CAPTURING AND MAINTAINING THE CLIENT'S REQUIREMENTS

SYSTEMATIC PERFORMANCE REQUIREMENTS MANAGEMENT OF BUILT FACILITIES

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ABSTRACT

The successful 'project definition' phase is the corner stone in realising satisfying end products. In the building and construction domain, this phase is particularly important, yet it is often rushed and poorly conducted. Jumping straight into technical solutions is the modus operandi. Typically, the architect's first proposal for a building layout acts as the baseline for the decision-making throughout the entire project. Inclusion of the end user objectives usually happens (unsatisfactorily) by simply asking for comments on the proposed technical solutions. This can easily lead to a loss of value and can cause problems during the use of the building, and lead to disputes during the construction. It is widely recognised that human and organisational questions need more attention than technical solutions in the early phases of the process. The performance approach has been presented as one potential catalyst for positive change in this area. The performance approach is concerned with what the building is required to do, not with describing the technical solutions i.e. how it is constructed.

A key driver for the performance approach implementation in Finland has been a software tool called EcoProP. Its next generation version, PRISM, stands for 'Intelligent Systematic Performance Requirements Management' and is currently being translated and revised for application in Australia and other countries.

In this paper, current problems in the project definition phase are presented. The requirements management and performance approach are introduced, and the barriers to implementation are discussed. The use of EcoProP on projects in Finland is presented, and in conclusion, the use of PRISM for performance requirements management in various countries is discussed.

1. INTRODUCTION

The importance of fulfilling customer expectations to attain a satisfactory end product is clearly documented (Lindkvist, 1996; Smith, 1998). In a construction project, this can only be achieved by considering the different stakeholders' needs and aspirations during the earliest possible stages of the project, however there are many difficulties in capturing these requirements in practice (Huovila, 1998; Kumaraswamy, 1997). The problems of project briefing are mainly the same as they were thirty years ago, and the current practice has many deficiencies (Barrett, 1996; Ohrn, 1998; Kähkönen, 1999; Lahdenpera, 1988; Huovila, 1999; Koskela, 2000); the brief consists of unclear or conflicting objectives, original requirements are not documented in the brief, transformation lacks creativeness and flexibility, selection of the contractor is based on price, and the construction phase is full of communication problems and 'corner-cutting' causing the loss of essential requirements. The process is mainly production-driven instead of being customer-driven. (Kamara, 1999) states four deficiencies of the briefing process:

1. often no formal or structured procedure in the evaluation of the brief is applied.
2. horizontal integration among stakeholders is inadequate (communication problem).
3. lack of information technology support causes problems when chances to requirements occur.
4. traceability of design decisions to client requirements is inadequate.

The decisions in the building construction process are based on the investment costs. When the life-cycle costs of an office space are calculated, it can easily be concluded that the investment cost is not that important when considering the bigger picture (Hattis, 1971; Romm, 1994). Salaries of the workers are a vastly bigger issue than the investment cost. Increasing worker satisfaction and productivity by providing a well performing space is much more important than saving money in the design and construction phase. It is evident that a more thorough analysis of users' needs and ultimately, behaviour and increased productivity, is potentially where the maximum benefits can be achieved (Hattis, 1971). This philosophy has been around for more than thirty years, yet still, the majority of decisions are made, based purely on the investment cost.

Research shows that during the project definition phase, the human and organisational questions are more important and need more attention than technical aspects, and that the analysis of the client's needs is the most important during the earliest stages of the process (Lindkvist, 1996). To reach the best result it is vital that project parties have a means to communicate their requirements to the design team (Smith, 1998).

2. REQUIREMENTS MANAGEMENT AND PERFORMANCE APPROACH

2.1 REQUIREMENTS MANAGEMENT APPROACH

The requirements management process ensures that we know what the customer wants and that the solution also efficiently meets these requirements. There are also other terms to represent the same procedure, like requirements engineering. Requirements management represents straightforward work, which benefits are realized at a later date (Stevens, 1999). The goal is to understand, model and analyse the needs of users and stakeholders' task for validating whether the vision is correct (Sampaio, 2000; Robertson, 2000; Haumer, 2000). The purpose is to establish a complete, consistent and unambiguous requirements specification (Haumer, 2000). Furthermore, it is emphasised that requirements management process is a continuous and concurrently developing procedure during the whole life time of the building.

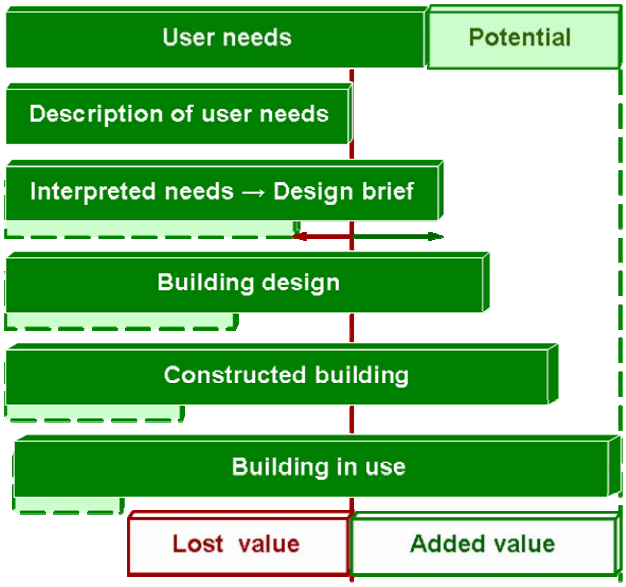

Figure 1 – The value can be added or lost in the process.

The end product of the building construction, the building itself, should fulfil the needs of all stakeholders in a comprehensive manner. In order to attain this, the user requirements need to be captured. As shown in Figure 1, capturing the user needs is critical for maximising the value of the end product. This is the ultimate target of requirements management. Since it is impossible to satisfy all the needs of relevant stakeholders the practical objective of requirements engineering is to merge various user requirements to a realistic but holistic solution. Effective decision support tools to facilitate this are needed.

2.2 PERFORMANCE APPROACH IN THEORY

The performance approach is the practice of thinking and working in terms of ends rather than means (CIB, 1982). It is about describing what the building is expected to do, and not prescribing how it is to be realized (CIB, 1982). Performance specification should include statements about (International Standard, 1984):

1. Performance requirements (expressed as ranges of values and grades) for buildings or their parts under specified conditions and referring to:

a. related user requirements;
b. agents relevant to building performance, such as climate, site conditions, occupancy characteristics or design consequences;

2. Methods of assessing each performance characteristics, including performance over time referring to the requirements and agents, as in 1.

The first step of the performance requirements management is to recognize the users. By user, in this context, we mean relevant stakeholders of the project, such as occupants, owners, managers and financiers of the building (CIB, 1982). It is also vital to know the activities taking place in the building (use of building). The user requirements are often qualitative statements (Gross, 1996). Based on user requirements and the surrounding conditions (climate, existing buildings etc.), the quantitative performance requirements are set (Bjorneboe, 1982). The technical solutions proposed during the design phase are verified against the set performance requirements. If they match, then the proposed technical solution may be approved. In addition to verification during design phase it is also important to verify that the desired performance is reached also during operation (Sneck, 1988). In many cases project definition phase doesn't proceed straightforward and possibility of changes is more than probable. Therefore, change management is carried out simultaneously with verification process. This summary of performance requirements management is outlined in Figure 2.

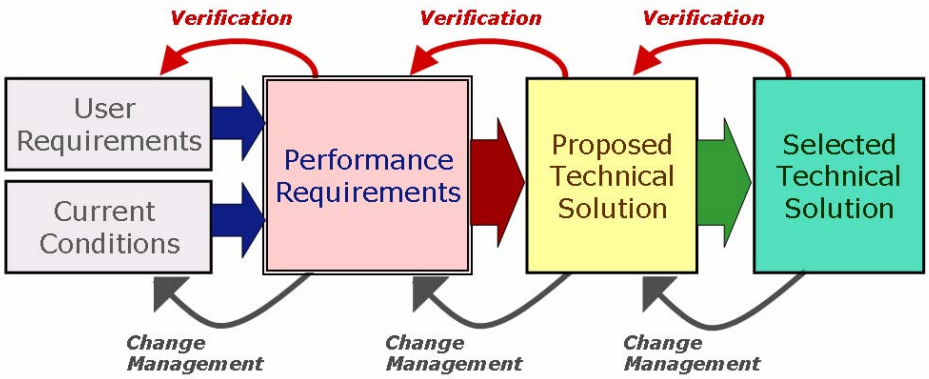

Figure 2 - Performance requirements management process.

In addition to the essential aspects described above, there is also other important information which can help implementing the performance approach in building construction project (Gross, 1996):

1. Commentary - Background and rationale behind the performance requirement.
2. Deemed to satisfy documents - Examples of technical solutions that fulfil the requirement.
3. Quality control manuals - Documents that describe the quality procedures during project.
4. Post-occupancy evaluation - Evaluation of the actual performance of the building providing feedback for future work.

2.3 IMPLEMENTATION BARRIERS

Based on Hens (Hens Hugo, 1996), there are also inherent barriers in implementing the performance concept:

1. Disintegration of design, engineering and construction.
2. The fragmentation of the design and the construction side.
3. The guilds mentality.
4. Too strict market approach of the manufacturing industry.
5. The low level of R&D investments in the construction industry.

With the new performance based procurement practice we are able at least partly remove the first two and possibly third barriers. It is assumed that when: i) architects and engineers exploit their core knowledge to create the overall technical solutions that fulfil the set performance requirements; and ii) construction companies have the opportunity to take long-term responsibility for building parts developed together with architects, engineers and product suppliers; the quality of the end product improves. Based on the authors' experience there are also other major problems of implementing performance approach:

1. The client does not trust the construction companies to provide the quality that is expected unless the technical solutions are described in detail.
2. There are no tools in wide use that would support the implementation of the performance approach.
3. There is not enough knowledge (or understanding) of the performance approach in the construction industry.
4. There is a common concern among practitioners that performance approach requires a lot of effort, uses a lot of time and generates information that is not precise.
5. A lack of agreed quantitative performance criteria for key requirements

2.4 SYSTEMATIC REQUIREMENTS MANAGEMENT IN PERFORMANCE APPROACH PRACTICE

CSIRO Manufacturing and Infrastructure Technology (Australia) and VTT Building and Transport (Finland) are currently developing a software tool called PRISM, for systematic performance requirements management. The PRISM software helps to fulfil customer requirements and expectations by describing the properties of the final product using a hierarchy of performance requirements and different performance 'levels'. The technical solutions can then be designed based on the specified performance requirements. PRISM can also be used to estimate life-cycle costs associated with different scenarios, based on the environmental 'costs' which result from the construction and operation of the building. A screenshot from the PRISM software is shown in Figure 3.

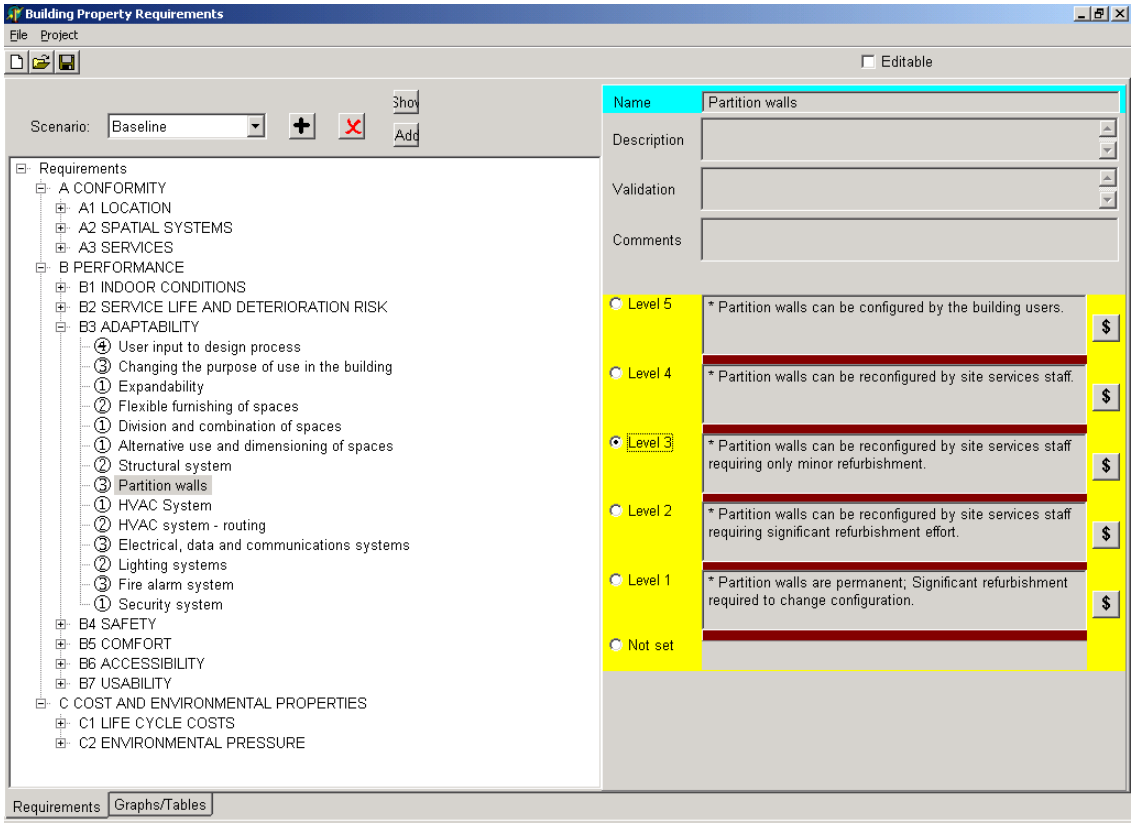

Figure 3 – PRISM software screenshot

Although the English language version of PRISM is still under development, a Finnish language version of the software (EcoProP) has been used in various projects in Finland including office buildings, schools, nurseries, residential developments and shopping centres. One of the companies which has used the tool, is the owner and operator of the vocational education facilities of the Jyvaskyla region (JKKK). The other is a consultant company (Controlteam) that provides project management services for JKKK. They have worked together for several years successfully using the traditional practice: JKKK collects the user requirements for a new building from the educational unit that will use the building. Based on this information, Controlteam manages the design phase and arranges the request for tenders with near-final versions of the design and drawings. Since JKKK is a publicly owned company, the cheapest offer is selected. JKKK people have recognized that this does not lead to the best possible performance and life-cycle cost of the facilities. They feel that the buildings they operate should have a long, well performing life cycle and small operating costs. At the beginning of the project, the JKKK people assisted by Controlteam will set the performance and environmental requirements together with the users. Also the cost effects of the requirements are analysed. Final document containing set performance requirements acts as an enclosure to design brief.

The investment cost analysis is not originally supported by the performance approach. It is not the performance requirement that drives the investment costs but the corresponding technical solution. In this sense the process is iterative. The effect on investment costs for particular technical solutions have to be analysed and if necessary, changes must be made to the performance

requirement. The goal of tool is to give a rough level estimate of the annual cost based on the current performance and environmental requirements and expected life cycle with certain interest rate. Hence it is possible for JKKK to show to the company decision makers that it pays back to select an alternative that might be a bit more expensive at the construction phase. Furthermore, EcoProP has proven to be a valuable aid in implementing the performance approach in Finland because the users are 'forced' to think their objectives through, before jumping into the technical solutions.

PRISM can be used in a team session or one user can set requirements. The use of PRISM in a team session improves the quality of the selected targets and goals of the project since participants challenge each other's ideas and selections. Also the commitment of the project team members increases. The scope of controlling and managing the requirements has to be seen in a broader context, where customers can link all relevant information from their point of view to software managing performance requirements. This means that decisions can for example lean on to company's business plan and relevant other information gathered. This leads to more transparent decisions and combine varied approaches which for example owner, user, designer and architect have.

3. DISCUSSION

PRISM was originally developed, and has been successfully used, in Finland. In development of PRISM, the potential influence of national culture has been explored. In particular, it can affect what attributes of PRISM would be considered most important by its users. Research suggests that national culture can have a strong influence in certain circumstances. Two leading researchers in cross-cultural study both categorize nations in terms of cultural clusters. Fons Trompenaars has suggested that there are four categories of corporate culture that arise from national values (Trompenaars, 1993). He has called these: Family, Guided Missile, Incubator and Eiffel Tower (no prizes for guessing which category he put French companies into – yes that's right: Family). Within these categories he identifies common characteristics, or more specifically, ways of thinking. For example, German corporate culture is said to value logical, analytical and rationally efficient thinking. This attribution of characteristics is broadly consistent with the findings of Geert Hofstede (Hofstede, 1994). Also, it is similar to the anecdotal evidence put forward by requirements management experts in the United States (Hooks, 2001).

Clearly, the systematic approach offered by PRISM is highly compatible with analytical thinking. However, in other national cultures other types of thinking are more valued. For example, it has been suggested that Russians have excellent analysis skills and little tolerance for mistakes. On the other hand, it has also been argued that they do not have such a ready inclination to interact with customers. In this type of cultural setting, the structured approach in which PRISM provides for improved customer interaction can be highly valuable. Japan perhaps offers the perfect implementation environment for PRISM. This is because the Japanese are familiar with advanced methods for analysing customer priorities. As a result, they understand the iterative nature of requirements management. Nevertheless, when Japanese companies work overseas they can find themselves dealing with one-off

clients with less knowledge of the construction process than their Japanese counterparts. In this type of situation, PRISM provides a robust tool which offers a universal and standardised set of procedures. It goes a long way towards filling gaps that can be caused by expert contractors assuming that customers are as familiar with requirements as they are.

Other benefits of PRISM may be valued more in the “Anglo” cultures of Australia, Britain and the United States. It has been reported that this type of culture is characterized by impatience with delays, acceptance of mistakes, the urge to improvise and bias towards assumptions (Hammond, 1998). Clearly, these types of situations make a structured requirements management system all the more important. Yet, they can make implementation quite challenging. Hence, counter actions may be required. For example, users could develop simulations to validate high risk requirements. The requirements engineering phase could be occasionally turned into an improvisation exercise by anticipating the potential future problems (Trompenaars, 1993). Overall, national culture can have an influence on what users value most (or not) about a tool such as PRISM.

4. CONCLUSIONS

Incorporation of different stakeholders needs and aspirations, and setting of clear performance requirements at the earliest possible stage in a construction project leads to a vastly improved end product. The authors’ experience has shown that through intelligent performance requirements management, this can be achieved with less effort, in less time, and with improved precision, than through more traditional approaches.

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