Requirements management tool as a catalyst for communication

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Summary

Construction is a hands-on business. The communication between stakeholders mainly occurs only for resolving unexpectedly appeared problems. Nominal interaction and ineffective information exchange between construction project parties' causes major problems in the concurrent construction projects. This paper describes how improved requirements management and performance approach can help to resolve these problems. The authors have earlier developed a tool, EcoProP, to provide assistance in the project definition phase to develop the design brief. To work as a single entry for project requirement information where the stakeholders can add their requirements and edit dated information, the next generation version will be a web-based tool. This will help to improve the interaction in the construction process by creating a common ground for communication.

Keywords: performance approach, requirements management, construction, communication

1. Introduction

Buildings are intricate products requiring multi-faceted expertise to be designed, constructed, kept up, adapted and refurbished cost-effectively and eco-efficiently to meet the needs of their changing owners and users over a long life span. One challenge is to capture and maintain both expressed and unexpressed requirements of different stakeholders along with the process in order to ensure that what will be achieved corresponds well with what is needed. Other is to be capable to produce what is required. Both can be improved. This paper emphasises the former, counting on its resulting effect to the latter.

Our approach towards requirements management has been to [1]:

- Use the performance approach i.e. to concentrate on what is expected from the building instead of describing it
- Introduce formal tools and procedures to empower decision-making i.e. to methodise focusing to do right things at a right time – without constricting the users' creativity and control over decision.

The core content in both is to support communication within and between different actors involved with the process.

New challenges may lead to compulsion to rethink and question predominant routines. Building-related environmental research has given a rich and expanded view of the relevant technical performance issues [2]. The next generation version of our EcoProP tool, developed to meet the sustainability challenge – to express and verify environmental demands for buildings, is launched as a vehicle to support communication within real estate services in the future market of the built environment.

2. Performance based requirements management

2.1 Requirements management and engineering

The requirements management process ensures that we know what the customer wants and that the solution efficiently meets these requirements. Requirements engineering represents up-front work, for which benefit does not appear until later [3]. Requirements engineers' duty is to understand, model and analyse the needs of users, and stakeholders' task is to validate whether the vision is correct [4, 5, 6]. Requirements engineering purpose is to establish a i) complete ii) consistent and iii) unambiguous requirements specification [6].

The end product of the building construction, the building, should fulfil the needs of all stakeholders in a comprehensive manner. In order to attain this, the user requirements need to be captured. This is the first target of requirements engineering. Since it is impossible to satisfy all needs of all stakeholders for various reasons the second target of requirements engineering is to put the different user requirements together. And the compliance of design with the requirements should be verified constantly during project. When requirements of the various stakeholder contradict, it is difficult to judge whose need is more important than other's. Robertson et.al. [5] suggests that the ranking of stakeholders' opinion is based on the power, interest and proximity of the stakeholder.

General requirements engineering problems are i) communication problems between developers and users ii) lack of a systematic approach iii) need for domain knowledge and iv) changing requirements [7, 8]. Stakeholders often see the requirements effort as a disruption to their work [5]. Part of the requirements are missed or lost at the outset or during design process [9]. Maintenance requirements are missing in concept design phase [10]. There are no effective means to integrating clients' requirements into the design process and ensuring compliance [11]. Many key contributors are identified and included too late in the process [12].

A requirement is a statement identifying capability, physical characteristics, or quality factor that bounds a product or process need for which solution will be pursued [13]. Good requirements are [6, 14, 15, 16, 17, 18, 19]:

- Complete, unambiguous, consistent, feasible, solution neutral, traceable, necessary, requirements are not used for wrong purpose, concise, correct, verifiable.

2.2 Performance approach

Performance approach is concerned with what the building is required to do, and not with describing the technical solutions i.e. how it is constructed [20]. A preliminary study of applying the performance concept was done in Finland, partly based on experiences from the Netherlands. It emphasized that the approach forces the clients to think what is really needed to support their business processes. The main identified potential advantages of the approach are [21]:

- better exploitation of the suppliers' expertise
- design emphasis moves earlier in the process
- communication between stakeholders improves
- competition between different technical solutions based on the same performance specifications is possible.

Also building owners and facility developers can benefit from the performance approach. The ability to link trends in organizational change with building design/quality factors allows decision-makers to determine which buildings are most at risk from failing to support the requirements of tenant businesses [22]. This information can be used for example in the refurbishment project to focus on those performance properties that are most important for the tenant organization. In addition, owner can also direct marketing efforts to the right client sector based on the particular strengths of the building performance.

The performance approach is dual in a sense that first there is a need to identify and quantify two types of constraining sets i) basic and intrinsic aims that the end product is expected to satisfy, ii) restraining general forces and environmental conditions [23]. It is essential to distinguish performance issues between i) design features and ii) management, operation and process issues [24]. Phases of performance requirements management based on Becker [23] are (Figure 1):

1. Translating needs to user requirements
2. Transforming the previous into technical performance requirements and quantitative criteria that do not dictate solution
3. Responding to these requirements during various stages.

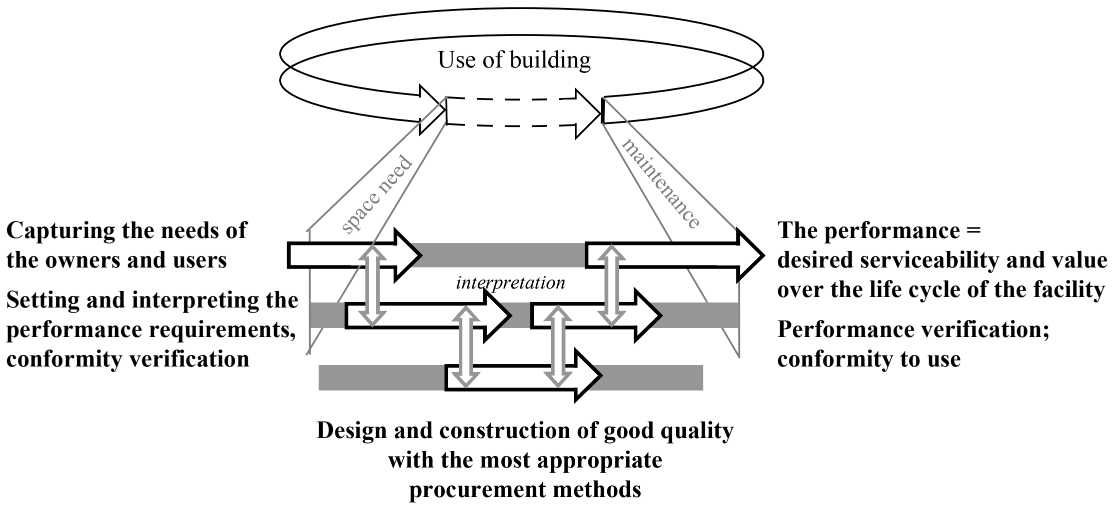


Figure 1 - The performance approach in the building process[1]

The attitudes towards applying performance approach have been positive. General feeling among building owners and users is that it would enhance the quality of the final product by increasing communication and providing incentives for development. One case were the performance approach was partly implemented in a hospital project in Hong Kong is described in Chan [25]. However, the use of performance approach has so far been nominal in building construction. Major barriers of implementing performance approach from the application point of view are the following [23]:

- Lack of tools for some of the decision-making phases in the process
- Lack of common, preferably computerized, design platform.

In addition, the fear of the potential change in the power and responsibility structures may cause some hesitation. Also, the legislation is a common scapegoat when new ideas are introduced.

3. eProP - 2nd generation performance requirements management tool

As described in the previous chapter there are clear indications that a tool that provides support in the decision-making phases of the project is needed. Also the requirements management in the building construction sector has been sufficient. In addition, the communication still causes problems during realization process especially in the form of lost value.

3.1 VTT ProP® Building property classification

The core of eProP tool is an extensive building property classification, VTT ProP ® (Table 1). It is a generic and holistic building performance classification which has been developed in VTT Building and Transport taking into consideration Finnish and international standards, norms and classifications.

Table 1 - VTT ProP® Building property classification

1 CONFORMITY 1.1 Core processes 1.2 Supporting processes	A PERFORMANCE A1 INDOOR CONDITIONS	B COST AND ENVIRONMENTAL PROPERTIES	C BUILDING PROCESS C1 Design C1 Site operations

[1] adapted from illustrations produced by Government Building Agency, the Netherlands

1.3 Corporate image 2 LOCATION 2.1 Site characteristics 2.2 Transportation 2.3 Services 2.4 Impact on immediate surroundings	A1.1 Indoor climate A1.2 Acoustics A1.3 Illumination A2 SERVICE LIFE A2.1 Service life A3 ADAPTABILITY A3.1 Adaptability in design and use A3.2 Space systems and pathways A4 SAFETY A4.1 Structural safety A4.2 Fire safety A4.3 Safety in use A4.4 Intrusion safety A4.5 Natural catastrophes A5 COMFORT A6 ACCESSIBILITY	B1 LIFE-CYCLE COSTS B1.1 Investment costs B1.2 Service costs B1.3 Maintenance costs B1.4 Disposal and value B2 ENVIRONMENTAL IMPACT FROM LAND USE B3 ENVIRONMENTAL IMPACT OF BUILDING B3.1 Embodied environmental impact B3.2 Recycling B3.3 Environmental impact from use of building B3.4 Environmental impact because of users	D OPERATION D1 Usability D2 Maintainability

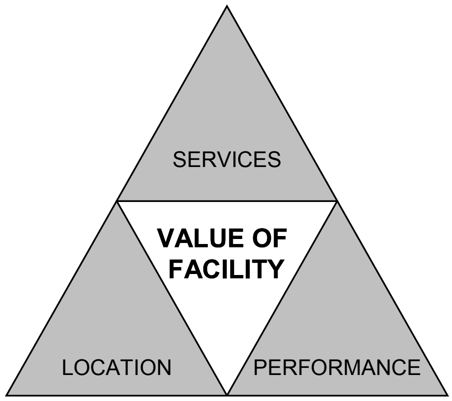
3.2 eProP tool

The tool, eProP, works in www-environment. Users only need to have a standard Internet browser like Netscape Navigator or Internet Explorer. The eProP provides a single point of entry for all requirements information created during the project. Using ASP-technology the tool retrieves and sends information from and to the database based on the selections users does. First the user selects the building type, and eProP creates the relevant property pages to set requirements to. After the user has set requirements to the properties, he/she can collect them to a printable format. The set requirements are also saved to the database so that the requirements can be visited and changed later. The requirements set in the previous projects can be utilized. The requirements that are missing from the database can be added during requirements setting so that they are available when the user sets target for the next project. This enhances learning and innovating process making the application more useful every time it is used. The ideal situation for the requirements setting is sessions where several stakeholders participate. The experiences of the implementations of the 1st generation tool, EcoProP, show that the commitment of stakeholders and the quality of the requirements is the better the more stakeholders share their opinions during requirements setting sessions [26].

Comparing eProP to the requirements of the ultimate requirements management tool, traceability is missing. The tool so far does not provide an easy way to link requirements and design solutions though this is important if something goes wrong in the final product. Also, more verification methods need to be added to provide a quick analysis over the suggested design solutions.

4. Discussion and Conclusions

Our approach emphasises the performance of the building from its clients' perspective as a starting point. An example of tool development and implementation for systematic requirements management is presented. Our experiences from live projects using the described approach have been encouraging. The established practice, however, seems to be slow and reluctant to change everywhere in spite of potential benefits. Is it a feature specific to the sector or a general barrier for change? There seems to be suspicion among the professionals against new tasks, responsibilities and risks. Human factors must be considered together with technical aspects. Human-computer interaction with strong end user control needs to be supported.



Another key issue is where the added value is found in the future. And who will be the actors that provide it. In the real estate sector the importance of the location of the facility must be recognised. Our tools up to the present emphasise managing the performance of the facility. Its interrelation with the value for investor still needs further clarification. What seem to be clear is that even these two aspects are not enough. The services in addition form the third pole in relation with a brand that can add value to owners, users and the society.

Figure 2 - The value triangle of the facility

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