Third International World of Construction Project Management Conference 2010
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LIFE CYCLE COSTING IN CONSTRUCTION PROJECTS – A CASE STUDY OF A MUNICIPAL CONSTRUCTION CLIENT ORGANISATION

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Abstract. *Demands for sustainable and long-term decision making in the construction project management process is increasing. However, a wider use of decision support methods, such as LCC (Life Cycle Costing) seems still to be missing within project management practice. Considering that project managers in construction have key roles for a broader application of sustainable building it is interesting to investigate the interrelation between project management practice and LCC thinking. This issue is studied in a research project that goes beyond the prevailing technocratic view of LCC research by focusing on practices, praxis and social interaction as acts of organizing when developing technology, tools and concepts for sustainable building. The case study presented in this paper is a part of this project and investigates the development process of a customized LCC tool within a municipal construction client organisation. Tentative results indicate that there is a fragmented perception among project managers what LCC incorporates and which impact the use of LCC has and might have on the construction process. This, in turn, influences the actions of the construction project managers.*

Keywords: Investment process, decision making, Life Cycle Costing, project practice, Sweden

1 INTRODUCTION

Life Cycle Costing (LCC) is often brought forward as a potential facilitator[1-2] and enhancer of competitiveness in construction industry when sustainable building is discussed[3]. This paper is based on a case study done within a research project that investigates how the business concept of LCC is adopted and acted upon by decision makers within building owners, clients, and developer organisations, i.e. actors in position to act for an energy efficient and sustainable construction process. The study fills a gap within sustainable building and investment decision research by adding a social practice perspective to the prevailing technocratic perspective. As such the study focuses on values and norms, and agency and human interaction. Aspects that often are set forward as crucial for sustainable development in the building industry but seldom examined thoroughly. The research project thus goes beyond tool production under the assumption that a change towards a more

sustainable building industry needs less focus on tool production and more on understanding the management process and the interactional roles tools play in this process. This perspective takes into account that individuals when making decisions use cognitive skills and preconceptions which are influenced by social and organizational aspects. Drawing on institutional and descriptive decision making theories the research project investigates acts of organising that concern how the concept of LCC thinking enters the business agenda and how LCC is embedded into decision making processes and management practice of project managers.

The aim of the case study is to define and further develop the research field regarding the use of LCC in construction projects. This is done by examining the development process of a customized LCC tool within a municipal construction client organization.

2 BACKGROUND AND THEORETICAL OVERVIEW

A lack of demand for and supply of sustainable buildings have been noticed by both policy makers[4] and by industry[5]. In order to strengthen the demand for sustainable buildings a number of organizational and behavioral measures have been suggested. Inter-organisational measures on an institutional level concerns enhanced stakeholder influence[6], deepened cooperative actions such as partnering[7], and stronger leadership among public authorities (such as municipalities) and clients[8]. On an intra-organizational level suggestions concern improved management of technology[9], and changed values and mindsets combined with a strengthened willingness to take a comprehensive responsibility for societal and environmental issues[10]. For a wider adoption of sustainable building and diffusion of ideas, such as LCC, it is also suggested that management must support sustainable concepts and communicate them so that organisational members perceive them as motivated[11]. Furthermore they need to be perceived as legitimate[12] and connected with a competitive advantage[13]. An advantage that preferably is linked with financial performance showing a direction of action and result[14]. To improve decision making practice it is suggested that environmental and financial benefits from sustainable building not only is acknowledged but also communicated through channels that are adapted to the communicative culture in a specific setting[15-16]. However, although suggested as important, few studies have profoundly investigated management practices, praxis and social interaction as acts of organizing when developing technology, tools and concepts for sustainable building[17]. A perspective that acknowledges that these acts in turn create institutions, which provide patterns for behavioural norms and values within a specific setting[18]. All of the above affect and influence the project manager and frame the action and choices that are feasible.

In, for example, housing organizations those who make business-strategic decisions, including those on sustainability, are seldom the same people as those who possess environmental expertise[19]. While the members of one group represent environmental interests, the members of other groups represent financial, marketing or technical interests. These different groups represent disparate mindsets where one group may be guided by short-term prerogatives (e.g., financial results) and another is guided by long-term prerogatives.

One suggested way to increase the interest and demand for sustainable buildings is through

the description, assessment and communication of financial advantages and reduced risks in comparison with conventional buildings. By translating and integrating the concept of sustainable development into areas of responsibility and action it would more easily enter the business agenda[4]. Here the business concept of LCC has been suggested as a facilitator and breaker of communicative barriers between different organizational groups[1-2]. LCC expands the system boundaries of traditional investment cost calculus to also include life cycle costs. The development of LCC as a decision support tool for the building industry that considers sustainability dimensions has been ongoing for at least a decade and today there is a rich flora of LCC models on the "market"[20-21]. However, the success in making it attractive and 'understandable' for a wider adoption in the building industry is emerging but still limited[22].

3 RESEARCH APPROACH AND METHOD

The study presented in this paper is the first study within a larger research project with an overall objective to stimulate LCC thinking and environmental concern and responsibility in construction projects. This involves development of investment decision making and communication practices for construction projects. It also involves the improvement of leadership/agency among client organisations (municipal and private), both as authorities and clients, for sustainable buildings. These objectives are key concerns for the implementation of the results from the research project.

To fulfill its objectives the research project adopts an explorative approach, applying a research process that is developed through an iterative and dynamic process influenced by empirical findings, existing theory, previous research and continuous dialogues with actors representing research and industrial communities. Close collaboration with companies and organisations together with a seminar and interview centered approach, facilitate a continuous dialogue between researchers and the industry, which in turn influence values and norms and stimulate LCC thinking. In total seven companies are involved in the whole research project. These are chosen under the principle that they represent a variety of stakeholders for sustainable of buildings, such as property owners (municipal and private), developers and energy experts.

The initial case study presented in this paper involves elements of action research where the researchers' work in close collaboration with a municipal construction client organization during the implementation phase of an LCC model. The research objective is to stimulate and support development in the studied organizations, but also to visualise and raise knowledge and understanding concerning biases and consequences from decisions made.

The initial case study was performed at a municipal construction client organization, the Gothenburg Premises Office (GPO). The case study aimed to map the process when an LCC-tool was developed and implemented. It also aimed to identify how the process had impact on the decision making process regarding the choice to either renovate the old buildings or demolish and rebuild. During spring 2010, interviews were held with the persons most involved in the development process of the LCC-tool. In total nine persons were interviewed. The interviews were semi-structured, focusing on the development process and its outcome. They were 1-2 hours long, recorded and transcribed verbatim. The interviews were held in the

interviewees' offices or in conference rooms at GPO's office. After the interviews, follow up discussions regarding interview results (by telephone, email and/or in person) were held with seven of the nine interviewees. During the same period, the researcher spent three days a week for almost two months at the GPO office, studying internal documents such as meeting protocols, project management systems and other guiding documents. The researcher also attended formal meetings and took part of informal discussions at the office.

4 RESULTS

4.1 About the municipal construction client

The Gothenburg Premises Office, GPO, manages all municipal investment projects concerning premises for schools, pre-schools, housing for elderly and housing for people with special needs. Their task as a municipal actor is to make sure that the capital expenditures in facility investments are as effective as possible. Investment projects include new construction, renovating, rebuilding and extensions. Due to a recognition that a large share of the municipal budget covered costs for premises on behalf of operative activities within the premises the municipal board soughed a better way to control how the capital expenditures were managed. As response GPO was founded in 1999. The organization has since start grown from 4 to 37 employees and is currently divided into three divisions; project management, strategic facility planning and a department dealing with the municipality's rental contracts. In 2010, the investment budget was 710 MSEK (71 MEuro), distributed on approximately 40-50 projects annually.

4.2 The investment context and LCC

A large numbers of pre-school buildings in Gothenburg have reached their physical lifespan, and further renovation of them is questioned. Many pre-schools originate from 1960-ies and 1970-ties, a period when the pre-school activities expanded rapidly in Sweden and Gothenburg. This was also a period when energy prices where low, and therefore energy efficiency was not yet in focus. Furthermore, the numbers of children in day-care groups were at that time approximately 25% less than today. New legislation regarding accessibility and indoor air quality also drives a need for more modern buildings. More, when the pre-school buildings were built, the predicted lifespan was ten years, and the majority has now been in operation for more than 40 years. That is, current buildings are considered as outdated.

During spring 2008, project proposals regarding renovations of two old pre-schools and one old house for elderly were questioned to be too costly. This led to a discussion within GPO concerning cost efficiency when renovating old buildings. The opportunities of using LCC to support investment decisions came up. Hitherto GPO had mainly focused on investment costs when making decisions to renovate. Three important drivers for initiating the use of LCC as a mean for cost efficiency were; 1) several premises with a similar need for costly renovations had come into question and others were expected to follow, 2) two years

earlier GPO had received critique from the city council concerning high investment costs, 3) one of the project managers had recently been working with LCC with another employer and was therefore familiar with it. In addition, the head of GPO also wanted to send the message to the city council that their directives regarding energy efficiency and sustainability caused higher investment costs and was hoping to do this through the means of LCC calculations.

After a discussion within GPO the head manager assigned a small internal group to explore and evaluate the benefits of using an LCC analysis in complement to the traditionally used decision support methods. The aim was that a detailed LCC tool would be developed for the project managers. The initial task was to perform detailed LCC-calculations on two pre-school buildings. The detailed calculations were, however, soon given lower priority and postponed indefinitely. This was due to that the complexity in the calculations was perceived as unmotivated and the required cost information about operation and maintenance was not available. The small group was therefore expanded and a large part of the project management division became involved in the continuing discussions. The focus also shifted from the intended detailed tool towards finding a quick and easy way to compare two alternatives; rebuild or replace old premises. An excel-based LCC- was developed within the group. The model was tested on 15 pre-schools during the following year, resulting in increased knowledge about general considerations regarding renovating old buildings but also continuous adjustments of the LCC model.

The project manager and project coordinator as well as the strategic planning division at GPO now occasionally use the excel-based model when they, during the pre-study phase of projects, choose between renovating and rebuilding. In the strategic division, a modified LCC-model is used occasionally for two purposes; 1) to assess the cost-efficiency of building new, renovation or renting in order to satisfy a certain need, and then communicate the results with the district administrators, and 2) for finding outsets for future discussions regarding issues related to what type of premises to invest in.

4.3 Experiences of the development process and LCC

The interviewees were asked about the results of the development process and their current use of the LCC-tool. It was not clear to the majority of interviewees that the discussions and development of LCC-tool can be categorized as a development process, even less as a development project. The excel model itself was not mentioned as an important result of the process by any of the interviewees, instead the learning process was emphasized. A main result of the process is, according to the interviewees, increased certainty in arguments when questioning large renovation projects, due to the experiences from the calculations performed. A majority of interviewees said they already had a gut-feeling of the cost inefficiency of renovations of building that had passed the technical lifespan, but that they previously lacked a structured way to evaluate the alternatives.

Furthermore, performing LCC-calculations on several projects led to increased knowledge about the buildings also for the operation and maintenance staff. According to two of the interviewees, the maintenance department was enforced to compile specific cost information

about operation and maintenance for the existing buildings. This information had not been compiled, structured and made available for GPO, in a similar way before.

4.4 Applying LCC in a municipal organization

The process of developing and implementing an excel-based LCC-model started off as discussions at GPO about cost-inefficiency of renovating old buildings and how to convince the municipal politicians to approve higher investment costs with prospect of reduced costs for operation and maintenance. The process resulted in;

a) increased knowledge about the existing building stock and increased certainty when questioning costly renovations of old buildings,

b) integration of life cycle considerations in the decision making process of investment projects. Even though actual LCC-calculations were not performed for each specific project, the head of the project management department and project coordinator now perceive that they got an experience based knowledge regarding when and why LCC-calculations can support decisions on building new energy efficient buildings,

c) sporadic use of results from LCC-calculations in communication with customers in strategic planning of premises and for internal decisions about which alternatives to propose to local authorities.

The study shows that a widely spread use of the LCC-tool is not the main result from applying LCC in the decision making process regarding investment projects in this municipal organization, but rather a gained experience and understanding regarding to what extent it is cost efficient to renovate old premises. The study shows that a learning process took place in GPO resulting in all project managers becoming familiar with the reasoning, albeit not experts, of LCC. After performing a number of calculations, the organization perceive that they now only have random need of the tool, since the life cycle perspective in their opinion has been integrated in the organisation’s decision making practice and the project managers’ work practice.

5 DISCUSSION

The research project aim to understand management processes for a sustainable construction process, in particular how actors behave and the interactional role of tools rather than the tools in themselves. A benefit from the initial case study at GPO is that a complete process concerning development and implementation of an LCC-tool could be studied. The study has enabled us to identify phenomenon that emerges during a development process. The development of LCC at GPO started as a project aiming at delivering a tool to be used in practice in projects. However, rather than a tool LCC became a concept used when approaching investment projects. One could say that the tool moved from use-in-project to

influence-on-project. The development process shifted from tool development to creating a conceptual approach with purpose to communicate between and affect various parties' (eg. project management, city council, strategic planners) reasoning concerning whether to renovate or rebuild. One could also ask if it ever became a tool or if the development actually rerouted to become a concept framework guiding how decision should be grounded. Looking at it from this viewpoint one could say that the tool production resulted in a concept embedded in the organizational practice of GPO. It has become an approach of how to manage investment projects that is embedded in organizational culture and behavior. As such it became more powerful than as merely a tool that could be used or not dependent on the decision makers' choice. The challenge in this case is to articulate and clarify the need of exchanging knowledge concerning the approach and further develop it.

If we look at the decision making and action among the group of project managers running construction projects it is clear that they initially anticipated a tool. However, the tool was only presented in an introductory way and not packaged in such a way that the project managers could have it ready for everyday use. Instead the analysis method is currently used only by the head of the project management department and the project coordinator when evaluating possible alternatives based on feasibility studies and/or technical briefs. The project managers however have to frame their projects according to the concept of the tool; i.e. evaluating possible options by the logic of life cycle costing.

6 CONCLUSION AND FURTHER RESEARCH

The development process studied in the case study give rise to a number of questions which fit in well with the overall aim of the research project. There are many more aspects to go deeper into and investigate. The case-study of GPO opens up for studies beyond tool production that aim to understand behavior and practices, and it has become all clear that the process from tool development to implementation not always is a straightforward one. From a research perspective the study opens up new issues and contributes to understanding of organizational behavior and development of tools and methods.

A conclusion drawn from the initial case study is that there is room for other approaches than tool-oriented ones. Interestingly, the aim to produce tools can in itself be a tool, or approach, to achieve the change needed in the organization. Another conclusion regarding the decision making processes is that, as far as can be stated based on the case-study, the LCC approach within GPO has been considered a successful one from an external viewpoint.

There are also a large number of unanswered questions and new ones that will be carried forward in the on-going research project. In addition to the challenges concerning development of knowledge mentioned above other issues of relevance are:

- How does management routines and procedures for decision making interact with the

long term perspective of LCC?
- What role does managerial structures and strategies play in the decision making process for sustainable renovation and the consideration of LCC?
- How does LCC interrelate with stakeholder demands, legitimacy, norms and values, vulnerability, competitive advantage, technology and knowledge?

The above issues are but a few of the questions raised as a result of interviews and they point to the need for further work within this area. To broadly influence project managers to adopt a long term decision making practice also needs a governance mechanism that promotes that perspective. Society, to a large extent, provides that today, but it still has to find its way into construction projects. One reason for this is inadequate financing models which do not fully take these issues into consideration. As long term perspectives often seems more costly from a short term horizon also financing and economical models needs to be changed. There is therefore a real challenge for the project managers in construction, whether on the client side or the contractor side, to understand the social and organizational settings they find themselves in to better understand the outset for decision making regarding energy efficiency and sustainability – it is not only a technical matter.

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