service may be provided by engaging a *managing agent* who, being an external organization or individual, manages the client organisation's own employees (Atkin & Brooks, 2000). Although this latter arrangement is popular with some overseas government departments (Williams, 2002), it was not found in the sampled private commercial buildings. Except in the two extreme cases as mentioned above (i.e. either total in-house execution or total outsourcing), a *managing contractor* was commonly employed to manage a range of O&M trades via subcontracts. In addition, it was common that the managing contractor has to coordinate and monitor some specialist contractors' work (e.g. O&M for lifts and escalators, illustrated as Trade C in Figure 4) although there was no direct contractual relationship between them.

Communication of O&M Information

A pre-requisite of quality maintenance work is effective communication between the client and the O&M management team, and between this team and the workforce (Nanayakkara & Smith, 1997). Among 75 types of management skills and knowledge, 'communication' (oral or written) was ranked only second to 'leadership' in general construction, and was perceived by senior

managers as the topmost important skill/knowledge in refurbishment work (Egbu, 1999). Generally, communication of O&M information can be identified at two interfaces of three strata. For instance, a request for maintenance may be raised by the building users to the O&M management team; who in turn would inform the O&M contractor to execute work if it lies within their scope, or otherwise command the in-house labour to do so.



Figure 4: Contractual and Communication Links in a Management Contract

The practices of communicating O&M information correlate very well between the "User – Management" and "Management – Contractor" interfaces (Figure 5). Interestingly they are comparable to the benchmarks reported by IFMA (2001): "Fill out paper request" (38%); "Use a call center" (70%). However, it was less common in sending O&M request electronically (compared with 68% in IFMA, 2001) despite economical information technology has been available for some time.



Figure 5: Means for Communicating O&M Information

Computerized maintenance management system (CMMS) can facilitate effective communication and tracking of O&M activities (Sullivan et al., 2002). In contrast with the common practice (64%) in North America (IFMA, 2001), only 24% of the surveyed companies made use of CMMS, notwithstanding the most experienced user has already been using it for 14 years. The summary in Table 2 further categorizes the practices adopted by the companies for communicating O&M activities. Different from the practices revealed by IFMA (2001), it is evident that the O&M practitioners in Hong Kong relied heavily on 'manual-tracking', which may contribute significantly to the deferred maintenance backlogs experienced by 56% of the interviewees in the preceding 12 months. Proper tracking of productivity data would allow effective assessment of O&M performance (Wireman, 1998) while sharing such data among members of the service production team is crucial to attaining total quality (Grigg, 1996). Similar to the IFMA (2001)'s findings, maintenance productivity data were seldom shared with the customers (18%) and contractors (24%). The limited extent of sharing, which was mainly among the senior management (41%) and managerial staff (53%) in addition to the staff who undertake the work (53%), shows a distinct difference from the practice common in manufacturing and process industries (e.g. Pintelon & Van Puyvelde, 1997; Arts, et al., 1998), although there has been an increasing concern in hospitality buildings in Hong Kong (e.g. Chan et al., 2001).

Activities	CMMS	Manually	Not tracked	Unknown
Repair work requests	24%	76%	0%	0%
Preventive work requests	18%	71%	6%	5%
Project work requests	12%	82%	0%	6%
Contractor work requests	12%	76%	6%	6%
Repair parts and supply costs	18%	76%	0%	6%
Maintenance tool records	12%	71%	12%	5%
Daily rounds activities	24%	71%	0%	5%
Building and equipment records	18%	76%	0%	6%
Periodic activity reports	6%	76%	6%	12%

Table 2: Practices for Communicating and Tracking O&M Activities



Figure 6: Management Performance of Contract and Communications among O&M Personnel

The respondents were asked to rate on a Likert scale of 1 (very poor) to 5 (very good) separately for the management performance of the contracts; and the achieved communication in three different aspects, namely inter-communication between the O&M management team and the contractor, internal communication among the O&M management team members and that within the contractor team. The results (Figure 6) demonstrate positive correlations between communication and management performance of contract.

Operation and Maintenance Costs

The in-depth interviews enquired into the values of the O&M contracts for air-conditioning installations, the most labour intensive type in buildings. The collected data cover mainly the routine operation and maintenance with little material resources involved. In addition to the average monthly salary of different ranks of in-house staff, the interviewees were also asked to indicate their input, in full-time equivalents (FTE), for both managing the outsourced air-conditioning O&M contract and accomplishing the work internally (Table 3). The average FTE of different ranks was calculated by equation (1) based on the full-time equivalent (*FTE_j*) and number (N_j) of in-house O&M staff at work level *j* (1: top management, 2: managerial, 3: supervisory and 4: operational) involved in the work; and *N* is the number of surveyed contracts with relevant information available. The monthly routine O&M cost of a particular trade was taken as the sum of the outsourcing contract sum (OC) and the in-house staff cost (IC). The latter was computed by equation (2) where S_j is the monthly salary of staff.

$$\overline{FTE}_{j} = \frac{N_{j} \times FTE_{j}}{N}$$
(1)

$$IC = \sum_{j=1}^{4} N_j \times S_j \times FTE_j$$
⁽²⁾

Table 3: In-house Staff Salary and FTE for the Building Air-Conditioning O&M Work

Staff rank	Average monthly salary (HK\$)	Average FTE	Range of FTE
Top management	69,433 <i>(N = 9)</i>	0.014 <i>(N = 17)</i>	0 - 0.2
Managerial	40,528 <i>(N = 18)</i>	0.070 <i>(N</i> = 17)	0 - 0.5
Supervisory	22,063 <i>(N</i> = 19)	0.514 <i>(N = 17)</i>	0 - 2.0
Operational	11,773 <i>(N = 18)</i>	1.761 <i>(N = 17)</i>	0 - 9.0

It should be reasonable to expect that older buildings and hence more worn-out installations would require higher O&M expenditure to upkeep functionality and performance. However, the scatter plot of the survey results shown in Figure 7 does not support this expectation; there is no significant correlation between the normalised annual air-conditioning O&M costs (on per unit installed capacity basis, measured in ton of refrigeration (TR)) and the building age. The particular outlier aside, the O&M costs range from HK\$10/TR to HK\$60/TR and stay low for buildings aged between 20 and 30 years.



Figure 7: Air-conditioning O&M Costs and Building Age

As expenditure on operation and maintenance may also be regarded as an investment, less money would be spent on maintenance of buildings approaching the end of their economic life span for the lower return (Davies, 2000). The life span of air-conditioning equipment, however, can be significantly shorter than that of a building (CIBSE, 2000) and thus might be on list for replacement within the lifespan of the building. Once there is plan to replace equipment, less maintenance work for the equipment would be undertaken. After replacement, the new equipment would also demand less maintenance work. These are factors that may give rise to fluctuations in O&M costs during the life span of a building.

On the other hand, the air-conditioning O&M costs show significant correlation with the airconditioned area of the building and the air-conditioning plant capacity (Figures 8 and 9). This implies that in commercial buildings with larger air-conditioned areas and hence greater airconditioning plants, higher demand of labour resource, be it in-house or outsourced, is required to operate and maintain the installations. In particular, it is noted that one Grade C building, which is equipped with split-type air-conditioning units, required little O&M expenses as no routine maintenance was done.



Figure 8: Air-conditioning O&M Costs and Conditioned Area



Figure 9: Air-conditioning O&M Costs and Plant Capacity

Further examination of the in-house and outsourced O&M costs for the air-conditioning systems (Figure 10) reveals some observations concurring largely with the prediction in Yik & Lai (2004). The outsourcing contract sums generally increase with the plant capacities at the lower range of plant size, which suggests that it is more economical if a larger amount of work is outsourced. For medium air-conditioning plants, in the 'total outsourcing' case the complete work was undertaken by a contractor under a packaged facilities management contract of which the portion of contract sum pertaining to operating and maintaining the air-conditioning system was unavailable but estimated as shown in the figure. Despite only relatively few data are available in the upper plant capacity range, the majority of the O&M works for such plants were found being performed predominantly in-house; which suggests that the large amount of work tends to fully utilize the in-house team and is therefore more economical to resource internally than to hire outsourcing contractor.



Figure 10: Outsourced and In-house Air-conditioning O&M Costs and Plant Capacity

CONCLUSIONS

The survey unveils that O&M works which require intensive labour resources, specialist knowledge or skills for dealing with proprietary components, or on which the statutory requirements have imposed strict control are commonly outsourced. Managing contractors are usually employed by building owners to mediate a range of specialist O&M trades but packaged contracts extending across building boundaries are rare in the private commercial sector, probably because economies of scale is absent.

It has not been a common practice in Hong Kong of communicating O&M information electronically and the use of CMMS stays embryonic. Nonetheless, good communication within the management team and the contractor team as well as between the two parties is important to the management performance of outsourced O&M service.

The costs for operating and maintaining air-conditioning installations in the commercial buildings have no apparent pattern over the age of buildings, but they generally increase with the extent of air-conditioned area and hence the plant capacity. The reliance on outsourced O&M increases from small to medium air-conditioning plants, while for larger plants the extent of outsourcing tends to revert to in-house provision.

The findings have uncovered some correlations between the practices and contract performance. Yet, more research is needed to verify the suggested causes and to investigate the full picture which is believed to be evolving dynamically.

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COMPUTER SELF-EFFICACY AND THE USE OF MAINTENANCE MANAGEMENT INFORMATION SYSTEMS

K.S. Cattell

R. McGaffin

K.A. Michell

K. Musambachime

Department of Construction Economics and Management, University of Cape Town, South Africa

Abstract

This paper examines the relative intrinsic importance of computer self-efficacy in the use of maintenance management information systems. The findings from a questionnaire survey are presented. Data were gathered from property managers overseeing maintenance operations in the Western Cape region of South Africa. The findings indicate that maintenance management systems are essential in the management of all maintenance activities. In addition, the information systems are underutilised in the management of the maintenance of property. Computer self-efficacy is identified as a primary reason for the restricted use of maintenance management systems.

Keywords: Computer self-efficacy; information systems; maintenance

INTRODUCTION

Because property is an investment asset class that can produce a return, it needs to be managed and maintained if it is to maintain its value and attract and retain tenants. Broadly speaking, "management" in this sense refers to portfolio management, asset management and basic property management (Cooke 1998). Specifically, property management includes tasks relating to inter alia: tenant mix, lease negotiations, rent collection and payment, physical maintenance, service charges, and the enforcement of lease covenants. Maintenance is often regarded as the least attractive aspect of property management (Seeley 1987). Notwithstanding this, maintenance plays a very important role in retaining and enhancing the value of a property by ensuring that it is kept in a condition that enables it to fulfil its operational, legal (health and safety) and investment functions. Maintenance is a complex task because the many different components of a property deteriorate at different rates. The degree of deterioration is obviously linked to the property's ability to perform, physically and economically. Furthermore, a costbenefit analysis is needed to determine the economic feasibility of attaining a certain maintenance standard. As a result, property maintenance requires not only the systematic collation, monitoring and benchmarking of data, but also the making of strategic decisions regarding the level of maintenance required to attain the required objective (Pitt 1997).

The introduction of computers and customised software has greatly enhanced the ability of property managers to fulfil these maintenance functions (Scarrett 1995). According to Jones and Collis (1996), computers have been used to assist in the maintenance management process since the early 1970s and by the 1980s, a substantial number of maintenance organisations were using software developed for large mainframe computers systems (Pettitt 1983). In the early 1980s, the first maintenance management information systems (MMIS) appeared (Pintelon *et al.* 1999). This was mainly due to the recognition of maintenance as an important business function and it was facilitated by cheaper and more powerful computers. Today, the use of computer systems in property management has become not only a pre-requisite to gain competitive advantage, but also a necessity to ensure that organisations keep abreast of change (Nagarur & Kaewplang 1999).

Research questions and propositions

This paper will show, however, that although the importance of maintenance is recognised, it is not being maximised through the use of computer systems because of problems related to computer self-efficacy (CSE). Two research questions were addressed in this study, they are:

- "For what major activities are maintenance management information systems used?" and
- "How do levels of computer self-efficacy influence the effective utilisation of maintenance management information systems in the management of property assets?"

The research propositions related to these questions were:

- Maintenance management information systems are not fully utilised because their use is restricted to non-analytical and non-decision making roles.
- The level of computer self-efficacy influences the degree to which effective use is made of maintenance management information systems.

The significance of this study is that it highlights the importance of maintenance as a business function and shows how computer self efficacy influences the use of MMIS in property maintenance and organisational output.

Methodology

A wide literature review was undertaken to ascertain the role and importance of property maintenance, the use of management information systems (MIS) in business and in maintenance; and the significance of CSE in the use of such systems.

A structured questionnaire was sent to ten respondents, comprising managers and personnel, responsible for property maintenance in five property organisations in Cape Town. Limited statistical analysis was subsequently undertaken on the results from these questionnaires. Following this, a number of in-depth, but unstructured, interviews were carried out in some of the organisations to obtain an insight into the perceptions of the individuals utilising the systems. Due to the distinctly small size of the sample, the analysis of the data produces findings that are largely descriptive and exploratory. The purpose of the analysis was to describe and indicate the intensity and magnitude of MMIS use and the relationship that exists between CSE and the use of MMIS.

Limitations of the Research

Preliminary discussions with potential survey respondents suggested that there is limited use of MMIS in the Cape Town property management industry. It was only possible to obtain information from five establishments who employed some or other system to manage the maintenance activity. This may affect the extent of what can be inferred from the data and limit its transferability.

LITERATURE REVIEW

A review of the literature revealed the following with respect to the role and importance of property maintenance, the use of MIS in business and MMIS in maintenance; and the significance of CSE in the use of such systems.

Definition of self efficacy

The construct of self-efficacy refers to individuals' beliefs about their capability to exercise control over their own level of functioning and over events that affect their lives (Bandura 1997; Wood and Bandura 1989). Or put differently, it refers to individuals' belief in their ability to perform a particular task (Bandura 1977,1982; Gist 1989). Many empirical studies have validated this postulation of self efficacy as a determinant of performance in a variety of settings, including employee attendance (Latham and Frayne 1997), idea generation among managers (Gist 1989), complex decision making (Wood and Bandura 1989) and computer skills acquisition (Gist 1989). The most effective means by which an individual develops self-efficacy is through repeated performance accomplishments.

Role of property maintenance

Because property is typically a long-term investment and is required to be a durable asset, continual management, maintenance and reinvestment are necessary to sustain its value and utility (McGregor and Then 1999). The role and challenge of property maintenance management is on the one hand, to minimise maintenance costs, but on the other it is to ensure standards that enable a property to produce maximum returns. The efficient collation and presentation of data is therefore critical to a maintenance manager for monitoring, benchmarking and decision-making purposes. Failure to implement proper maintenance systems can lead to a deterioration of the value of the asset, a reduction in the performance of the operation and the escalation of health and safety risks (Geraerds 1985; Drucker 1988).

Management information systems

Management information systems (MIS) were first developed by eliminating the manual elements of the management process where possible with the aim of increasing efficiency, reliability and the availability of time as well as improving the ability to make strategic decisions (Davis and Olson 1985; Senn 1990). Recognising the benefits of these systems, many property-related organisations later adapted and implemented MIS programs in property management and maintenance, producing what is referred to in this paper as MMIS (Pitt 1997). These new systems were extensive databases that enabled the rapid processing and translation of large amounts of data into a format that allowed instantaneous and specific interrogation (Park 1994). Over time, these MMIS were progressively required to produce more decision-support capabilities, which led to the development of specific maintenance software customised to the needs of the maintenance manager.

There is, however, evidence to suggest that MMIS have been used far more to automate functions like data collection and processing, than they have in the decision-making process (see Labib (1998); Jones and Collis (1996); Hammer (1990); and Pintelon and Wassenhove (1990)). Edington (1997) argues that this underutilisation of management information systems in the property industry may be due to inadequate training, coupled with an unwillingness to take risks. Furthermore, there is evidence to indicate that computer self efficacy (CSE) is a significant determinant of effective IS usage (see Compeau and Higgins (1995a); Hung and Liang (2001); Vandenbosch and Higgins (1996); and Igbaria and Iivari (1995)).

Computer self-efficacy and its effect on the use of MIS and MMIS

Computer self-efficacy was derived from the broad construct of self-efficacy defined above. Various behavioural factors affecting computer use or performance, including the identification and measurement of CSE, have received increasing attention since the late 1980s. Many of these empirical studies have shown that CSE has a significant positive effect on the use of information systems (Alavi 1982; Belcher and Watson 1993; Vandenbosch and Higgins 1996). Studies by Compeau and Higgins (1995b), Hill *et al.* (1987) and Taylor and Todd (1995) show that in applying the concept of CSE to understanding users' behaviour in accepting MIS, one would expect that an individual who has a strong sense of his or her capability in dealing with computers is more willing to accept and fruitfully utilise the system. Hung and Liang (2001), Vandenbosch and Higgins (1996) and Igbaria and livari (1995) have all confirmed this by revealing that the use of MIS and MMIS is positively correlated with CSE. In summary the literature suggests that CSE has a very positive effect on the acceptability and use of MIS and MMIS use cannot be fully realised unless individuals have a high regard for their ability to use a system.

The remainder of this paper reports on an investigation of the extent to which the issues in the literature outlined above pertain to property management organisations in Cape Town.

RESULTS AND DISCUSSION

In order to investigate the role of CSE on the effective usage of management maintenance systems in Cape Town, a number of maintenance managers were surveyed through the use of questionnaires and follow-up interviews.

Profile of sample group

The survey and interview respondents were drawn from five property management companies and the sample consisted of ten managers and personnel responsible for the property maintenance in these organisations. Of the ten respondents, five had held their current jobs for a period of less than 5 years, four for a period of between 6 and 10 years, and one for more than 10 years. They were generally well qualified, with six being degree holders, two holding postgraduate degrees and two being diploma holders.

The respondents also possessed high levels of computer literacy, with three having used a computer for 8 years or more, six for 6-7 years and one for 4-5 years. Nine of the respondents had received training in word processing, eight in spreadsheet use, four in database management and four in statistical data processing.

Importance of maintenance and the use of MMIS

There was generally consensus that maintenance is regarded as important by the respondents' organisations; the weighted average score out of 10 for this perceived importance was 7.3. A high percentage (8 of the ten) indicated that they had received training in the use of MMIS software, but two indicated that no formal training was provided and they were rather expected to learn through experience. There was also consensus about the belief that MMIS were important in the management of property maintenance, with the finding that the weighted average rank out of 10 was 8,2. Regarding the types of systems used, seven reported the use of customised MMIS programs, while the remaining three utilised a module in a property management package.

The perceived importance (measured as a weighted average rank out of 10) of the database function of MMIS was found to be 8.7, and of the scheduling and planning function, 8. Only four of the respondents used MMIS for decision-making support, for which the importance ranking was 3.75. All of the respondents ranked the importance of the communication function as 2.

This is an important finding because it reveals an obvious belief that maintenance, computer training, and MMIS are important, but it also reveals a perception that MMIS are important in only certain of their functions. It would be difficult to argue that the functions perceived by the respondents as relatively unimportant (decision making support and communication) are indeed so. This perception, as will be shown in the next section, reflects more about the respondents than it does about the software.

MMIS use and levels of CSE

The measure of CSE in this study was based on the framework established in the work of Compeau and Higgins (1995a). The respondents were asked to rate whether they were confident or not in using certain types of software under a number of conditions, and to rate this out of 10 (see Appendix A for questions). The mean score was 5.46, which is described as "moderately confident". This also accurately describes the entire sample, as both the lowest (4.8) and highest (6.6) scores fit this description better than the "not confident at all" and "totally confident" labels.

The research then sought to establish if there was a relationship between these levels of CSE and the extent to which individuals utilised MMIS. Four key findings emerged:

- None of the three respondents with an efficacy level of less than 5, utilised their MMIS for analysis and decision support. The activities for which these respondents did use their systems were mainly as a database, for scheduling, planning, word processing and personnel management. It was further established that all of the individuals that used their MMIS for analysis and decision support had efficacy levels above 5.
- The number of years as a computer user also seemed to have an effect on the average efficacy levels of respondents, based on the finding that individuals who had utilised a computer for more than 8 years had an average efficacy level of 5.9.
- There is a positive correlation between the level of CSE and the hours of time spent using MMIS. The respondents who had an efficacy measure of less than 5 on average spent less than 15 hours a week utilising these systems.
- Only one respondent used the systems for communication, two for inventory control and four for analysis and decision support. All of those who indicated that they used their MMIS for

analysis and decision support gave it a rating of less than 5 on a 10-point scale, suggesting that the individuals employing MMIS do not effectively utilise its analysis and decision support function.

Evaluation of research propositions

Regarding the research proposition that: (i) "maintenance management information systems are not fully utilised because their use is restricted to non-analytical and non-decision making roles", the empirical research discussed above indicates that this is true and therefore this proposition is accepted; (ii) " the level of computer self-efficacy influences the degree to which effective use is made of maintenance management information systems", the empirical research suggests that this proposition could be accepted because it shows that individuals with higher levels of self efficacy tended to spend more time utilising their systems and also used them more effectively for data analysis and decision making.

CONCLUSION

Caution should be exercised in interpreting the findings of this research because its geographical context was confined to Cape Town. This means that the sample size and the nature of the responses are conditioned by the size of the property management industry and the relative number and sophistication of the properties being managed in Cape Town. Obviously, had the research been conducted in a city like Johannesburg, different findings might have been obtained. Notwithstanding this, it does appear that in the Cape Town maintenance management industry, MMISs are being underutilised. This is consistent with the finding that some MMIS functions are perceived as relatively less important than others. It is, however, inconsistent with the recorded general belief that maintenance is important, because the maintenance function would clearly be enhanced by the effective use of the decision support and communication elements of MMIS. The explanation for this inconsistency appears to lie in the findings related to CSE. CSE scores were on average relatively low, but within the range of scores found, there was a clear relationship between lower scores and the underutilisation of the decision support and communication functions of MMIS, and vice versa, However, even when decision support functions were reportedly used, they were not ranked as very important with an average score of 3.75 out of 10.

It seems clear from this research that MMIS are underutilised and that this could be resolved if more training occurred and/or experience gained in the use of MMIS. No attempt was made to measure the economic consequences of MMIS underutilisation, but since the problem appears to be related to mediocre levels of CSE, it is likely that there are detrimental economic consequences that could be improved through raising levels of CSE generally.

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APPENDIX A: COMPUTER SELF EFFICACY MEASURE

The questions ask you to indicate whether you could use this unfamiliar software package under a variety of conditions for the activities for which you use your MMIS. For each of the conditions, please indicate whether you think you would be able to complete the job using the software package. Then, for each condition that you answered "yes", please rate your confidence about your first judgement, by circling a number from 1 to 10, where 1 indicates "Not at all confident", 5 indicates "Moderately confident", and 10 indicates "Totally confident".

I COULD COMPLETE THE JOB USING THE SOFTWARE PACKAGE ...

		Not confident at		Moderately confident		/	Totally confident			ent	
			all								
Q-1if there was no one around to	Y	1	2	3	4	5	6	7	8	9	10
Q-2if I had never used a package	Y	1	2	3	4	5	6	7	8	9	10
like it before	N Y	1	2	3	4	5	6	7	8	9	10
manuals for reference.	Ň		-	Ŭ		Ũ	Ũ	,	U	U	10
Q-4if I had seen someone else	Y N	1	2	3	4	5	6	7	8	9	10
Q-5if I could call someone for help if I got stuck	Y	1	2	3	4	5	6	7	8	9	10
Q-6if someone else had helped	Y	1	2	3	4	5	6	7	8	9	10
Q-7if I had a lot of time to	Y	1	2	3	4	5	6	7	8	9	10
software was provided.	Ν										
Q-8if I had just the built-in help	Y	1	2	3	4	5	6	7	8	9	10
Q-9if someone showed me how	Y	1	2	3	4	5	6	7	8	9	10
to do it first.	N	1	2	2	4	Б	6	7	Q	0	10
before to do the same job.	N	I	2	5	4	5	U	1	0	9	10

(Source: Comp 1995a)

THE DEVELOPMENT OF SERVICE LEVEL AGREEMENTS FOR RELOCATION MANAGEMENT – A PRELIMINARY FRAMEWORK

Lisa Campbell

Edward Finch School of Construction Management and Engineering, The University of Reading

Abstract

The development of *Service Level Agreements* (SLA's) for both contractors and in-house services has become common practice in the field of facilities management. However, there are areas in which the implementation of SLA's is proving more challenging than others, accommodation and relocation management being amongst them. In every organisation there are uncontrollable variables and unforeseeable changes which render it difficult for service providers to meet customer expectations. In this paper a case study of a multinational pharmaceutical organisation is presented. The study shows that the time required to implement moves is only weakly associated with the 'number of people' involved in the move. Other factors needed to be modelled in order to have any certainty about the required move time. What is required is a multi-factor approach that captures the influencing factors. The steps involved in developing SLA's in the fields of accommodation and relocation management are detailed in this paper and the key factors which determine the effectiveness of such service contracts identified. The results of an extensive analysis of the move management schedules are also considered. Finally, the barriers that have been encountered in committing to performance goals are discussed.

Keywords: Service level agreements; move management; change management; relocation

INTRODUCTION

Many of today's multinational organisations are experiencing increasing difficulty matching unpredictable space demands with supply. The changing economic situation has left many reluctant to commit to long term leases or property acquisitions. Even when such space becomes available, the resulting service is not always acceptable to customers, where they are not provided with the information needed to plan their work activities around the accommodation changes.

Setting service standards is fundamental to the provision of high quality customer service. It requires managers to divide their performance goals into measurable components, which provide both their subordinates and customers with a common understanding of the minimum level of performance that is acceptable. Whilst the establishment of service level agreements (SLA's) has become common place in many service environments, there are areas of the facilities management industry in which difficulties are still emerging in the setting and meeting of performance targets. One such area is that of accommodation and relocation management. The impact of uncontrollable variables on accommodation and relocation management which result in alterations to deadlines and diminished resources, have a severe impact on customer satisfaction. Everyday difficulties which can arise include matching unpredictable space demands with supply, managing complications in the renovation of outdated facilities, co-ordinating the efforts of in-house and contracted service providers in the management and maintenance of property and assets, dealing with the competing space and facilities demands of different departments, and combing long-term strategy (e.g. adjacency needs) with immediate requirements (e.g. arrival of new employees). As the size of the organisation increases, so too does the complexity of the accommodation and relocation strategies. The development of welldefined SLA's offers a solution to improved customer satisfaction, although complications such as those listed above make this process problematic.

Allied to the need to develop SLA's, is the need to maintain a degree of flexibility whereby such agreements can be revised to reflect alterations to work processes and customer demands. Applying rigid and structured service contracts limits service providers' ability to respond to organisational changes (Burstow, 1994). Furthermore, future developments in work processes and technology to support accommodation and relocation management, such as office IT, furniture and communication equipment, will alter workplace strategies (Gilleard & Tam, 2002) and therefore performance contracts. With this in mind, it is clear that periodic revision of service level agreements forms a fundamental part of the process of their establishment. Performance needs to be monitored continuously and service contracts revised at regular intervals to ensure that they are consistent with the changes that have taken place. Monitoring performance in accordance with SLA's not only facilitates management of customer expectations, but allows the service providers themselves to set well-defined performance improvement targets and to monitor the contributions that they make to the organisation. As stated by Whitaker (1995):

"Now more than ever, senior management is scrutinizing the contributions of facilities management departments to the organization's overall success. To improve, you must first understand how your group is doing – are you meeting the expectations of management and your customers? Facilities managers who do not know the answer to this question will have a difficult time documenting their contributions and improving their services." (p. 6)

The aim of this paper is to provide a preliminary framework of the process involved in developing service level agreements for accommodation and relocation management groups. A background description of the organisational departments that partook in the research is provided, followed by a description of the stages involved in developing SLA's. This includes identifying the variables against which SLA's should be set and analysing the current performance levels of accommodation service providers so that realistic performance targets can be set. This study provides details of the performance of both the Relocation Management Department and the Accommodation Management Department in the participating organisation. The findings of these analyses provide the basis for the development of performance agreements with the customer. Finally, the use of an "SLA calculator," which sets individual SLA's with customers based on their requirements and the results of the performance analyses, is described.

CASE STUDY

The present research study took place in a multi-national pharmaceutical organisation, in which the accommodation and relocation management departments participating had a remit of over 7,000 customers regionally in the UK. The aim was to aid these groups in setting realistic targets based on their actual performance, which would form the basis for service level agreements with their customers. Accommodation Management involved strategic planning of current and future accommodation needs, including adjacency requirements, predicted growth modelling, and space planning. Relocation Management involved the actual operational relocation of individuals to a new work area, where the needs of the customers were clearly defined and space was available for the relocation to proceed. Separate analyses were conducted for these two workgroups (i.e. Accommodation Management and Relocation Management).

A summary of the work process involved is as follows; Customer requests were received by the Accommodation Management Team who reviewed the requirements in terms of the overall site strategy. Customers in this instance are defined as employees of the organisation who required the services of accommodation and relocation management service providers. The Accommodation Management Team made certain that customers' requests were consistent with long term adjacency, head count growth and building refurbishment plans. This ensured, for example, that finance was not invested in refurbishing a building that was due for demolition. They then passed the request to the Engineering if structural alterations to a building were required, and to Relocation Management who organised the moving of people, assets and technical infrastructure once the structural changes were complete. Relocation Management involved a wide variety of service providers, including CAD teams who were responsible for plans as to the layout of the building, telecommunications service providers who transferred phone extensions and network sockets, furniture suppliers if new furniture was required, and removal contractors who transported furniture and assets to the new location. A basic illustration of the accommodation and relocation work process is provided in Figure 1.



Figure 1: Accommodation and Relocation Work Process

Whilst some accommodation and relocation requests such as optimisation and cosmetic upgrades were of a lower priority, more urgent requests such as co-locating product development project teams and supplying accommodation for large numbers of new employees, were business critical. Failure to deliver the services required in a timely and efficient manner could not only effect customer satisfaction, but employees' ability to carry out their job, and consequently, the productivity of the organisation.

DEVELOPMENT OF SERVICE LEVEL AGREEMENTS

A service level agreement (SLA) is a contract between a service provider and a customer that specifies in measurable terms, the performance that the service provider will deliver. When setting SLA's, there are a number of key questions that need to be answered; What are the variables against which SLA's should be set? What are the current performance levels? Can they be improved? In this paper, the variables against which SLA's should be set in the field of accommodation and relocation management are identified, the performance levels on which they are based are analysed, and the difficulties which arise in committing to SLA's are discussed.

Thus, the stages involved were:

- Identify key independent and dependent variables in the development of SLA's. Examples of key independent variables on which SLA's can be based include performance timescales, costs and quality.
- Calculate descriptive statistics of current levels of performance according to the independent variables, and investigate their combined influence using an analysis of variance.
- Use the results of the analyses to calculate the SLA for each individual customer request, depending on customer's requirements.

In the final section of this paper, a discussion of the difficulties in committing to SLA's in the field of relocation and accommodation management is presented.

IDENTIFYING KEY VARIABLES

The first stage involved in the process of setting SLA's was to identify the key variables against which the contracts should be set. Over 30 semi-structured interviews were conducted with customers in order to determine the information that they considered to be most important in the provision of accommodation services. Customers were almost unanimous in their agreement that precise timescales should form the basis for SLA's. All other variables (e.g. cost) were secondary to their need to plan work activities around the relocation. With *timescales* identified as the key dependent variable, the next stage was to identify the key independent variables which impact on this.

Interviews with a range of departments involved in the provision of facilities management services, as well as a case study analysis of the top 16% of requests (i.e. those that took longest to process), identified the *number of employees* involved in a request as the main factor that impacted on timescales.

Other factors which were identified as impacting on timescales specifically for Accommodation Management (rather than Relocation Management) included:

- Whether the request was strategic or operational.
- Whether the request involved engineering services.
- Whether the customer required re-planning of existing space or the allocation of additional space.

It should be noted that these factors are not generic to all accommodation management departments. Indeed the independent variables impacting on timescales differ for every organisation and a thorough investigation identifying these should therefore be conducted. However, for the purposed of the current study, the categories specified above represented the main independent variables and formed the basis for examining their performance levels.

ASSESSING CURRENT PERFORMANCE LEVELS

A computer-aided facilities management (CAFM) database, FaclityCenter, which supports the effective management of organisational infrastructure and records timescale data for processing move and accommodation requests, was used to collate and analyse the data. FacilityCenter provides an integrated approach to an organisation's property, facilities management, maintenance and operations processes. This overall perspective makes it possible to identify areas in which improvements and cost reductions can be made. Key variables such as the date that a customers request was submitted, the date it was completed, the services required and other variables such as the request type and number of customers, provided the data necessary to conduct the following analyses.

Correlation Analysis

A correlation analysis revealed a significant positive correlation between the number of employees involved in a move request and the amount of time in weeks taken to complete those requests. That is, as the number of employees increased, the number of weeks required to process that request also increased. The positive though weak relationship between timescales and number of customers is illustrated in the scattergraph in Figure 2. However, the variability demonstrated that this factor alone could not serve as a predictor of likely move time.



Number of Subjects Moved

Figure 2: Scattergraph of Correlation between Time in Weeks and Number of Employees for Relocation Management

The correlation co-efficient and significance level (n = 603, r = .11, p < .01, one-tailed) indicated that whilst the number of weeks increases with increases in employee numbers, there were levels of variance evident in this correlation. A perfect correlation (i.e. where r = 1) is one in which the number of weeks increases systematically per number of employees (e.g. a 1 employee move requires half a week, a two person move requires one week etc.) However, as the correlation co-efficient was less than one (r = .11), this indicates that although the timescales increase with larger number of employees, the exact number of weeks by which it can increase can varies.

Analysis by Group Size

Table 1 shows the average, minimum and maximum number of weeks required to process requests according to the number of employees involved in the request. Clearly, whilst the data does indicate a between time taken and number of people employed, it provides little certainty for the purposes of guidance and decision making. What is required is a more accurate predictor that captures those factors that influence the relocation time most significantly. Group size on its own provided little insight.

Table 1: No. of Weeks Required to Process	Requests versus Number of Employees
for Relocation Management	

Time in Weeks							
	N	Mean	Std. Deviation	Minimum	Maximum		
1 - 2 Employees	497	1.98	1.94	1	14.4		
3 - 5 Employees	76	3.46	6.14	1	45.0		
6 - 10 Employees	20	4.66	6.73	1	28.0		
11-15 Employees	8	3.97	3.61	1	10.0		
16-20 Employees	7	2.77	1.59	1	4.8		
21+ Employees	26	3.36	3.63	1	16.0		
Total	634	2.33	3.15	1	45.0		

Descriptives

The descriptive statistics revealed that accommodation requests involving one to two employees were processed most quickly (mean = 2 weeks), while requests involving 6 to 10 employees were the most time consuming to complete (mean = 4.7 weeks).

A means plot of the average number of weeks required to complete accommodation requests depending on the number of employees involved in the request is provided in Figure 3.



Figure 3: Means Plot of Number of Weeks for Processing Requests per Number of Employees for Relocation Management

Interviews with management in the participating organisation were conducted to investigate the reasons for the trend in the above findings. It was concluded that as moves involving 1 to 2 employees could be reasonably easily accommodated, and those that involved large number of employees were planned well in advance, such requests could be processed more efficiently. Moves of 6 - 10 employees presented the greatest difficulty as they required large amounts of space and supporting facilities, and were often requested at short notice.

CALCULATING THE SERVICE LEVEL VALUE

Based on the results of the analysis of variance, the constants were entered into the following equation which was used to calculate the timescale for processing a customer request based on the independent variables specified:

Working Days = Constant + Number of Employees a + Strategic b + Engineering c + Re-

plan d + interaction effect 1 + interaction effect 2....

- Where the value '**Strategic**' is the correlation factor based on a binary assignment of strategic or operational
- Where the value for '**Engineering**' is the correlation factor for a binary assignment based on whether the move involved engineering services
- Where the value '**Re-plan**' is the correlation factor for a binary assignment based on whether the customer required re-planning of existing space or the allocation of additional space

So for example, for a 2 person accommodation request which was strategic, requiring engineering services, and involving re-planning of existing space, the time required could be calculated as:

Working Days = 26.8 - 4.3 + 4.2 + 16.5 - 13.4 + 9 = 38.8

In order to make the calculation of SLA's for each individual customer request more efficient, this process can be automated using a relational database tool such as Microsoft Access, as illustrated in Figure 4.

	E 5	LA : Form	
Independent ——— Variables		LA : Form Service Level Agreement Request # 000423 Requested by Anne Murphy, Request Details Replan or New Accomodation Replan or New Accomodation Replan or New Accomodation Strategic or Operational Strategic Number of Cutomers 9 Engineering Required	
	Rec	SLA for Request = 22 Working Days	Dependent Variable

Figure 4: Microsoft Access tool to Calculate SLA According to Individual Customer Requests

Using this method, the constants in the above equation can be re-calculated and the automated Access tool modified as work process become more efficient and the performance of the Accommodation Management department improves. It is thereby possible for departments to monitor their performance and decrease the timescales in their service level agreements in accordance with their improvements.

DIFFICULTIES IN COMMITTING TO SLA'S

This paper has thus far highlighted the procedures and importance of developing SLA's but there are a number of difficulties which render this process complex. Whilst consistency in the timescales for processing requests can be maximised through streamlining and standardisation of work processes, levels of variance in these timescales will inevitably result from the influence of external factors which are not under the direct control of accommodation and relocation management teams. Examples include complications and delays in the construction of new buildings, sudden increases in headcount growth, and last minute alterations to customer requirements, all of which can impact on accommodation management team's ability to meet their service commitments. Such experiences will undoubtedly lead to decreased customer satisfaction, a situation which requires empathy, and regular, effective communication with the customer.

Allied to this difficulty is the need to overcome resistance to the introduction of SLA's amongst the service providers themselves. The development of service level agreements requires performance measurement of facilities management teams, which may generate resistance from the work groups involved, particularly where there are known to be process inefficiencies and unsatisfactory levels of performance. This will be most prevalent where service providers are inhouse rather than contracted. Support, encouragement and effective communication from management can help to overcome such barriers to the development and measurement of performance goals. The tendency for contractors (rather than in-house service providers) to utilise service level agreements supports the finding by Mintel International Group Ltd. (2003) that between 1998 and 2003, there has been an increasing reliance by companies to contract or outsource facilities management services, with the outsourced UK facilities management market growing from £60.7bn to £69.2bn. Indeed, outsourced services now hold a 60% share in the marketplace compared to the 40% share of in-house service providers.

Finally, there are a number of limitations specific to the present analysis which should be noted. As the data used in the analysis was from a live organisational database, many of the control procedures employed in a sterile research environment were not feasible. Limitations of the data included missing values and administration delays (e.g. entering a customer request data up to 2 days after the request had actually been submitted). Also, as the sample size in the analyses of Accommodation Management was very small, the results have been used to demonstrate the procedures involved in setting up SLA's rather than as accurate measures of the Accommodation Management Team's performance. In spite of these shortcomings, the results illustrate the stages involved in developing SLA's and the difficulties that relocation and accommodation management groups can encounter in the process.

CONCLUSION

The aim of this paper has not been to conclusively establish the optimum procedure for the development of service level agreements, but rather to provide a preliminary framework which with further refinement will allow relocation and accommodation management departments to achieve this goal. Weaknesses of the process described in this paper include the need to account for levels of variance in the delivery timescales which will impact on a service provider's ability to meet their performance targets. Inevitably there will remain a percentage of requests that fall outside the SLA due to environmental factors and exceptional circumstances.

Whilst the process of developing SLA's detailed in this paper does not remove uncertainty, it does take the first step towards providing accommodation and relocation management groups with an objective method for developing service delivery targets and monitoring performance. It is a significant improvement on the traditional "finger in the wind" approach to setting SLA's which has prevailed in many organisations, and provides customers with an expected delivery timescale as well as the maximum and minimum number of working days that may be required. Continued development of the process of setting up SLA's in the fields of accommodation and relocation management will facilitate refinement of this process and will help to further increase the accuracy with which commitments to customers can be made.

In summary, monitoring performance timescales allows accommodation and relocation management teams to form SLA's, to benchmark their own performance, and through the use of before-and-after measures, to examine the impact that alterations to their work processes have on their performance. It facilitates a mutual understanding between customers and service providers of the predicted service timescales, which not only provides customers with the security of knowing that their request is being processed, but allows them to plan and manage their work activities accordingly.

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SELECTING RELATIONSHIP TYPE IN FACILITY SERVICES

T. Ventovuori

T. Lehtonen

CEM Facility Services Research, Helsinki University of Technology, Finland I. Miettinen

BIT Research Centre, Helsinki University of Technology, Finland

Abstract

The expansion of existing outsource contracts and the outsourcing of the strategically more important services have created the need to develop relationships based on a more collaborative approach. Since collaborative relations do not work in every situation, there is the need to develop an understanding of the different relationship types. The aim of this paper is to identify the factors that influence the choice of relationship type and the factors that distinguish collaborative relations from adversarial relations. The research is qualitative, based on thematic interviews, informal discussions and focus group interviews. Empirical findings are compared to and linked with the findings in the literature. The results indicate that transaction cost economics could be used to support decisions related to the selection of relationship type in facility services. When selecting a partner for a collaborative relationship, the perceived potential for long-term improvement as a result of joint learning processes is more important than the immediate financial benefits. In an adversarial approach, the most important criterion for selecting the service provider is often price.

Keywords: facility services; inter-organisational relationships; sourcing strategy; transaction cost economics

INTRODUCTION

Growing competition has increased the amount of attention being paid to client satisfaction and the reduction of fixed costs in many local markets (Ancarani et al. 2004), including the Finnish property market. Companies need to supplement their core competences by creating alliances with other providers of complementary competences to satisfy their customers. Productivity and quality improvements are not achievable unless the other business providers want to support the joint supply chain effort against other supply chains, and create innovations to the best of their abilities alongside their partner organisation (Macbeth 1994). As a result of these trends, companies have been involved in looking at optimal relationship types related to non-core activities such as facility services.

Facility services can be divided into technical (i.e. building services) and non-technical services. They are mostly intangible services, even though there is usually some production of material included in them. Nevertheless, services can be described by service contracts, and their performance can be measured against key performance indicators (Hinks and McNay 1999, Gilleard and Yat-lung 2004). In contemplating a mix of building services such as technical building maintenance, and non-technical services such as cleaning, ground maintenance, and waste management, it is easy to see the diversity of the tasks involved (see Atkin and Brooks 2000, Ancarani et al. 2004). In his study of facility services Salonen (2004) identified the specific characteristics in the studied case. These may be classified as the duration of the service, the required skills and expertise and the importance of the service to the client and end-users. Most of the facility services such as cleaning do not require high levels of expertise, services such as statutory equipment testing and the maintenance of major appliances do (Atkin and Brooks 2000).

In Finland, companies began a downsizing transition during the 1980's. More and more operational functions, such as cleaning and real estate maintenance, were outsourced. This
phenomenon was accelerated by the economic depression in the early 1990's, when the amount of outsourcing was increased and also management functions were often outsourced. At first, many companies focused on price as the most important factor in purchasing. This, in turn, resulted in adversarial relations with their suppliers. As existing outsource contracts were expanded and strategically more important services were outsourced, it was realised that relationships based on a more collaborative setting were also needed (Incognito 2002). Currently, problems exist in describing the optimal type of relationship and defining the different factors that influence the choice of relationship arrangement under certain purchasing situations.

As Gadde and Snehota (2000) state, some relationships with suppliers are important because of the volume of business they represent, others because they affect the future of the company in that they are sources of technical development and important for product or service quality and performance. The impact of a specific supplier relationship depends on how it fits into the operations and strategy of the buying company and how other customer and supplier relationships are affected by it. This means that the role and value of a particular relationship cannot be assessed based on its product or service content only.

The extent of relational co-operation varies widely, while the profusion of terms describing relational approaches can often confuse the uninitiated. Often, so-called relationships can account for a range of relationship types, such as strategic partnering and arm's length co-operation. Clearly, not all relationships are the same, and there may be risks in treating them as if they were (Bensaou 1999, Möller and Halinen 1999, O'Toole and Donaldson 2000). This is in line with Miettinen et al. (2004) who suggest in their research that in facility services the term partnering is used rather loosely and to refer to a variety of different relationship types.

This study deals with the choice of relationship type. The focus is on the relationship between the client and the facility service provider. Clients are defined in the study as the property owners or managers, and the service providers are the companies that provide facility services. The objective of the study is to identify the factors that influence the choice of relationship type, and the factors that differentiate collaborative relations from adversarial relations. The research questions in this paper are defined as follows:

- 1. What are the factors that influence the choice of relationship type?
- 2. What are the differences between adversarial and collaborative relationships?

In answering these questions the aims is to help the participating companies to develop their business in the future. The answers will also point to guidelines for future research.

RESEARCH METHOD

Most of the literature in the area of purchasing and supply management has traditionally concentrated on the purchasing of goods. Various researchers have pointed out that organisational buyers view the purchasing of services as being essentially different from the purchasing of goods (Jackson et al. 1995, Grönroos 2000). It has also been recognised that the manner of purchasing of certain services varies between different types of services. Further earlier studies on the purchasing of facility services were limited; it was clearly necessary to seek a deeper understanding of the subject under exploration through an empirical study. The aim of the empirical study was to provide deeper insight into the evaluation of relationship types as a part of sourcing strategy formulation and relationship management, and to fill in the gaps between theory and practice. The empirical findings are compared to and linked with the literature.

This paper reports on the results of two different research projects. The first project studied sourcing strategies in facility services. In the second project, the quality and type of relationship between clients and service providers were studied. Using the data from two independent research projects made it possible to view relationship types from two different perspectives, which increases the reliability of the results (see Voss et al. 2002).

The data in the two projects was collected using thematic interviews, which were conducted at the interface of a service provider and a client. These interviews with different themes were comprised of questions concerning the elements of sourcing strategies and the type of relationship between these two interest groups. The interviews were recorded and later

transcribed. These transcripts were then coded manually with Atlas.ti ® software to produce the categorization of the data. The categories helped the researchers to structure the research data.

Interviews were conducted in the spring and summer of 2003. All interviews were conducted in Finnish, which was the native language of both the interviewers and the interviewees. Each interview lasted from one to one and a half hours, and altogether 41 higher-level managers (i.e. at the strategic and tactical level of the organisation) from 9 client and 10 service provider companies were interviewed in 37 interviews. The strategic level was chosen because people at this level are assumed to have the best knowledge of the business environment and future trends. The managerial level was chosen because it consists of people who are involved with procurement planning and sourcing decisions, and because it represents people who are responsible for managing a relationship after it is established. All the 19 participating companies are major players in the Finnish property market and they participated in the two projects as corporate research partners. By interviewing these companies, a comprehensive sample of best practices was attained.

According to Woodside and Wilson (2003), multiple sources (i.e. data triangulation) are needed to gain a more comprehensive understanding of the same event. Thus, the primary qualitative data was supplemented with further evidence from secondary sources. These were informal discussions and focus group interviews. Focus group interviews are defined as a research technique that collects data through group interaction on a topic determined by the researcher (Morgan 1997). The focus groups consisted of representatives of clients and service providers and were directed by the researchers in order to outline the practical problems related to the development of sourcing strategies, and to deepen the understanding of the research group of different types of relationships.

RESULTS AND DISCUSSION

In this chapter, the factors that influence the choice of relationship type are first presented, after which the nature of collaborative relations is compared with the nature of adversarial relations. Results are presented in a way, which combines the opinions of interviewees with the literature related to transaction cost economics (TCE).

The factors that influence the choice of relationship type

Since companies are always seeking to economize or reduce costs, the successful sourcing strategies for a company must be those that constantly address the issue of which type of internal or external relationships are most useful for achieving a particular purpose (Cox 1996). Whether a company makes or buys, that is produces for its own needs or procures a service from an outside supplier, turns largely on the transaction costs of managing the transaction in the firm. Where each transaction takes place depends on the attributes of that transaction, on the one hand, and the costs and competence of alternative modes of governance, on the other. Thus, the relevant question in facility service buying is which parts of the key business process under consideration should be acquired externally and which should be provided internally (Ancarani et al. 2004). Such a make or buy decision requires the buying company to carry out a full evaluation of the strategic importance of the service to the company's performance (Kraljic 1983, Blumberg 1998). By assessing strategic importance, facility managers can determine the need to control their own activities and the buying company's position against the characteristics of the supply market.

TCE is used as a theoretical basis in many articles investigating the level of collaboration in buyer-supplier relationships (see Williamson 1985, Heide and John 1988, Reve 1990, Cox 1996). TCE maintains that the key dimensions for describing transactions are asset specificity, uncertainty and frequency. Of the three, asset specificity is the most important and most distinctive (Williamson 1996). Williamson's (1985) analysis combines TCE with governance theory to determine the optimum type of relationship a company should develop depending on the characteristics of investment (i.e. the asset specificities) and the frequency of buying transactions. However, as Blumberg (2001) states, frequency is an obvious dimension in determining the optimum type of relationship, but volume is more appropriate if the meaning of frequency is less clear. The volume of co-operation describes the amount of money that is at stake. Frequency has two dimensions in facility services. The need for facility services is usually continuous and relationships with service providers are based on long-term contracts. While the

frequency of purchasing transactions is low, and the frequency of service transactions is a mix of regularly recurrent and one-off service events, the concept of frequency is somewhat unclear.

The strategic importance of the transaction is in relation to its asset specificity (Cox 1996). Asset specificity can take many forms. Williamson (1985) distinguishes four types of asset specificity: (1) site specificity, as where successive stations are located in close proximity to one another so as to economize on inventory and transportation expenses; (2) physical asset specificity that relates to the development of specific equipment and systems tailored to a particular business need; (3) human asset specificity, which arises when workers have developed extensive job-specific knowledge and expertise; and (4) dedicated assets, which are discrete investments made to meet unique specifications or volume of production at the behest of a particular buyer. Later, two other types of assets specificity have been added: (5) brand name capital, which refers to image-enhancing investments, and (6) temporal specificity, which calls for time-critical investments (Williamson 1996).

Highly specific (idiosyncratic) transactions are ones where the assets required for production are extensively specialized (Williamson 1985). A shared database (e.g. computerized management system) between a client and a facility service provider was mentioned as an example of an idiosyncratic investment. According to Anderson and Weitz (1992) the level of idiosyncratic investments is dependent on specific knowledge. Some of the specific investments may be transferable to other relationships, but some of the knowledge is useful for particular relationships. The termination of relationship would be accompanied by a loss of idiosyncratic investments, and this factor may motivate attempts at maintaining long-term relationships. This is in line with Heide and John (1988) who state that a company with more specific assets committed to the relationship is more dependent on the relationship for its success. Underlying the arguments of above, the results indicate that investment-specific knowledge and systems seem to have an influence on structural bonding between a client and a facility service provider.

Under high asset specificity and regarding core competences the contract must be controlled internally by the organisation (Cox 1996). High asset specificity refers to the skills and expertise that are the core competencies of the company in sustaining their ability to make a profit in a market and that are necessary for the company in attaining its strategic goal (see Reve 1990, Hamel and Prahalad 1994). Thus, when activities and capabilities have a critical effect on the performance of the client company (Krumm et al. 1999) or they are nearer to the core competences of the company, the more vertical the integration is likely to be considered and the more the organisation's own control is needed (Reve 1990, Cox 1996). For instance, from a real estate investor's point of view, property management is an important function, because the property management company is responsible for the letting of premises, maintaining the working conditions of building users and the value of properties (c.f. Barrett and Baldry 2003). In this case, collaborative relationship (e.g. partnering) may be chosen. On the other hand, collaborative relationships are challenging governance structures to manage. If parties are able to generate co-ordination mechanisms such as trust, they may be able to create a most efficient solution with a major joint surplus (Blomqvist et al. 2002).

The basic argument is that the higher the specificity of the assets, the greater the mutual dependence of the companies is. Therefore, the costs involved in switching are high (Kock 1991). Switching costs are the costs incurred in changing suppliers. The higher the switching costs are, the greater the specific investment, which each party has made in the relationship, and the greater the tendency to choose a collaborative strategy. Switching costs can result from human as well as physical investments. Standard products will usually have lower switching costs than customised products (Campbell 1985). A high degree of service customisation exists when the service process is adapted to suit the needs of a particular buyer (Silvestro et al. 1992) and a unique service packet is compiled for each buyer. Based on our study, customization seems to be needed in the case of knowledge intensive service tasks that can be utilized only in a particular relationship.

Low asset specificity refers to those skills or areas of expertise that are not the key to the success of the company. Low asset specificities (i.e. non-specific transactions) are activities, which are of standardised types and for which continuity have little value, since both parties can easily arrange new trading relations regarding them (Williamson 1985). This corresponds with Bensaou's (1999) view that each party can turn to the marketplace and shift to another business partner with low switching costs and minimal damage. As low asset specific goods and services represent residual competences, the contract can be based on competitive market criteria (Cox

1996). This is also suggested by Insinga and Werle (2000) who state that non-key activities, which have little value, cannot be sources of competitive advantage, in which case weak relationships are appropriate. Thus, external contracts can be adversarial (see Cox 1996) and partnerships cannot offer any advantages (see Virolainen 1998). For instance, according to interviewees answering from a property owner's perspective, non-technical service contracts tend to be adversarial because they are not that important in maintaining the value of properties at an appropriate level. This is not the case with technical service contracts.

If there is a lack of critical value regarding the performance of the client, the activities can be provided by multiple providers (Krumm et al. 1999). Having multiple suppliers reduces the client's dependence on one supplier. With multiple suppliers, the client is able to choose more than one supplier for a specific purchase and exercise buying power by allocating and changing the size of an order given to any supplier (Cunningham 1982). The buyer is always in the position of being able to choose alternative sources of supply because there are multiple sources of supply in the market place and relative certainty exists concerning replacement goods and services from alternative suppliers (Cox 1996). On the other hand, according to interviewees, a wide supplier base may be problematic if the client is seeking a collaborative relationship with the supplier. It tends to lead to an adversarial relationship arrangement because buyers that have scarce resources may not have enough time to manage multiple relationships in a collaborative way.

Comparison of adversarial and collaborative relationships

Compared to adversarial relations, collaborative relationships are based on a longer-term commitment and usually the impact of the success of collaborative relations on both parties' business is more significant. As a result, there is a need for continuous development. As respondents saw, it is necessary that both parties participate in the development process and suggest potential development targets. This is in line with Macbeth's (1994) and Mohr and Spekman's (1994) views. Participating in development is a sign of commitment to the future of the relationship, whilst also enabling both parties to have the information needed to develop the relationship to their mutual benefit.

As Ellram (1991) states, mutual benefits should arise, if a collaborative approach is chosen. These benefits are necessary, for example, in encouraging the parties to take part in development activities. The interviewees generally described a mutually beneficial relationship with the win-win metaphor where each party, in addition to their own success, gains from that of their partners. This means that both parties support each other's business and the other's existence is dependent on the other one's success. This corresponds to Mohr and Spekman's (1994) view that the level of dependence also results from a relationship in which both parties gain mutual benefits from interaction. Respondents also believed that collaborative relationship should mean more than just financial benefits to participants. Although most factors are eventually linked to financial gains, these types of benefits may exist. The feeling of mutuality and mutual respect in the relationship are examples of these types of softer benefits.

In adversarial relations both parties have their own goals within the relationship. From the client's point of view the most important thing is that services are provided as promised. Service providers see adversarial relations as business opportunities, which provide a steady cash flow and do not require any extra effort other than holding the operational service provision.

In adversarial relations service providers are not able to put effort into development activities because there are no longer-term guarantees of business. When there is no conditional necessity for continuous development from the client's point of view and the switching costs to another supplier are low, relationships can be based on shorter-term contracts. When purchased facility services are not especially complex, buyers are able to specify their requirements down to the last detail without the need for alternative suggestions from the service providers. In such cases the most important criterion for selecting the service provider is often price. This corresponds to Webster's (1992) view that in the case of occasional transactions the price contains all of the necessary information for both parties to conclude the exchange. Thus, the buyer need not consider any inter-organisational ties beyond the transaction level of interaction (Cooper and Gardner 1993). While this approach often results in a lower purchase price, it assumes that there are no differences in the suppliers' ability to provide value added services, technology gains, process innovations, and other means of gaining differential advantages (Spekman 1988).

Collaborative relationships are based on mutually agreed and clearly defined goals. As Mentzer et al. (2000) state, conflict between the parties is possible, if there is no congruence between the short- and long-term goals of the buyer and those of the supplier. Based on our study, it seems to be that goals can be a combination of either the respective goals of the parties or their mutual goals. Above all, it is important that both parties know what these goals are and accept them as such. Both short- and long-term goals are needed, especially if the outsourced function is a strategic one from the client's point of view. The main purpose of goals is to direct the development of the relationship.

In collaborative relationships, interactions are frequent and not just problem-driven. Meetings are arranged regularly. Some of them involve information sharing with a view on preventing difficulties. Others are arranged explicitly for reasons of relationship building (Macbeth 1994). These findings were supported in our study. According to interviewees, information sharing should be systematic in collaborative relations and there is a need for an open discussion about the problems that each company faces in their own operation. Furthermore, parties should report any need for change, development ideas and new innovations without being prompted. In addition, future needs and financial factors are communicated openly. In adversarial relations there is interaction between organisations at the beginning of the relationship and later in most cases, only when problems occur. People who are involved in interaction mostly represent the operational level.

In collaborative relationships both sides work actively to make improvements in order to help themselves and each other, with an agreed sharing of benefits. It is not just the personnel at the operational level, but also the top management, who participate in the development of the relationship. According to Lee and Kim (1999), top management support is usually considered a prerequisite for every successful outsourcing relation, which is based on a collaborative approach. Respondents saw that the role of top management is to set mutual strategic long-term goals and to try to discover the potential synergies between the operations of the service provider and the client. Top management is also needed to solve conflicts that the staff at the managerial and operational levels is not able to solve and to make decisions about personnel changes at the managerial level, if problems appear to be developing.

According to interviewees, more trust is needed in collaborative relationships than in adversarial relationships. This is in line with the work of Wicks et al. (1999). They suggest that there must be an optimal level of trust, depending on the value of the relationship for the firm. If excessive trust is placed in a business partner, one may be misallocating precious resources or taking unnecessary risks that could have a substantial negative effect on the firm's performance. On the other hand, underinvestment in trust is also problematic. It bypasses opportunities for more efficient and mutually beneficial exchanges and creates significant added risks (e.g. opportunism) and costs (e.g. monitoring).

CONCLUSIONS

TCE could be used to support decisions related to the selection of relationship type in facility services. In addition, TCE emphasizes strategic considerations that are important in deciding whether to make or buy facility services and it also helps clients to make more justified purchasing decisions taking into account the essence of asset specificities. TCE may help justify the reasons for different relationship forms as well as factors that are to be considered when making restructuring purchasing decisions in facility services. Thus, it is also an important part in developing sourcing strategies in facility services.

Companies should evaluate each relationship more thoroughly and decide, which relationship type to apply in each sourcing situation. More precise goal setting for the building of interorganisational relationships is needed because current goals, if they exist, are often too vague. It is evident that these goals should be based on the overall short- and long-term objectives of the company. In addition, it is necessary for companies to try to change their mindset from an adversarial one to a more collaborative one. However, this does not mean that collaborative relations should be used in every situation. Two firms involved in an adversarial relationship can also have a high-quality relationship.

The more the facility service activity may add value to the client's business, the more collaborative the relationship needs to be. A collaborative approach is chosen in cases where the

strategic importance of service is high for the client business, the purchased service is complex, there is the need to share sensitive and strategic information or the purchasing volume is high. As a result, the relationship with the partner is important and a co-operative relationship is necessary to make sure that the partner is conscious of the core business needs of the company and of the changing nature of these needs. The cost of switching suppliers is usually high, and the process will take a considerable amount of time. Thus, the perceived potential for long-term improvement as a result of joint learning processes is a more important factor in partner selection than immediate financial benefits.

In the case of standardised support services without significant strategic importance, the choice of a collaborative approach in facility services is justified by purchasing volume. Purchasing volume per transaction is increased when clients group sites or bundle outsourced services into wider contract packets. Purchasing volume makes it economically profitable to put more effort into relationship development activities. The implementation of wider service packets mean that the number of partners is reduced. This could be a risk, especially in the case of single sourcing. The dependency of the client on the service provider then becomes higher, resulting in greater vulnerability. Additionally, for instance in the Finnish property market, there are only a few alternative facility service providers who are able to provide bundles of services or operate nationwide.

If a collaborative strategy is chosen, increased trust and transparency of information are needed. On the other hand, mutual benefits should be realised. Compared to adversarial relations, collaborative relationships are based on a longer-term commitment and usually the impact of the success of relationship on both parties' business is more significant. Where sensitive and strategic information is shared, mutual trust between the parties is obligatory. There is also a need for continuous development so as to keep the service concept up-to-date and, thus, maintain the client's competitive advantage. These development activities are directed by mutually agreed and clearly defined goals. It is not just the personnel at the operational level, but also the top management, who participate in the development of the relationship. Furthermore, as the relationship deepens, it is necessary to systematise it (e.g. by reporting and meetings) in order to prevent problems related to communication and information sharing.

As the pre-transaction activities, "decisions made before the purchase", seem to have an affect on the post-transaction activities such as managing and controlling the supply network (see also Ancarani et al. 2004, Bröchner et al. 2004), there is the need to investigate those activities that occur prior to using facility services more profoundly. There is also a need for further research in which more exact descriptions of different types of relationships in the real estate industry and guidelines for managing these types of relationship are provided. It would also be interesting to carry out the same studies in different countries in order to find out possible culture-related differences.

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OUTSOURCING FACILITIES SERVICES: NEEDS AND PRACTICES OF SWEDISH OWNERS OF COMMERCIAL PROPERTY

J. Bröchner
Chalmers University of Technology, Göteborg, Sweden
S. Carlsson
Johnson Controls Integrated Facility Management Nordic AB, Stockholm, Sweden
J. Nyman
Chalmers University of Technology, Göteborg, Sweden

Abstract

Why and how facilities services are outsourced is a question that continues to attract interest. The purpose of this study has been to investigate links between categories of property owners and their demand for packaged facilities services. The empirical part is based on questionnaire responses from 20 large owners of commercial property in Sweden, and on interviews with 11 of these owners. Owners are characterized by portfolio value, geographical spread of properties, investment horizon, core business, and average tenant size. Three owner segments are identified and tentatively labelled Building Managers, Active Asset Managers, and Passive Asset Managers. Their outsourcing policies and practices differ clearly.

Keywords: Outsourcing; facilities services; commercial property; market segmentation

INTRODUCTION

In many countries, property owners have increasingly come to rely on contracts with external providers of facilities services (Bon and Luck, 1999). Outsourcing of facilities services is a complex phenomenon (Katsanis, 2002; Usher, 2004). While the rate of growth in FM outsourcing can be seen to vary between countries and industries (Bröchner et al., 2002), the entry of foreign investors and other actors in a market such as the Swedish may result in new priorities and practices (Kadefors and Bröchner, 2004). An earlier study of Swedish property owners and their capabilities for coordinating facilities service suppliers has indicated that there are identifiable owner segments that behave differently when faced with the issue of 'serviced offices' (Bröchner et al., 2004).

The present study has the purpose of investigating links between categories of property owners and their demand for packaged facilities services.

After an outline of our survey methodology, we describe how we have characterized the owners who have participated. This is followed by the segmentation of owners into three different groups, which are explained. Finally, an overview is given of how owners in these groups perceive issues related to outsourcing of facilities services.

THE SURVEY

From an initial Swedish list of 40 private sector owners of commercial property with either national holdings of offices and shopping centres in excess of MSEK 6,000 market value per company or with holdings in excess of MSEK 2,000 in the Göteborg region, 28 owners were drawn at random. (SEK 1 is about the same as HKD 1.) The mean value of their property holdings was about MSEK 10,000. These 28 owners received 6-page questionnaires, which were filled out and returned by 20 owners, implying a 71 per cent response rate. In a second stage, 12 of the 20 owners that responded to the questionnaire were approached with requests for an interview. One company declined to participate, leaving a final number of 10 interviews.

Some companies were foreign owned, but had at least one manager permanently stationed in Sweden.

The questionnaire included 42 questions, many of which relied on a five-degree Likert scale where the respondent indicted degree of assent to a proposition:

- 1. The use of our properties is: [%]: Office/Industry/Residential/Other
- 2. We own properties in an X years' time perspective: 0-5/6-10/11-15/16-20/>20
- 3. Our properties are located in metropolitan areas rather than in other regions (1-5)
- 4. Our properties have a large geographical spread (1-5)
- 5. We have a few large commercial tenants rather than many smaller (1-5)
- As company we prioritize the following aspects: (rank 1-4) Low risk/Low costs/The relation to tenants/Flexibility
- We create value for our tenants primarily by: (rank 1-4) Low rent/Buildings in attractive areas/High service level/Other
- 8. We believe that the best way to raise company profit is through: (rank 1-4) Increased turnover/Lower operation costs/Offer new concepts to the tenants/Other
- 9. Most of our property management functions are organized as follows:

Own subsidiary/Own department/External supplier/Other

- 10. We have the following property management functions in our business and they are performed as follows: [three alternatives: In-house/External supplier/None]
 - a) Asset management: Build, refurbish; Financing; Long term business planning
 - b) Coordination of functions
 - c) Financial management: Rent administration; Accounting; Property law
 - d) Technical management: Energy management; Operations; Maintenance; Customer service
 - e) Property care taking: Green areas; Room care taking; Janitorial
 - f) Tenant service: Interior; Switchboard; Mail; Catering
- 11. We have well developed routines for purchasing property management services (1-5)
- 12. We are satisfied with the system that we have today for performing property management (1-5)
- 13. We have performed our property management in about the same way for: [years]
- 14. We have earlier experience of external suppliers (1-5)
- 15. Number of our external suppliers of property management today:
- 16. We are good at evaluating and monitoring supplier performance (1-5)
- 17. We are good at coordinating our suppliers of property management (1-5)
- 18. We strive to build competence to improve coordination of our property management (1-5)
- 19. We want external suppliers to take responsibility for the coordination of property management functions (1-5)
- 20. The average period for our contracts with external suppliers is: [years]
- 21. We feel strong relatively the suppliers when we purchase property management services (1-5)
- 22. The company core business is financially focused rather than on property management (1-5)

- 23. We have gone through a process of clarifying our core business and support functions (1-5)
- 24. To enter and to monitor contracts with external suppliers is part of our core business (1-5)
- 25. We work for long term relations with our suppliers of property management services (1-5)
- 26. The following functions belong to our core business:

Property care taking/Technical property management/Financial property management/ Asset management/Tenant service/Coordination of property management

- 27. Proximity of function to the company core business (1-6): [alt. as for question 26]
- 28. We would prefer short to long contracts with most of our suppliers of property management functions (1-5)
- 29. We mostly buy complete packages of several property management functions of out external suppliers (1-5)
- 30. We wish that we could buy more property management services as a package (1-5)
- 31. We believe that increased service offers to our tenants will bring higher net incomes (1-5)
- 32. In the future we will increase the service offers to our tenants (1-5)
- 33. We have great experience of outsourcing of non real estate related services, e.g. IT (1-5)
- 34. We think that this outsourcing has benefited the company (1-5)
- 35. We will outsource more services within property management in the next five years (1-5)
- 36. The greatest advantage with outsourcing of property management is (rank 1-6): Lower costs/Increased quality/Increased focus on core business/Minimization of risks/ /Better control/Other
- 37. We consider that the term 'Facility Management' covers: [alt. as for question 26]
- 38. The greatest disadvantage of outsourcing of property management services is (rank 1-7):

Immature market with suppliers unable to deliver what we want/Lost competence/Lost control/ /Decreased contact with customer/Decreased customer satisfaction/More middlemen/Other

- 39. The greatest disadvantage of outsourcing of coordination of services is (rank 1-7):
- 40. Immature market with suppliers unable to deliver what we want/Lost competence/Lost control/
- 41. /Decreased contact with customer/Decreased customer satisfaction/More middlemen/Other
- 42. We prioritize the following aspects when we select external suppliers (rank 1-9):

Behaviour/Competence/Availability/Flexibility/Price/Terms of delivery/References/

/Reputation and image/Other

The whole survey was conducted in 2004, and all interviews were held in May, either in Stockholm or in Göteborg. In four cases, the managing director was interviewed; in the remaining seven, other top managers gave their opinions.

The 20 owners can be characterized by portfolio value, geographical spread of properties, investment horizon, core business, and average tenant size.

Portfolio value

The market value of the 20 company portfolios ranged between MSEK 2,400 and MSEK 33,000, although only four owners had holdings with market values in excess of MSEK 15,000.

Geographical spread

Four of the companies had considerable and national spread of their portfolios. Most companies held properties in cities or close to cities, but there were exceptions to this pattern. Office properties dominated almost all portfolios.

Investment horizon

About 40 per cent of the respondents claimed that they invested in a long term perspective, meaning a horizon of twenty years or more; 25 per cent indicated that they saw their property investments in a much shorter perspective of up to 5 years, and other respondents were to be found on a range between these extremes. The choice of investment horizon was often explained by referring to basic company policies: spreading risks between countries for foreign-owned investors, or attaining a leading market position for domestic owners. It also appeared that the proportion of property assets to shares and other assets on the balance sheet of a given owner was related to the choice of horizon.

Core business

Ten of the twenty owners saw their core business as having a financial focus, rather than being centred on property management. Those that take a financial asset view of properties tend to have few employees in their property function, and they mostly share a history of emerging from banks or trust funds. Regardless of the financial/non-financial divide, about eighty per cent of the firms had gone through a process of defining what should be their core business and what should be regarded as support functions for the core.

Average tenant size

One owner in five had concentrated on a few large tenants, and this concentration was mirrored in how they organized their facilities management. Here, it was usual that tenants themselves took a greater share of organizing the supply of facilities services, while the owner would engage only in major alterations and refurbishment likely to affect the value of a particular property.

THREE OWNER SEGMENTS

Although a sample of 20 companies is small, statistical clustering based on the five characteristics just described led to the identification of three segments of owners. Tentatively, they can be labelled Building Managers, Active Asset Managers, and Passive Asset Managers. Responses from the firms belonging to each segment (group) were tabulated and led to easily recognizable profiles.

Group I: 'Building Managers'

The important characteristic of the first group of property owners is their long perspective on investment. Almost all owners belonging here have indicated a horizon of more than twenty years. On the other hand, this group has the smallest geographical spread of properties when compared to the others. It is also typical that Group I owners have their core business focused on property management rather than on financial matters. Here we find represented traditional property companies that have emerged over the years from a construction business. Most of the Group I owners have been in the Swedish property market for many years, and have accumulated considerable knowledge of their properties and of markets. Within this group, there is variation in portfolio size. As long-term investors, they were often relying on in-house resources for facilities management, although it was often said that they were sensitive to economies of scale, so that they more ready to outsource services in locations were they had less than critical mass.

Group 2: 'Active Asset Managers'

For the Group 2 owners, their short-term view of property ownership is conspicuous. This narrow horizon is usually combined with a high degree of geographical spread of their property holdings. Typically, they have many small tenants. It is here that we often find foreign property owners that have entered the Swedish market. Most of the owners in this group are listed public companies.

Given their short-term view of ownership, it is obvious why the whole organization focus on buyand-sell procedures.

Group 3: 'Passive Asset Managers'

Our third group of property owners are characterized by having a long investment horizon and few, large tenants. So far they resemble Group I owners. However, in Group 3, the core business is financial rather than being preoccupied with operational facilities management. We find companies from the banking sector and pension fund owners here, not all of them Swedish. Although we have some of the largest owners of property in Sweden in this group, they tend to have few people employed in the property function. Consequently, they rely on outside providers for facilities services - or on their tenants, when these happen to be large.

FACILITIES SERVICES AND THE THREE GROUPS

All owners were asked to assign priorities to costs, relations, flexibility, and risk. What emerges is that while customer relations were ranked as very important by owners belonging to all three groups, the first group put the greatest emphasis on customers. It also appears the Group 2 owners assigned slightly lower priority to achieving low costs than other groups did.

When asked to prioritize among factors that are associated with 'creating value for customers', the greatest difference between the three groups related to 'Attractive locations', which was emphasized particularly by Group 1 owners. 'Low rental cost' was given lower priority consistently, while 'High service level', being a third mechanism for 'creating value' was somewhat more important for Group 2 owners but throughout seen as important.

How various owners saw the possibilities for raising the profitability of their business was also investigated. The three alternatives were Expansion, Cost reduction, and Offering new concepts to customers. Again, Group I owners stood out by seeing expansion as their most important path to higher profitability, whereas the other two groups assigned almost equal weights to the three alternatives.

As to perceived advantages of outsourcing of facilities services, Group 3 was the one that emphasized cost reduction, although – as with the other two groups – increased focus on core business came out in the top position. Service quality improvement as an effect of outsourcing was less of a concern for Group I owners. Effects such as improved risk management and improved control were usually rated as slightly lower in importance throughout the three groups.

Of all drawbacks associated with outsourcing, the three groups all singled out 'Loss of customer relations' as the most important. Less important negative aspects, although felt in all groups, were Competence loss, Control loss, Customer dissatisfaction, and More agents.

Purchasing facilities services in bundles rather than as particular service tasks was more popular with Group 2 and 3 owners than with the remaining group, which typically had a tradition of buying single services.

For the future, it is interesting to note that Group 3 owners were more ready than those in the other groups to affirm that facilities service outsourcing had had good effects on their companies. Nevertheless, they were also those who were least likely to increase their rate of outsourcing in the future. The simple reason appears to be that they have almost exhausted their potential for outsourcing in Group 3.

CONCLUSION

Using responses from our survey of Swedish owners of commercial property, we have identified three owner segments: 'Building Managers', 'Active Asset Managers', and 'Passive Asset Managers' and found that they differ in their outsourcing policies and practices. It is vital for suppliers of facilities services to refine their understanding of the background factors that shape the needs and policies of potential customers among property owners. In the future, it is possible

that the ownership distribution of the national stock of commercial properties will shift, with consequences for the demand for packages of facilities services, both the degree of bundling and the content of service bundles. Considering that the Swedish context is influenced by local historical developments and cultural phenomena which probably reduce the general applicability of our findings, there are good reasons for studying and comparing facilities services outsourcing in other countries.

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