Research concerning usability of facilities has its starting point in a need to understand the interaction between facilities and use and the characteristics of this interaction. Simply put; how buildings support the activities carried out in them by the users. This issue is also relevant to the construction sector as a whole as the focus on quality, value, end-users requirements and client needs is increasing. As “use” is a general term encompassing several aspects and perspectives there is a need for a framework to map and describe what has been in focus in different studies in order to define and relate different research approaches to each other. If use is discussed in relationship to ongoing organizational development or in relationship to a specific ongoing construction project the contexts are different. The framework presented can be a useful tool for communicating research within the area of usability of facilities and as such an input in further development of the field of usability and understanding of users needs in the built environment.

KEYWORDS: Facilities Management, usability research, end-users, construction clients

INTRODUCTION

Starting point

This paper reports on a development of a framework emerging out of a research project focussing usability. In the REBUS project, User-oriented Benchmarking for Usability and Sustainable Performance of Real Estate, a need for a framework to map, describe, understand and discuss aspects of usability was identified. A framework that also could illustrate what had been in focus in different studies as well as a possibility to relate different research approaches to each other (Blakstad, Lindahl & Nenonen 2010). In the research project discussions led to a development of a framework that enable positioning of research related to studies of usability of facilities. If use is discussed in relationship to ongoing organizational development or in relationship to a specific ongoing construction project, the contexts are different. The framework presented in this paper is an input to further development of
research in the field of facilities management, usability and management of client requirements. It can also serve as a useful tool for focusing and communicating research within the area of usability and contribute to a structured FM-discourse on processes, organizational development, usability of places and construction projects.

The REBUS-project
The field of construction and real estate has often been accused of not utilizing the experiences of former construction projects and repeating the same mistakes and irregularities in recurring projects (Egan 1998; Granath & Hinnerson 2002; Kamara, Amumba & Evbuomwan, 2002). The stakeholders and users in the field of construction and real estate need versatile and systematic feedback data about the usability and functionality of the buildings they use. There is also a need for methods concerning project management of the design process and methods to capture the characteristics and aspects that support usability. If construction industry professionals can better understand the requirements of the users and translate them into the design and construction processes the results should be more efficient facilities. It is, however, not only about new methods and better processes, it is also about the actors in the processes and what governs their actions. Improvement depends on how professionals benchmark and how they manage usability related issues. The REBUS project addressed two issues where end-user orientation has a major role. (Blakstad, Lindahl & Nenonen 2010) These were:

- How to achieve usability by the support of the project management processes in construction, *The project and facilities management approach*
- How to achieve usability through benchmarking of usability and of buildings in use, *The benchmarking approach*

The first issue is connected to defining and setting the criteria and values guiding the construction process from the end-user perspective, this concerns the processes to capture information about usability as well as to develop processes that transform this information to knowledge between different stakeholders. The first issue also includes management in order to achieve a relevant product and facility. The second issue concerns the information and data gathered to be used in benchmarking buildings’ usability and functionality from the user perspective. This approach is also strive for, albeit with focus primarily on the building, in the CREDIT project focussing benchmarking (Karud, et.al. 2010).

**RESEARCH APPROACH AND COMMON GROUND**

The REBUS-project took its starting point in a user-orientated approach, or even user-based, that starts in the use of facilities and not in the construction process that deliver the facilities. The facilities in use are created through the interaction between organizational, business and spatial development. Complementing to this approach there are approaches that aim to understand user requirements from a business perspective, a contractors business development need, a strict work environmental perspective, power issues etc. It is important to recognize that different approaches need different sets of theories to be congruent.

The research carried out in the REBUS project was done by a network of researchers from TKK (now Aalto University) in Finland, Faculty of Architecture and Fine Art, NTNU and SINTEF in Norway and Chalmers University of Technology in Sweden. In addition to these there also were participants from DTU in Denmark and Iceland. The research groups included experience from research within the field of Facilities Management, architecture,
real estate, briefing processes and project management in construction. Several of the participants are also active in CIB W 111 a network of academic and industry partners investigating the concept of usability of workplaces. The group was created to apply concepts of usability, commonly used in the fields of IT and engineering, to provide a better understanding of the user experience of buildings and of workplaces. Important tools in the work by W 111, and also in the REBUS project, have been design interventions, walk-throughs and observations, narrative descriptions, structured or semi-structured elaborated interview techniques. In addition there were also work-shops based on case reports and more open workshops intended to develop frameworks of concepts in the early exploratory phase. Significant for these ethnographical methods is that it is basically a qualitative method but can be enhanced by including relevant quantitative data. The methods call for a close interaction between observers and the observed (Nenonen, Junnonen & Kärnä 2008; Workspace project 2001). As pointed out in earlier works, evaluation of usability requires multi-method strategies, and combination of both qualitative and quantitative methods (Blakstad, Hansen & Knudsen 2008). Theory also affirms that context-dependent knowledge from case studies is not less valid than general theoretical (and context-independent) knowledge (Hansen et.al. 2010a, b), a fact that validates the research approach described above.

USABILITY

Buildings are built for a purpose: to support and shelter the human activities. Depending on how well buildings serve their purpose and deliver relevant and appropriate experiences and effects for their users, they impact on the efficiency of the user organization, the satisfaction of the individual end users and the possibility of achievement of goals for the businesses that occupy them. Studies have shown that in order to assess usability one has to focus on the effect of the building on the user organizations fulfilment of goals, as well as the end users satisfaction and experience (Alexander et.al. 2005). Understanding the user needs and being able to use this as guidance is believed to enable more efficient facilities and facilities that through their matching against user needs also are resource effective. Traditional programming or briefing of buildings focuses on the properties of the building itself. (Ryd 2003) They define the functional properties of the building and assume that usability will follow as a causal effect of a functional design. This has caused difficulties when the design and effect have not been working along the intentions that governed the original project. Issues like value-management, process orientation and studies of how to incorporate users in the construction process have been the result. (e.g. Alexander et.al 2010; Emmit & Prins 2005; Karud et.al 2010) The outset for the research presented in this paper is that the key issue is usability of the premises in use.

The first aspect when discussing and studying a building is usually functionality. Functionality can be defined as a property given to an artefact in order to create a practical effect (Warell, 2001). An important effect can be described as usability (ISO 9241-11). In ISO 9241-11 three factors or aspects 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 desired effect. The third factor is satisfaction that describes the users feeling and attitudes to the artefact and its effects, thus connecting experiences to use of facilities. In addition to the above it is important to recognize that the technical and physical properties of the artefact and its theoretical potential to deliver a certain effect do not automatically make it usable in the real
world. As a result of the definition of usability it 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. Both context and values change with time and place. Usability may through the connection to time and place also be understood as the relationship between users and buildings (Blakstad 2001; Kernohan et.al. 1992). According to Fenker (2008) this is always socially constructed and is hence related to the users’ experiences of the facilities. This means that the usability of a building never only depends on the building as such and that usability must be understood in context.

COORDINATION OF RESEARCH FINDINGS AND EXPERIENCES – A FRAMEWORK APPROACH

The REBUS project concerned knowledge of usability and how this can be benchmarked to be used to improve use and operation as well as development of new buildings. It has addressed the evaluation of usability as such, as well as the process of implementing knowledge of usability in the construction of new projects and in improvement and management of existing buildings. As the researchers had been active in several usability oriented research projects previously there was a broad knowledge in the group. The projects had covered issues from dialogue based processes in conceptual stages to research on how to implement users’ requirements in construction projects in as different settings as organizational change projects to actual refurbishment projects. The broad approach and experiences led to a discussion on how the different approaches were related. During the project several models and frameworks were discussed in order to grasp the different approaches in the national studies and to define and relate the different projects to each other. There was also a perceived need to relate what had been done in previous research to establish some state of the art understanding of how the concept of usability and uses were defined and utilized. As a result of discussions in workshops of the REBUS-project a framework was developed based on experience and knowledge in the research team. The framework developed is based on the steps presented below and is called USEframe.

Facilities in use
Organizations have facilities that they use to support their activities in order to achieve the goals set for that organization. This use "happens" in the context for that organization, context being societal, social, political, financial etc. A situation in which the relationship between the building and its users is socially constructed (Blakstad 2001; Fenker 2008). The facilities are used on a daily basis and during this use issues arise continuously among staff and maintenance staff concerning the effects of the facilities. These experiences are fed forward to development of knowledge. Important to recognize is that much of these experiences from in use are tacit, or unarticulated (Polanyi 1983).

Development of knowledge
The experience from use form the basis for new or revised knowledge and is collected in several ways, usually through reporting systems, regular health and safety surveys or through facility service organizations. This can be done incrementally and unstructured as well as structured through for example evaluations and questionnaires or other methodologies. However, a lot of experiences from daily use are also not articulated and documented and this step therefore point to the importance of articulating and reflecting on experiences to form new knowledge. (Ellström 2011; Schön 1983)
Some issues that arise from daily use are of simple character and can be fed directly into action; changing the use or changing the facilities. Experiences during the use are often acted upon on daily basis and fed back as new, often unarticulated, knowledge and actions. A typical example is the janitor that over the time of use learns the intricacies of a building.

Some experiences are also never or seldom collected until a process to act requires them, for example a redesign of a facility may require that staff is interviewed, e.g. as a starting point for a refurbishment project. This means that the loop from experience to project is shortened and that, depending how efficient knowledge development is, it may or may not contribute to the process. These processes can also be based on research results from projects like the REBUS project, they can be developed by professionals within the field of FM. It can also be a situation where the people carrying the actual experiences and knowledge are not part of the knowledge creating process, the project. (Lindahl 2008)

Development of knowledge can be augmented and supported by methods like walk-throughs, study visits, participation etc. (Blakstad, Hansen & Knudsen 2008; Granath 1991; Lindahl 2001) or through evaluation approaches such as Post Occupancy Evaluation, POE (Preiser & Visher 2005). But also conceptual briefing methods can be used in this phase (Blyth & Worthington 2010; Ryd 2003).

**New knowledge**

From the development of knowledge a new set of beliefs and data is formed. The new knowledge that is created can, as noted above, be fed directly back to the daily activities or it can be evaluated and developed and fed forward to e.g. briefs, policies, guidance, or directives. It can also be more difficult to get a hold of when it is carried by actors in the process (Davenport & Prusak 2000). Often experiences and knowledge about facilities in use are carried by for example maintenance staff and users that need participative processes to share that knowledge with stakeholders involved with development and management of facilities. The new knowledge must be articulated, or explicit, to be fed forward, otherwise it may only be carried in the actions of the people concerned. This process has much in common with the SECI-process described by Nonaka and Takeuchi (1995) where knowledge develops through an interactive and iterative process from tacit to explicit. In construction, once it gets to the project, the largest problem is to manage knowledge from project to project and not to lose valuable information and experiences (Anumba, Egbu & Carillo 2005).

**Governance**

The new knowledge that has been created and fed forward forms the basis for governance and management of actions. Often this concerns knowledge about the importance of the relationship between space and organizational performance (Becker & Steele 1995). This step concerns the development of principles that shall control or guide action. Included in this is for example the building brief as a governing document. (Kamara, Amumba & Evbuomwan, 2002; Ryd 2003) Documents and principles of action govern what can and shall be done. Governance can also be rooted in cultural aspects that govern what actions and standpoints that are appropriate in a specific organizational context and culture.

**Action**

When we know what to do, as documented in briefs, guidelines etc, and when we have guidance on how to do it, via project management policies, and acquired knowledge of with which resources and responsibilities that apply; then we can act. Briefs and guidelines can be regarded as more or less well defined starting points, and as the knowledge of what to do ideally develop through an iterative process between briefing and design this guides action.
The understanding of usability, e.g. by doing usability evaluations will also provide a better point of departure. The action is managed in a context; organizational, cultural, political etc. (Fenker 2008; Lindahl & Granath 2006) The action is directed to support, affect or change the future use of, in the REBUS-project, facilities for organizations.

**Facilities to be, to use**
Once the experiences have been transformed and fed forward to the project the new or changed facilities will be completed. Figure 1 illustrates the steps described above.

Figure 1. The basic framework.

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**THE FRAMEWORK USEFRAME AND THE REBUS-PROJECT**

The framework presented above, in Figure 1, was developed in the REBUS-project to map how the different national studies related. If Figure 1 is "translated" to the REBUS-project the terminology changes slightly. The development of knowledge is then primarily the usability evaluation. This is supported by a set of multiple methods, including interviews, focus groups and walk-troughs as in the Norwegian project. In the same way the Finnish project and its development of PROPAL for feedback (Kärnä et.al. 2009) can be positioned as a survey method covering the steps from evaluation results to feedback/forward eventually governing the project whereas the Swedish project concerned how requirements where documented and managed. This is illustrated in Figure 2, below.
The framework can also be used to illustrate the main focus of the three national projects in the REBUS-project. Although the projects that were studied generally touched upon a full loop, from studying actual use to development of use via new knowledge implemented in projects, the main focus from a theoretical and empirical standpoint was much more defined in each national project. The main fields are illustrated in figure 3, below.

Studying the framework above one must bear in mind that even these ovals encompass a huge set of issues. The Norwegian project had its focus on methods to collect and structure user experiences in relationship to quality of use, but looked also into adjacent research issues to frame the main question. As did the Swedish and Finnish projects, e.g. the Swedish project studied evaluations but in order to develop briefing and project management, not in order to develop the evaluations methods as such. The Finnish study focused on feedback and feed forward flows and on the feedback gathering systems and possible IT-applications.
Comments to the REBUS framework
The loop in the framework presented implies that there is a full circle from use to various inputs in the process of changing or building facilities. However, there is often no complete process unless the user organization has an ongoing process that monitors use of space/workspace in the organization. This is of course due to the fact that most organizations do not build/refurbish on a continuous basis. Often the maintenance organization maps certain aspects and the business organization others. Usually health care and hospitality are the two areas where this is actually done in a more elaborate form. Health care often having facility providers that continuously work to match the needs of the medical and organizational processes, whereas in the hospitality industry, the hotel room or conference venue is challenged by new customers every day. (Hinnerson 2008)

Projects, borders and measuring
As the framework describes a complete loop, it doesn’t indicate borders or limitations between the steps. Most projects, and especially construction projects, are defined by a specific goal to be delivered on time and to a certain cost and quality. This usually imposes delimitations on how many steps that can be included in a project. Often there are also different organizations involved with different tasks to fulfil, the consultant group with focus on the design, the contractor with focus on the production and the various user representatives from management/client to user/staff. How the usability issues are being brought from daily use to an effect of the facility requires a thorough approach that for example could include facilitators as suggested by Blyth and Worthington (2010). Thus there is a need for development of knowledge and mechanisms that can support integration between projects and phases of projects as well as between areas like spatial, organizational and business development. This concerns inter-organizational, intra-organizational and cross-disciplinary studies. Dissemination between projects and project phases is a recurring challenge in the “projectified” world of construction; this applies also to the management of user requirements. Through systems and methods like PROPAL and other systems that work with indicators, the user requirements are framed in a method. The limitation of these, even if they drive development based on the assumption that it is good to at least measure what can be measured, is that they measure what can be measured and may miss what is experienced as useful in the daily activities. A multi method strategy therefore is more likely to grasp the complexity of daily use. (Blakstad, Hansen & Knudsen 2008; Olsson, Blakstad & Hansen 2010)

Loops and communication
The connections, the arrows in the framework, can also be viewed as loops. Each of the arrows can for example be reciprocal, guiding principles can be developed by an iterative process between ”new knowledge” and ”governance”.

If we start in the use, context of use, experiences are fed forward in the process via knowledge development to action where is articulated in a project. From a ”use point of view” this is where a construction project would be positioned. A Facilities Management, FM, project would, depending on whether it concerns strategic or operational FM, be positioned either in the knowledge development to governance loop or fed directly back to use once data from systems have been assembled to adjust systems managed.

A construction project not based on a long term strategic interaction with the organization concerned, as is the case with most construction projects, would follow along the arrow from action, or project, to use, which in this case would be the delivery of an artefact, building. That does not mean that knowledge developed in the user organization is not disseminated to
the project. The construction project level, however, is different from the knowledge development happening continuously in an organization. There is also a challenge for the user organization to feed forward knowledge to guiding principles that govern the management of the project (Hansen et al 2010).

Another issues arising from the steps, arrows, in the framework is the communication between them. Each step feed forward knowledge in an articulated form. The more professional actors that participates the more special are their specific terminology and language. This point to the need for mechanisms that can manage the translation of knowledge and also the crossing between different projects; the user project, the organizational project and the construction project to name but a few.

Other approaches and relationship to other research
The steps in the framework can be associated to knowledge development models based on reflection and reflective processes (Schön 1983) or general models of actions and feedback like Deming’s PDCA (Plan-do-check-act). The framework fits the purpose of a starting point to discuss the REBUS-project and other facility oriented research as well as to position different research approaches in the area of usability, buildings, architecture and construction management. As several research approaches address issues related to users, feedback, benchmarking and customer orientation a framework that can be used to discuss and to position approaches can be useful. This framework aims to contribute to this.

As the framework, to some extent, is generic describing the loop from use via knowledge development to implementation trough governance and management and back to use, different areas of research and theory development can be positioned and related in the framework. It is important, from a clarification point of view, to have the possibility to position and delimit research as the use of the terms; value, user, user-orientation; clients etc are recurring within several research approaches. The traditional construction project is related to the “context of project” rather than to the “usability evaluation and learning from the past” etc. This underlines the importance of congruence and being clear of what client and what user that is in focus.

Summary of comments to the framework
As noted earlier, the researchers in the REBUS-project saw a need of a framework describing a loop from users to completed project where different studies could be positioned. The framework assumes a complete loop, but with defined projects, knowledge transfer processes and professional languages affecting what is addressed and fed forward. The framework presented, USEframe, is an input in a discourse on usability and should not be viewed as a framing and definite model. It is an input to further research and development. If the use of the framework should be summarized it can be used to:

- See how different research projects fit together or match each other
- Put bits of previous and current usability research in a “map”
- Support clarity, clarifying what are we talking about and where an issue would “be” located/positioned in the model
- Contribute both to understanding and to feed forward of data/info
- Satisfy user needs by putting/illustrating/explaining their loop in the model
- Satisfy the real estate business by providing a context for methods, it can be communicated and used by professionals
CONCLUSION AND FURTHER DEVELOPMENT

The discussions in the REBUS project led to a development of a framework that enable positioning of research related to studies of usability of facilities and subsequently to a possibility to map where a research project has its focus. The framework is presented in this paper as an input to further development of research in the field of usability. It concerns use of facilities, usability and management of client requirements. It can also be a useful tool for communication of research within the area of usability of facilities and as such also an input to further development. The model aims to be a basis for development of a structured FM-discourse on processes, organizational development, usability of places and construction projects.

Describing and/or understanding the process – further studies

The framework can of course also be used as a basis to discuss the process from “as is” to “to be” and when doing that methods and approaches can be put in a framework context and discussed. The framework does not illustrate an ideal process or the process, however, it is believed that it in its basic form actually does grasp all the important steps in a process concerning understanding of the user and user context. A key aspect is that the “knowledge development process” actually also is outside the “context of action”, e.g. a project, and thereby allows for understanding of user requirements outside of project constraints. Researchers in the REBUS project aim to further study the relationship between understanding of usability and governance of projects. With a growing interest in integrative support as for example BIM, Building Information Modelling, it is likely that advocates for that approach will argue that these models can do the “trick”. On the other hand there are several methods that include participation and workshop approaches; all of these aiming to deliver what the client and user needs. Which approach to choose is likely to be contextual.

Another issue, related to the above, that is important to study further is the short cut, often used in construction, from “as is” to project within “context of project”. This enables efficient projects but raises questions of how to get data and client requirements from “the knowledge development process” into the “context of action”.

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