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EMPLOYEES IN THE DUAL ROLE OF EMPLOYEE AND END-USER – A NEW SOURCE OF INNOVATION FOR COMPANIES?

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ABSTRACT

This study describes a process in which a company involves an employee as the end-user in the innovation activities of the company. While it has been recognised that end-users sometimes innovate and that user/producer relations are important for product development, little is known about employees in the dual role of end-user and employee. This paper argues that companies can benefit from using employees as end-users in their innovation activities. This research is based on a qualitative case study of a major manufacturer of building materials. The study draws on user-driven innovation theories and innovation theories in general. This case indicates that it has been an advantage to involve the employee as a user in the innovation activities of the company as this gives the company access first of all to a new context – the user's context – which is detached from the traditional bindings of the company, and secondly to new knowledge that is based on the user's generation of knowledge and lessons learnt in the use situation. The investigation shows that employees as end-users can contribute to companies' innovation activities concerning the product, the organisation and the marketing. However, in order to benefit from this new type of collaboration, the company may consider how this process influences the practices of both the company and the employees, and attention must be paid to the dilemmas resulting from the process.

1. INTRODUCTION

Buildings consist of many products integrated in complex product systems. Furthermore buildings are produced in complex design and production systems (Gann and Salter, 2000). There is a growing issue of criticism and lack of confidence in the construction industry concerning performance, supply and product quality. Concurrently, the sector faces increasing demands from the building authorities, latest in the shape of the new requirements to energy performance as implemented in the Danish Building Regulations.

Innovation has for a long time been seen as part of the solution to the problems of the construction sector. In recent years, the Danish government as well as other policy makers in Europe has prioritized the topic of user-driven innovation and put it on top of the innovation policy agenda. User-driven innovation has been introduced as a new source for companies' innovation and as a strategy to comply with growing global competition. The strategy of user-driven innovation focuses on developing competences and structures in order to capture inspiration etc. from users. The aim is to understand not only the stated, but also tacit consumer needs and focus more on developing solutions to meet consumer needs. While the prominent policy and research position of lead-user driven innovation focuses on innovation taken place outside the company, much less attention has been paid to the employees in the dual role of end-user and employee.

Seen from the position of manufacturers of building materials, the most important target groups have traditionally been the architects and consultants, while communication with end-users has been rather limited. This study explores how manufacturers can involve user perspectives in new ways to stimulate innovation. More specifically, this case study focuses on the design, configuration and building process of a single-family house and the employee in the dual role of employee and end-user.

2. STATE-OF-THE-ART REVIEW

2.1 Types of innovation

Innovation is generally considered a way to increase productivity in the construction industry (Barrett and Sexton, 2006). In recent years, services have emerged as a growing innovation area together with physical products. Services include 'financial deal structuring, planning and design, specialist consultancy, customer support and training, supply-chain coordination, production and risk management' (Gann and Salter, 2000:962). Consequently, the third edition of the Oslo Manual (OECD, 2005) describes four types of innovation: product, process, organisation and marketing. Further, it is stated that innovation within one area influences other areas and in that sense innovation will often occur in more than one area.

2.2 Innovation process

There has been an ongoing theoretical development of the perception of innovation, where the aim has been to address and define the departure for innovation and to understand the innovation process itself. Jones and Saad (2003) describe the development of the conceptual framework for innovation as a progressive process from a single- to a multiple-factor analysis. Single-factor analyses are analyses with focus on whether innovation is driven by technology push with focus on R&D and with very little attention to users or whether innovation is driven by the perception of demands also known as Need-Pull. The interplay between companies and surroundings is now in focus and more factors have been included. Social, cultural and institutional factors have been assigned an explanatory value for the development of the innovation process and the internal environment of the company has been assigned an influential role. In this way interaction and feedback processes between companies and their surroundings have become important for the perception of the innovation process and focus has been put on their significances for development and adaptation by companies and surroundings.

Jones and Saad (2003:146) point to the fact that today concepts are characteristic of reflecting 'Innovation as a coupling and matching activity marked by a multi-factor process which requires high levels of interaction and integration at intra and inter-organisation levels'. Common for the developed perception of innovation is that a boundary exists between the company and its surrounding. We can almost talk about the existence of an inherent dichotomy in the discussion of innovation. A central theoretical question is whether there is a position on this boundary and whether this departure can give rise to new implications for the innovation process?

2.3 Lead users

Within the innovation management theory, von Hippel has introduced the idea of lead-users. The central actors in this perspective are the users and the manufacturers and the focus is on their interplay in the innovation process. Von Hippel (2005:3) defines users as: 'firms or individual consumers that expect to benefit from *using* a product or service'. In this sense 'users' mean to existing users. In contrast manufacturers are defined as: 'manufacturers that expect to benefit from *selling* a product or a service' (von Hippel, 2005:3). The motivation of the studies can be found in the assumption that traditional product developments can no longer satisfy users' needs. Furthermore products often do not match needs and users have to compromise if they buy the products. On the other hand this is what motivates the users to innovate.

A central driver in user-driven innovation is the users' and the manufacturers' asymmetric knowledge. Von Hippel (2005:8) points out: 'Product developers need two types of information in order to succeed at their work: need and context-of-use information (generated by users) and generic solution information (often initially generated by manufacturers specialising in a particular type of solution'. Users tend to

be experts on knowledge about needs and context-of-use information, while the product developers tend to be experts on generic solution information. So the challenge for management is to find methods to bring these two knowledge bases together. Von Hippel (1986:791) defines lead users as: 'Lead users are users whose present strong needs will become general in a marketplace months or years in the future. Since lead users are familiar with conditions which lie in the future for most others, they can serve as a need-forecasting laboratory for marketing research. Moreover, since lead users often attempt to fill the need they experience, they can provide new product concept and design data as well.'

In this perspective, lead users are very important users and much attention has been paid to identify lead users and to find out under what circumstances companies and lead users can benefit from each other. The difference between this perspective and the perspective in this research is that the employee plays both roles and the asymmetric knowledge of this dual role is integrated in one actor.

2.4 Co-construction of users

Haugbølle and Forman (2006) suggest that users of single-family houses should be considered as *multi-centred users*. That is, users of single-family houses hold multiple perspectives or focal points that are time-dependent in two ways since they are coupled to the life-cycle of the building as well as the life-cycle of the actor. However, from a functional point of view the one and same actor has to deal with at least three different roles rolled into one: that of client, owner and customer.

First, as a client the user has to deal with not only the erection of the building but also continuous maintenance, repair work and re-building – some of which is even done as do-it-yourself (DIY) activities. Second, as an owner (or owner in the making) the user will have to consider issues related to financing often through mortgage loans, taxation schemes, and the potential sale of the building sometime in the future. As Ozaki (2003) has pointed out in his study of home-builders in UK, the users already consider e.g. the selling price of a house when they purchase it. Clearly, the issue of financing is also a very important precondition for users to become users at all. In other words, if you cannot afford a house or the mortgage institution is not willing to lend you the necessary sum of money you will be deemed a non-user. Third, as a customer the user will address issues of identity, security, neighbourliness etc. In a study of families living in older villas and in standard houses since the 1970s, Bech Danielsen and Gram-Hanssen (2004) demonstrated how residential neighbourhoods are associated with different symbolic values and how these values influence the choice of home.

2.5 Innovation in communities and configuration

Jeppesen and Molin (2003) have explored a process in which firms rely on external consumer community for innovation. They describe what commercial firms can do to motivate and capture user-driven innovation and its related benefits. They suggest that learning and innovation efforts, from which a firm may benefit, need not necessarily be located within the organisation, but may well reside in the consumer environment. They point out that consumer innovation can be structured, motivated, and partly organised by a commercial firm that organises the infrastructure for consumers' interactive learning in a public online domain. Thus the company can organise and support consumer communities where members help each other, formulate problems and make innovations.

In this paper, we would like to draw the attention not to a community of end-users but to a community of manufacturers of building material. The difference from Jeppesen and Molin (2003) is that the interplay is between an employee and a network of suppliers and focus is on how a company can borrow and use this network.

Jeppesen and Molin (2003) point to the connection between a high level of complexity in adaptation/configuration of a product for the user in the use-situation and the benefits for the company if the user himself is active in this process, as it mean that a part of the company's work with adaptation to the use-situation can be done by the user himself. Similarly this issue about configuration can be seen in connection with the configuration of a building, but in this situation it is not a single product from a single company that has to be configured but different building-components from a network of different companies.

2.6 Marketing concept as a mediation junction

Schot and de la Bruheze (2003) try to reconnect production and consumption. They focus on the process between production (supply) and consumption (demand). They see this process as a mediation process characterised by mutual articulation and alignment of product characteristics and user requirements. They involve not only the user but also spokespersons for the users in the articulation of user requirements. Mediators are actors who mediate between demand and supply. Schot and de la Bruheze (2003:234) define a mediation junction as 'the place at which consumers, mediators, and producers meet to negotiate, articulate, and align specific technical choices and user needs'. In this paper the development of a new marketing concept can be described as a mediation junction, as they tested new products, developed new building solutions and promoted the products in public space.

Schot and de la Bruheze (2003:245) suggest that an out-house mediation junction creates more favourable conditions than in-house mediation junction: 'out-house mediation junctions seem to provide better opportunities for more symmetry, and in that sense they have more potential for clarifying confrontations, assumptions, expectations, and scripts of the actors involved'. It is a question whether there is a position on the boundary between in-house and out-house for mediation junction and the implications for the mediation process. In the case of the employee in the double role of employee and end-user functions as a mediator on the boundary between in-house and out-house.

3. RESEARCH PROJECT

3.1 Project description and objectives

The overall purpose of this study is to explore user-driven innovation in the construction sector, and in this project the specific focus is on the end-user in the dual role of client and employee of the manufacturer.

The objectives are:

- To explore the end-user in the dual role of client and employee and the conditions under which such innovation processes can take place.
- Advantages and disadvantages of involving employees as end-users.
- To explore the consequences of user perspectives for manufacturers of building material.

3.2 Research methodology

The research is based on a case study. Case studies are relevant in situations where there is a need for exploring phenomena as they appear in reality. The case study is a research method where we go in depth with a single or few cases, and draw out the specifics, which can have a more general character and interest. By choosing the case method, the choice of case becomes an important methodology question. Flyvbjerg (1991) defines different strategies to select cases:

1. The paradigmatic case is chosen when the wish is that the case can work as a metaphor or establish a new way of dealing with issue dealt with in this study.
2. Extreme and deviant cases are cases where you look for example for the specifically problematic or the specifically successful.
3. A critical case concerns a superior aspect and makes it possible to generalise within this superior aspect.
4. Maximal variation cases are cases where we involve various different cases to examine the problem and where the cases are different concerning one dimension.

These strategies cannot be considered as separate strategies, but can be used to specify limits and possibilities of the case you are working with. For this research, especially strategy number 1 is relevant where focus is on the possibilities for using the case as a metaphor for the manufacturers' use of their employees in the dual role of employee and user in their innovation activities and the implications for the manufacturers' business strategies.

Rockwool A/S has many features in common with other suppliers of materials to the building sector. They are often large companies with their own product-development departments and marketing departments. They supply components to the building sector, and their most important target groups are usually architects, consultants, contractors and DIY people. That is why their contact to the ordinary end-users is often missing. In this sense, the case is paradigmatic and the experience gained from the case can be generalised concerning other similar manufacturers.

In this case, the employee represents a couple of users: The professional, the client, the customer and the owner. He was a professional user in the sense that he is a trained carpenter and a building engineer working as a consultant at Rockwool. Besides being a carpenter and building engineer, the employee has a wide knowledge of insulation and Rockwool's products via his job at Rockwool. He was a client, owner and customer in the sense that he was building the house for himself and his family. It is not exceptional in the construction sector that employees have both an education as a craftsman and a further and higher education such as for example building technician, architect or engineer. Further, it is not unusual that employees in the construction sector have or have had influence on the design and building of their own home. Therefore you can find the employee of this case again in many companies in the building sector. The critical aspect in the case is that the company actually chooses to involve the employee in the dual role in the company's innovation work. It must be expected that when it can happen here, it can also happen with other manufacturers, and this makes the dual role of employee/user especially interesting for the building sector compared with other industries.

This case focuses on an employee, who is also an end-user. Whether the same result could be reached by cooperating with external end-users in a similar project was not examined and should be examined. But it is evident that there is a relationship of trust between the company and the employee, which must be assumed to have an important relevance.

The research design of this study combines the reading of documents with qualitative interviews. Firstly general information like annual reports has formed the background of the case. Secondly the project has been followed at the company homepage during the building process, and written documents relating to the project have been analysed. Thirdly the employee who build his own house and an employee from the marketing department responsible for the communication through the homepage were interviewed. The final case report was discussed with Rockwool to validate the data.

4. RESEARCH RESULTS AND INDUSTRIAL IMPACT: CASE

4.1 Introduction

In 2006, the Danish Building Regulations introduced new requirements to the energy performance of buildings with the aim of reducing their energy consumption. Among other changes in the Danish Building Regulations (BR06) were the requirement to the tightness of new buildings, and a classification of low energy buildings in two classes (Aggerholm and Grau 2007:10). These new requirements have caused uncertainty among construction professionals on how to meet the new requirements in practice.

In 2007, an employee at Rockwool Denmark built his own house. The employee's ambition was to build a house for his family. He decided to build a low-energy house belonging to energy class 1 due the challenge of building one and the money he could save by reducing energy consumption. The employee designed the house himself. Based on his competencies as both a carpenter and a building engineer, he was capable of developing designs and practical solutions. But the challenge was to find solutions that made the house tight so that the house complied with the requirements in BR06. During the design phase, the employee chose the suppliers he wanted to use and used them as dialogue-partners. Apart from an architect and the suppliers, no other professionals were involved. As a carpenter, the employee could do much of the workmanship himself, which he did. What he could not do himself, he hired craftsmen to do.

As client, owner and customer, the employee visualised demands and wishes to the product and building process; aspects that would not have been visualised in traditionally developing projects. This was expressed for example through the employee's principle of using known methods and techniques in order to reduce uncertainty. It also became visible in the employee's interpretation of the situation where he wondered why there is not more information about the actual possibilities, and concluded that the advice you can get from consultants and suppliers are at best fragmentary and more rooted in the consultants' and suppliers' own needs than in the users' need. This made him identify the users' need for a more connected whole concerning information and more knowledge about the relations of the products.

Just prior to the employee's building project, Rockwool had developed an air tightness programme consisting of different products that can be used in the building process to ensure tightness of a building. The tightness programme was developed to meet the new requirements in BR06.

As the employee began to focus on tightness and energy in his building project, the product manager at Rockwool saw a possibility for testing the tightness programme in practise. Furthermore, Rockwool saw in the employee's project an opportunity of getting into contact with the users in a new and closer way. By following the project at Rockwool's homepage and describing the process as an ongoing story, they could give some practical instructions concerning the problems that occur when you build and have to integrate considerations of energy performance. This was new for many actors and received widespread attention. Rockwool therefore saw a great need for further development of solutions and information about the issue.

4.2 Process

The central actors in the building process are the employee, the suppliers and craftsmen. During the construction process the employee and the suppliers developed different practical technical building solutions of how the construction could be executed to ensure air tightness. And a subsequent test showed that the solutions were valid as the house was tight. The employee chose all the suppliers and craftsmen. When the employee had chosen the suppliers, he then told Rockwool, and afterwards Rockwool contacted the suppliers to ask them to prepare descriptions for use on the homepage. In this way Rockwool could 'borrow' the supply network of the employee. Concerning Rockwool's

development of the homepage, the product manager and employees from the marketing division participated. The product manager was responsible for coordinating the product aspects concerning the homepage, including contact to the suppliers, while the employees from the marketing division were responsible for the rest.

When it was decided that the project should be followed and described on Rockwool's homepage, the suppliers became very interested in participating in the project. The perspective shifted from just being an ordinary sales-situation to being a possibility of being participants in a public story, inscribed in a concept for a low-energy house, and a place on Rockwool's homepage. A place on Rockwool's homepage represents more than just free advertisement, and should be understood symbolically as a kind of network alliance between Rockwool and the suppliers, where the value is connected by trust, quality etc.

As the project was connected with Rockwool, a challenge emerged around Rockwool's relations with suppliers in general and how Rockwool could avoid favouring some over others. Rockwool cooperates with many suppliers and usually do not favour one over the others. To prevent favouring specific suppliers, the communication of the case has stressed that choices of suppliers are made by the employee, not Rockwool. Rockwool has not clarified how this dilemma can be solved in the future about on one hand the wish to participate in projects with other suppliers and on the other hand to treat all suppliers the same.

4.3 Innovation

In the present case the most important areas of innovation concerns a combined product and marketing innovation. It is also characteristic of the case that the project shows a lot of small single innovations that are woven into each other to form a technical, social and organisational reality.

Viewed from a product perspective, first the tightness programme was tested in real life in the building process and the programme demonstrated its functionality as the house built passed the tightness test required by BR06. Concurrently, the employee developed new technical solutions to tightness of houses through the building process. In this sense, the tightness programme had descriptions of use added that were anchored in use situations. Second, bringing the air tightness programme of Rockwool together with components of a number of other manufacturers created a cohesive concept of low-energy houses. At present, low-energy houses are not very common in Denmark. However, to ensure overview of the complex concept, each of the suppliers was asked to write informatively about the specific problem area at which their product was targeted and the solutions provided by the products. By giving the suppliers space on the homepage, the actor network becomes visible. By linking the homepages you also link information, and the user needs linked information in a complex system, as a guided way of finding his way around the homepages.

Viewed from an organisational perspective, the project has indicated the possibility of using employees in the dual role of employee and user in the innovation activities of a company. For the company it is an opportunity to combine professional skills and user perspectives in the same activity.

Viewed from a marketing perspective, the project resulted in a new marketing method in which the testing of new products, development of new technical building solutions and promotion of the products are integrated processes that take place in a public space on Rockwool's homepage. During the building process, newsletters have been published with descriptions of the different phases in the building project, the different situations of choice and problems and solutions have been highlighted in the continuing story. With this communication method Rockwool has both reached their traditional target groups (architects, consultants, contractors and 'do-it-yourself' (DIY) users) in new ways and also a new target group that they have identified as 'do it yourself – do it for me' users.

This new target group consists of consumers who want to have a more pronounced influence on their own buildings but do not want to construct the buildings themselves. The target group is characterised by being critical of the construction industry and that is one of the reasons why they want to ensure the quality of their buildings by qualifying themselves to be better by being in dialogue with the actors in the construction industry.

5. CONCLUSIONS

This case indicates that it has been an advantage for the manufacturer of building materials to involve the employee in the dual role of employee and end-user as a new source in their innovation work. The new user perspective can influence the innovation process concerning the product, the marketing and the organisation itself. Rockwool and the employee played different roles in the project. Where the employee was the driver of the building process, Rockwool was the driver of the development of the marketing method. The employee's house would be built, whether Rockwool participated or not, but on the other hand, Rockwool's development of their new marketing method depended on the employee's project – or a similar project. In that sense, involvement of user perspectives in innovation work of companies may be not so much a question of whether a user perspective exists in the construction sector, but rather a question of how the companies can recognise where and when the user perspective is visible and how they can organise themselves around the user perspective.

The dual role and the employee's alternating between the internal and external position vis-à-vis the company, made it possible for the employee firstly to get the end-users needs visible and secondly to establish a supplier network of manufacturers of building components, which Rockwool could borrow and use in their marketing. The case showed that user-perspectives influence both the internal and external structures of companies. Unintended, but as a consequence of the project, it seems that a new market segment of 'do it yourself – do it for me' users and a new business strategy with a closer strategic partnerships between the manufacturers of building components were co-shaped.

Apparently, a virtual network that links products, information and suppliers can shape the frame for the new market segment to relate to the whole and to the individual components. In the future, Rockwool estimates that more suppliers begin to have more links on their homepage in order to tie the products together in a context. A future challenge will be the development of strategies for project cooperation between suppliers that handle the dilemma with inclusion/exclusion. All in all, trends suggest the establishment of stronger supplier network and a stronger focus on the end-users. Obviously it is the company, which decides whether it will change its business strategy toward stronger strategic partnerships.

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EMPLOYEE INVOLVEMENT AS KEY ISSUE WHEN IMPLEMENTING CHANGE IN LARGE AND COMPLEX ORGANIZATIONS

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ABSTRACT

When implementing change in a complex company, it is a large challenge to convince employees to accept the change and start working according to it. One of Sweden's largest construction companies, here named CC, is continuously improving its performance and working methods which also require a continuous process of change implementation. This paper presents results of an investigation about CC's change implementation process. The purpose is mainly to realize how it handles change implementation, what the main problems are regarding employees' involvement and what can be done to improve the situation. An interview study was performed and the results show that the main problems are three fold: too little involvement of the employees, limited incentives for commitment and resistance to change. This paper presents recommendations for improvement.

1. INTRODUCTION

The management of change is one of the hardest challenges to deal with in large and complex organizations because it always meets lots of obstacles from employees that have to change their working routines. There is a need for adopting new techniques and working routines to remain competitive; therefore changes and improvements are necessary. For getting the change into practice an implementation phase is required. A top manager at a centralized part of an organization might have developed a great idea that could double the profit of the company, but the idea itself does not bring any changes. It is really needed to get the change through the whole organization's system, from the centralized part to the most decentralized part, where the change actually needs to be taken into practice. This can be very tough and time consuming. Kotter and Cohen (2002:27) express this as: "*Moving a mountain for an enterprise can be so hard; you might logically think that a crisis, externally forced or internally induced, is necessary. Forget trying to persuade them; light their pants on fire*".

The study presented in this paper focuses on how changes are implemented in a large and complex organization by focusing on employees' involvement. A case-based inductive approach has been used where the case organization is a large construction company, called CC in this paper. The organization has a number of development projects running simultaneously to improve their operation. One of the issues they currently are struggling with is how to implement the results of these development projects, i.e. how to really put the changes into practice. Two research questions are addressed in this study:

- How is a change implemented at CC and how is it a part of the whole development project process?
- How can employees' involvement influence change implementation process and how can the problem be mitigated?

The aim is to find answers to these questions and then to come up with suggestions for improvements for CC's implementation process by considering employees' concerns.

2. THE CASE ORGANISATION

CC is a company group that was founded in 1887. It is among the top 10 largest competitive construction companies in the world with more than 56 000 employees worldwide. Sweden is an important market for CC and the Swedish based company is today one of the largest construction company in Sweden with almost 11 000 employees working all over the country. The revenue of the whole CC group was approximately SEK 140 000 million in the year 2007. CC has operations in 21 regions, 105 districts and has more than 3 500 ongoing projects in Sweden. The organization has headquarters in Stockholm where the management and technicians work to support the regional offices. Most of the employees work in decentralized parts of the company, i.e. in regional or district offices or on construction sites. One of CC's important activities is to carry out development projects. CC is currently working on 18 different development projects (e.g. regarding aspects of the environment, production technique and technical construction solutions). Some of the projects are implemented in the whole organization while others only affect particular parts of the organization.

3. METHOD

A qualitative interview study was used to achieve the objectives in this study. With the interviews it was possible to collect a lot of first hand information in a quick way. In order to efficiently collect information about the implementation processes at CC, structured in-depth interviews were made with four employees in different positions in the company: a development manager (interviewee 1) who has seven years work experience at CC with two main responsibilities; the management system in which he coordinates different departments in all project phases and controlling the process and integrating legislations into projects to develop and maintain the system, a development coordinator (interviewee 2) who is working for two years at CC to coordinate between 18 ongoing development projects. As she pointed out, managing the so called major development projects and focusing on one certain development project regarding the whole process of development, from the idea to the benefits of the result, are her two main responsibilities. Furthermore, two regional project managers (interviewee 3 and 4) in one specific development project were also interviewed. They are managing the process of the same development project at CC for two years. The project is expected to be finished in 2010. All the interviews took approximately one hour and they were all located at CC's main office in Gothenburg. Two of the interviewees work in CC's office in Gothenburg and two work at the headquarters in Stockholm. The two in Stockholm were interviewed together in a video conference. All the interviewees in this study worked with development projects and they are all well-educated, having MSc degrees in different branches of engineering.

The interview questions were carefully designed in order to provide reliable support in answering our research questions. The main questions were sent to the interviewees in advance to receive more structured and comprehensive information. Extra questions as well as follow-up questions were also posed in the interviews to get more information and to create a natural and relaxed atmosphere. During the interviews two group members asked question while the other took notes. The interviews were written down almost word for word and after the interviews the different notes were compared, compiled and analyzed. The relevant information that could be used as support or evidence to help answer our research questions was sort out and then was grouped into two main themes: the current way of handling development projects (initiation, planning and implementation) and the main obstacles of change implementation by considering employees' concerns.

This study focuses on one case organization and therefore cannot be generalized for all construction organizations. Moreover the limited number of interviewees prevents us from making any definitive statements about implementation issue. However, our findings may serve as an indication and support of the need for further research.

4. THEORETICAL FRAMEWORK

There are three main ways of managing implementation in an organization according to Egbu *et al.* (2004): by employing consultants, by specialist departments within the company and by integrating the process with the mainstream activities of the firm. A closer look will be taken at the second alternative since this is the choice that our case organization, CC, has chosen. This method, i.e. having a special department for development projects, is most suitable for internal organizational development. The largest advantages of using internal development department are knowledge about the organization and also close connection with the employees. On the other hand a disadvantage can be lack of time for managers. Another disadvantage is that specialist's design all changes and those who should follow them may lack commitment (Fryer *et al.,* 2004:184-9).

According to the explanation of Fryer *et al.* (2004), a process of change starts with a period of *recognising a need for change*, where an idea is generated either by an external or internal pressure. After a change has been decided on, the next step is to plan and design the change, i.e. the period of *planning organisational change*. In this stage, the idea is developed further and the whole change process is designed. When the change has been fully designed, the last stage can begin; the *implementation period*. This means that the change is put into practise and in the end of the period the change has hopefully been achieved. One important matter when managing change is to realize that change takes time. A long-term perspective is very beneficial when managing change (Clegg *et al.,* 2006). By considering change process proposed by Fryer *et al.* (2004), the important issue is *how* to implement change successfully when every employee has own attitude about changes. In fact, according to Chen (2007), the main issue in organizational change is not, structure, strategy, culture or system, it is how to change employees' behavior to contribute in change implementation process. He believes that this factor would affect the success of the changes. It is obvious that complex organizations are more influenced by employees' behavior and contribution as they have lots of employees (Chen, 2007).

Kline and Jan (2007) specify a Change Implementation Model with seven influence factors; *employees concern, clear vision to all, success celebration, strong leadership, trust making, enabling environment* and *change within the culture*. Communication is a very important issue that must be considered in every step (Kline and Jan, 2007). Having a good communication can also accelerate the change implementation. By considering the main objective of this paper and also the obstacles found in all interviews at CC, the first three mentioned factors would be most important to ease the change implementation of CC. Therefore, they will be described and discussed more in detail compared to others in the following.

4.1 Employees' concern

Since engaged employees are very important assets of projects, the change implementers should consider their attitude toward change. According to the consultant company Bacal & Associates (Bacal, 2008) there are four different stages called *behavior cycle* when employees face changes: *denial*, *anger and resistance*, *exploration and acceptance,* and *commitment*. In the denial stage they reject the change that is happening. In the anger and resistance stage, employees have realized that the change will happen and they tend to be more aggressive. With good leadership the disagreeing employees should be able to move on to the next stage, the exploration and acceptance. When this stage is reached the toughest part of implementation has been accomplished. The employees now are open-minded and participative in the process. In the last stage, commitment, they work to implement the change even though they might not have fully accepted it, for example when it concerns downsizing. At this stage the employees will do what takes to make the organization successful (Bacal, 2008). The first two stages mentioned above are negative for the change process, but they can be shortened and

decreased by numerous ways. One important factor is that at an early stage of implementation, employees' voices should be heard. Everybody should be welcomed to state his/her concerns about change since that will increase employees' participation and involvement in the change process (Kline and Jan, 2007). According to Yerkes (2001), the incentive programs are required to motivate employees to contribute. Having incentives not only makes company profitable, but also makes employees satisfied and encourages them to contribute more. If further contribution is desirable, the employees should be rewarded (Yerkes, 2001). According to Forsyth (2006), the rewarding could be by being announced publicly instead of in private, endorsing by seniors, notifying in an internal newsletter, giving certificates or badges etc.

On the other side, to travel through the behavior cycle, employees' attitudes need to be changed. According to Fryer *et al.* (2004) there are two socially appropriate methods to change employees' attitudes, *education* and *persuasion.* Education means informing them both about the change itself and about its consequences, which are the basis for accepting the change. According to Kline and Jan (2007), one useful method when educating employees is to explain similar experience that another organization has already done. Regarding the persuasion part, managers need to convince employees of the change benefits (Fryer *et al.,* 2004). Furthermore, personal contact is very effective in this context. Using *opinion leaders* is another suitable approach. In fact, these are popular and respected employees who are asked to take special interest in the change process by attending meetings or actively seeking information in other ways. These persons then influence other employees as they pass on new information and ideas (Fryer *et al.,* 2004).

4.2 Clear vision to all

The purpose of change should be explained to employees as clearly as possible to raise their contribution. At the beginning, they do not know exactly what the problems are and what the purpose of the change is. When implementing development projects it is important to know that strategies can assure employees and give them confidence as well as making believes of a better future and how to get there. Strategies do not 100% provide how to do and what is best to do but it helps employees to orientate (Clegg *et al.,* 2006). To have a clear goal for the change, both long-term and short-terms visions are very important. One way is to follow the SMART term: specific, measurable, achievable, relevant and timed (Fryer *et al.,* 2004). On the other hand, it is not only enough to explain the changes. The employees need to know what will occur after change (Kline and Jan, 2007), how it will affect their work and how they interact with each other during the implementation period. They also need a plan to follow, so they know how to act in new circumstances. According to Wilson (1992), having just a detailed vision does not mean that the changes are successfully implemented. He counts five main characteristics that each vision strategy must have to be successful; clarity, communication power, coherence, flexibility and consistency (Wilson, 1992). These factors will be described in the following.

According to Wilson (1992), the simple and basic principles should be emphasized to clarify the vision. In this case, the vision is understandable for everybody involved and it leads to increase employees' support and commitment. The theoretical vision strategies cannot be implemented unless they are communicated in a correct way. In fact, the vision strategy should be communicated broadly, continuously and consistently by CEO or executives. This communication must be carried on as long as it becomes a part of organization's culture. To make employees being more aware about the reasons of changes perfectly, the vision can be communicated by several methods such as speech, interview, meeting and writing (Wilson, 1992). The coherency is another essential issue to clarify vision if employees' contribution is expected. According to Wilson (1992), "*this coherence is vital if the vision is to stand up to critical analysis. A coherent vision helps a company endure through changes in 'the real world' and helps persuade employees to*

carry it out". On the other hand, the vision strategy sometimes need to be redefined a bit to consider involved employees' attitudes. Therefore, the vision strategy should be flexible and open to be able to change during implementation (Wilson, 1992). The consistency also plays a significant role for achieving expected objectives. In other words, the corporate action and decision must be monitored continuously during implementation phase to avoid inconsistency (Wilson, 1992).

4.3 Success celebration

By dividing the final goal of a change into smaller steps, it is possible to celebrate the short-term achievements for encouraging employees to participate and collaborate more in the process. The short-term goals that would be celebrated are cost reduction, improvement of process and customer satisfaction. According to Kotter (2002), the short-term achievements should have three characteristics: "*visible, unambiguous and clearly related to the change effort*". As Townsend (2008) mentioned, the success celebration is one of the seven steps in CQP (Complete Quality Process) that increases employees' contribution. The success celebration should not be always complex. It can be enough to gather employees and mention the milestone that teams have completed and thank team members for their efforts (Falkowski, 2005). In fact, thanking involved employees for their efforts causes them to stay more in change implementation. On the other side, success celebration can also encourage others to start participating in changes process. According to Falkowski (2005), the frequency of success celebration varies depending on project managers' decision. In some cases, the success can be celebrated based on tasks progress; e.g. after completing 10% of task plan. On the other hand, sometimes it can be celebrated after reaching the final goal or at the certain time, e.g. every month (Kline and Jan, 2007). The main issue when celebrating success is focusing on teams' success instead of personal success (Falkowski, 2005).

4.4 Other factors

As mutual trust between involved work forces in a project can have an impact on the procedure, building trust between top level and low level employees is very important (Kline and Jan, 2007). Every change implementation should be integrated, reliable and fair in order to succeed. On the other side, changes are rarely implemented without strong leadership. It is very important that leaders motivate everyone to contribute and take responsibilities during the implementation of change. If employees have sufficient motivation and enough awareness of positive effects of changes, they will work hard to fulfill the leaders' willingness of implementation of change (Kline and Jan, 2007).

The organization needs a comprehensive plan for enabling changes. This plan should be introduced by the organization as early as possible. The potential barriers are important concerns that should be considered in this plan. Among the variety of barriers, hostility, apathy and lack of knowledge are the main obstacles in almost all organizations during implementing of change. Suitable solutions to overcome these barriers should be a part of this plan (Kline and Jan, 2007). One of the important factors that should be considered in the change plan is to make change within culture. According to Kline and Jan (2002) changes must become a part of the culture (principally the norms and shared values of the organization) instead of trying to change it. Leaders often try to change culture, but that can hardly be done. In the USA, there are a lot of examples where change lasted only as long as the current leadership since the leaders tried to change the culture itself, e.g. the State Department and within the military services. In fact, change agents must find ways of grafting change into existing culture.

5. RESULTS

The findings from the interviews have been divided into two topics: first, how CC handles the development project process currently and, second, the problems that arise in the implementation phase.

5.1 The current process of a development project

The development department at CC is responsible for reviewing change implementation. Although our considered case has a broad decentralized part, all sub-organizations work under supervision of CC's centralized part with the same brand, i.e. according to interviewee 2 "*We are one company"*. As a result, CC chose to have a development department that is appropriate for internal development. On the other hand, as the changes are the heart of any project development, considering the effects of change in the case of implementation is essential for each organization. In other word, no project is successfully developed unless some changes are carried out. Therefore, the responsibility of finding a solution to ease the implementation of changes has been assigned to development department at CC. The process of a development project starts with a CC's employee. The employees at all levels in the organizations are able to come up with new ideas for improving performance and techniques, although most of the ideas come from the top management team (interviewee 2). There is though no incentive system to encourage employees to come up with such ideas, so only the very proactive ones create them (according to all interviewees). The next step is the reviewing of the new idea and consideration of implementation by the management team. In September every year, a top management meeting is held where decisions are made regarding development projects. In these meetings it is decided which ideas will become new development projects and which ongoing projects will be canceled. The projects discussed by the top management team are mostly called major development projects (interviewee 2). Minor ideas, coming from lower levels in the company can however be adopted by managers on a regional level.

CC has developed its model of handling development management which comprises four stages of development process: *pre studies*, *development (design and planning), implementation* and *administration*. CC started to use a general model called PPS (Practical Project Steering) in 2006 which is a model for supporting an organization's portfolio, program and project management (TietoEnator, 2008). This model, PPS, is not especially focused on the implementation phase. PPS can be adjusted to each organization by for example including own templates and documents in the model (Interviewee 2). According to interviewees 3 and 4, this is not a holistic way of how to run development projects. In addition, interviewee 2 mentioned that PPS just explains *what* to do but not *how* to do it. Therefore, they are currently developing a more user friendly process which includes PPS as a part. According to interviewee 2, the hardest challenge of all development projects is the implementation phase. It always takes more time than assumed in the design phase and the resistance of employees is always more than expected.

The initial planning and delivery plan for the development project are available for everyone (interviewee 1). This is to ensure that from the start of the development process employees can be involved and feel more enthusiastic and motivated to come up new ideas. Furthermore, it can help CC in their effort to reduce the communication gap between the top management team and the employees working on sites.

To form a development project team, qualified employees from different levels are selected who will continuously work on the development project. During this process CC sometimes uses *review groups* from different levels within the company to give feedback (according to all interviewees). One example of a development project recently implemented at CC is the IBX (Integrated Business Exchange) project which coordinates the purchase of tools and materials in an electronic database. To make implementation

of IBX easier, a competitive element was introduced. The competition rewarded purchasers that made most purchases through it. The winner was declared in the CC magazine and on the intranet.

5.2 Issues and problems when implementing change

In the starting phase of a development project, CC wants as many employees to be involved as possible; however there are no specific incentives for them to do so, for example by giving an award to the employee with an idea (interviewee 2). Nevertheless, the creation of new ideas is according to the all interviewees not the main problem at CC; it is how to implement them.

When a new idea is accepted, a project team is formed (interviewee 2). The members of this team are recruited from different parts of CC which gives the group diversity. The problems arise at this point as people in project teams tend not to have enough time for extra work on top of their routine tasks. Therefore, delay is predictable in such development process especially when the employees are not rewarded enough.

According to interviewees 3 and 4, the focus on financial results instead of improving the process, as well as the nature of complex organization makes the implementation even more difficult. The complexity of CC is about having widespread business, large number of employees and many regional sub-organizations which forms CC as a centralized/ decentralized organization. These result various organizational stakeholders who become a strong restraining force with resistance to change as they have parochial self-interest, own ways of working and different goals. So far there are no practical guidelines for the implementation; this is what the development coordinator is looking into.

All the interviewees expressed that people at higher levels in the organization are more eager to implement changes than lower level employees as they do not see problems and necessity of solving them. According to all interviewees, they are not aware of the problems that CC faces on at higher level and essentiality of changing them to fulfill the company's goals. As a consequence, interviewees 3 and 4 believe that higher managers underestimate the effort that takes to implement change. According to interviewee 1, it took a long time to convince employees to use the purchasing model IBX (Integrated Business Exchange) since they did not understand the benefits of it and the need for changing their daily routines. All interviewees mentioned that lack of computer skills of employees in the decentralized part was another problem in both IBX and Asphalt 20-10 since they required good computer skills.

According to interviewees 3 and 4, two factors that seemed to ease implementation was having visible results (visible for the management and also for employees who work on the site) and to have review groups for getting feedback. As interviewees 3 and 4 mentioned, one of the development project, Asphalt 20-10, reflected useful experience from implementation. The project managers were firstly taking to the site managers and then letting them to explain to the workers. A similar approach is currently applied where trained supervisors are assigned for each project in order to help others for adapting to the project.

6. DISCUSSION

At this moment, the implementation of change is the most difficult phase at CC. They do not have an inclusive practical model or strategy plan for the execution of implementation. Due to the limited size of the study presented in this paper, it is of course impossible to design a holistic implementation plan for CC, but some important factors for the process will be discussed and dealt with.

When considering the three interviews, it looks like the largest hindrances in the implementation process at CC are lack of employees' involvement, limited incentives for commitment and their resistance to change. When talking to interviewees 3 and 4 who on a daily bases deal with local managers and employees, it was obvious that they were quite tired of the resistance. In this context, it is very fruitful to look at the literature to widen the understanding of human cycle of behavior. To understand that it is human's nature to resist change and keep their working routine can be very helpful when dealing with employees' resistance. Having a plan of how to deal with resistance, which always comes up, is also another important key.

Regarding employee's involvement, it can be found in the literature that employees need to be heard and trusted by their company in order to have a positive attitude towards change. As all interviewees mentioned, lack of knowledge about existing problems and also necessity of solving them among lower level employees caused obstacles of implementing changes at CC. Therefore, according to Wilson (1992), having a clear vision can increase the employees' commitment and contribution in change implementation process. As discussed in theoretical framework, providing the simple and clear vision which is understandable for everybody and meanwhile communicating broadly and continuously can be useful to raise employees' involvement at CC (Wilson, 1992).

All interviewees mentioned that CC has no success celebration at this moment. Therefore, according to Falkowski (2005), CC can prepare simple celebrations frequently by gathering employees and thanking them for their effort. In this case, not only involved employees are encouraged to contribute more, but also it is a motivation for others who have not been involved since they become familiar with other employees' achievements.

As described in result part, all interviewees mentioned that lower level employees have less contribution as they are not aware of changes' reasons and goals. This problem would be the result of poor mutual understanding among different levels at CC. Therefore, as Fryer *et al.* (2004) mentioned, informing employees about changes and its achievements can affect their attitudes and let them contribute more. As a result, using of review groups at CC seems to be a very positive way to involve employees with different positions in the organization. In fact, as review group members belong to different sub-organizations, each expertise area is represented and therefore makes it easier to communicate with others in an effective way to get mutual understanding. On the other hand, as described in theoretical framework, another fruitful way to involve and encourage employees is the idea of opinion leaders, which the 'project supervisor' at CC can be seen as an equivalent to. If the ideas of changes are presented to employees by someone working close to them especially at the same level, they are influenced much more to be involved. For example, if the painters need to use a new kind of brush it is better if his foreman introduces this new brush face-to-face instead of someone from the office sending them a document and telling them what to do.

The main important issue when informing people on the construction site is speaking to the employees instead of handing them a written report (Räisänen and Gluch, 2009). In fact, the face-to-face speaking is much more effective in construction industry. Implementation of developing projects that are rely on guidelines in text could be hard for the craftsman to read, and thus he will not feel importance to participate in the change (Clegg *et al.,* 2006). As explained in theory earlier, good communication makes employees more enthusiastic and aware of the company's goals and problems and also builds a trust between managers and employees. To emphasize effective communication can help CC in the transition from a 'get the job done' company to a company that focuses on improving their processes in order to increase their efficiency and profitability.

Having no incentive to encourage employees would be a reason of why they do not contribute in CC's change implementation. However some proactive employees come up with new ideas for developing projects, it should not expect that others contribute in implementation phase since they do not have enough motivation. As mentioned in result, CC already had successful experience from IBX (Integrated Business Exchange) project and also they had rewarded the employees who contributed more. Therefore, the encouragement of employees as such could be one of the reasons that led to the success of that project. As a consequence, CC can set up an incentive program to encourage employees such as introducing them publicly (as what they did in IBX project), giving bonus, sending them to vacation, giving certification, presenting badges, etc (Forsyth, 2006). In the case of stimulation as such not only involved employees are appreciated, but also for others find enough motivation for contributing. On the other side, a friendly atmosphere is created and employees would feel that the organization understands their efforts.

7. CONCLUSIONS

The main focus of discussion has been proposing of appropriate solutions to overcome major obstacles in CC's change implementation process regarding to employees' involvement. The main outcome is that CC struggles with implementation issue due to three main problems; too little involvement of the employees, limited incentives for commitment, and resistance to change. Based on the theory analyzed and findings from interviews we conclude that employees' attitude is one of the essential issues that must be considered during both planning and implementing of change to reduce resistance. In fact, while managing implementation of change, it is important to bear in mind that the main actors in the play are the employees of the organization. The employees' attitudes must be taken into consideration and their ideas need to be eagerly listened especially during change planning. This approach can be a bit time consuming in complex organizations like CC due to large number of employees, but the changes would be implemented more successfully. On the other hand, the employees need incentive to be encouraged for coming up with new ideas regarding to changes in development projects and meanwhile contributing in implementation phase. Furthermore, if more contribution in every phase is desirable, CC's employees must be informed much more to understand the change's reasons and goals.

By considering CC's main obstacles, having review group and project supervisors seems to be an effective way to increase employees' awareness of change perspectives and also to get feedback. Therefore, sending messages from CC's centralized part to decentralized sub-organizations continuously, broadly and clearly is strongly recommended. On the other hand, frequent celebrating of short-term success would be an appropriate way to get CC's employees more involved. Finally, it should not be forgotten that employees need motivation to contribute into implementation, so preparation of incentive program is surly aid CC's centralized part to encourage employees for effective and continuous participation.

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POWER RELATION AND ITS IMPACT ON INNOVATIVE PRACTICE DECISIONS IN HEALTHCARE INFRASTRUCTURE PROJECT ORGANISATION

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ABSTRACT

There have been many studies on innovation in PFI, but they seem usually to focus on generating checklists of incentives and obstacles to innovation diffusion. Rarely have they been focused on how and why these factors influence decision-making on innovative practices in a project-based organisation. Power relations between organisations have an impact on innovation adoption decisions in the procurement of healthcare infrastructure. Resource dependence theory on those power relations forms the theoretical foundation of this research. The development of a grounded theory on project-based organisation enables the results to be generalised to both PPP and non-PPP projects in various sectors. The decision on innovative practices in a PFI hospital project seems to be a function of the power relations among different parties in the project organization. This is in line with the way that demand for essential resources changes at different stages of the procurement process. This illustrates how to optimise resource acquisition and operation in a project-based organisation.

1. INTRODUCTION

The context in which NHS Trusts operate is in a state of technological and political flux. The healthcare services that trusts deliver must respond to these environmental fluctuations. Thus, trusts need to adopt new ideas that improve their service delivery. In other words they need to innovate. Most of healthcare service delivery takes place within buildings. Therefore, healthcare facilities need to be innovative, too, to accommodate the constant changes. The Private Finance Initiative (PFI) has been a popular form of public private partnership (PPP) in the healthcare sector. PFI was expected to incentivise innovation adoption and diffusion in NHS hospital projects by introducing private sector expertise and special financial arrangements (Treasury, 2000). However, after a thorough examination of the drivers, barriers and critical success factors for PFI in the UK, Dixon *et al*. (2005) conclude that PFI is lack of flexibility and innovation. Ball *et al*. (2001) explore how public sector has been benefited from risk transfer, innovation and value for money through PFI projects, and conclude that PFI may not be as significant as some proponents suggest. Their research indicates that due to the risks associated with innovations which encourage special purpose vehicle (SPV) to adopt tried and tested solutions to project delivery rather than experimenting with innovative ones.

The 'push' and the 'pull' forces for innovation spreading[1] in the procurement process of a healthcare infrastructure come from various directions, but always from the different stakeholders. The project organisation is the medium through which these push and pull forces are operated. Barlow *et al*. (2008) studied the NHS's performance in taking up and spreading innovations and existing best practice, and found that the organisational structures of current NHS system and those of different organisations within this system are potentially significant barriers for stimulating the adoption and diffusion of innovation in the NHS.

[1] The 'push' force is the supply side to drive innovation, which can come from those who create innovations; while the 'pull' force is the demand side to drive innovation, which is generated by such as the innovation adopters.

The resource dependence theory (Pfeffer and Salancik, 1978, Pfeffer, 1992) identifies formal organisational structure as a source of organisational power. The resource dependence theory has been applied to explain both inter and intra-organisational co-operations (e.g. Provan *et al*., 1980, Salancik and Pfeffer, 1974). However, project–based organisations and their operations in the context of PPPs have been largely neglected in power relation studies. This research analyses organisational structure based on power relations within the project organisation, and contributes to this research gap by exploring the impact of the project organisational structure on decision-making about the generation and/or adoption of process and product innovation within healthcare construction projects under different procurement arrangements. Thus, the research question is to ask how different project organisational structures impact on process and product innovation adoption during healthcare infrastructure procurement process.

In the rest of this paper, the resource dependence theory and its implications on this research will firstly be reviewed and then the preliminary study will be presented, followed by the conclusion.

2. STATE-OF-THE-ART REVIEW

Resource dependence theory (Pfeffer, 1992, Pfeffer and Salancik, 1978) is a theory of rational organisational adaptation to exogenous changes in the environment (Pfeffer and Salancik, 1978, Ulrich and Barney, 1984). It provides a theoretical foundation for understanding the dependencies both within organisation and between organisations that enable coordination and change (Tillquist *et al*., 2002). In this section, the resource dependence theory will be reviewed, followed by the introduction of innovation and PFI in NHS.

2.1 The resource dependence theory

Research on the bases of power within organisations began as early as Weber (1947), while the concept of dependencies and its implications for power relations were first studied by Emerson (1962) and Blau (1964). The study on power was then extended to inter-organizational relationships, most notably, by Pfeffer and Salancik (1978).

In resource dependence theory (Pfeffer, 1992, Pfeffer and Salancik, 1978), an organisation is assumed to acquire control over resources that minimise its dependence on others and/or maximise others' dependence on it, by which means, exchange between organisations is supposed to be affected and thereby the power relations between organisations. It is also assumed that there is scarcity of valuable resources to organisation's survival. As such, organisations face the problem of environmental uncertainty in recourse acquisition. This then poses the interdependence of an organisation with its external environment.

Resource dependence theory proposes that to survive, an organisation must be able to gain control over environmental resources. Almost anything can be resource as far as it is perceived as valuable, from, such as, building contracts to the physical location of one's office. To evaluate the criticalness of resources, three factors should be considered: the importance of the resource to those from which power is being sought; the scarcity of the resource and its substitutes; and the level of competition between organisations for control of that resource (Pfeffer and Salancik, 1978).

An organisation can acquire needed external resources by modifying its power relations with other organisations. Power here is defined as "the potential ability to influence behaviour, to change the course of events, to overcome resistance, and to get people to do things that they would not otherwise do" (Pfeffer, 1992:30). Power comes from being in the right place or position, which can provide control over resources (e.g. budgets, physical facilities), be used to cultivate allies and supporters, provide access to valuable

organisational information, and provide formal authority. Resource dependence theory portrays power in a dynamic fashion, that is, power relations between organisations can change over time. To maintain or gain the power, one must be able to recognise and even create sources of power; and have the ability to control them.

Not all the organisational activities involve the power use to the same extent; the level of power involved depends on at least four factors: interdependence, goal, means of achieving the goal, and the importance of the issue (Pfeffer, 1992). Interdependence, as indicated above, is largely derived from the resource scarcity. It is argued that power is used more frequently under conditions of moderate interdependence because under high interdependence condition, people have incentives to forge common goals, and means of achieving the goals. Different organisations could have different goals even when they are working together. This could because of the differences between organisations, which include different interests and specialisation in one's own area. It is found that serious disagreements are more likely to emerge when there are absences of clear objectives and external threat or competition (Pfeffer, 1992). All the same factors can also result in the disagreements on the means of achieving the goal. The goal and the means together largely define the performance measurements for organisation activities. Power is believed more likely to be used for domains in which performance is more difficult to assess, such as PFI projects, which normally last for about 30 years, by the end of which, the final conclusion on the performance measurement can be drawn. Finally, the more important is an issue, the more likely power will be used on decisions regarding the issue, for instance, innovation adoption, which normally requires resource acquisition and relocation and likely to evolve high risks during its implementation.

The principles of resource dependence theory have been applied in various disciplines. Pfeffer (1976) examined the advantages and disadvantages of different organisational strategies (i.e. merger, Joint venture, cooptation, personnel movement, regulation, and political activity) for managing inter-organisational interdependence. In international business studies, resource dependence theory has been applied to explain the managerial activities within multinational corporations (MNCs) (Bouquet and Birkinshaw, 2008, Ambos and Schlegelmilch, 2007, Ghoshal and Nohria, 1989, Johnston and Menguc, 2007, Loveridge, 2002, Martinez and Ricks, 1989, Medcof, 2001, Mudambi and Navarra, 2004, Prahalad and Doz, 1981); as well as the relationships between MNCs and their external environment (Birkinshaw *et al*., 2001, Blumentritt and Nigh, 2002, Wilts and Skippari, 2007, Eden and Lenway, 2001, Rehbein *et al*., 2004, Teegen *et al*., 2004). Resource dependence theory has also been used in operational management studies, for instance, just in time management and supply chain management (Handfield, 1993). Resource dependence theory has been studied under various contexts as well, including university (Salancik and Pfeffer, 1974, Pfeffer *et al*., 1976), hospital (Pfeffer, 1973), government (Pfeffer and Salancik, 1977) and co-operation boards (Pfeffer, 1972).

PFI is formed for the public sector to utilize private resources, which poses a resource exchange and organisational interdependence relations between the public and the private partners. However, the subject, such as, project–based organisations and their operations under PFI context has been largely neglected in power relation studies. In next section, innovation and PFI procurement will be discussed from a resource dependence perspective.

2.2 Innovation and PFI in healthcare procurement

Innovation is regarded as an idea, practice, or object that is perceived as new by an individual or other unit of adoption (Rogers, 2004). Rogers (2003) identified five characteristics of innovation that would determine an innovation's rate of adoption, four of which – relative advantage, compatibility, trialability and observability are believed to have positive correlations with the rate of adoption, while the fifth one - complexity is the only characteristic that has a negative correlation with the rate. Resource dependence theory (Pfeffer, 1992) sees innovation as an inherently political activity

since it almost invariably threatens the status quo. Thus, it often if not inevitably involves obtaining the power and influence necessary to overcome resistance.

A number of studies have indicated the potential role of PFI to enable effective diffusion of innovations (Carrillo *et al*., 2006, DTI, 2003, Dulaimi *et al*., 2002, Green *et al*., 2004, Leiringer, 2006, Koskela and Vrijhoef, 2001). Innovation can also be the resource for a party to gain more power over others, and the means for achieving goals in a PFI project.

The International Project Finance Association (IPFA) defines PFI as (Dixon *et al*., 2005:413):

> "The financing of long-term infrastructure and public services based upon a non-recourse or limited recourse financial structure where project debt and equity used to finance the project are paid back from the cashflow generated by the project."

A typical PFI construction project comprises three main parties: the awarding authorities, the special purpose vehicle (SPV), and third party funders. Figure 1 illustrates the PFI project structure and the parties in the project organisation. These three parties in a PFI project have different responsibilities and objectives. The arrows in the figure indicate the hierarchical and obligational relations among parties in a typical PFI project. The awarding authority is responsible for procuring the project, and its objective is to achieve value for money. The third party funders invest their money in the project and aim to make profit from it. The SPV is the project company normally in form of a joint venture, comprising a construction contractor, facility management provider, investors and other specialist contractors. The SPV is responsible for delivering the PFI project with the objectives of minimising the risks and generating profits (Dixon *et al*., 2005). Each of the main parties will hire a group of consultants and sub-contractors, this, from resource dependence point of view, helps each of the main parties gain more resources of power (Boyd, 1990).

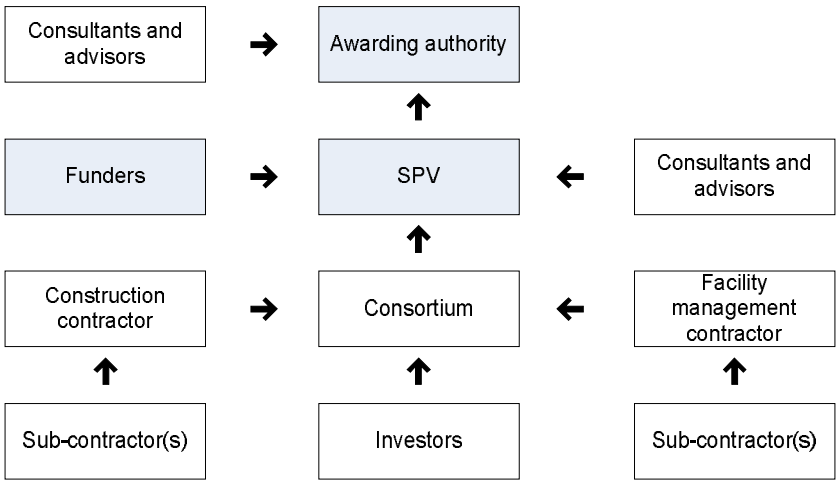

Figure 1. PFI project structure (Source: Dixon *et al*. (2005:415)).

Figure 2 illustrates the PFI procurement process in NHS. As it shows, this is a long negotiating process containing 17 to 20 steps depending on the project size. All the bidders compete to each other for the bid till the preferred bidder is selected. Therefore, during this period of time, the client, i.e. the Trust, has the overwhelming power over the bidders since it has the right to decide the bidder that it would like to work with on the project.

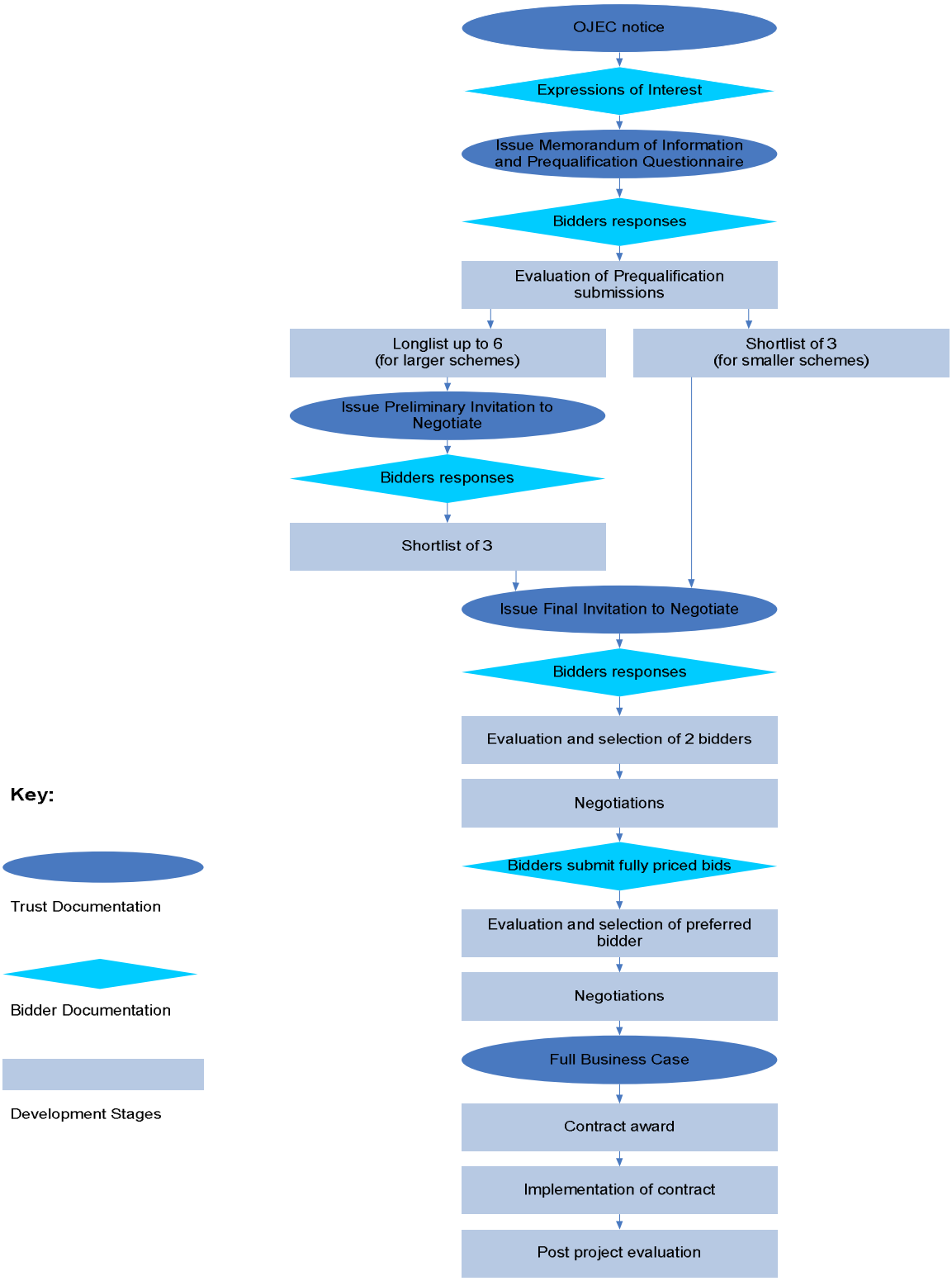

Figure 2. PFI procurement process in NHS (Source: NHS (2007:5)).

This formal authority is the source of power for the Trust at this stage. During this period of time, the bidders tend to be more dependent on the Trust. From the point that the

preferred bidder is chosen to the financial close (i.e. contract award), the Trust and the preferred bidder will negotiate on contract and work on the Full Business Case together. At this stage, the preferred bidder has gained more control over its position in the project although there is still one reserved bidder, thus the power of the preferred bidder is likely to be increased and comparing to the previous stage, interdependence between the Trust and the preferred bidder tends to be moderate, thus power is more likely to be used. Once the contract is finally awarded and the construction starts, the contractor gains largely control over the project (at least on the project progress), and its power is expected to be further increased. At the same time, the dependency relations between the Trust and the contractor are institutionalized which provide more predictability and certainty to both parties (Tolbert, 1985).

3. RESEARCH PROJECT

3.1 Project description and objectives

By adopting the resource dependence perspective, this research interprets organisational structure through power relations within the project organisation. Power is used to influence the decision-making and achieve the goal in situations of uncertainty and disagreement, which typify decisions on innovative processes and products. Decision-making about generation or adoption of innovation provides an appropriate arena for the study of power relations in organisations. The different resource structures in publicly and privately funded healthcare construction projects provide the opportunity for observing different power relations within these organisations. Three research objectives were set as following:

- To map organisational structures within publicly funded and privately financed healthcare construction projects
- To identify innovative processes and products generated and/or adopted in the delivery of healthcare buildings.
- To study the interrelations between project organisational structures and outcome of decision-making processes about process and product innovation.

3.2 Research methodology

In order to identify the dependent and the independent factors that influence innovation adoption and diffusion decisions in PFI hospitals and the way they exert this influence, comparative case studies are carried out. To address the 'what' and 'how' research questions posed in the context of different project organisations, data is collected through semi-structured interviews. This will allow data collection to be in line with the theoretical enquiries, yet without strict limitation on the information that interviewees could provide (Yin, 1994).

Cases are selected based on their procurement arrangements, size and time of completion. Four hospitals, one procured through PFI, one through LIFT, and two through traditional procurement will be studied. This will strengthen the generalisability of the research. Semi-structured interviews are held with project managers from the Trusts, the main contractors, the design consultants and representatives of financial institutions providing the funds. To validate the research evidence relevant documents and information generated from research workshops with wider community of research and industry will be used as well.

The unit of analysis is the decision-making processes on innovation adoption in different delivery mechanisms of healthcare buildings. Data subjects are asked about their role and responsibility within the decision making process, their perspective on innovations within the projects (such as the advantages and disadvantages of innovation adoption, and the resources needed to operate it), as well as the path-dependence of the

influential factors on the decisions (which can be either adoption or rejection of innovation) that has been or is about to be made.

4. RESEARCH RESULTS AND INDUSTRIAL IMPACT

The research is still at its data collection stage, thus it is far too early to draw any conclusions. However, the preliminary data analysis from one pilot case study still generates some tentative results.

4.1 Tentative results

The whole NHS PFI procurement process can be divided into three stages based on the power relations between main parties in the project organisation. The key resources of power are likely to include financial resource, time, formal authority, knowledge on hospital operation, knowledge on hospital design and construction, reputation, and location in communication network. The power relation between the Trust and the contractor (the bidder before the financial close) is expected to change throughout the process with the power of the latter one gradually increasing. It is likely the funders in the PFI project manage to maintain a stable powerful position till the project construction completed.

It is expected that during the first stage of the process (i.e. from OJEC notice' to 'Evaluation and selection of preferred bidder') to be an innovative project is automatically a goal for the Trust (due to the PFI requirement), while for bidders, innovation proposed in the tendering proposal is more likely to serve as the means to win the bid. Therefore, although there are incentives for both parties to introduce innovation at this stage, the mismatching between goal and means among different parties tends to generate conflicts. Although Trust as the more powerful party at this stage could have led the innovation decision, its lack of knowledge on hospital design and construction as well as its inability to produce a good project brief in time could diminish its power to generate a client lead innovation.

At the second stage of the process (i.e. from 'Evaluation and selection of preferred bidder' to 'Contract award'), the power gap between the Trust and the preferred bidder tends to be reduced. Power is expected to be used more frequently. It seems 'delay' (Pfeffer, 1992) is the most often applied power use technique to make things down, since both sides start to lose two critical resources - time and money. In the studied case, the Trust tried to incentivise bidders to introduce innovation into the project, however, the time was not on its side due to a long delay in the previous stage, thus it had to sign the bidder who was backed up by a more reputable designer than the one worked for another bidder although the chosen design was no innovative to the Trust.

At the last stage (i.e. from 'Contract award' onwards), the contractor is expected to gain even more power. However, any significant innovation is quite unlikely to be adopted because any changes will consume considerable resource, especially time and money. Thus, neither of the parties is likely to propose innovations at this stage.

4.2 Implementation and exploitation

The first two stages of the procurement process are crucial for innovation adoption decision. The Trust needs to be able to produce a good project brief to incentivise the bidders on innovation adoption. However, in the studied case, the Trust was lack of skills on project brief making, and could not get help from other experienced Trusts due to the competition on the funding. Thus, more trainings and supports are needed for the Trust in this regards. On the other hand, more incentives are needed to incentivise bidders to adopt innovation. The recognition of innovation as a resource of power might be helpful.

Further exploitation needs to be done on the power structure of those three key parties – Trust, SPV, and funders over the procurement process, also the location of the key resources on each party throughout the project. Finally, the role of funders on innovation decisions needs to be examined as well.

5. CONCLUSIONS

The tentative results show how power relation between key parties impacts on the innovation decisions at the three stages of the PFI procurement process. It seems that the condition of the power relation and the changes of it are more likely to hinder innovation adoption. However, the findings generated so far are yet to be valid to draw any solid conclusions; studies on PFI projects which adopted innovation (either with successful or unsuccessful outcomes) would complement current findings.

6. ACKNOWLEDGEMENT

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EFFICIENCY THROUGH DECISION MAKING AND CUSTOMER SATISFACTION IN A REAL ESTATE CONTEXT

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ABSTRACT

There are numerous examples of how the design of an organization influences the final result of a product. This is the case for real estate companies, where customer satisfaction is of great importance to becoming and remaining profitable. This paper examines how a real estate company's organizational change has influenced its customer satisfaction. Previous theory and research on efficiency related to customer satisfaction is compared with empirical data consisting of interviews. The results show that the company exhibits more consistent handling and focus on efficient relationships with customers. There are also similarities to theories on feedback and feed-forward loops in the company's new organization and improvement work. Surveys done after the implementation of the change indicate increased customer satisfaction, but there is some uncertainty whether these improvements can be accredited to organizational change as there is an expected delay of the effects.

1. INTRODUCTION

"Organization design matters just as much as any other kind of design … ugly organization design produces bad managing" (Clegg *et al*., 2008:528) is a statement that Stewart Clegg and several other experts are making nowadays. For instance, the specific design of Dell or United Colors of Benetton organizations directly influences the products of the brand and the efficiency in designing and producing their products. Behind products and efficiency, it is customer satisfaction that is the aim, the final and critical goal of most organizations. Customer satisfaction is utterly important for companies as the customer is the final agent that pays the company for the product or the service provided. Therefore, the satisfaction can directly influence the financial health and the success of a company. Several parameters influence customer satisfaction, including communication, efficiency, cost or standard. This study deals with efficiency impacted both by organizational design and relationship between owner and customers.

According to Clegg, "*the organizational design is the plan of an organization's rationally designed structure and mode of operation"* (Clegg *et al*., 2008:528). Organizational design of a company directly influences, and sometimes even creates, what is called the informal organization of the company. The informal organization has a direct impact on the company's culture. A company's culture, among several impacts, influences the result of the company by having a great effect on inner organizations performance and efficiency. Studying organizational design is actually a key point in order to understand and ameliorate company's results.

Based on previous theory and research, a case study has been performed on a real estate company, in this paper called CREC. The study includes three interviews with employees of the company chosen according to their position in the organization; each main position on CREC's hierarchical organisation has been interviewed. CREC is commissioned to manage, redevelop and expand premises and buildings for Chalmers University of Technology (CUT), Göteborg, Sweden. In the year 2007, CREC faced a change in its organization to manage the campuses in a more efficient way. This change is an interesting point that this study exploits.

The aim of this paper is to analyze empirical data and previous research, and relate it to CREC's efficiency on customer satisfaction. The paper focuses on similarities and differences between theory and the case study. The impact on customer satisfaction due to their organizational change is also explored.

2. THEORETICAL FRAMEWORK

General information about organizational efficiency linked with customer satisfaction in real estate markets has been gathered and evaluated from literature sources. The literature presented in this section tends to bring a broader view on how actors could benchmark their organization in terms of efficient functioning and take the correct steps to make and assess changes in the organization. The other issue tied to efficiency, specifically in real estate management firms, is how companies manage to characterize the level of customer satisfaction and improve it. The theoretical framework consists of selected reports, books and information from an administrative authority in Sweden.

The discussion around the issue of customer satisfaction in the real estate market arose as the property values during the 1980s increased. It has been suggested that the absence of appropriate traditional property management in the past has led to new definitions, such as facilities management, that lead to *total quality management* and *sustainable development*, are today used by organizations to maximize their profit. It is common for investment property management organizations to use indicators of rental costs and potential increase of capital value as a tool for performance measurement (Walters, 1999).

2.1 Efficiency through learning: loops of feedback and feed-forward

A theory, which is related to the level of efficiency in an organizational structure, focuses on learning through falling into loops of feedback and feed-forward. Therefore, empirical information gained through different situations is passed through the loop and result in expeditious organizational achievement. The discussion brought up by Argyris and Schön (1978) highlight the value of learning through double-loops. Their theory makes a distinction between 'theory in-use' and 'espoused theory'. The first represents the action that is actually taken in real life and in a reflexive manner towards exposure to situations. The second definition represents the belief system that is governing the response to the situations. Mentioned in the discussion, the 'espoused theory' either is, or is not applied in the 'theory in-use' (Argyris and Schön, 1978).

2.2 Decisions and effects on customer relationship: sequential decision making

In any process, the decision making part is subject to risk of bad judgment. A simple mistake in decision making can quickly lead to fluctuation in the income and profit margins. It is important to understand that decisions made within an organization have a set of consequences through time which could interact with each other and cause real different outcomes than expected. Therefore, *sequential decision making* could be recommended to manage customer relationship. In this method the decision maker must not only consider the cost and benefits of a single decision but must take into account the package of series of decisions that interact with each other over a time sequence and lead to a variety of results. With the gathering of appropriate data related to customers' response to the decisions, a decision maker will be able to identify the patterns that lead to a series of outcomes throughout time (Noaki *et al*., 2002).

This process can actually be seen as a complement to the previous theory of learning through loops of feedback and feed-forward. Indeed, sequential decision making permits to gather data from customer feedbacks on decisions taken, but not only on isolated decisions and actions, but on the whole package of decisions made through a significant

period of time. Sequential decision making leads to a process of continuous learning on the system. In this system, decision making is standing at the top and is adjusted by sequential feedbacks on different decisions made through time, creating a whole general and understandable feedback package.

Going to the next level in decision making means asking a fundamental question often avoided by decision makers. Do we know about what customers' value? This extends to the knowledge of the decisive organization about customers' expectations and satisfaction. The process of gaining knowledge is then extended into a poll or *self assessment* (Drucker, 2008). For instance, the chairman of Marriot Hotels defined three groups that he has to satisfy. They were composed of customers, employees and shareholders. For him, the employees are the most important (Walters, 1999). Listening to customers is indeed decisive to keep a sustainable business.

2.3 Efficiency in terms of organizational structure

When looking at the definition of organizational efficiency, it seems that the meaning has changed during the years and the perception of an organizational approach towards efficiency has been reintroduced. In many cases, the alternatives are left to the decision-makers to make their choice of action. The theory of organizational efficiency has been dominant since 1977 when Campbell introduced the phenomenon (Walters, 1999).

The key issue for efficiency in an organization is the decision-makers, which are formed into units and act as a coalition towards the issues faced. The main designator for efficiency in organizational structures is how the decision-makers cooperate and interact within the organization (Goodman and Pennings, 1977). Based on these definitions and emphasizing on Campbell's theory, the criteria of competing values projects the paradoxes of real life management. The criteria are constituted of focus (internal-external), structure (control-flexibility) and outcomes (means-ends).

Figure 1 shows the relationships between these criteria (Quinn and Rohrbaugh, 1983).

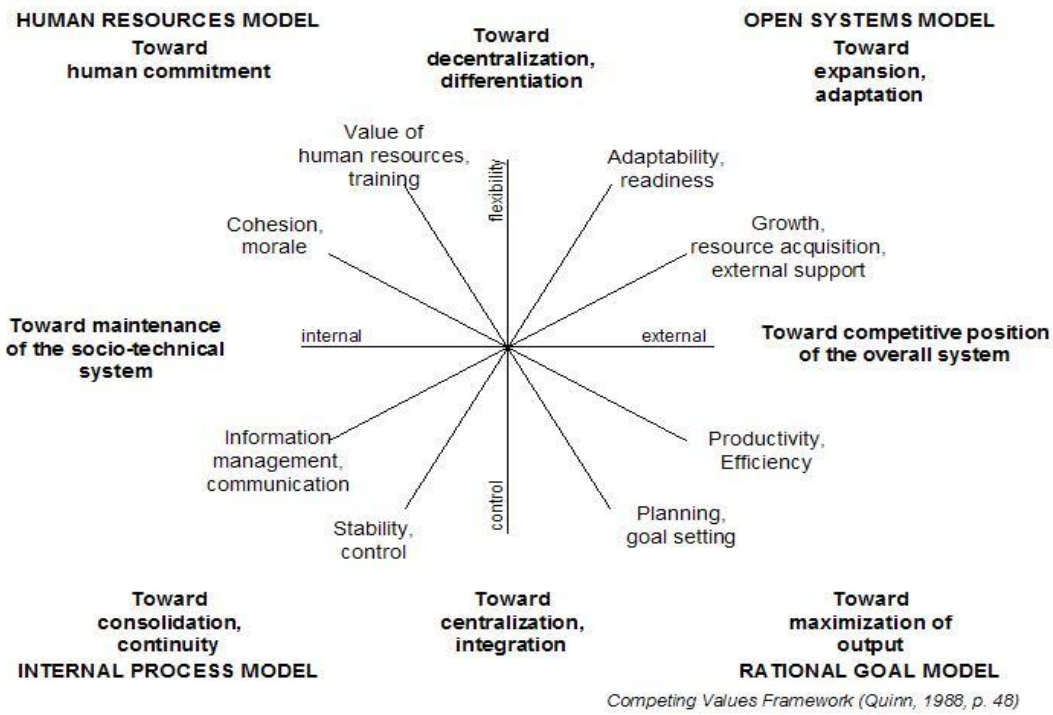

Figure 1. Main strategies of organizations to achieve efficiency.

In order to find the actual goal that an organization is heading towards, the figure illustrates major directions and their sub-units to clarify the definition of organizational efficiency. It is discussed that having even proportions of these items could lead to a structured and well functioning community, resulting in an efficient organization.

2.4 The use of inquiries and surveys in Sweden: Nöjd Kund Index and Campus Index

Loops of feedback and feed-forwards and sequential decision making would not be able without customer inquiries and surveys. In Sweden, a model to quantify customer satisfaction in the public sector has been developed: the NKI (Nöjd Kund Index) model. The model is developed by the Statistiska Centralbyrån (Statistics Sweden) (SCB, 2008) and is adaptable on many different businesses within the public and private sector. The aim of the model is to identify weak and strong parts of the organization in order to minimise, improve or enhance them. It is done by analyzing and producing statistics on answers acquired from surveys and inquiries composed by SCB. The surveys and inquiries contain narrow and easy-to-answer questions adapted to a specific clientele. The answers are provided by giving a note on a scale from 1 to 4 (see Figure 2). By doing this on a regular basis, it has also become a way of profiling the company and promoting it due to the ability of comparison between different companies in the same public area (SCB, 2008).

1 = Do not agree at all 2 = Do partly agree 3 = Do broadly agree 4 = Do completely agree

	1	2	3	4
1. It is easy to get in contact with us				
2. It is easy to get in touch with the right person				
3. The answer you got was useful				
4. The correspondent used an easy vocabulary				
5. The case has been treated fast				
6. Generally speaking, you are satisfied with us				

Figure 2. Example of a NKI survey (Falkäng and Wilhelmsson, 2005:26).

Educational Environment in Stockholm
How satisfied are you with…

	Not Satisfied at all 1	2	3	4	5	6	7	8	9	Totally Satisfied 10	No opinion
1. …The introduction you got when you first started at this school?	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
2. …The quality on your education?	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
3. …The competence of the teachers?	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
4. …Access to the library?	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
5. …Access to study places?	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Figure 3: Example of a CI survey (Statistiska Central Byrån (Statistics Sweden), 2008).

Especially designed for Swedish academic campuses, Campus Index (CI) is also broadly used throughout Sweden. This index operates very similarly as the NKI one, by using surveys and inquiries and applying statistical analysis on the results. It has the advantage of being more focused on Campus issues. CI is thereby complementary to NKI by focusing on accurate issues of Campus life. The scale used to answer the surveys is broader than the NKI one, going from 1 to 10 points with the option of "No opinion" – see Figure 3.

3. METHOD

In order to evaluate how the organization of a company can affect the company's customer satisfaction, a qualitative case study was performed, where theory was compared with the results from an empirical study. The empirics are based on a study of a small scale real estate company, CREC, located in Göteborg. Since CREC is a Swedish company and not all information was available in English translations of some documents and terms have been done by the authors.

Three interviews were held with employees at CREC. In order to receive different aspects and views about how the company's structure can affect customer satisfaction, interviews where held separately and with employees at different hierarchical levels within the company. Interviews were held at each level of the organisation: with the Managing Director, the Properties and Letting Manager / Head of Operations and one of four Campus Planning Managers. The Campus Planning Manager is the lowest level in CREC's organisation having direct contact with the customers. The questions asked during the interviews were direct, and occasionally complemented with follow-up questions. The questions regarded the employees' perception as well as the company's view of issues related to customer satisfaction within their company.

4. RESULTS

Chalmers University of Technology (CUT) founded CREC as an underlying company in 1999 with the purpose to take care of the planning and the supply of premises of CUT's campuses. The aim of CREC is to create an attractive, purposive, competitive and world leading campus environment. Their work consists of estate management, leasing and designing properties for both study purpose as well as for private external customers established in Chalmers Campuses. A goal for the department of Properties and Letting at CREC is to provide CUT with the most cost/service efficient buildings as possible. Quality, quantity and a good environment for students, teachers and researches are key words for CREC's business.

CUT is obligated to use CREC as their premises provider. The type of ownership and responsibility of management of the campus is unique in Sweden. Therefore, there is a certainty within CREC that the company will be operating as long as Chalmers is active. This is motivated by that CUT prefers to manage their real estate services in-house. Hence, CREC claims that the risk of being out of work is minimal. CREC do not believe that they have any rivals to their core activity, which is to supply CUT with premises at a low rental cost. CREC has two main customers: the internal customer, CUT, and the external customers, consisting of the tenants that are leasing on the campus area without being a part of CUT. The situation and the relationships between CREC's internal and external customers are different.

As CREC is a non-profit making real estate company, success and progress has to be measured in some other way than profit. In CREC's case, customer satisfaction is an important indication of the status of their work. They measure customer satisfaction for both internal and external customers with the NKI system. According to the surveys, the external customers are more satisfied than the internal ones. Campus Index (CI), which has many similarities with the NKI as described in the theoretical framework, is used as

an extra tool to measure the internal customers' satisfaction with the campus environment. The data collected from the NKI and CI surveys are evaluated and discussed during an annual workshop in June. The discussions result in work packages of what CREC shall improve and focus on during the coming year. The work packages are controlled every three months to follow the progress. CREC has also visited other campuses to get inspiration and ideas of how to continuously improve the campuses. CREC finally use an external consultant to evaluate its own performance within the company.

CREC reckons that the work differs between the internal and the external customers. There is a tendency to put more effort on the external customers. This has to do with the competition on the real estate market, and the fact that the more rent income CREC is able to receive from their external customers the more CREC is able to reduce the rent for its internal customer, CUT. This reduction in rent for CUT is a huge asset for CREC as it greatly satisfies its main customer. The satisfaction of their internal customers is nevertheless still their main focus and all improvements that can be made on the external market would, in the end, benefit CUT by having lower rents.

CREC's organization worked for several years with an extremely formal decision making organization. A hierarchy indeed existed but no real borders where visible in CREC's previous organization. In case of problem, when a customer contacted CREC, it was often the first person to answer that was responsible to sort out the problem. A real informal culture and flat hierarchy was used. This organization ended up in lack of clarity for the customer and a lack of efficiency within the organization. The lack of defined and officially recognized units of decision making was the main problem.

A couple of years ago, CUT asked for more clarity in the management of the campuses real estates. This resulted in that CREC made a shift in its organization structure. The intention was to create a more intimate relationship with the customers to be able to improve and speed up answer time to customers' requirements, services and communication. The structural change mainly consisted in dividing the campuses into four areas and in tying one person to each of them. By this change, the organizational design of the company was shaped into four independent units of decision making.

However, no clear strategy on efficiency through their organizational design is really claimed by CREC and no additional information has been highlighted during the interviews. It seems that CREC does not have a clear and well-stated strategy; nevertheless it does not mean that CREC has no strategy. The new change implemented last year within CREC's organization brought about an informal strategy strongly related to the new organization. This new organization based the informal strategy on three main points based on clearer relationships and responsibilities.

The first aspect of the change consists in the promotion of *easier and clearer relationships* with its customers by being organized in four geographical regions. The customer now has one contact person at CREC for any type of problems. The second aspect relies on the new division into four areas of CUT's Campuses, which permitted a *reallocation of the responsibilities* within CREC's organization to manage the campuses. Each area has a responsible in CREC who is able to take decisions and handle day to day issues. These kind of simple relationships between CREC and its customers and the clear distribution of responsibilities helped to create a good atmosphere and trustful relationships that improve customer satisfaction. Clarity is emphasized in providing easier relationships and on giving responsibility at the scale of the area manager also helped to increase efficiency within CREC. Efficiency has thereby a direct impact on customer satisfaction.

The last aspect of this informal strategy pointed out during the interviews: CREC tends to know a relative *informal distribution of responsibilities*. The responsibilities and the decision-making tend to move to the bottom of the organization when it comes to day to day tasks or in case of urgent situations. The exchanges between the decision makers within the company are therefore enhanced by this informal culture. As CREC is a small

organization, this kind of informal distribution is possible without creating a disorder in the organization. On the contrary, it actually helps CREC to be more reactive and better able to answer efficiently to their customers' expectations.

5. DISCUSSION

CREC enjoys a relative success in its mission of managing CUT Campuses. Last year's figures show a healthy positive trend with a good satisfaction of their customers, both internal and external. In few words, CREC is in a good health with good results and relatively satisfied customers. The results of the interviews at CREC furthermore show strong similarities, but also slight differences with previous research and the common practices in the real estate sector.

CREC has many similarities with governmental organization and thus can be easily likened to one of them. In governmental organizations, the main goal is to provide an efficient public service with the lowest amount of cost. This is the case of CREC, as it has to provide the best and efficient services at the lowest costs. To fulfil its mission, the company leans on an efficient organization to avoid any kind of waste and on external customers which give CREC a financial income in order to lower the rent for CUT.

In order to manage efficiency, previous research has shown that focusing on the process of learning through loops of feedback and feed-forward based on empirical information is one of the best ways forward. By using the Campus Index and the NKI models to evaluate its performances towards its customers and by using an external consultant to evaluate its own performance within the company, CREC seems to be a good pupil by showing a real interest in learning through loops and feedbacks based on empirical information. This way of tackling effectiveness in a pragmatic way seems to bear fruit for CREC. The main review is done once a year, which is too few if there are no other feedback. Yet, the practice of assigning one contact per area permitted an increase in the amount of feedbacks. The weekly meetings also help to manage this feedback and permit to implement reactions and loops processes such as describe by Argyris and Schön (1978), to improve CREC inner process and performance.

However no holistic approach on the feedbacks has been observed within CREC's organization. Sequential decision making as described in the theoretical background is therefore not applied. The use of a more holistic analysis of the feedbacks would help CREC to understand each impact of decisions and actions they made as a whole. It is obvious that customers do not pay attention to each action taken by CREC, but customers base their opinion on CREC by looking at the entire package of actions that CREC took through a significant period of time (from 1 month to several years). Using a sequential decision making as described by Naoki *et al.* would be greatly beneficial for CREC's efficiency.

According to previous research, high efficiency is also linked with decision-making, the importance granted to the decision-makers and the exchanges between those decision makers within the organization. The allocation of four decision making units and of one decision maker per unit is a step towards a better efficiency through a clearer decision-making structure. Nevertheless, CREC could improve its process of decision-making and its distribution of responsibilities. The main impression that the interviews gave is that CREC have a tendency to base the decision-making process on an informal way where the bottom of the organization is relatively free in making decisions. This kind of practice permits CREC to be more efficient in answering customer's requirements and to have a closer relationship with its customers. Indeed, this informal shortcuts culture enhances exchanges between CREC's employees, which are particularly beneficial for the company's efficiency in customer satisfaction. However, it can only work in small organizations where informal communication between employees works well. This point could become a weakness if CREC would expand or if communication within the company would deteriorate in the future.

The organizational structure of CREC has been changed through the change applied few years ago. The organization cannot be strictly categorized into one kind of organizational structure that has been seen in the theoretical background. CREC's organization tends to move toward a decentralization structure at its bottom structure with no inner competition. Yet, the new distribution of decision-making into four units could have an impact on the inner competition between the employees. The top of the organization still keeps a hierarchical style with plans and goals settings. The maximisation of the outputs stays of great interest in the organization. CREC's structural organization emphasizes flexibility and informal shortcuts in decision makings to guarantee a fast reactivity and satisfied customers. This kind of organization is to develop but a more official structure allowing flexibility is preferable to high informal shortcuts out of any control.

The common practices within the real estate sector, especially in North America, show that a lot of companies carry out frequent benchmarking, using the same review on several companies of the same type, in order to evaluate their position concerning the market and their performance. CREC did several visit to Swedish and international universities to get inspiration for their mission. However CREC is not familiar with using benchmarking as the company does not fully operate within a competitive environment. A five-yearly benchmarking could be helpful and a good source of inspiration for CREC, without being too much demanding.

The information and opinions that came out from the interviews can be regarded as reliable as CREC is a small company of 20 employees and the interviews were held with three persons, each one representing different levels of the hierarchy. However since the change in the organization occurred last year, the impacts cannot yet be well identified and measured, thus the study does not dwell on this point. Nevertheless, the study is reliable for the analysis done on the change concerning informal and clearer responsibilities, decision-making, simpler relationships with the customer.

6. CONCLUSIONS

Despite the fact the CREC has a particular status due to that its owner is also its main customer, the study carried out well reflects in a general way the recommendations advised in previous research. The new organizational change that occurred last year within the company had a positive impact by clarifying the relationship with the customers and the decision-making process. Due to its small size CREC enjoys a relative informal decision-making process at the bottom level of the company which facilitates a high reactivity and improves the company's efficiency. However this kind of informal process could become risky as it relies essentially on individuals and good relationships rather than on a clearly defined process.

The use of loops of feedbacks and feed-forward in order to evaluate CREC's performances with the customer and within its own company, as previous research recommends, seems to be very effective and produces good results. Still a lack of comparison with other campuses and real estate companies has been identified. Benchmarking of such kind would help CREC to improve its performances. A next stage would be to analyze, after a minimum period of three years, if indeed the new change in the organization affected customer satisfaction. The different mechanisms of the impact on customer satisfaction will be to explain in order to capitalize the knowledge take out of this case study.

7. ACKNOWLEDGEMENTS

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THE FIRM'S ACTIVITY COORDINATION – IDENTIFICATION OF RESEARCH QUESTIONS

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ABSTRACT

Industrial markets are distinguished by a multitude of activities, performed in the refinement and movement of products, as well as in the production and consumption of services. Such markets can be recognized as consisting of complex structures of activities, theoretically identified as activity patterns. These patterns are characterized by relatedness between activities, continuous change with regard to this relatedness, and the central role of the firm. The way the firm coordinates its bundle of activities has major implications on its competitive ability. Therefore, this paper will explore the firm's activity coordination with the aim of specifying relevant research questions. Three distinctly different activity interdependency types, and related concepts for analysis, have been identified, together with four alternatives for activity adaptation. As a result, five research questions targeting the firm's activity coordination have been specified.

1. INTRODUCTION

Industrial markets are distinguished by a multitude of activities, performed in the refinement and movement of products, as well as in the production and consumption of services. When observing such markets, a number of individual branches can be identified. Industries such as automotive, construction and textile can be seen as separate, working in their own business environments characterized by particular conditions (see, for example, Altany 1992). Some industries are for example distinguished by very fluctuating demand, while other industries rely upon a more stable demand pattern (Berger and Piore 1980, Hiebert 1990, Cheung and Ng 2007). In addition, some products are seasonal, whereas other products display more non-seasonal demand pattern (Rand 1986, Withycombe 1989).

Regardless of product in question, industrial branches are often identified based upon the consumer-related end-products that they deliver. From this perspective, the automotive industry produces various kinds of vehicles, in comparison to the textile industry, providing us with for example clothes. What is often not reflected upon to the same extent are the numerous activities preceding for example the delivery of a car. The car manufacturer primarily assembles parts from different suppliers. These suppliers, in turn, are relying on their suppliers for providing them with the input needed for their operations. Continuing on this path, we end up in steel plants, cotton fields and coal mines, representing the extraction of raw materials used for a vast number of purposes. Just as the identification of raw materials allows the linking of different industrial branches to each other, so does the breakdown of individual products. From an industrial perspective it thus seems difficult, and also misleading, to separate between branches, especially when considering the raw materials from which the products originate. Instead, we are faced with a picture of industrial activities as diverging and converging at different places on an industrial market, enabling the production and final delivery of end-products. As a result, industrial markets are more accurately identified as complex structures of activities, related between in a way not describable through the separation of industrial branches or end-products.

Industrial activities are performed by firms. Some firms are involved in the refinement of several different end-products, some of them distinguished by a fluctuating, seasonal demand, whereas other are instead experiencing demand stability. In activity structures,

firms hold different positions. Some firms perform only a very limited number of activities, consider for example a smaller specialized firm, while other firms are more vertically or horizontally integrated (Ensign 1998, Ciarli *et al*. 2008), performing a higher number of activities, for example for pursuing economies of scale and scope. How the activities of a firm are being performed and related greatly affects its competitive ability, understood as the firm's opportunities for establishing and repositioning itself in an activity structure. For this reason, activity performance is not something established once and for all, but it changes, for example when new business opportunities reveal themselves. A firm constantly works at identifying and approaching new customers. At the same time, old customers might be lost to competition or turning unprofitable due to changing business conditions. For this reason, once a firm has established itself in an activity structure, it needs to work with repositioning.

The activity structures result from the relatedness of activities. The activities performed within an individual firm are for example related into forming various production processes. On a more aggregated level, firms are identified as related in their respective exchange activities. An individual firm, as well as an individual activity, is dependent on receiving input somewhere from, and delivering output somewhere to. This relatedness does not come about without effort. Given this realization, relating activities becomes something of a conscious action of the firm, attempting to organize its intra-firm activities at the same times as positioning itself as best it can in the activity structure of which it is part. This relating of activities is often referred to as coordination (Van de Ven *et al*. 1976, Malone and Crowston 1994). Considering a firm producing a certain product, coordination is identified as planning and organizing done for facilitating this production. It can also refer to adjustments made of the production process, for example as a response to the changing needs of an important customer. Not trying to be exhaustive, these examples indicate the wide range of initiatives that can potentially fall under the heading of coordination. From an activity perspective, coordination can be translated into the matter of making adaptations. For example, it has been shown that benefits can be reaped from suppliers and customers making adaptations to one another (Hines 1994). There are several examples of ways in which firms try and relate through a more tight adaptation of their individual activities, considering for example the adoption of management strategies such as SCM, JIT, and BTO (Turnbull *et al*. 1992, Arshinder and Deshmukh 2007, Gunasekaran and Ngai 2009).

2. THE PHENOMENON OF INTEREST

As established above, industrial activities forego in complex activity structures. These structures are characterized by relatedness between activities, continuous change with regard to this relatedness, and the central role of the firm. The firm is identified as the 'relater', the one creating and changing the relatedness between activities, sometimes on its own, considering intra-firm activities, sometimes in cooperation with other firms, when instead focusing on exchange activities. Relating activities is identified as coordination, recognized as a conscious action of the firm for establishing and repositioning itself in an activity structure. The coordination of activities is of crucial importance for all firms present in an activity structure, given that it affects most issues relating to the current and future operations of a firm, e.g. the division of labour (Galbraith 1977), the utilization of resources (Penrose 1959), and the cooperation and affiliation with other firms (Richardson 1972). As interpreted by Burton and Obel (1984), coordination can be compared with an iterative approximation of a solution to an optimization problem. This statement supports the notion of activity coordination as representing an ongoing challenge for a firm.

Following these thoughts, the phenomenon for exploration in this paper is the activity coordination of the firm. That is, the active and reactive relating of activities, within as well as between firm boundaries. Given that the basic entities of the activity structure are the activities themselves, individual activities and their relatedness will pose as the

starting point for this exploration. Of central interest is the variety of ways in which activities are coordinated by the individual firm. This interest involves two separate dimensions; one targeting principal ways in which activities can relate to each other, the other involving the likely need for adaptation of one or several activities for creating this relatedness. Thus, the purpose of this paper is to identify research questions for the exploration of the variety of ways in which activities are coordinated by the firm, in turn enabling analysis of as to how this coordination implicates on the competitive ability of the firm. Given this purpose, the paper differs from a more regular conference contribution in that it entails a problem analysis, enabling and defining future research efforts.

2.1 From activity patterns to individual activities

The complex activity structures identified when exploring industrial activities can theoretically be understood as activity patterns (Håkansson and Snehota 1995). Activity patterns consist of a multitude of individual activities directly and indirectly related to each other (Håkansson and Johanson 1992), exemplified in Figure 1 below.

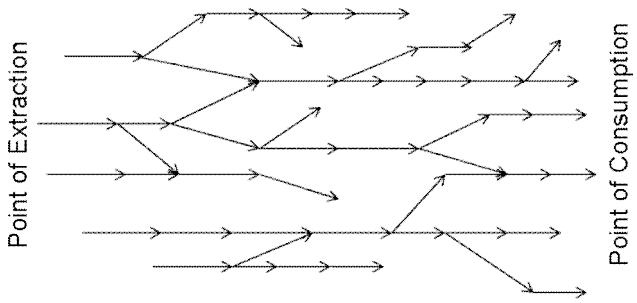

Figure 1. Exemplification of an activity pattern.

Activities are related both in sequence and parallel in the activity pattern. It is easily recognised that products consumed usually originate from several sources of raw materials. On the extraction side we find steel plants, cotton fields and coal mines, often identified as process industries, sourcing production processes positioned further into the activity pattern. In these production processes, inputs from various sources are combined and refined for creating outputs with new characteristics. An output might in turn be assigned to a single following activity, i.e. be customised with regard to that activity, or used as input for several following activities. The sequential relatedness between activities in the activity pattern allows the identification of activity chains (Håkansson and Snehota 1995).

Figure 2. Exemplification of an activity chain containing five individual activities.

Activity chains are observable for example in production processes and the delivery and subsequent refinement of a product. In actuality, all activities are part of one or several activity chains, as they require input for their performance, as well as result in some output. The parallel relatedness in the activity pattern can be identified as relatedness between individual chains. It is also recognizable when considering an activity preceding several following activities, which are otherwise preformed independently. Taking it one step further, the individual activity is up for scrutiny. Activities are performed for

achieving certain outputs. From an industrial perspective, these outputs can relate to the transformation or transaction of a physical product, or the fulfilment of a service. What is actually identified as an individual activity differs depending on analytical purpose; sometimes the production of an entire car can be considered as one individual activity, but more often the level of analysis represents an increased level of detail, for example breaking down the assembly line of the car producer in a number of sequential activities. As a guidance, activities can be identified based upon the actor performing the activity, the resources activated for this performance, as well as when the activity is being performed.

2.2 The actor in the activity pattern

Activities are performed by actors, identified as companies (Håkansson and Snehota, 1995), business enterprises (Snehota 1990), or firms (Bygballe 2006) etc. In this paper, the concept of firms will be used. This concept holds ground even when acknowledging the increased importance of for example strategic alliances and business nets, complementing the traditional view of the firm as a monolithic actor (Möller *et al*. 2005). At the same time, this realisation broadens the concept of the firm somewhat, as the identification in this paper is related to the observation of active and reactive relating of industrial activities. From this follows that also business units, especially when considering large diversified firms, or certain partnerships can be conceptually identified as separate firms for the purpose of this paper. In the activity pattern identified above, each firm performs a number of activities. In this perspective the firm is seen as a bundle of activities (Gadde and Håkansson 2001). These activities are usually related both in sequence, considering the activities of a production process, and in parallel, identified for example when two otherwise unrelated activities utilize the same machinery for their performance.

Activities performed within the boundaries of the firm are identified as transformation activities, whereas activities crossing firm boundaries and thus connecting different firms to each other are identified as transaction activities. These two activity types are coordinated differently. For activities performed within the boundaries of a firm, it is the responsibility of the firm to relate them in the best way possible. Considering instead transaction activities, these coordinate between the internal activities of several firms, why their coordination also becomes an issue for these firms. For the purpose of this paper, the most important role of the firm is the active and reactive relating of activities, within as well as between firm boundaries. How this is done represents the variety of ways in which activities are coordinated by the individual firm. Considering the individual activity, coordination becomes an issue of adaptation. That is, coordinating two activities to each other might imply the need to adapt of one of them, or both. For the firm, this challenge looks principally different depending on if both activities are performed internally, compared to if another firm is also involved in the activity performance.

2.3 Activity coordination

As already established, coordination is identified as the conscious act of relating activities to each other. Two separate dimensions are involved, one focusing on the variety of ways in which activities relate, the other on the need for adapting activities for creating relatedness. For creating a working definition of the concept of coordination, its aim also needs to be reflected upon.

The way activities are performed is of fundamental importance for the efficiency of the firm (Håkansson and Snehota 1995). Further, acknowledging the existence of activity patterns puts emphasis on the relatedness of activities. An individual activity can always be maximized in its own right, but it is in relation to other activities that the value of the activity is determined. Successful coordination of activities should therefore provide the firm with opportunities for establishing and repositioning itself in the activity pattern,

thus positively influencing its competitive ability. From this realisation follows the definition of coordination, used for exploration of the purpose of this paper; *Coordination is the act of relating activities with the purpose of providing the firm with opportunities for establishing and repositioning itself in the activity pattern.* As implied by this definition, coordination could be considered as an activity in its own right. For avoiding confusion, the activities object for coordination are identified as either transformation activities, performed within the boundaries of a firm, or transaction activities, performed for connecting the transformation activities performed by different firms (Dubois 1994). Transformation activities are directly related to the refinement of physical products, for example as parts of a production process. Transaction activities connect different firms with each other by connecting these production processes. As such, the transaction activity could be identified as a coordination activity, as in fact what it does is to relate transformation activities of different firms to each other. The distinction here is that, at the same time as we acknowledge the coordinative aspects of the transformation activity, coordination is recognized as focusing on the interface between two activities.

2.4 Activity interdependence

As discussed in previous sections, activities are related. A concept commonly used for targeting this relatedness is interdependence (see, for example, Forsgren and Johanson 1992 or Håkansson and Snehota 1995). Activity interdependence captures the need for relating activities with regard to each other; an individual activity only makes sense in relation to other activities. Coordination of activities thus results in activity interdependencies, which in turn can be of several different types. Given the activity pattern above, two principally different activity interdependency types can be identified.

The sequential interdependence between activities has been exemplified above and is immediately identifiable when observing industrial activities. It is considered to represent one of the most obvious ways in which activities are interdependent. *Sequential activity interdependence* is identified between two activities when one of them can only be performed given the successful performance of the other (Thompson, 1967).

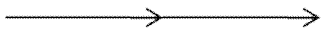

Figure 3. Sequential activity interdependence.

Extending the analysis of activity interdependencies further it is identified that two activities can be interdependent through their individual sequential interdependence to a common third activity. Beside the pure sequential interdependence involving multiple activities, two principal kinds exist; two activities both preceding the same activity, with which they are sequentially interdependent, or, two activities following it. This interdependence, recognized through the relatedness to a common third activity, is identified as *parallel activity interdependence*, targeting the parallel relatedness identifiable in the activity pattern.

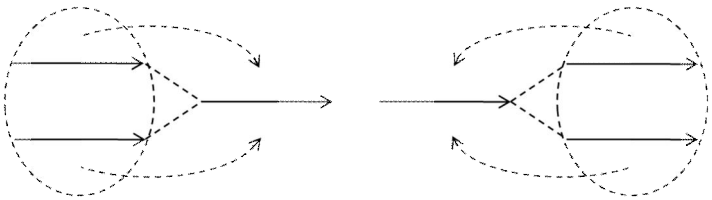

Figure 4. The two kinds of parallel activity interdependence.

A product is identified as a resource element, required for activity performance (Håkansson and Johansson 1992). Firms make use of a wide variety of resources, both tangible and intangible (Håkansson and Snehota 1995). For the purpose of this paper, a distinction between two principally different kinds of resources is made. First, we have resources such as the product described above. This resource represents an object for the activity performance, that is, the resource is in itself refined as a result of the performance of the activity. Second, we have all the resources necessary for enabling this activity performance. Consider for example the machines utilized in a production process, the personnel employed for overseeing and improving this process, and the administrative routines established for facilitating the activity performance. These resources are not refined and changed as a result of the activity performance, but are instead viewed upon as enabling this. The first kind of resources is recognized in the input and output of activities and as such implied in the sequential and parallel activity interdependencies identified above. The second kind of resources is on the other hand not covered by these interdependency types, and need therefore be considered separately. A firm has a certain resource collection (ibid), consisting of for example machines and personnel. These resources are required for performing individual or multiple activities (Håkansson and Johansson 1992). Activities can therefore be related in that they share the same resources. The resulting interdependency type is recognized as *resource-related*. Its importance relates to the need for performing two activities in a way allowing for their common resource to be utilized for the performance of both of them.

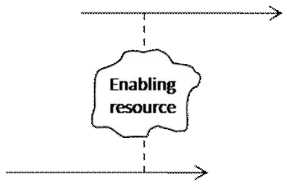

Figure 5. Resource-related activity interdependence.

2.5 Concepts for the analysis of activity interdependency types

This section will present concepts enabling the future analysis of activity interdependency types. The concepts target the simultaneous need for balancing between the specific and the general, although approached from different angles. Considering only activities within the boundaries of a firm, the challenge for the firm is related to maximising the activities, both in isolation and in their coordination. If the firm is allowed to pursue economies-of-scale in operations, not considering whether someone absorbs the produced outputs or not, this will enable the firm maximum efficiency. Standardising activities and organising resources accordingly will maximize their utilization. The need for customisation is introduced to the firm through different business relationships. These relationships differ with regard to the character of their activity links (Håkansson and Snehota 1995), in some cases making it necessary for the firm to adapt its activities specifically with regard to an individual customer, or supplier.

The direction of the activity pattern highlights the sequential activity interdependencies present between activities. Activities being sequentially interdependent need to be performed in a certain order, as one activity can only be performed given the successfully completion of a previous activity. Two neighbouring concepts that can be used for analysing the sequential interdependence between activities are *complementarity* and *close complementarity* (Richardson 1972). Complementary activities represent different phases of a production process and require coordination (ibid). Indicating an even stronger need for activity coordination, close complementarity

between activities denotes an activity directed to a certain other activity (ibid). This distinction represents the difference between standardised and customised activities, where the former are performed for various purposes and users, while the latter are part of only one end-product related activity structure (Dubois 1994). From a sequential perspective, a firm needs to perform both complementary and closely complementary activities, acknowledging the concurrent need for performing activities of more general nature, among other for pursuing economies-of-scale, and more specialised, for adapting to the needs present in individual business relationships.

Having established that activities can be interdependent through their individual sequential interdependence to a common third activity, also this interdependency type needs a related concept. Given the sequential aspect of this interdependence, a distinction between standardised and customised is also to be identified here. A distinction is made whether the activities, being object to parallel activity interdependence, are exclusively related to the third activity in question, or if they are also, individually, sequentially related to other activities. Considering when two activities are related in that they both source the same third activity with inputs, the distinction represents two alternative situations. Either, the two activities are exclusively sourcing the third activity, or, they are individually also sourcing other activities. When two activities are related in that they share input from a common third activity, the distinction represents the difference between if the activities only receive input from this single activity, or, if they individually also receive inputs from other activities. Depending on situation, the two activities will affect each other differently. As identified in this paper, the concepts for analysis of this parallel activity interdependence are defined as *specific and general parallelism*, respectively.

As established above, firms need resources to enable the performance of activities. These enabling resources can be tangible, considering for example machines and facilities, or intangible, identified as the knowledge and skills of the personnel etc. For capturing this resource-related activity interdependence, Richardson (1972) defines activities which require the same capability for their undertaking as *similar* activities. This means that the capability, or resource, can be used for undertaking (performing) more than one activity (Dubois, 1994). A machine possible to use for the performance of several activities of a production process exemplifies such a resource, but it can also be a resource enabling the concurrent performance of two or more separate activities. Activities which require different capabilities for their undertaking are instead identified as dissimilar activities (Richardson 1972).

2.6 Activity adaptation

Activity coordination is effectuated by making adaptations. Creating relatedness between activities is thus a matter of adapting these activities to each other. From the perspective of the business relationship, adaptations can therefore be seen as an investment process (Brennan and Turnbull 1996). In this paper, adaptation is closely connected to activity performance, focusing on the way firms actively and reactively respond to the needs posed upon them through existing business relationships, resulting in adaptation of their internal activities. Identifying the firm in the activity pattern above, it is recognized that only a very limited number of activities are performed within the boundary of one individual firm. The other activities are performed outside this boundary, by other firms. As activity interdependencies cross firm boundaries, firms need to relate their respective activities to the activities of other firms. The interdependence between activities performed by different firms is captured with the concept of activity links, which in turn is identified as part of a business relationship. According to Håkansson and Snehota (1995), the linking of activities reflects the need for coordination and entails adaptation of activities between firms. When activities are performed by an individual firm, coordination becomes an internal matter of the firm. If the activities are instead performed by different firms, the interdependence crosses the

boundaries of the involved firms, exemplified with sequential activity interdependence below.

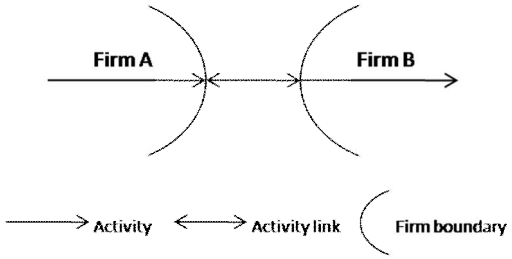

Figure 6. Sequential interfirm activity interdependence.

The involvement of separate firms implies that potential adaptation of the activities needs to somehow come about in interaction between these firms. The adaptation can involve both activities, only one of them, or, if relying on a more standardised exchange, both activities are changed at a minimum. This realization provides us with four alternatives for coordination of activities from the perspective of an individual firm.

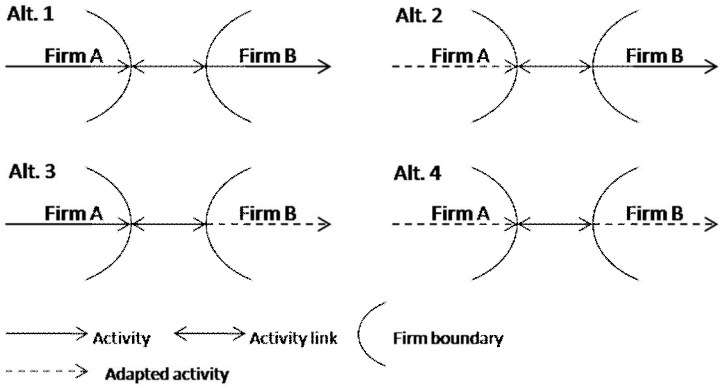

Figure 7. Alternatives for coordination of activities through activity adaptation from the perspective of Firm A.

3. RESEARCH QUESTIONS AND CONCLUSION

The exploration of the firm's activity coordination has led us to discuss the relatedness of industrial activities, identified as activity patterns. In these patterns, firms establish and reposition themselves through the coordination of activities. How this is done has major implications on the firms' competitive ability, why it needs further specification. For this reason, a number of different activity interdependency types have been identified. In connection to this, the adaptation of activities has been approached by discussing principal ways in which relatedness can come about, seen from the perspective of the firm. Expanding upon the purpose of this paper, it is now possible to identify more specific research questions for further exploration:

- How does the firm coordinate activities for creating sequential activity interdependencies, exploring the concepts of complementarity and close complementarity?

- How does the firm coordinate activities for creating parallel activity? interdependencies, exploring the concepts of general and specific parallelism?
- How does the firm coordinate activities for creating resource-related activity interdependencies, exploring the concept of similarity?
- How does the firm coordinate its bundle of activities for balancing between all three activity interdependency types?
- What implication can be identified from the coordination of activities concerning the firm's opportunities for establishing and repositioning itself in the activity pattern?

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COST INEFFICIENCIES IN CONSTRUCTION

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ABSTRACT

Cost inefficiencies in construction are identified, thereby contributing to the current debate about unsatisfactory productivity in the industry. The paper suggests that by focusing on the reduction of cost inefficiencies it is possible to increase productivity. The methodological approach is based primarily on a comprehensive review of relevant literature. Four key issues leading to cost inefficiencies have been identified: (1) a great deal of non-value adding activities (waste), (2) high degree of uncertainty, (3) lack of standardisation, and (4) resistance to change. The interrelatedness of these issues is discussed and an integrated model is presented for consideration. Awareness of how to reduce cost inefficiencies is important in order to improve profit margins in construction. Identifying, discussing, understanding their interrelatedness and addressing these cost inefficiencies are necessary steps towards improvement.

1. INTRODUCTION

Although productivity in construction is commonly considered to be unsatisfactory, statistics clearly show that year on year overall productivity has risen steadily (e.g. Hauptverband der Deutschen Bauindustrie e.V., 2008; BERR, 2007; SCB, 2008). This apparent contradiction needs to be explained. One possibility is that that overall productivity in construction has risen because of advances in technology that has helped to reduce labour costs. If productivity is defined as the ratio between outputs and inputs, the value will increase when the input is reduced while the output is held constant or when the input remains the same and the output is increased. Advances in technology can also be related to the decreasing number of employees in the construction industry over recent years. The perceived low productivity in the construction industry is not actual productivity per se, but cost inefficiencies that are triggered by poor decisions and actions. Overall productivity has risen but at the same time a high degree of cost inefficiencies remains.

From a comprehensive review of relevant literature, four key issues have been identified as contributing significantly to cost inefficiencies in the construction industry. This paper discusses these key issues, which are: (1) a great deal of non-value adding activities (waste), (2) high degree of uncertainty, (3) lack of standardisation, and (4) resistance to change. Other issues that contribute to cost inefficiencies yet are not considered key and therefore not dealt with in this paper include; low levels of knowledge, poor communication, and little competition.

2. NON-VALUE ADDING ACTIVITIES (WASTE)

2.1 Defining waste

The term 'non-value adding activities' is commonly used synonymously with the term waste (Womack and Jones, 2003; Forsberg and Saukkoriipi, 2007). Formoso *et al*. (2002) maintained that "in general, a very high level of waste is assumed to exist in construction." This was agreed upon by Dainty and Brooke (2004) who stated that the construction industry has a "…lamentable waste management performance…" and referred to McGrath and Anderson (2000), who stated that the typical waste rate within the construction industry is 10-15%. Josephson and Saukkoriipi (2007) claimed that the

waste rate in the construction industry can be as high as 35% of a project's cost. They suggested that the reason for the varying data is that "...information comes from investigations in which the definitions, perspectives, viewpoints, scopes, methods etc. are different…"

Even though numerous authors have identified a high level of waste in construction (see, for example, Josephson and Saukkoriipi, 2007; Dainty and Brooke, 2004; Treloar *et al*., 2003; Formoso *et al*., 2002), the issue neither gains much attention in the literature nor in practice. Treloar *et al*. (2003) stated that "There has … been little development internationally of innovative waste management strategies aimed at reducing the resource requirement of the construction process." This indicates that waste reduction is one of the most important challenges in the construction industry that can help to increase cost efficiency. It is therefore necessary to define what is meant by waste when applied to construction.

Waste refers to both physical waste, also called material waste, and to non-value adding (NVA) activities. According to Forsberg (2008), NVA activities are conditions, circumstances, activities and processes that do not add value to the product. Formoso *et al*. (2002), focusing on the construction industry, defined waste "…as the loss of any kind of resources – materials, time (labour and equipment), and capital – produced by activities that generate direct or indirect costs but do not add any value to the final product from the client." According to Hines and Rich (1997) and Womack and Jones (2003), activities can be categorized into the following three groups:

- NVA activities comprise actions that are irrelevant for the process and can therefore be removed completely without any consequences to the outcome of the final product. NVA activities can be equated with waste. Removing waste should, however, be conducted carefully. For example, attempting to decrease unnecessary movement caused by a spacious setup within a production facility can possibly backfire because the workers might perceive the space as part of a good working climate. Productivity, in turn, might decrease when changing the setup. Also, new wastes can possibly emerge.
- Necessary but non-value adding (NNVA) activities are described as activities that are necessary but that do not add value during the processing. Examples for NNVA are safety regulations that affect the process or unnecessary movement caused by weak layout of the facilities. These kinds of waste can be reduced or removed by changing the setup of the processing.
- Value-adding (VA) activities are those activities that add, due to the processing, value to a product.

The distinction between NVA activities and NNVA activities might in practice not always be distinct. Therefore, reducing waste is a task that has to be conducted carefully. The aim should be to optimise activities or processes without negatively affecting other activities or processes. Womack and Jones (2003) named this process 'value stream mapping.'

2.2 Nine Types of Waste

When talking about waste in general, the production system and philosophy of the Japanese car manufacturer Toyota is commonly referred to. Liker (2004), who analysed the 'Toyota Way' in detail, referred to 7+1 types of waste. At Toyota, seven wastes have been identified, but Liker (2004) added an eighth waste, which cannot be seen as a true waste but more of a potential loss, namely the unused creativity of workers. For the purpose of construction, a ninth waste is suggested to be added to the list: material waste. The rationale behind this is that reusing material is often not possible and recycling of materials is usually expensive in construction. When analysing the seven wastes identified at Toyota, 'Overproduction' 'Inventory' and 'Correction' (rework and

scrap) are arguably related to material waste. However, for the purpose of construction, it is suggested that material waste should also be included. The resulting nine wastes are as follows:

1. *Waiting* occurs when employees have to wait for something to be done within the production process due to various reasons such as machines, stock-outs, delays, or capacity bottlenecks.
2. *Overproduction* occurs when items are being produced without an order. Such items will be unnecessary inventory and in turn lead to storage and transportation costs.
3. The waste *motion* describes unnecessary movement that employees have to perform during the course of their work, such as looking for, reaching for, or stacking parts, tools, etc. Walking can also be considered a waste.
4. *Inventory* corresponds to excess inventory, raw material, work in progress, or finished goods that cause longer lead times, obsolescence, damaged goods, transportation/ storage costs, and delays. Extra inventory can hide problems such as production imbalances, late deliveries from suppliers, defects, equipment downtime, and long setup times.
5. *Processing itself* relates to over-processing and/or incorrect processing where unnecessary steps are taken. Inefficient processing can be caused by poor tool and product design and lead to unnecessary motion and production defects. Waste is also generated when providing higher-quality products than required.
6. *Correction (rework and scrap)* refers to the production of defective parts leading to correction, repair or rework, scrap, replacement production, and inspection. Time and effort are lost.
7. Unnecessary *conveyance (transportation)* of materials, parts and/ or finished goods. This includes transportation of work in process, transportation over long distances, inefficient means of transportation, and the moving materials, parts, or finished goods into or out of storage or between processes.
8. *Unused (employee) creativity* is the risk of losing time, ideas, skills, improvements, and learning opportunities by not engaging or listening to employees.
9. *Material waste* occurs when, for whatever reason, material is being used inefficiently. This kind of waste is usually caused by poor planning, poor material handling and faulty assembly.

2.3 Importance of Reducing Waste

Hines and Rich (1997) argued that removal of waste is important in order to develop a competitive advantage. They further claim that waste reduction does not focus on increasing quality but on increasing productivity. The view that reducing waste is a means of increasing productivity is held by numerous other authors (see, for example, Tangen, 2004; Fearne and Fowler, 2006; Lindell, 2006; Forsberg, 2007). Hines and Rich (1997) used the expression 'leaner operations' to describe an increase in productivity by means of removing waste. It is argued that 'lean thinking,' a term that has been very popular in the last few years, is a concept that was known long before Womack and Jones coined the term. Liker (2004) claims that the idea of 'lean' is based on the Toyota production system that has been in place since the 1960s. Fearne and Fowler (2006) outline the connection between lean thinking and waste by stating that "The rationale behind 'going lean' centres on waste removal both inside and between companies."

The above indicates that waste reduction serves as a means of increasing productivity and helping to develop a competitive advantage. To gain a practical insight into the problems of waste, Josephson and Saukkoriipi (2009) conducted discussions with a number of experienced practitioners from the Swedish construction industry about the most common causes of waste in the industry. The conclusion was that the causes of waste in construction can be categorised as follows: (1) lack of overall view, (2) structure of the industry, (3) competence, (4) business culture, and (5) leadership.

3. UNCERTAINTY AND RISK

Uncertainty can be defined as "…the lack of all the information required to take a decision at a given time" (Winch, 2002). Winch explained that uncertainty has two sources; complexity and predictability. Complexity reflects the problem of information flow and information processing; due to the high cost involved and/ or the excessive time required, it is not feasible to gather, analyse and disseminate all available information connected with a construction project. The problem of predictability mainly deals with prognoses about the future; as the future is uncertain, it cannot be assumed that experiences from previous projects can automatically be applied to future ones; although experiences can provide valuable guidance.

Mills (2001) maintained that construction projects often incorporate high levels of uncertainty. Furthermore, with reference to Hayes *et al*. (1986), Mills (2001) stated that "...risk and uncertainty are part of all construction work regardless of the size of the project." Mills (2001) also noted that assessing project details by conducting studies before the project initiation is a process that contains assumptions about the future and therefore it has to be considered uncertain. This enforces the notion that dealing with uncertainties is crucial to construction projects.

During construction, hidden and irremediable defects sometimes occur. The uncertainty of bad workmanship, which can lead to problems and/ or extra expenses, needs to be taken into consideration. Market conditions can influence prices and thus affect ongoing projects. As calculations are usually conducted long before actual construction starts, price fluctuations can have a negative impact on the budget of a project. Unanticipated behaviour of external stakeholders is another cause of uncertainties in the construction industry. Even if a comprehensive stakeholder analysis has been conducted, stakeholders can change their views over time.

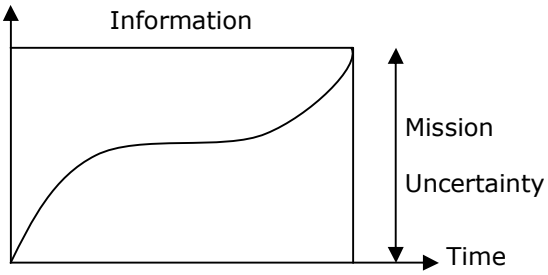

Figure 1. Mission uncertainty over time (Winch, 2002).

3.1 Decreasing Uncertainty over Time

In construction, uncertainty over such things as project details and specifications decreases over time. This is due to an increase in available information for the project (Winch, 2002; Chang and Tien, 2006). The decrease of mission uncertainty caused by the emergence of new information is depicted in Figure 1.

Two links can be established between uncertainty and cost inefficiencies. (1) The relatively inaccurate budget estimates at the beginning of a project are caused by uncertainties. When, over time, information becomes available the estimate becomes more accurate. The lack of accuracy can also be seen as the reason for the separation of design and construction. A shift of risk from the designer to the supplier takes place at the tendering stage, at which time the estimation is about 90% accurate. (2) Due to high uncertainties at the beginning of a project, the possibility to control costs throughout the life of the project may lead to poor decisions. Such decisions can cause great expenses because at a later point in time it might not be possible to change them. Mills (2001) stated that decisions at the very beginning of a project usually have a great impact on the final cost and duration.

4. STANDARDISATION

4.1 Lack of Standardisation

The concept of standardisation is closely connected to the reduction of both process and product variability (Santos *et al*., 2002; Ungan, 2006). Santos *et al*. (2002) defined standardization as an approach that aims at the critical disentanglement of processes in order to foster waste reduction by reducing the process variability. Reduced process variability can further benefit the organisation by reducing uncertainty (Ungan, 2006). Santos *et al*. (2002) identified "…the need of introducing information into the process as an instrument to induce homogeneous practices within construction processes" and state that "Without standards, there is no way of knowing whether an activity is performed correctly or not." In construction, variability refers to the fluctuation, or "process noise" of the elements of the iron triangle, namely time, cost and quality (Santos *et al*., 2002). Less variability leads to a higher degree of consistency. Another advantage of standardisation is that it "…eases the task of identifying the root causes of production problems" (Santos *et al*., 2002). Ungan (2006) stated that "With standardization, the production or service becomes routine with well-defined tasks."

Another point that emerges from the literature is that standardisation reduces construction waste. Dainty and Brooke (2004), who conducted interviews with key stakeholders of construction projects, found that "Standardisation has the possibility to dramatically reduce the current production of construction waste." Edum-Fotwe *et al*. (2004) suggested that, by increasing the degree of standardisation, an organisation can achieve higher productivity. This suggestion is in line with an analysis conducted by Santos *et al*. (2002) who concluded that standardisation encourages companies to focus on reduction of cost inefficiencies.

There appears to be agreement among researchers about the reasons and benefits of standardisation but there are many different views about what standardisation actually is. Although the majority of relevant literature deals only with the standardisation of processes, for the purpose of construction the following three categories of standardisation should be considered; (1) Standardisation of products, (2) Standardisation of processes, and (3) Standardisation of organisations.

4.2 Standardisation of Products

The advantage of standardised components and products was pointed out by Dainty and Brooke (2004). In a study about material waste minimisation, they found that "By designing room areas and ceilings heights in multiples of standard material sizes a substantial reduction in off-cuts had been achieved." The standardised dimensions of gypsum boards are a useful example in this regard. However, material standardisation should also be viewed critically because it can be argued that if all materials in construction were customised, an overall decrease in construction waste could be achieved.

4.3 Standardisation of Processes

Process standardisation deals with the question of how a process ought to be conducted. Giving the workforce proper education to successfully achieve a task is the key to success. Controlling exactly how a task is performed, such as the way in which tools are used, is usually not necessary as long as the process is conducted as specified. Santos *et al*. (2002) talked about "…the need of introducing information into the process as an instrument to induce homogeneous practices within construction processes." Kondo (2000) maintained that workers are encouraged to find new ways of working more efficiently if they are given a feeling of freedom. A positive side effect with this is that this freedom creates a feeling of responsibility but still a control of the overall process is kept.

Santos *et al*. (2002) referred to Imai (1997) who divided standardisation of processes into the following features; (1) standards should represent the best, easiest and safest way to perform an activity, (2) standards provide a method for managing knowledge through the institutionalisation of 'know-how' so that it stays in the company regardless of the comings and goings of employees, (3) standards should be used not only as a reference to evaluate performance but also as a basis for maintenance, improvement activities, training, auditing and diagnosis.

4.4 Implementing Standardisation of Processes

Process standardisation requires changes in the organisation (Gudmundsson *et al*., 2004). A standardised process can be viewed as a routine with a well-defined task (Ungan, 2006) and both time and finances need to be available in order to develop and implement standardisation. This concerns both the development of the process and the education of the personnel. Ungan (2006) claimed that the real challenge with process standardisation is to "get the tacit knowledge out of process participant's head and put it into written documents". He argued that "…knowledge, KM [knowledge management] and process documentation play key roles in standardization." The main problem that makes it difficult for a construction company to implement higher degrees of standardisation is the necessary capital and the time it takes to make the measures work. Financial means and time are usually not available, especially in smaller construction firms. Even though standardised processes could be implemented by construction companies, the constant adaptation to new projects, involving among other things new designs, new sites, and new subcontractors, would arguably make it difficult to sustain.

4.5 Standardisation of Organisations

Standardisation of the organisation focuses on the holistic picture of a firm and the interaction between different levels of the organisation. One aspect is the standardisation of the flow of data. Unstructured information exchange is problematic and can lead to confusion.

5. RESISTANCE TO CHANGE

According to Josephson and Saukkoriipi (2007) "There is a broad opinion that each building project is unique, the building sector is different from other sectors, and the building sector is conservative." Griffin (1995) maintained that "attitudes are of interest in part because of their presumed connection with workplace behaviour". Josephson and Saukkoriipi (2007) contended that the attitudes held within the construction industry are difficult to change, especially in regard to finding new ways of working and reducing costs and stated that "…we convince ourselves that it is not possible to work smarter."

Such an attitude creates suspicion against ideas for new ways of working and makes it more difficult to change (Ford *et al*., 2002).

There is a tendency amongst workers in the construction industry to foster the present situation rather than allowing for changes. The status quo creates a feeling of safety, whereas a future that is unknown, or uncertain, creates a "threat of change" and undermines the stability of individuals (Ford *et al*., 2002). The threat of increased uncertainty is the reason for construction workers to be resistant to changes. Ford *et al*. (2002) further maintained that anxiety and a fear of real or imagined consequences can emerge. The attitudes of conservatism and reluctance to change in construction can also be attributed to the relationship between employee and employer in which their respective beliefs and the "psychological contract" dictate their reciprocal obligations (Rousseau, 1990).

Schalk *et al*. (1998) highlighted the connection between the necessity of change and remaining competitive and provided the following definition of change: "Changes … is the deliberate introduction of novel ways of thinking, acting and operating within an organization as a way of surviving or accomplishing certain organizational goals." The implications of this definition are that alterations in the environment can force an organization to change in order to survive and that conservatism is not beneficial in today's rapidly changing, globalised environment. However, it has to be mentioned that conservatism and resistance to change are not prevailing throughout the whole industry. According to Josephson and Saukkoriipi (2007), numerous younger company leaders of Swedish construction companies believe that production cost can be cut in half and that the industry is capable of working much more effectively.

It is clear from the forgoing that the construction industry is faced with problems of conservatism and resistance to change, even though it is an industry that has experienced major changes over the last 50 years (e.g. Holt *et al*., 2000) and requires constant change to deal with complex projects and organisational structures.

In terms of cost inefficiencies, it can be said that conservatism and resistance to change prevents, or at least slows down, the implementation of new ways of working that are more efficient and would therefore reduce costs. Overcoming this resistance to change can be seen as the key to success. In a rapidly changing and globalised environment, the ability to change and to adapt is more important than ever.

6. DISCUSSION AND CONCLUSIONS

The literature review has shown that there is no single reason behind cost inefficiencies in construction that ultimately lead to unsatisfactory productivity. The review also revealed that low productivity in construction is not the productivity level in terms of more output for less input (this has actually risen) but cost inefficiencies triggered by poor decisions and actions.

The four key issues leading to cost inefficiencies identified in the literature are difficult to fully distinguish from each other and to some extent may be seen as interrelated. To clarify this point, the following examples are provided:

- High amounts of waste in construction can be related to a host of other issues. It is arguable that the high degree of uncertainty, lack of standardisation and people's attitudes in construction could be viewed as sub categories of waste, NNVA activities or NVA activities.
- The business culture and the structure of the industry can be connected to the resistance to change and the prevailing conservatism among construction workers.
- Uncertainty can be attributed to the lack of an overall view.
- The lack of competence and poor planning can be viewed as causes of the lack of standardisation.

- An increase in the standardisation of products, processes and organisations, could lead to a reduction in uncertainty connected to cost estimations.
- Changes in people's attitudes could result in a feeling of responsibility towards the standardised organisation and an interest in the bigger picture. This could also increase the awareness of waste and lead to a personal motivation to reduce waste.
- Waste could be reduced by having stricter standardisation within the industry.

The above indicates that it is not possible to view each factor that contributes to cost inefficiencies separately. Instead, the interrelatedness of the factors can best be viewed by integrating them into a productivity model as shown in Figure 2. A detailed exploration of the relation between the factors is recommended for further research.

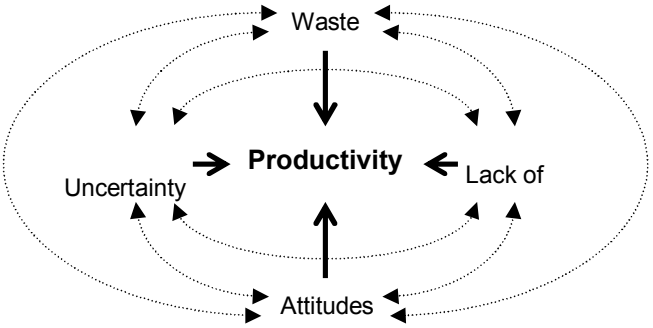

Figure 2. Interrelations between productivity and cost inefficiencies.

Awareness of how to reduce cost inefficiencies is necessary in order to improve profit margins in construction, and to achieve this, cost inefficiencies must be identified, discussed, understood, and addressed. The interconnectedness of cost inefficiencies also needs to be taken into consideration and treatment of only single issues has to taken with a pinch of salt.

This paper focuses on cost inefficiencies related to low productivity. The paper contributes to the ongoing debate about productivity and the reasons for cost inefficiencies in construction. It is clear from the reviewed literature that while there is consensus with regard to the problems associated with cost inefficiencies, there is still considerable debate over how to tackle the underlying issues. Although, further research is needed to find ways to address cost inefficiencies, the following ideas and concluding thoughts are intended to stimulate discussions on the way forward.

There seems to be a need for the construction industry to organise itself in a better way. It is necessary to not only address individual problems, but to also find ways of dealing with the issues on an industry-wide scale. This could for instance be achieved by establishing a cross-company association that would assist in achieving higher levels of integration among the different disciplines involved in construction and promote product and process standardisation; the establishment of a separate institution to promote product and process standardisation is also a feasible idea. The use of cross-company education facilities and training should not only lead to an increase in quality but would also be more cost efficient. Furthermore, such facilities could help to reduce resistance to change by providing a deeper contextual understanding of the whole industry.

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EXPLORING THE COMPLEXITY OF PRODUCTIVITY IN CONSTRUCTION

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ABSTRACT

Productivity is a complex term for which there is no clear definition. This is reflected not only in the daily use of language but also in scientific literature. Terms like efficiency, effectiveness and performance are used interchangeably with productivity. The purpose of this paper is to explore the complexity of productivity in construction and to disentangle the terms and their link to productivity by providing a historical perspective and presenting theories from peer-reviewed literature. Based on this literature, some common definitions have been amalgamated and key issues have been identified for discussing and interpreting the concept of productivity. Most companies focus on profitability in order to satisfy the needs of shareholders, which means that short-term financial goals are placed before long-term productivity considerations. The paper contributes to the discussion about productivity from the perspective of those involved in the construction industry.

1. INTRODUCTION

The high cost of construction has been debated for a long time. Reducing costs is currently a priority for the sector as well as for individual companies. The following statements from top managers in major construction companies support this contention.

> "*Reduced costs is the most important issue in the civil engineering sector*" Mats Williamson, former CEO of Skanska Sweden, www.fiasverige.se, 22 April 2008.

> "*We have decided a difficult, challenging and ambitious goal in reducing the cost of construction by five percent per year in the next five years. And it does not mean to reduce the standard, because that means that you reduce the quality of the end product*" Tomas Carlsson, CEO NCC Construction Sweden, www.byggindustrin.com, 28 November 2007.

In terms of productivity, the construction industry is often criticised for its slow pace of improvement. Productivity is, however, a complex term that raises many different issues. A literature review of productivity identifies problems in the various scientific categorisations and individual understandings of productivity. Due to these differences no prevailing universally-accepted definition can be identified.

However, there does appear to be an agreement that productivity includes comparing outputs and inputs and in recent years the debate has turned towards which of them should be compared. Economists, engineers and technologists have different professional understandings of productivity and therefore focus on different aspects of the value creating process. When focusing on productivity it is therefore important to be clear about for whom and for what purpose productivity is being measured. Different understandings and categorisations of productivity provide a variety of suggestions as to what may be included in the term.

The purpose of this paper is to explore the complexity of productivity with regards to construction. The paper begins with a historical background in order to learn how the perception of productivity has changed over time. To illustrate the complexity of productivity, individual, professional and organisational categories of productivity are presented. The terms efficiency, effectiveness and performance, often used

interchangeably with the term productivity, are described and their relationship to productivity explored. Finally, it is suggested that companies within construction should consider both efficiency and effectiveness when dealing with productivity and relate them to the iron triangle of time, cost and quality in a way that can be assessed by all actors within construction.

2. HISTORICAL BACKGROUND

From an etymological point of view, the term productivity derives from the French word *productif* first mentioned in 1612. This word in turn stems from the Medieval Latin word *productivus*, which means, 'fit for production' (Harper 2001). Tangen (2005) and Kinnander and Almström (2006) maintained that the word productivity was first used in 1766 by François Quesnay, a French economist of the Physiocratic school, in the Journal de l'Agriculture. Harper (2001) stated that the word appeared for the first time in 1809 and was then defined as the "quality of being productive." He further explained that in 1899 it was defined for the first time in an economic sense as the "rate of output per unit."

Until the Industrial Revolution in the late 18th century, productivity was associated with the productivity of land, especially in an agricultural context. Modern technical advances contributed to that productivity of land after the industrial revolution became less important (Tangen 2004). The productivity of land can be increased by modern agricultural methods. Therefore, economic well-being is no longer necessarily dependent on the productivity of land (Pritchard 1995).

The shift from agriculture to industry caused by the Industrial Revolution was accompanied by a shift in use of the term. These days, in the industrialised parts of the world, the term productivity is most commonly related to the productivity of labour (Forsberg, 2008; Pritchard, 1995). During industrialisation, a country moves from low productivity and low income to high productivity and high income; this transition takes time, Clegg *et al*. (2005). Figure 1 illustrates the different steps of the transition process. The starting point is the state of low productivity and low income. Technical innovation and the development of new processes lead to new products and services that encourage the establishment of new industries, which in turn lead to increased labour productivity. In comparison with the previous state, this leads to an increase in output, which in the long run achieves a state of higher productivity and higher income. The whole process is iterative and can also be used to explain the development of countries.

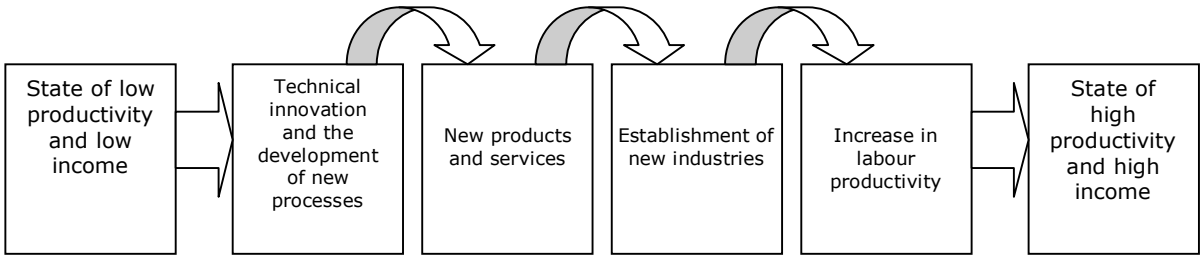

Figure 1. Four steps to increase income and productivity (developed from Encyclopædia Britannica 2009).

It is only since the beginning of 20th century, when organisational scientists started to study organisational structures, that productivity was recognised as an important organisational measure (Pritchard, 1995; Ghobadian and Husband, 1990). According to Rämö (2002), Taylor's ideas, presented in 1911, led to the 'revolution in manufacturing' and the development of facilities for mass production. Since Taylor's 'Scientific

Management', numerous other theories have been established – all with different views regarding the question "how to optimise labour productivity" (Clegg *et al*., 2005). Pritchard (1995) claimed that, since the 1970s, numerous scientists in the field of behavioural science have focused on productivity. The diversity in definitions is identified as the main reason for the difficulty of disentangling the term productivity.

3. DEFINITIONS OF PRODUCTIVITY

No predominant definition of productivity can be identified. Instead, different aspects of productivity are presented. The different definitions found in the literature underline the complexity of the term. A common idea is the relationship between the use of resources and the gains of value, and output compared to input. The literature also identifies the measurement of productivity by focusing on labour. The definitions from the 21st century contain more specified contextual elements and fewer formulas. There is a general discussion regarding the question of which inputs and outputs to compare, as well as whether different organisations need different measures (Forsberg, 2008; Tangen, 2004).

3.1 Three Understandings of Productivity

The individual understandings of productivity described by Ghobadian and Husband (1990) identified three main categories:

1. The engineering understanding
2. The economist understanding
3. The technological understanding.

Each understanding finds applicability with certain individuals on the basis of their different professions (Ghobadian and Husband 1990, Sink 1985). To further elaborate on the understandings a model by Johnston and Jones (2004) is utilised. The model was used in a different context and for the purpose of this paper been dismantled so that each understanding can be examined separately.

The Engineering Understanding

Individuals with an engineering background often use the engineering understanding: it is inherent in their way of thinking. This understanding focuses on the relationship between actual and potential outputs of the inputs and their conversion process (Figure 2). The actual process is the key element in this concept.

Figure 2. The Engineering Understanding.

To explain the three understandings with the aid of a practical example, the combustion engine is taken. From an engineer's point of view, increasing productivity would mean looking at the utilisation factor of the engine. Theoretically, all energy in the fuel before combustion can be transferred into kinetic energy after combustion. This is not the case, since most of the energy is transferred into heat and therefore lost without being used. Increasing productivity from an engineer's point of view would mean to try to increase the utilisation factor.

The Economist Understanding

Individuals with an economic background commonly hold this point of view. Its main focus lies on the financial resources that are allocated for processing inputs into outputs. Of special interest are the financial means used (inputs) and the gains that emerge (outputs) by the process. Figure 3 simplifies the economist understanding. Inputs are exemplified as the cost of human resources, for example cost for labour and other resources like renting machines and buying materials. The outputs are exemplified as revenue, profit and value added.

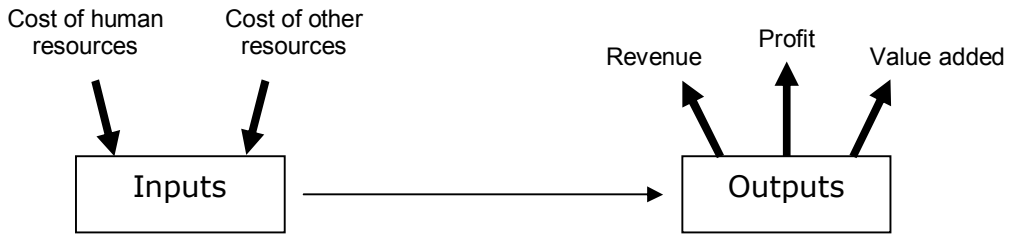

Figure 3. The Economist Understanding.

In the combustion engine example, the economist would look at the costs for running the engine and compare them with the financial outcomes gained from doing so.

The Technological Understanding

Individuals with a practitioner's background are often subscribed to this view. Productivity is viewed as the ratio of non-financial outputs to non-financial inputs used in the production process – see Figure 4. The non-financial inputs contain measures such as the number of costumers and the units of human resources or units of other resources. The non-financial outputs can be exemplified as the units of human resources consumed, the units of other units consumed, the number of goods or services sold and the number of customers processed.

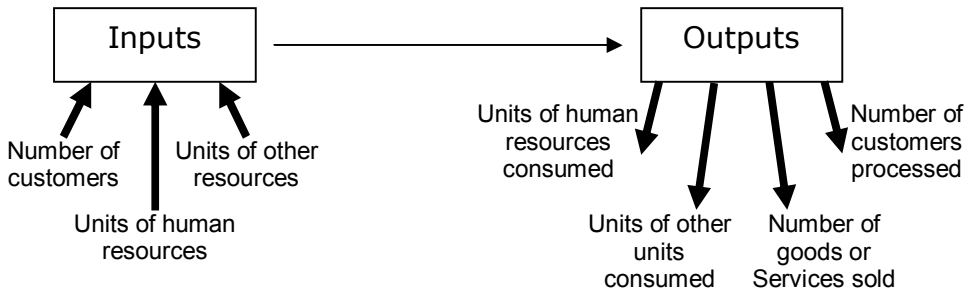

Figure 4. The Technological Understanding.

Looking at the combustion engine once more, the non-financial inputs can be viewed as the amount of fuel before use and the non-financial outputs as the amount of fuel left in the fuel tank after the engine had been run. The means of increasing productivity from a technological understanding is to decrease the inputs and/or increase the outputs.

When looking at these three understandings, it is evident that misunderstanding and misinterpretation can easily emerge. The reason is that, in practice, it is unrealistic to

distinguish between the three understandings because to some extent they are mixed and synthesised.

3.2 Three Categories of Productivity

A definition presented by Pritchard (1995), focuses more on what to include when measuring productivity. A different viewpoint is taken and this categorisation is therefore detached from the individual understandings given above. It distinguishes between three categories of productivity as shown in Table 1.

Table 1. Three Categories of Productivity (adapted from Pritchard, 1995).

Category I	Productivity is a measure of outputs divided by inputs.
Category II	Productivity comprises the two dimensions of efficiency and effectiveness.
Category III	Productivity essentially includes any characteristics that make the organization function better.

Productivity in terms of Category I is usually measured in cost or units in order to allow interpretation and comparison across different settings. The productivity measurements in Category I solely concern the ratio between the inputs that have been used and the outputs that have been generated. Other important factors of the organisation are not considered. Numbers of m^3 concrete, m^2 gypsum boards or m^2 tails or their respective monetary value are examples of output measures, whereas raw materials, labour, machinery or energy are examples of input measures.

Category II introduces the terms efficiency and effectiveness. Efficiency is defined as the ratio between input and output, which can be equated to Category I. Effectiveness, in turn, can be translated as "…the ratio of outputs relative to some standard or objective." Pritchard (1995) expressed in simplified terms, that Category II establishes a link between the output/input measure and a reference value to which this measure needs to be compared.

Category III broadens the scope of the two previous definitions. Based on the second category, it takes a number of additional factors into account. Category III "…essentially includes any characteristics that make the organization function better" Pritchard (1995). Examples of this are, besides effectiveness and efficiency, quality of output, work disruptions, absenteeism, turnover and customer satisfaction.

The question of which of these categories is the most applicable in construction is controversial: caution is imperative when using the term productivity. Some individuals may rightfully claim that the definition used is not valid or not in accordance with their view. To avoid this, Pritchard (1995) argued that agreement should be reached on what productivity comprises before any measurements of it are made.

3.3 Single Factor Productivity and Multi Factor Productivity

Calculating productivity as the ratio between outputs and inputs can be done in various ways. The simplest model found in the literature is single-factor productivity. This measure takes one factor of each input and output into account. The more sophisticated value is that of multi-factor productivity, where numerous factors are considered (Crawford and Vogl 2006). A common single-factor productivity measure is the average labour productivity (ALP). Crawford and Vogl (2006) explained that ALP is calculated by dividing an output measure, usually gross value added (sometimes also gross output), by labour input, which is usually given by the number of workers or hours. An example

of a common multi-factor productivity measure is total factor productivity (TFP). Using the concept of a production function can depict TFP measures.

$O = A \cdot f(C, L, M)$ ...Equation 1 (developed from Crawford and Vogl, 2006)

This equation shows how output (O) and inputs (Capital (C), Labour (L) and Material (M)) are related. *f* () is a function that gives the output for specific inputs. A is the so-called 'shift-factor' that:

> *"…represents technological progress in the production of outputs for a given set of inputs. These include the quality of management, knowledge and techniques, and best practice in various production activities. A is assumed to be 'neutral' in that it acts by shifting the production function f (), not by augmenting a particular input"* (Crawford and Vogl, 2006).

Crawford and Vogl (2006) favour multi-factor productivity over single-factor productivity. They suggested that "…the simple-to-calculate output/labour input ratios used in most studies do not enable the establishment of robust cause-and-effect relationships, leaving the reader largely in the dark about drivers of performance and their relative importance." Instead, a suggestion is made to establishing a robust measurement framework with the goal of being able to "…explain as much as possible of construction output in terms of the resource inputs used to generate it" (Crawford and Vogl, 2006).

Multi-factor productivity measures can be considered more precise than single-factor measures as they take more dimensions into account (Crawford and Vogl, 2006). However, the conflict that occurs when accumulating different aspects into one value is an issue that still needs to be resolved. Further research is needed to fully understand how to measure, what to measure, and how to use those measures. Another aspect that needs to be discussed further is how applicable or practical the measures are, to whom the measures are directed, and how different individuals interpret them.

No uniform definition of the term productivity has been found. This complexity and multipurpose use causes confusion. Interpretations and implications of the term differ from individual to individual, company to company and industry to industry (Tangen, 2004). The lack of a clear definition makes it complex and difficult to assess what input and output ratios to use when measuring productivity.

4. CONCEPTS RELATED TO PRODUCTIVITY

The terms efficiency, effectiveness and performance will in this section be regarded as dissociated from the term productivity even though numerous authors use the four terms interchangeably. There seems to be no uniform understanding of how to distinguish between the terms. This differentiation will be the basis for the suggestions of what to contain within the term productivity so that it can more easily be agreed upon.

4.1 Performance

According to Oglesby *et al*. (1989) and Sink (1985), productivity is one aspect of performance. Oglesby *et al*. (1989) stated that "the word 'performance' involves all aspects of the construction process." They further argued that productivity is mainly connected to activities on the construction site or activities that directly influence that work. Oglesby *et al*. (1989) attributed four main items to the term performance: productivity, safety, timeliness, and quality. This partly corresponds to the seven criteria that Sink (1985) identified as constituting performance. He argued that effectiveness, efficiency, quality, quality of work life, innovation, profitability, and productivity are aspects of performance. Tangen (2005) stated that performance is a:

> *"…term that covers both overall economic and operational aspects. It includes almost any objective of competition and manufacturing excellence whether it is related to cost, flexibility, speed, dependability or quality … Furthermore, performance can be described as an umbrella term for all concepts that considers the success of a company and its activities. Nevertheless, the types of performance that a particular company strives to fulfil are very case specific"* (Tangen, 2005).

This indicates that there is no common definition for the term performance, either. The literature agrees that performance constitutes various aspects, although there seems to be no agreement over what these aspects are. Therefore, the definition should be kept rather broad instead of adding specific aspects that might limit the definition. In this sense, the definition by Tangen (2005) is the most applicable as it is possible to relate the presented differentiation to the three categories of definitions for productivity presented above. For the purposes of this paper Category III is not seen as dealing with definitions of productivity but rather with performance. This leaves Category I and II, and to further limit the scope of productivity, it is necessary to differentiate between efficiency and effectiveness.

4.2 Efficiency

The Oxford English Dictionary Online (2008) defines the term efficiency as "the ratio of useful work performed to the total energy expended or heat taken in." Pritchard (1995) drew on Max Weber's idea of bureaucracy where efficiency is defined as "maximum output with minimum input." These two definitions can be equated with Category I. Sink and Tuttle (1989) defined efficiency as doing things 'right,' which can be interpreted as singularly looking at the output/input factor of a process without comparing it with other processes or looking at the value added. Sink (1985) defined efficiency as "… the degree to which the system utilized the 'right' things." Tangen (2005) stated that efficiency is:

> *"…often linked to the creation of value for the customer and mainly influences the numerator (outputs) of the productivity ratio. A good, simple description of effectiveness is 'the ability to reach a desired objective' or 'the degree to which desired results are achieved"* (Tangen, 2005).

Achabal *et al*. (1984), quoted by Keh *et al*. (2004), took the definition one step further. They discussed the use of input resources and how to optimize the ratio between output and input. They stated that:

> *"efficiency deals with the allocation of resources across alternative uses … [it] is achieved when the marginal productivity per unit of price is equated across all resources that contribute to the firm's output. Another way to look at efficiency is, given a level of output, how does the firm minimize input?"* (Achabal *et al*. (1984), quoted by Keh *et al*. (2004)).

As these definitions generally point in the same direction, it can reasonably be deduced that a common understanding of the term efficiency exists. This can be compared to Pritchard's (1995) Category I (see Table 1).

4.3 Effectiveness

The Oxford English Dictionary Online (2008) defines effectiveness as "the quality of being effective (in various senses)." To be effective can, in the context of this paper, further be defined as "having the power of acting upon the thing designated." (Oxford English Dictionary Online, 2008). Pritchard (1995) provided a more specific definition by claiming effectiveness to be "…the ratio of outputs relative to some standard or objective." Keh *et al*. (2004) quoted Achabal *et al*., (1984) who stated that:

> *"… the effectiveness question is concerned with determining which retail strategy, among all possible strategies, maximizes long-run ROI. This search for the most effective use of resources assumes resources are used efficiently"* (Achabel *et al*., 1984, quoted by Keh *et al*., 2004).

Sink (1985) defined effectiveness as "the degree to which the system accomplishes what it sets out to accomplish," whilst Sink and Tuttle (1989) defined effectiveness as doing "the 'right' things, on time," when doing the right thing is compared to other related processes and the bigger picture in order to make sure that value is added According to (Tangen (2005), effectiveness "…is commonly defined as the minimum resource level that is required to run the desired operations in a given system compared to the resources actually used." As the definition of efficiency ranges somewhat, it can be maintained that effectiveness comprises a comparison between an actual output and a reference value that has been defined beforehand.

4.4 Different Definitions of Productivity for Different industries

The apparent diversity and complexity of productivity presented in the literature, makes it hard to find a common denominator for the use of the term for all industries. Different industries use different definitions because inputs and outputs vary greatly, as do business objectives (Pritchard, 1995; Tangen, 2004; Forsberg, 2008). This can be illustrated by an example of measuring labour productivity: Forsberg (2008) compared labour productivity of a car manufacturer (SAAB) and a construction company specialising in the production of prefabricated timber houses (Älvsbyhus). SAAB measures productivity in terms of cars produced per employee per year, whereas Älvsbyhus measures productivity in terms of the production cost per built house (Forsberg and Saukkoriipi (2007).

The categorisations show how distinct the viewpoint of different authors is, and the complexity of comparing between industries. The complexity increases when considering Category III, which essentially suggests that productivity cannot be regarded in isolation but should be contextualised and include any characteristic that makes the organization function better. Pritchard (1995) identified the three categories but claimed that it should be agreed upon beforehand what the term productivity should comprise. In this regard, Category III is seemingly too complex and broad to be considered a suitable base for defining productivity in the construction industry.

5. DISCUSSION

The suggestion of what to include in the term productivity for the construction industry should not only disentangle connected concepts and lessen the complexity of the term, but also establish the basis for further discussion and for the creation of 'tools' suitable for use by all actors in the construction industry.

According to Sink and Tuttle (1989), productivity should be viewed as an important aspect of total performance. Category II defines productivity as comprising the two dimensions of efficiency and effectiveness, both of which should be used as the baseline for measuring productivity, even though aspects such as quality and profitability may also be included. This category of definition suggests that an input/output measure (efficiency) needs to be compared against reference data (effectiveness) and is preferred for the paper since a singular comparison between input and output is of little use unless related to pre-assigned values and viewed from a broader perspective.

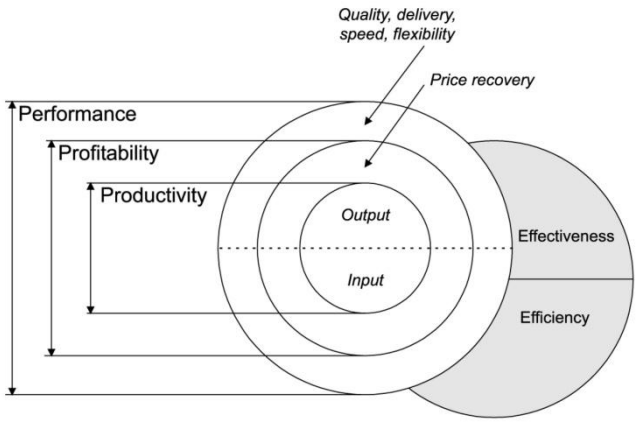

Figure 5. The triple P-model (Tangen, 2005).

Tangen (2005) developed a model to link the terms. The triple P-model, presented in Figure 5, takes into account performance, productivity, efficiency, effectiveness, and profitability. The model is divided into the two dimensions of input and output with productivity forming the centre. Moving from the centre towards the outer rims, the dimension of profitability is added. "Profitability [in the model] is … a monetary relationship in which the influences of price-factors (i.e. price recovery) are included" (Tangen 2005). The outer rim of the model is the performance dimension. It includes both productivity and profitability. Tangen (2005) stated that effectiveness and efficiency are:

> *"…somewhat cross-functional when it comes to the other three terms. Effectiveness represents the degree to which desired results are achieved; efficiency represents how well the resources of the transformation process are utilized"* (Tangen, 2005).

The dimension of profitability as depicted in the triple P-model suggests that productivity is closely linked to profitability. This is not in line with the viewpoint of the authors of this paper. Productivity, as the definition by Tangen (2005) suggests, consists not only of the dimensions of effectiveness and efficiency but also of different individual viewpoints, which increases the complexity. Profitability is merely economists' understanding and is not representative of individuals' definition of productivity. To get a more holistic view of productivity, profitability should be added as an aspect of performance. To add the aspect of construction to the concept of productivity it is suggested to make use of the iron triangle of time, cost and quality, as presented by Atallah (2006) and Santos *et al*. (2002). By connecting already defined key issues known to all actors in construction the complexity of the term productivity may be reduced.

6. CONCLUSIONS

All aspects of productivity, historic, individual, professional and scientific, should be used when exploring the complexity of productivity. Based on the reviewed literature, the following aspects of productivity are suggested as a way of reducing its complexity so that all construction participants can understand it. In line with the argument of Pritchard (1995), the suggestion focuses on applicability with the understanding that the term has to be agreed upon by all actors before it can be effectively used.

Productivity is suggested to consist of the twin dimensions efficiency and effectiveness. The former constitutes the ratio between measures of input and output, whereas the latter gives a pre-assigned value to compare against and relate to. Without the benefit of comparison, a meaningful conclusion is difficult. However, it is reasonable to assume

that most productivity measures are carried out for the sake of optimising time, cost and quality, and that it is important for all actors in the construction industry to understand and be able to use the measures.

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MEASURING PSYCHOSOCIAL WORK ENVIRONMENT IN CONSTRUCTION

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ABSTRACT

The study of psychosocial factors is highly relevant for a project-based sector like construction for reason of the following: mobility of workers, constant change of workplace, diversity of work performed, physically demands, high health and safety risk, meeting deadlines, monetary constraints and male-dominated industry. All these factors contribute to the industry having unique and different sets of psychosocial factors affecting the working environment. An important scrutiny is to highlight the psychosocial factors affecting the management team and operatives on construction sites. Further analysis into the differences of psychosocial problems encountered by these two cohorts will be probed. To perform this study, an action programme identified as *Utmärkt Bygge* (Excellent Construction) was adopted. *Utmärkt Bygge* was designed with the aim of improving the cooperation and effectiveness of all players in a construction project. The measurement instrument in the programme is *Spiken* which is in the form of checklists. The authors analysed the impact of psychosocial factors among these two cohorts comprising of 38 site managers and 103 operatives from a large construction company, where established questionnaires and structured interviews were used to identify and examine the issues at the workplace. Overall, the findings indicate that 75% of site managers and 60% of operatives are in agreement that the psychosocial working environment is satisfactory. The work helps to identify the psychosocial problems faced by both the management team and the operatives on construction sites. This in turn provides the company with knowledge on areas of improvements for personnel on construction sites.

1. INTRODUCTION

Since the early sixties, many attempts have been made to gain more insight into the particular relationship between work-related psychosocial risks and employees health by means of theoretical models. This is evident through studies performed among employees whom are reported of being exposed to psychosocial stressors at work, which results in health complications such as traumatic injury, musculoskeletal disorder (MSD), chronic and fatal illnesses, central nervous system disorders, skin disorders, noise-induced hearing loss, family contact disease, burnout, reduces quality of life, sickness absence, decrease motivation and productivity (Salem *et al.,* 2008; Kristensen *et al.,* 2005; Jongel and Kompier, 1997). Previously, these issues confronting the construction industry were silenced on site but now have gained enormous attention to address the causes of psychosocial problems.

Assessment of psychosocial factors and their impact on the health of construction workers is an extremely relevant and topical subject. In a study by Jongel and Kompier (1997), 35% of employees claimed that they would still be working if preventive measures were taken at the early stage. Therefore this study aims to examine the psychosocial problems confronting both the management team and operatives on construction sites. Furthermore the study will also examine if these cohort groups experience the same psychosocial issues at the workplace or differently.

2. STATE-OF-THE-ART REVIEW

2.1 Construction Work Environment

The construction industry is always associated with dirty, dangerous and demanding. The picture painted is always a poor working environment. Therefore it is essential to create a healthy working environment in construction which includes providing a sound physical and psychosocial environment. The physical work environment deals with how the work are performed while the psychosocial work environment focus on the working climate, comfort and factors that affects the work (Sundström, 2007).

It is the responsibility of the employer to ensure a systematic work environment and rehabilitating programme exists for workers on site. Preventive, systematic work environment management is conducive to a good work environment from which everyone stands to benefit. The following describes what constitute of a good working environment on a construction site according to the Systematic Work Environment Provisions, AFS 2001: low risk for fall; good working condition of personal protection, low noise and proper lighting, consideration on workload and ergonomic; good in-house climate; proper handling of dangerous chemicals and managing mobbing.

2.2 Psychosocial Work Environment

The English Dictionary's definition of psychosocial pertains to the influence of social factors on an individual's mind or behaviour and to the interrelation of behavioural and social factors. Psychosocial factors include exposures thought to impact on the well-being and health outcomes of workers (e.g. temporal aspects of employment and the work itself, aspects of work content, work-group, supervision, organisational conditions). Other factors that can be included in an assessment include strain (i.e. workers' psychological and physiological reactions to stressors in terms of anxiety, depression, high blood pressure, heavy smoking, alcohol consumption, etc.), coping strategies and high absenteeism (Tabenelli *et al.,* 2008) and bullying (Niedhammer *et al.,* 2008).

Several theories and models have been developed to explain how psychosocial factors can affect the stress at work and result in varied health outcomes including musculoskeletal disorder (MSD). Principally, the psychosocial models and theories as summarised by Salem *et al*. (2008) can be grouped as:

- Person-environment theory – interaction between person and the situation, and how well a person fits into the situation. The model can be viewed at the employee's level in terms of employee needs and job suppliers and discussed in terms of *needs-suppliers*. It can also be viewed at the job level in terms of job demands and employees abilities and discussed in terms of *demand-abilities*.
- Transactional model – this model emphasis the role of cognitive and coping factors of the individual and how they can alter the outcome of exposure to stressors.
- Psychosocial demand/decision latitude model – this widely recognised model by Karasek and Theorell (1990) also known as demand/control/model. This model focuses on subject of work related variables, mainly those of psychosocial demand, decision latitude and social support in the predicting stress outcomes.
- Work compatibility model – it is defined as a latent variable integrating the positive and negative impact characteristic of work related variables in the human-at-work system in the form of a prescribed relationship. Work compatibility allows the assessment of workplace characteristics including both physical and psychosocial factors using a common metric. According to the model work-related variables can exert a positive and a negative effect; the integration of both determines the final outcome.

In summary, an optimal psychosocial environment for workers is characterised by demands that are adapted to an individual's capacities (psychological demands), a satisfactory level of influence (decision latitude), adequate social support from superiors and colleagues, a balance between efforts expanded at work and interactions with clients (Salem *et al*., 2008).

Among the prominent risk factors having strong influence affecting the psychosocial working environment are: attitude, motivation, stress, working groups, gender perspective, leadership and communication. Attitude is a mental position relative to a way of thinking or being. It relates to a person's predisposition to think, feel or behave in certain defined targets (Arnold *et al.,* 2004). Each person has different attitude towards things for example attitude towards work organisation or new ideas. In order to work out this attitude, a person needs to identify what thoughts he/she associates with it (beliefs) and how he/she feels about it (physiological emotional or intuitive response). A positive working attitude leads to a better work inputs while a negative attitude leads to the opposite situation.

The driving force for motivation is driven by biological, social and psychological driving characters. Biological driving force example can be hunger or fatigue, while the social driving force deals with team support. Lastly, the psychological driving force focuses on feeling of appreciation, concern and popular. Workers will always thrive to fulfil all the three factors in the hierarchy as they established themselves at workplace (Maslow, 1970). Workers with high psychosocial risk factors such as high workloads, tight deadlines and monotonous work need to be constantly motivated. These risk factors will affect their response to the work and workplace including their relationship with the supervisors or even team members. These risk factors can result in stress-related changes in the body that can make workers more susceptible to insomniac, loss of memory, loss of concentration, high anxiety and pain in the body (HSE, 1999). Recent studies have shown these symptoms are associated with typical psychosocial factors such as low job control, high job demands and low workers support in various occupational groups (Karasek, 1979).

Team members have a strong influence in the psychosocial work environment. How the group communicate, handle conflict, deal with relationships among members and management team and security reflect the working climate on site (Lennéer-Axelson and Thylefors, 2000). Meanwhile, the management team should also be knowledgeable to recognise and manage psychosocial problems at work before it worsens. Effective management team is those who have good human relationship, able to listen to others, manage conflict and control problems. Effective communication is an essential tool for cooperation both within group and with other groups. Forms of communication can be any form whether verbal, orally or even the body language (Lennéer-Axelson and Thylefors, 2000).

In construction, there is the additional issue of gender dominated sector. Gender harassment constitutes common workplace stressors that demand serious attention which can lead to adverse psychological consequences as well as impaired work performance (Bergman, 2003). Important variables for health and a good work environment such as control over work, influence, meaningfulness, support and professionalism seems to be negatively influenced by these gender-related personal offences (Bergman 2003; Karasek, 1979). In addition, Vermeulen and Mustard (2000) argue that it is unclear whether the growing body of literature describing the health consequences of psychosocial aspects of the work environment applies equally well to men and women.

2.3 Utmärkt Bygge Scheme (Constructing Excellence Scheme)

The formation of Utmärkt Bygge Scheme (UBS) was inspired from the Considerate Constructors Scheme[2], UK to improve the industry's image. Considerate Constructors Scheme (UK) was formed in 1997. The Scheme is concerned about any area of construction activity that may have a direct or indirect impact on the image of the industry as a whole. The main areas of concern fall into three main categories: the environment, the workforce and the general public. In summary, the scheme seeks to:

- minimise any negative impact sometimes caused by construction sites to the neighbour, the general public and the environment;
- eradicate offensive behaviour and language from the construction sites; and
- recognise and reward the constructor's commitment to raise standards of site management, safety and environment awareness beyond statutory duties.

In Sweden, Byggrådet (Southern Chapter) had taken the efforts to set up the Scheme in 2001 and which was launched in 2004. UBS has the financial support from Boverket, Swedish Construction Industry, Engineering Faculty, Lund University, SABO, Byggcheferna, Byggherreforum, Byggnads, Rådet för Byggkvalitet and BQR. UBS provides an ideal framework to demonstrate a project's environmental good practice intentions.

Registered projects are monitored against a Code of Considerate Practices (CCP), designed to encourage best practice beyond statutory requirements. Interested clients and project managers are encouraged to register their projects in UBS which allows the users to have access to CCP. CCP can be accessed through Spiken, an internet-based measurement instrument. The themes for Code of Considerate Practices formed are:

- Collaboration – emphasis on all participants in the project working towards achieving the project's goals. Project goals must fulfil the users requirements and production specifications which can be addressed either orally or written. Furthermore, the collaboration between participants must be formed on respect and understanding of each other's role. All depending team must know how communication with each other should transpire, be documented and identify the project critical moment.
- Pre-planning – to ensure project success, the planning of the project must be completed before the project starts. Work preparation must be done before and during the project.
- Project management and site management – management should strive to ensure during all the project phases that the right person is doing the right job. Management must also create a good working environment and team work. This can be done by planning a routine on how communication between different trades should be performed. Everyone has its own part to execute and have the possibility to carry it out effectively irrespective of which construction stage they are at.
- Knowledge management – participants in the project are encouraged to function and promote knowledge building through documentation of experiences from the project. A routine for knowledge transfer must be made available. Participants must have access to project rules and regulations together with necessary training if required in order to undertake the project.
- Considerate – all activities are to be accomplished with positive consideration to the needs of traders and businesses, site personnel and visitors, and the general public. The idea is to create a positive working climate. Unsuitable and intolerable behaviour must not be accepted at the working site.

[2] http://www.considerateconstructorsscheme.org.uk/

- Respect for the environment – be aware of the environmental impact of the site and minimise as far as possible the effects of noise, light and air pollution. Efforts should be made to select and use local resources wherever possible. Attention should be paid to waste management. Reuse and recycle materials where possible.
- Good working environment – the project must have a clear working environment policy. Active participation from both the management team and the operative levels are required in order to secure a healthy and safe working environment. All workers concerned must be involved in the planning of the working environment policy and systematic working environment must be visible at worksite.
- Good neighbours – general information regarding the Scheme should be provided for all neighbours affected by the work. Full and regular communication with neighbours, including adjacent residents, traders and businesses, regarding programming and site activities should be maintained from pre-start to completion.

During the construction project, the compliance with the CCP is measured using Spiken and given a score between 0-900 points against the eight CCP, with each of the eight sections warranting between 0-10 points. A 5-points score in any of the sections indicates that the project is complying with the Code and is therefore operating beyond standard industry requirements. The average score of a project registered with the Scheme is around 450.

3. RESEARCH PROJECT

3.1 Project description and objectives

The research was performed to answer the following questions:

- How well does the Utmärkt Bygge Scheme measure the psychosocial work environment at construction site?
- Does the management team encounter the same psychosocial issues as the operatives? and
- What are the remedial actions taken to address the psychosocial work environment issues by the employer?

3.2 Research methodology

To address the research questions above, a case study of a single contractor company (Contractor E) was adopted. The sample will be from the projects undertaken by Contractor E, a well established company in the field of construction and civil engineering with a turnover of more than SEK 30 billion and 12 000 employees (2007) in Sweden and overseas. The company has striven to gain the title for 'Industry's best workplace' among its employees since 2002. Their working policy is that every construction project is considered as a company and the project manager is free to run the company as he/she sees fit. This freedom to manage has proved to be a key success factor in this organisation.

Questionnaires were designed based on the CCP in Utmärkt Bygge. Only six of the eight codes of practice were selected:

1. project management and site management;
2. collaboration;
3. knowledge management;
4. consideration;
5. good work environment; and
6. good neighbours.

The two remaining codes of practice that were discarded are pre-planning and respect for the environment. These two codes of practice have little influence on the psychosocial effect at workplace (Eliasson and Pemsel, 2008). The authors conducted face-to-face surveys using questionnaires together with structured interviews with 141 respondents from Company E.

4. RESEARCH RESULTS

A total of 141 respondents were interviewed throughout south of Skåne of which 103 were operatives and 38 from the management team. Figures 1 and 2 illustrate how these two cohorts evaluated the six CCP.

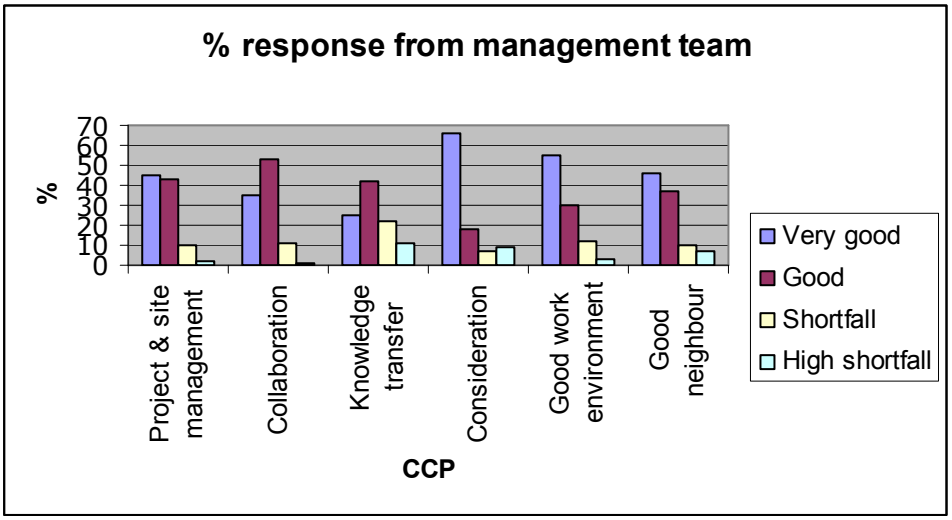

Figure 1. Percentage responses from the management team.

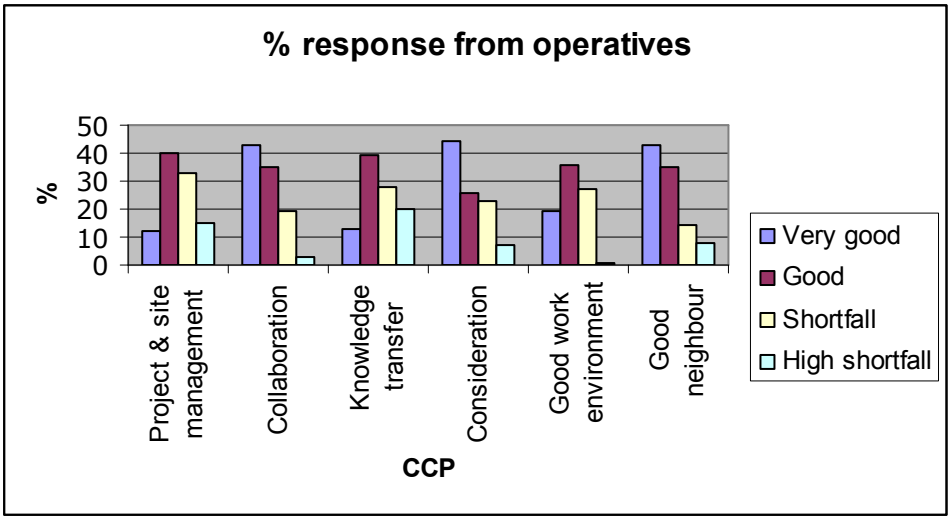

Figure 2. Percentage responses from operatives.

The management team is unanimous that they are experiencing a better psychosocial work environment than the operatives who feel that some areas in the CCPs are lacking. Table 1 demonstrates the overall results for both cohorts. The management cohort represents 38 respondents and operatives cohort represent 103 respondents.

Table 1. Results on how the management team and operatives experience the psychosocial work environment on site.

Category	**Management cohort (%)**	**Operative cohort (%)**
Project and site management	77	52
Collaboration	75	76
Knowledge management	65	48
Consideration	80	68
Good work environment	77	51
Good neighbour	74	70

4.1 Project and site management

Overall the management team scored high (> than 75%) for all the questions. Meanwhile, the operatives' cohort results show dissatisfactions for the following area:

- poor work preparation (73%);
- no induction on worksite (56%) – interestingly, on one site, the operatives do not even know who the site manager is even by name;
- poor communication with site management (55%); and
- constant miscommunication between trades (52%).

4.2 Collaboration

Both parties are in agreement that they are satisfied with the routines of communication between themselves, foreman and site management. The weakness in collaboration is that there is less respect and understanding of the task performed.

4.3 Knowledge management

The management team is satisfied about the practice of knowledge transfer on site. Contrary, operatives cohort felt that there exist weaknesses in the areas of documentation of knowledge transfer (61%) and project experiences to help with future work (51%).

4.4 Consideration

Generally, the working climate on site is considered well managed by the management team. Nevertheless, a small number express their dissatisfaction in this CCP. 18 operatives and 6 members from the management team had experienced some form of mobbing either from the leadership or colleagues, and discrimination about race, sexuality or function hinders at work. From the operative group, more than 50% felt that there exist situations where certain behaviour or language is considered offensive or unsuitable. They felt such behaviour is unacceptable at the workplace. Although the percentage is small, the situation must be examined seriously.

4.5 Good work environment

Overall, the management team demonstrated satisfaction with the work environment on site. The team follows religiously the project work environment policy and has a plan to handle crisis on site. The focus on providing a good work environment had begun from the planning stage. Meanwhile, the operative cohort score only 48% for this CCP. They did not share the same degree of agreement as the management team had claimed. They felt the site was disorganised. The following are areas of dissatisfaction:

- no knowledge of the project work environment policy (52%);
- no input on the project work environment policy (53%);
- weekly planned inspections were not performed according to the schedule (54%); and
- plans for knowledge transfer regarding work environment issues on site is poor (59%).

4.6 Good neighbour

Measures to manage complaints from neighbours had been done effectively by the management team. Workers on site have a healthy and active relationship. They are helpful with each other. Kinder treatment towards the public has accentuated.

5. IMPROVEMENT PLAN

By highlighting these issues experienced by both the management team and the operatives, Company E had taken a proactive approach to tackle the matter. The company had drawn an action plan to reduce unhealthy working environment and increase collaboration and better communication with the operatives. They addressed the issues by examining the working environment, working organisation, communication, competence development, wages form and leadership. Leadership and organisation are important to achieve these ambitions. The aim of the action plan is to improve the psychosocial working environment not only among the operatives but also among the management team too. This quality improvement includes changing of attitude, knowledge and habits.

6. CONCLUSIONS

The study has shown positive results reflecting the psychosocial factors affecting both the management team and the operatives using Utmärkt Bygge Scheme. From the total of 141 respondents, 103 are operatives and the rest are management team. Six CCP's were evaluated among these respondents: project and site management; collaboration; knowledge management; consideration; good working environment; and good neighbours.

Overall, the management team is experiencing a better working environment from the operatives. Contrary, the level of dissatisfaction among the operatives is spread more evenly. For the CCP project and site management, more than 75% of operatives cohort highlight the lack of communication on site, poor work preparation and absence of induction for new workers as issues that need to be addressed. Only half of the operatives are satisfied with their working environment. Operatives felt that they were neither involved in the formulation nor informed of the work environment policy.

Both cohorts agree that better transfer of knowledge management would benefit the project. Sadly, a small number of respondents suffer from mobbing and discrimination at the workplace. This issue is spelled out among other issues highlighted from the study in the action plan to be addressed by the management. Company E had taken measures to

work on the issues accentuate from the study with the aim of creating a better working environment for all.

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INFLUENCES AND BARRIERS FACING THE ADOPTION OF TOTAL QUALITY MANAGEMENT IN THE LIBYAN CONSTRUCTION INDUSTRY

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ABSTRACT

The Libyan construction industry has evolved significantly in recent years but quality management is an area that continues to present challenges at all levels. This paper sets out to explore the barriers that exist and that may act to help or hinder the wider adoption of quality management practices in the Libyan construction industry. Building on established paradigms of total quality management (TQM), existing frameworks for analysis (PEST) and empirical evidence from a survey of Libyan construction companies, this paper establishes a quantitative measure of TQM practice within a sample of the Libyan construction sector and outlines qualitative proposals to enhance future practice. The outcomes from this research are threefold. The first is a conceptual model for TQM that draws together threads of academic theory into a unified framework for analysis and which will be of interest to academics and researchers. The second is an assessment of TQM knowledge and understanding within the construction sector of Libya, which international businesses with an interest in engaging with the construction process in Libya will find of significant value. Last, the paper identifies socio-economic influences that have acted to help or hinder the adoption of TQM practices within the Libyan construction industry and proposes ways of addressing the issues raised.

1. INTRODUCTION

In recent years, Libya has emerged as a politically stable state, enjoying improving relations with most countries and has developed numerous bilateral, regional and international agreements to protect and encourage the movement of capital, goods and services in and out of the country (Evans-Correia 1993). Libya is considered by some to be of the world's most attractive countries for foreign investment and acts as an important gateway between Europe, Africa and the Arab states (DTI, 2002).

From an administrative point of view, the Libyan Civil Service is the largest employer in the country, providing jobs for more than half of the working population (Public Service Department's Computerised Personnel Information System, 2000). The Civil Service retains its role as the provider, facilitator and regulator of crucial services to the public and remains the most important institution ensuring the success of national development and administrative policies. Indeed it is the prime factor in ensuring the achievement and implementation of the country's development policies, objectives and programmers.

Within Libya there is a growing recognition that Total Quality Management (TQM) is an important issue in the battle to compete both in the global economy and in an open domestic market. Quality management initiatives such as TQM are increasing in popularity in the construction industries of many developing countries and Libya is not exempt from this trend (Dickenson *et al.,* 2000). Management within the construction industry aims to integrate the complex tasks of project design and construction while keeping to schedule, within budget and ensuring a completed product of the highest quality. To ensure that all project objectives are fully met, construction management personnel are required to utilize their skill and experience to develop realistic schedules, prepare accurate construction estimates, analyze alternative designs, study labour conditions, perform value engineering, and effectively coordinate the activities of the construction team (Round and Chi, 1985). Within Libya efforts to improve construction

management performance by adopting TQM practices require a culture shift away from traditional practices.

This research sets out to identify and analyse barriers inherent in the cultural shift that aims towards the successful implementation of TQM and assess which of these barriers may act to hinder the improvement of quality within the Libyan construction industry. The aim is to develop findings that can be used to assist organisations overcome the barriers they encounter. It is thought that this research represents one of the first such empirical studies looking into the barriers affecting the implementation of TQM within the Libyan construction industry.

2. STATE-OF-THE-ART REVIEW

This section aims to provide readers with an understanding of key issues that will enable a better appreciation of the influences at work in shaping construction management practice in Libya. Specifically, construction management in Libya is set in context to the wider economic development in the country and to developments occurring in the field of construction management at an international level.

2.1 Libyan economic development

In the late 1950s, the World Bank sent a team to assess the socio-economic situation of the country and its people. The team published its report in early 1960, concluding that:

> "Libyans live a very simple life, their food is simple, their necessities are limited, and their knowledge of twentieth-century technology very limited. The majority are farmers who consume most of their production. Their living quarters are very poor, and the majority live in shacks, hamlets or caves. They use donkeys, camels and horses for transportation." (Johns 1960)

The development of the Libyan economy from its independence in 1951 can be divided into five periods, which differ in respect to the overarching governmental policies that prevailed at the time (East-West Debt 2004, Johns 1960, Haftari *et al.* 1994). The first period, before 1959, was one where the population was primarily engaged in agriculture and animal husbandry and when aid from the UN and other organisations helped the country to survive. In the second period, from 1959 until 1969, the economic situation had changed after the discovery of oil and the need for direct foreign subsidies declined as international oil companies began to invest in Libya. The third period, from the revolution in Libya in 1969 until 1986, saw the country change from a capitalist to a socialist state and where most businesses became owned or controlled by the State. The fourth period, from 1987 to 2003, followed crises in the Libyan economy where the Libyan economic conditions and standards of living worsened and the State introduced a series of liberalisation measures including a significant role for the private sector. The fifth and current period, from 2003 onwards, was marked by the wholesale privatisation of the country's oil and other vital industries transforming state owner organisations into companies in which employees and others would be able to own shares.

According to the United Nations Development Programmes (UNDP 2007), Libya has made remarkable strides towards economic reforms and is courageously facing the new trends of change and involvement in the global economy. It is continuing in its efforts to privatise state-owned enterprises in addition to boosting the establishment of private companies, and trying to increase its attractiveness to foreign investors. The Libyan economy continues to be heavily reliant on the revenues from the oil sector, which make up nearly all of its export earnings and about 25% of its GDP, but these revenues, give Libya one of the highest per capita GDPs in Africa (CIA, 2004). The non-oil manufacturing sector in Libya accounts for about 20% of GDP and has expanded from processing mostly agricultural products to include the production of iron, steel, and

aluminium with the more popular craft items being carpets, pottery, leather goods, fabrics, and copperware Libya is now a medium-developed country ranked 56th out of 162 countries in human development index for 2007/8 (UNDP 2007).

2.2 The construction industry in Libya

Farley (1971) found that under the supervision of the Libyan civil service, the construction industry had played a prominent role in the economic development of Libya, adding that the industry got its first big boost as a result of foreign oil company investment during the 1960s. Since 1969 its growth had been regulated in accordance with successive five-year public expenditure plans set out by the government. In 1975 the government began to reorganise the construction industry to make it more efficient. At that time, there were about 2 000 contractors, many of them small proprietorships or partnerships. The minister of housing was given the authority to merge contracting firms into a smaller number of larger firms capable of carrying out large construction projects. Firms with capital in excess of LD30 000 were converted into corporations, and the majority shares were sold to the public or the government. Previously, the government had set up several state-owned construction companies to build factories and to carry out civil engineering projects. Among the firms were the National Industrial Contracting Company, the General Corporation for the Construction and Maintenance of Roads, and the General Corporation for Civil Works (Public Service Department's Computerised Personnel Information System, 2000).

East-West Debt (2004) stated that Libya's civil service was the largest employer in the country, providing jobs for more than half of the working population and played a key role in the construction industry. The civil service was considered it to be the prime factor in ensuring the achievement and implementation of the country's development policies, objectives and programmes, but during the 1980s the construction industry was damaged more than any other sector by a severe cutback in the number of foreign workers in the country. According to the Libyan Foreign Investment Board (2001) the number of construction workers dropped from 371 000 to 197 000 between mid-1983 and mid-1984 but the industry continued to employ about 30% of the total workforce and accounted for 20% of GDP.

During the 1990s, the construction industry changed to one where competitive advantage was increasingly based on the successful application of knowledge, as opposed to tangibles such as goods, services or production processes (Liang-Tan, 1997). Possibly, as a result of this change, Libyan construction managers are increasingly recognising that to be effective, quality management systems must address both the technical and non-technical (or behavioural) issues when trying to improve quality and performance (Low and Goh 1998). There is also a growing awareness of the importance of an underlying premise associated with quality systems, namely that everyone within an organisation shares a common cultural platform. This premise is often found to be untenable in international construction projects where people from diverse cultural background and nationalities work together (Cameron and Quinn 1999). This paper holds that the adoption of a TQM approach is a necessary precursor to any lasting improvement in the Libyan construction industry, if it wishes to compete in an increasingly globalized economy.

2.3 TQM in the construction industry

From an international perspective lessons can be learned from the UK where the Government commissioned a report, "Rethinking Construction", from a task force headed by Sir John Egan (Egan 1998). According to this report:

> "Much of construction does not yet recognise that its people are its greatest asset…. Too much talent is simply wasted, particularly through failure to recognise the significant contribution that suppliers can make to innovation… Difficulties are posed by … the fragmented structure of the industry, but construction cannot afford not to get the best from the people who create value for clients and profits for companies." (Egan 1998:17).

Overall, the Egan report recognised that the construction industry could and indeed needed to do better and it concluded that this was best achieved through the application of best practices in quality management. To achieve best practice the Egan report identified five key drivers to change:

1. Committed leadership: management believing in and being totally committed to driving forward an agenda for improvement, cultural and operational changes throughout the whole of the organisation.
2. A focus on the customer: the best companies provide precisely what the customer needs, when the customer needs it and at a price that reflects the product's value to the customer.
3. Integrate the process and the team around the product: the most successful businesses do not fragment their operations, but work back from the customer to determine the process and production and the value it delivers to the customer.
4. A quality driven agenda: quality means the total package; not only zero defects but right first time, exceeding customer expectations, delivery on time and to budget, innovating for the benefit of the client and stripping out waste in all its forms.
5. Commitment to people: this means not only decent site conditions and fair wages; it means a commitment to training and development of managers and supervisors.

In particular, the 'Rethinking Construction' report stated that the industry fell short in relation to quality management and it highlighted the challenge of bringing the best of the industry's practices to the attention of all companies. It described the construction industry as one with a lack of consolidated knowledge on best practice. Other, more generalised international research (Crosby 1979, Dale 1999, Deming 1986, Haigh and Morris 1995, Morris and Haigh 1996, Hofstede 1980, 1991 and 2001, Johnson and Scholes 1993, Kanji 1996, Kumar 2006, Low and Winifredo 2000, Oakland 2000, Riley *et al*., 2004, Triandis, 1990, 1994 and 2002, Yusof and Aspinwall 2000) has supported the UK findings highlighted in the Egan report, resulting in the identification of eight common problems that can lead to poor quality performance on construction projects.

1. Lack of management commitment. Management must commit time and resources and clearly communicate the importance and goals to all personnel.
2. Inability to change the organizational culture. Change takes time and effort. In order for the culture to change, the employees need to want change and be willing to participate. This requires reasons that management must convey. The change will only occur if the employees trust the management. It cannot occur from a state of fear.
3. Improper planning. Planning must involve all parts of the organization and be communicated clearly to employees.
4. Lack of training. The most effective training comes from senior management. Informal training needs to occur on a continual basis.

5. Organizational structure problems and isolated individuals or departments. Multifunctional teams will help break down some of these barriers. Restructuring is another method.
6. Ineffective measurement and lack of data. Effective decisions require that the employees have access to the necessary data.
7. Inadequate attention to internal and external customers.
8. Inadequate empowerment, lack of teamwork. Teams require training. Their recommendations should be followed whenever possible. Individuals need to be empowered to make decisions.

Any TQM system must address these problems, and Figure 1 sets out how this research has attempted to integrate the theory in a framework for further study.

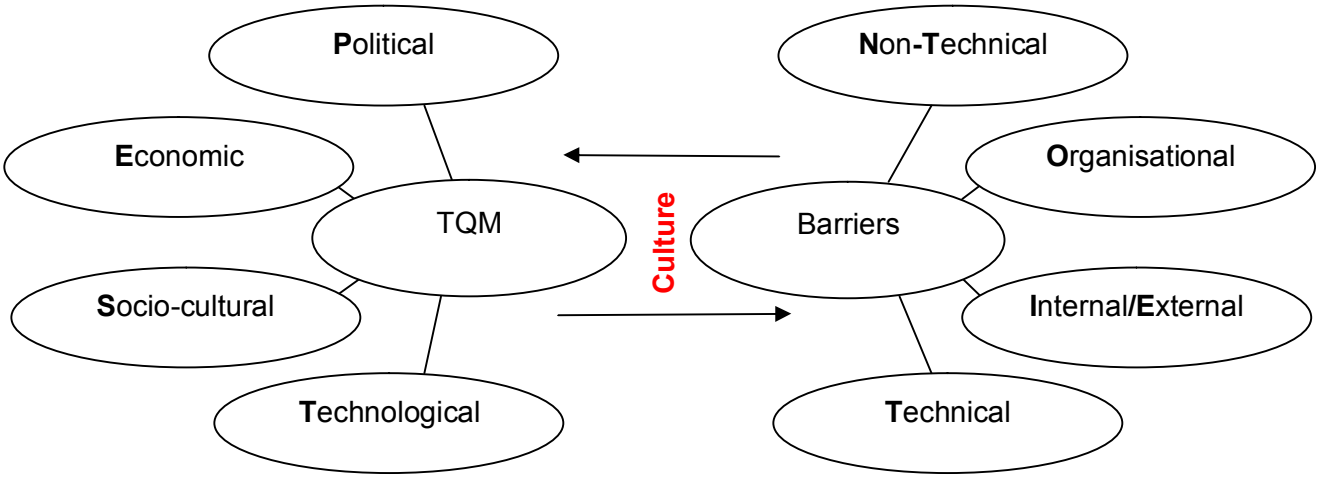

Figure 1. Conceptual framework showing links between traditional analysis approach to TQM assessment and barriers hindering its effectiveness.

3. RESEARCH PROJECT

3.1 Project description and objectives

This research aimed to critically evaluate the barriers affecting TQM, in the Libyan construction management sector, and to suggest ways of improving established practices. It assessed the knowledge and understanding of TQM philosophy and principles in two sample Libyan Construction Companies and enquired to what extent the elements of TQM were applied.

3.2 Research methodology

The main challenge facing this project was the lack of available data on attitudes and approaches to TQM within construction companies in Libya. For that reason the first objective of this research was to gather sufficient data to act as a baseline for further research using an in-depth questionnaire survey conducted during the period between 10 October and 12 December 2007. The survey included 322 respondents from two Libyan construction companies (hereinafter referred to as Company A and Company B). The number of respondents from each company reflected the relative size of each organisation, with 223 respondents in company A and 96 in company B. In order to gather opinion from all levels within the companies respondents were selected from four different levels of management; top management, middle manager, first line manager,

employees. Questions in the survey were presented using a semi-structured interview format. Yin (2003) states that interviews are one of the most important sources of information in case study research and both Mason (2000) and Sekaran (2000) identified that the semi structured interviews have important characteristics, which enable the researcher to clarify doubts and ensure that the respondents understood the questions and the responses are also understood by the interviewer. As this research dealt with complex social, economic and technical issues the semi-structured interview approach was considered to be the most suitable.

The survey included 59 questions with a mixture of qualitative and quantitative response options. Question content was based upon a conceptual model (see Figure 1 below) of TQM management and practice drawn from established theory. The questions aimed to identify the barriers affecting the implementation of TQM and to reveal attitudes towards these barriers within the different management tiers of the organisations surveyed.

4. RESEARCH RESULTS AND INDUSTRIAL IMPACT

This section focuses on some of the key findings from the survey, which indicate the scale of effect that Libyan culture has in creating barriers to the successful implementation of TQM practices within construction sector organisations.

4.1 Quantification of results

The results from the survey reveal that TQM in the Libyan construction companies sampled is less advanced than compared to other developed Western nations. The main barriers to TQM implementation, faced by both companies surveyed (A and B) was a lack of management leadership, unhelpful organisational culture, lack of finance to support TQM initiatives, no shared vision and the lack of a clear sense of direction to drive TQM forward within the organisation. These results are explained in more detail below.

Low employee morale

The results of the survey reveal that the majority of respondents were of opinion that the management of Libyan construction companies suffered from low morale. In this respect, the identification of low morale as a barrier to the successful implementation of TQM is consistent with the findings of Nwabueze and Kanji (1997) and their study on the implementation of TQM in the NHS in the UK.

Lack of management information

Both company A and B lacked information related to TQM or lacked information relating to new and current standards of TQM practice. This resulted in a generally weak understanding about the importance of quality management in international trade and the globalization of world markets.

Poor senior management communication

The results of the survey also showed that the majority of employee and subordinate managers were of opinion that senior management above them were not very effective at top-down communication. That would suggest that there is a lack of an effective communication management system in these Libyan construction companies, which is an important barrier to the creation of a TQM culture that must be driven by top management and disseminated downwards throughout the organisation.

Lack of opportunity for bottom-up communication

In association with the last finding, the opposite flow of communications (bottom-up) was also poor. The survey results reveal that the majority of respondents were of the opinion that the management of Libyan construction companies did not have an effective system to enable feedback from lower levels of management and employees to filter back to senior management.

Lack of employees' involvement in decision making

Both companies A and B lacked a system for employee involvement in decision making, solving problems and assessing of processes. A common problem resulting from this was that companies suffered from a high workforce turnover. In TQM terms this presented a different barrier to the creation of a TQM culture as new appointments to replace employees who had left often had little awareness of TQM.

Lack of education and training

Feedback from the respondents in both companies A and B identified that, when TQM policies were in place and were positively enacted, a low level of educational attainment at the employee level was an important barrier to the successful achievement of a TQM culture. Employees with low educational attainment could not understand the information related to TQM that was given to them by managers.

The analysis of the results from company A and B identified a widely held belief that employee autonomy increases control over work, responsibility, and general satisfaction in the workplace, but this is often hampered by a lack of financial commitment to training. The studies also indicated that a significant reason why the Libyan industrial sector lagged behind other industrialised nations is that Libyan management systems were bureaucratic, lacked efficiency and were often susceptible to corruption. For TQM to flourish in such an environment not only technical changes are required, but also social and economic changes. This culture change must offer an alternative to the current culture without creating a void, thus giving time for new culture establish the vision and goals of TQM. Key to the Libyan context is to increase the respect of the supervisor for the employees, increase employees' understanding of the difficulties faced by supervisors, and increase management's respect for employees. The change must address employees' negative attitudes to the construction company, reduce conflict stemming from the working environment, help employees better understand the reasons why many problems cannot be solved quickly, and instil in the employee a better understanding of the importance of product quality. Moreover all levels of company employee must be trained and educated to ensure they stay committed to the quality process remain aware of the TQM system.

4.2 Implementation and exploitation

As identified at the beginning of this study, data related to TQM implementation in Libya is strictly limited and as such this survey provides an important data set that will be of interest to any future researchers interested in TQM in Libya. In addition, managers currently working in Libya with an interest in or with responsibility for Quality Management will find the data from this survey, both instructive and informative. It is expected that these managers could use the result of this survey to reflect on their own practice and to better understand any barriers they are encountering when attempting to achieve better quality management in their organisation.

The results from this survey have been used to refine a conceptual model of TQM theory to take account of unique factors that exist in the Libyan construction industry. This in turn has enabled a more focussed study to be conducted aimed at developing a better understanding of the unique barriers that exist in Libya. The main aim from both of these further studies is to develop of a set of proposals that both national and international organisations working in Libya can adopt to improve the effectiveness on TQM initiatives.

5. CONCLUSIONS

In conclusion, this study reveals that the philosophy, principles, procedures, and practices necessary for providing customer satisfaction as well as achieving productivity and enhanced business performance in the construction industry of Libya are well established. The research has identified that several changes of behaviour will be required before TQM improvements becomes a reality. The implementation of TQM is a long-term and never-ending process, as such it must be closely aligned to the culture of the company and this study has revealed that without an appropriate culture TQM cannot function effectively. Within Libya there is a particular challenge aligning the views of employees and managers about the importance of TQM. If the companies feel the necessity to change they have the capacity to carry out the change.

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A COMPARATIVE STUDY OF PERSONALITY TRAITS RELATED TO RISK

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ABSTRACT

The construction sector has, from time to time, experienced problems delivering its products on time at the agreed cost and to the right quality. To reduce these problems different management approaches are applied, where one is risk management. Risk management in construction is traditionally based on the experience and individual judgements made by site managers, especially in smaller projects. Site managers in construction can also be regarded as key individuals, with an important role in the project organisation. To find out if there are personality traits that could be related to the site managers approach to risk management, comparative studies of managers from other industries were undertaken. Personality traits are also related to the approach to risk management. The most powerful difference found is the trait of need for change, indicating that construction site managers are more conservative than other managers. In this comparison, it is not possible to assign attributes to site managers as being more risk prone than other managers. Instead, a picture emerges of individuals who focus on details, are keen on following routines and who also have a work pace indicating stress tolerance. It is also concluded from this study that, due to the site managers' aversion to change, they remain at a less demanding level of problem solving.

1. INTRODUCTION

The construction sector has from time to time problems delivering its products in time at the set cost and with the right quality. This picture applies within the sector and in society outside the construction sector. There is also a prevailing picture of the uniqueness and special conditions that are present in the construction sector and the special personal characteristics that dominate the workforce (Yngvesson *et al*., 2000, Styhre and Josephson, 2006).

The profitability of the construction sector has been strained for many years and the challenge for the sector is to increase the profit on a long-term basis. Long-term profitability is associated with a stable, predictable business. The certainty gives the stability and securing the certainty is therefore important. Certainty is the opposite of uncertainty and the construction sector has been focusing for some years on controlling the uncertainties which are in turn closely related to what is called risk. Despite the many attempts to increase profits, reduce costs and errors and increase the reputation (good image) and quality delivered, construction companies continue to struggle with a lack of quality and increased costs in their products (Ericsson *et al*., 2002). In the past few decades, new management concepts have been introduced in the construction industry to solve this.

The reliance to individuals and their ability to achieve in projects is high. There is a trust in experience and personality rather than reliance to systematic management systems when it comes to manage risks in especially smaller projects (Simu, 2006). In this paper, the problem formulation is based on the fact that, in spite of the many attempts to make risk management objective and quantified, people make the judgments and assessments. At the construction site level, these people are the site managers. The aim with this paper is subsequent to determine if there are personality traits that could be related to construction site managers' approach to risk management.

2. THEORETICAL FRAMEWORK

2.1 Levels of problem solving

An error could be regarded as a realised risk, a risk outbreak, with a negative outcome. Error could also trigger secondary risks, which bring us back to the necessity of working in a continuous loop of risk management. It is therefore interesting to see how and why individuals make errors and understand what the causes are. According to Reason (1990), errors can be divided into three categories: those related to slips and lapses, i.e. skill-based errors; those related to previous experience and knowledge, i.e. rule-based errors; and, finally, those related to the fact that relevant knowledge is lacking, i.e. knowledge-based errors. Of these three, the first two are related to situations in which sufficient knowledge and experience is available. In construction, the reliance on personal knowledge and experience is high (Simu, 2006, Azinim and Edum-Fotwe, 2006) and the implication of the findings of Reason (1990) is therefore important for the construction sector.

One problem that occurs is that individuals make incorrect assumptions in new situations; they use previous knowledge and experience even though the situation is new. The attitude that is illustrated by the statement "this is something we have done before, so we know what to do" could be fatal. The decision could consequently be wrong and the error is what Reason would call "strong but wrong", as the individuals regard it as the right decision based on the right probability and consequence of estimating the proper risk. This implies that, even though the systematic approach with calculated probability and consequence is used, there might be an error at the end, making it difficult to realise the project objectives.

Experts, as well as skilled site managers, are experienced and have extensive knowledge which they can apply when making decisions. Novices and new site managers and foremen are required to seek new knowledge for many of the decisions that are needed and the decision process is therefore slower. As Reason has found, novices tend to focus on the surface features of the problem, whilst the experts focus on problems at a more abstract level. In a theoretical sense, this means that experts never need to work at the knowledge-based level, as they have a complete knowledge of what they do. In reality, however, it is more likely that the expert makes a strong but wrong decision at the skill-based or rule-based levels of performance.

The application for construction is the site manager with many years' experience and thereby knowledge of certain types of work who is put in a new situation with a new project. Relating to experience, instead of seeking new knowledge more suitable for the new circumstances, then jeopardises his/her ability to consider the right probability and consequence for the risk assessment. New circumstances could be anything from new techniques to a change in rules and legislation. Only when individuals realise that their knowledge is insufficient they will move from the rule-based levels of problem-solving to the next level, the knowledge level. At the knowledge-based level, the process involves finding cues to remind oneself of previous experience continuously as the process of finding new knowledge proceeds. People seek patterns and sort information, using the same processes to handle new information as they do to organise memory. This ability to organise and process information helps us to make simplifications in problem-solving; i.e. to make things easier (Reason, 1990). This explains why some people have a faster problem-solving process than others, an important skill for site managers in construction. The ability to make decisions at a fast tempo is vital if things change and action is needed on site to solve new problems. On the other hand, there is a risk involved with decisions that are taken too quickly. All the necessary information may not have been taken into account and the result might be an error. Working at the knowledge-based level can also be regarded as a matter of being able to work with continuous learning according to the descriptions used by Anheim (2001) and Senge (1995).

2.2 Individual experience as an influence on risk management

It has long been assumed that experience is an important key to risk management and perhaps in particular to risk identification. Recent research has, however, found that experience is not the key ingredient for effective risk identification; it is instead educational attainment and training that can improve the risk identification performance. Maytorena *et al*. (2007) have found that experienced project managers' approach to risk scenarios is less questioning and more reliant on procedures and their prior experience than that of more novice managers in the same situation. According to their study, there also appears to be a correlation between their definitions of experience, age, years in management role and years in current job, and the "orphan risks" and the more reactive approach of using checklists. Their definition of "orphan risks" is risks that are identified without prior searches for information or follow-up. Using the theories of Reason (1990), this would imply that experienced managers make decisions at the rule-based or possibly skill-based level, while the more novice managers work at the knowledge-based level, aware of their shortage of knowledge and searching for complementary information prior to decisions.

According to Brehmer (1980), trusting experience for the purpose of judgement and decision is not well founded when it comes to the ability to make better judgements and decisions. This is in line with the results reported by Maytorena *et al*.(2007). Brehmer's (1980) line of argument comes from the suggestion that, in order to obtain value from experience, one has to be able to learn from experience. He states that experience often gives us little information from which to learn. According to Brehmer, for most individuals in most situations, decisions are based on a deterministic approach instead of probabilities, in spite of the fact that the experience ought to provide knowledge about the probability that events will happen.

Coming to these conclusions about experience and the apparently contradictory reliance on it in construction, it is vital to understand more about the essence of experience and its relationship with judgements and decision-making. Several researchers have found that decision-making in connection with uncertainty and risk is a matter of judgement based on experience, knowledge and the individual ability to manage the risk (Lazarus and Folkman, 1994, Skitmore *et al*., 1989). Risk is often described as a combination of probabilities and consequences, as mentioned earlier. In order to undertake a proper assessment of a risk, an estimate of the probability and some assessment of the consequences if a risk were to break out are needed. In terms of probability, there are two ways of doing this: either estimated by experienced individuals or calculated from historical data or statistics. Experience, as a base for a probabilistic estimate, is a powerful tool that is frequently used in risk assessment. When an individual makes an estimate of probabilities, it is the experience and heuristics of that person that are used. The way a person perceives the world is also the way the same person makes judgements, evaluates information and makes decisions. If the information in a given situation is diffuse, reliance on long-term memory and experience is high. The ability to take in new information is therefore essential for judging probabilities. With the theories put forward by Reason (1990) fresh in one's mind, this would mean the ability to be aware of when there is sufficient knowledge, when work at the skill-based or rule-based levels is appropriate, or when it is time to go on to the more time-consuming, knowledge-based level and search for more information. If there is an expectation that things are going in one direction, the individual is making a judgement that this is also the most probable outcome. The risk outbreak and errors occur when this is the wrong judgement (Wickens and Hollands, 2000). Using the same line of argument, the consequence of a risk is assessed similarly and derived from the individual's ability to take in relevant information and use it in combination with experience.

2.3 The influence of stress

According to Butler (1995) cited by Smallman (1996), "*there is sufficient evidence to support the contention that managers with a high risk propensity are more likely to take decisions at short notice*". The interpretation of this statement is that personal traits influence risk management in organisations. This is also in line with the ability to work quickly at the rule-based level (Reason, 1990), with the possible outcome of "strong but wrong" decisions rather than working at the more time-consuming, knowledge-based level. Speed in decision-making thus appears to influence risk-related outcome.

It has also been found that there is a relationship between stress and increased risk (Hartzell *et al*., 2008). Working in a stressful situation has a negative impact on performance and increases the risk of defects, errors and accidents at construction sites (Djebarni, 1996). A study in the UK (Davidson and Sutherland, 1992) found that some of the main reasons for perceived stress at construction sites are time pressure, lack of resources and responsibility for situations outside the control of the site manager. During the last two decades, there has also been an increase in time pressure in construction projects (Theorell, 2006).

2.4 Theories of personality

Among the many theories used to explain personality, trait theory has become the prevailing one and the field of personality psychology relies on measurements (Brody and Ehrlichman, 1998). This area within the field of personality is also the one that has been most commonly adapted in the field of work assessment, such as job recruitment, and numerous tests are currently used for this purpose (Ones *et al*., 2007).

Trait theory is based on the idea that personality can be described through certain traits that are common to all individuals. This approach assumes that the personality has certain traits that are stable and consistent and can be measured and compared between individuals. These traits could also be used to predict future behaviour and are structured hierarchically, which means that various traits can be linked together at a secondary level to form traits at a more general level, also called factors.

In the research area of psychology, and within trait theory, the Big Five personality factors are the common and established way of describing individuals (Goldberg, 1992, Tupes and Christal, 1992, McCrae and Costa, 1989). "Big Five" is a general description that is theoretically accepted and is therefore valid as a reference to other tests claiming to describe individuals' traits. The five factors, the Big Five, were originally defined in 1961 by Tupes and Cristal in their work for the United States Air Force. The Big Five factors are: Surgency (extraversion), Agreeableness, Conscientiousness, Emotional stability and Intellect (openness to experience).

3. RESEARCH PROJECT

3.1 Project description and objectives

The aim of this paper is to determine if there are personality traits that could be related to construction site managers' approach to risk management. To be able to relate construction site managers' personality uniqueness, a chosen norm group consisting of managers from other industries has been used. The comparisons are made on a broad and general scale where the two different groups of managers are compared according to their mean values in each trait.

3.2 Research methodology

To be able to realise the aim the following research question was formulated:

> What are the differences between site managers in construction and other managers in terms of personal traits and in what way could those traits be related to risk management?

With the given research question, the appropriate research strategy had to be chosen. The research question gives hand that a personality test suitable for comparisons was needed also that the test was covering traits that could cover risk related behaviour in a work situation.

3.2.1 Personality and preference inventory (PAPI)

In the early 1960s, Dr M Kostick at the Department of Industrial Psychology at State College, Boston, designed what has now been further developed to become PAPI (Personality and Preference Inventory). The theoretical foundations of PAPI were mostly influenced by the research of Murray (1938) and his "need-press" theory of personality.

PAPI™ is an instrument used for testing personality and preferences by individuals in work situations. The first Swedish version was introduced in the early 1980s and the present version was introduced in 1997 with both the ipsative (PAPI-I) and the normative (PAPI-N) version. The ipsative version, PAPI-I, is designed to be used for personal development, while the normative version, PAPI-N, is meant to be used for comparison and selection. Since the purpose in this paper is to make comparisons, the normative version, PAPI-N, has been used and is referred to hereinafter as PAPI.

Different scales in PAPI are defined with the aim of describing the individual traits first and foremost in a working situation. According to the technical manual retrieved from Cubiks (Lewis and Andersson, 1998) there are ten scales for need and ten scales for roles that are identified in PAPI.

Different studies (Sanz *et al*., 2008, Cubiks, 2006) have been performed to investigate the relationship between PAPI and the Big Five. The findings from these studies show that the scales in PAPI correlate to the Big Five factors. The implication of this finding is that PAPI is a relevant way to measure personal traits and that the Big Five are a relevant way to describe personality in work-related situations as well. The match between the different factors is not perfect, however, as the Big Five factor describing emotional stability does not have any strong correlations with any of the scales measured in PAPI.

3.2.2 Sample

The PAPI test was conducted on two different occasions, during the autumn of 2007 and the spring of 2008, with the assistance of the Human Resources Department at NCC Construction Sweden AB. The sample comprises 194 construction site managers, where 97.9% were male and 2.1% were female. The mean age was 49.97 years with a standard deviation of 10.39.

Information necessary for comparisons between the samples in this study and norm groups from other industrial sectors was provided through Cubiks[3] and its established norm groups (2006) for the Swedish labour market. The chosen norm group used in this study comprises 186 Swedish managers, where 38.2% were male and 61.8% female. Information about age was available for 33% of the group and the mean age was 39.55 years with a standard deviation of 9.06.

[3] Cubiks is the international HR consultancy providing the PAPI test used in this study. Further information can be found at www.cubiks.com

3.2.3 Analyses of data

The research question aims to determine whether there are significant differences between site managers from the construction sector compared with mangers from other industrial sectors and especially in terms of traits (PAPI scales) that could be related to risk as described in the theoretical framework. Cohen's *d* (Cohen, 1992) has been used to calculate the effect sizes in the differences between the means in the PAPI scales and the means for the selected norm groups. *d* is defined as the difference between means divided by the standard deviation for those means.

$$d = \frac{meanA - meanB}{\sigma}$$

Different researchers offer different advice when it comes to interpreting the resultant effect size, but the most frequently accepted opinion is that of Cohen (1992), where 0.2 is indicative of a small effect size, 0.5 a medium effect size and 0.8 a large effect size. To analyse these data, the Statistical Package for the Social Sciences (SPSS) version 15, and Excel were used as a tool for statistical work.

4. RESEARCH RESULTS AND INDUSTRIAL IMPACT

4.1 Quantification of results

The research question focuses on determining whether site managers in construction differ from managers in other industrial sectors. If construction site managers are shown to differ on these scales, this could indicate more risk-prone behaviour and then also explain some of the problems with errors and a lack of quality that apparently exist. The personality traits represented by the PAPI scales which, according to the descriptions of the scales found in the technical manual of PAPI (Lewis and Andersson, 1998), could be related to risk are the scales I (ease in decision making) and T (work pace), as well as H (integrative planner) and D (attention to details), and are therefore of special interest.

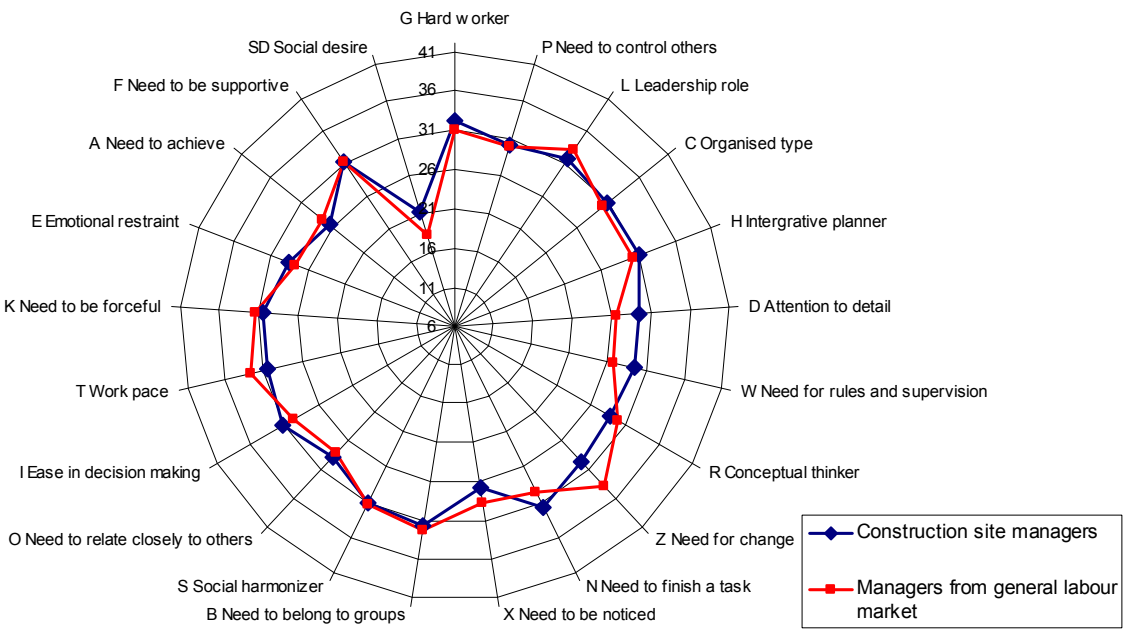

Figure 1. Comparison between PAPI scales sample of construction site managers and a norm group of managers other industries.

The construction site managers and the managers from general labour market are compared in a spider diagram, Figure 1, to illustrate how the groups differ. Maximum value is 42 and minimum is 6 for each scale.

In order to discuss whether there are any significant differences in each scale, the effect size is calculated – see Table 1. Effect size at 0.2 is thought to show a small effect, around 0.5 is medium and above 0.8 is regarded as high (Cohen, 1988). For this study, effect sizes above 0.25 are highlighted. These results reveal that there are some differences that are significant, according to Cohen's effect size calculations. The greatest differences appear in the scale Z (need for change). This result shows that the site managers from construction have less need for change than the norm group from other industries.

Table 1. Effect sizes in comparison between the sample of construction site managers and the norm group of managers from other industries.

Compared groups / PAPI scale	Construction site managers		Norm group 10 Managers		Effect Size *d*
	Mean	***Std***	***Mean***	***Std***	
G Hard worker	32,062	4,65	31,04	4,71	0,218
P Need to control others	30,093	4,12	29,89	4,4	0,048
L Leadership role	31,804	4,01	33,06	4,73	**-0,288**
C Organised type	30,990	4,78	30,15	5,8	0,159
H Integrative planner	31,175	4,23	30,15	5,08	0,221
D Attention to detail	29,418	4,92	26,44	6,5	**0,523**
W Need for rules and supervision	29,438	4,55	26,65	6,27	**0,517**
R Conceptual thinker	28,763	3,35	29,83	4,16	**-0,285**
Z Need for change	29,562	4,26	33,77	4,07	**-1,010**
N Need to finish a task	31,608	5,63	29,43	5,88	**0,379**
X Need to be noticed	26,619	5,58	28,65	5,36	**-0,371**
B Need to belong to groups	31,809	4,92	32,29	4,92	-0,098
S Social harmoniser	31,000	3,92	31,16	4,25	-0,039
O Need to relate closely to others	28,866	3,76	28,14	4,65	0,173
I Ease in decision making	31,227	5,17	29,65	5,39	**0,299**
T Work pace	30,381	4,15	32,66	4,34	**-0,537**
K Need to be forceful	30,412	4,55	31,31	3,91	-0,212
E Emotional restraint	28,552	4,79	27,76	6,2	0,144
A Need to achieve	26,577	4,86	27,66	5,16	-0,216
F Need to be supportive	31,211	4,09	31,18	4,43	0,007

The scale T (work pace) shows that site managers in this study have a lower value than the norm group, implying more risk-averse behaviour. When it comes to the other scale that is supposed to be related to risk, I (ease in decision making), the difference indicates that construction site managers find it easier to make decisions, i.e. might make decisions that are not always well considered. The effect size for the difference in scale I should, however, be regarded as small.

Within the scales D (attention to detail), W (need for rules and supervision) and N (need to finish a task), the site managers from the samples show a greater attention to detail and a greater need for rules and supervision, as well as a greater need to finish their work than the norm group of managers from other industries.

When it comes to the scales L (leadership role), R (conceptual thinker) and X (need to be noticed), there are differences with close to average effect sizes, indicating that site managers have less confidence in their way of managing things, less need to be noticed and that they also perceive themselves as less creative in addressing work-related problems than the norm group.

4.2 Summary and analysis of results

Site managers from construction and managers from other industries (Norm group 10) appear to differ in a third of the PAPI scales (7 of 21). However, these differences do not give any indication of site managers from construction being more risk prone then managers from other industries. A picture emerges of managers that pay attention to detail, need rules and supervision, work at a good and healthy tempo, are tolerant of stress and are keen on finishing their work. The one thing that supports the prevailing picture is the clear difference indicating little need for change that could be regarded as indicating that site managers from construction are more conservative than those from other industries. In a Swedish governmental report (Yngvesson *et al*., 2000), the images of construction employees as being more conservative is presented and this view could be seen as being confirmed by the large difference found in the comparison with the norm group in this study.

The norm group of managers chosen for comparison contains a majority of women (61.8%) and a minority of men (32.8%) (Lewis and Andersson, 1998). This means that, when it comes to this background information, there are differences between the samples and the norm group that might be important.

4.3 Implementation and exploitation

There is no such thing as site managers from construction being more risk prone or more reckless than managers from other industries, rather the opposite. However, construction site managers appear to be more conservative and more resistant to change and, as a result, they find themselves more easily caught up in old habits. This is, however, not solely an individual matter as the context of construction projects also has a preserving effect in the sense that there is rarely the time or resources to encourage problem solving at the knowledge-based level.

5. CONCLUSIONS

There are two different traits that have been found to indicate that construction site managers may have difficulty switching from working at the rule-based level of problem solving to the more demanding knowledge-based level. At the rule-based level, reliance on and the use of experience and instructions are high and, as a result, the decision-making process is rapid. This finding shows that the lower values for trait Z (need for change) and the higher values for trait W (need for rules and supervision) may preserve the way people work in projects and make it harder to break old habits. Construction site

managers have a high threshold when it comes to working at the knowledge-based level and they tend to stay with the more routine problem solving at the rule-based level.

Relating the personality traits of I (ease in decision making) and T (work pace) to a risk related behaviour seems appropriate according to the theoretical framework. Those traits are therefore used as important indicators to find out whether construction site managers are more or less risk prone then managers from other industries. The results show that construction site managers, by having lower values on the scale for Work pace, probably are more tolerant to stress then the compared group of managers. As a consequence this could be an indication that they are less prone to take risks. Further the results show that construction site managers only have a slightly higher value on the scale Ease in decision making then the compared group meaning that they do not take quick and possibly ill founded decisions for its own sake and by that being more risk prone. Construction site managers represent managers who are good at planning and paying attention to detail. It is therefore vital to understand and recognise that construction site managers are not being risk-prone individuals whom are responsible for the faults and errors occurring in the construction industry. Construction site managers are not more risk prone than other managers from the general labour market.

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MANAGING MAJOR RISKS INHERENT IN INTERNATIONAL CONSTRUCTION BUSINESS GROWTH

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ABSTRACT

Since the 1960s, the international business of the Finnish construction industry has grown to a substantial level, particularly in the EU and Russia. It is estimated that this international growth will continue. Finnish construction contractors and building product suppliers will face uncertainty and complex risks inherent in managing cross-cultural and contractual issues. Such risks may jeopardize goal-attainment, if they are not identified well and managed accordingly. The purpose is to define the characteristics of major cross-cultural and contractual risks (within the focal context), to suggest valid approaches to identifying and responding to such risks early at the business level, and to reporting briefly on the findings from the testing of the initial principles in real-life cases and the various international project situations that the selected Finland-based building product suppliers and plant contractors have faced. The findings indicate that the high effectiveness of project risk management can be ensured by focusing proactively on major risks inherent in (i) key managers' cross-cultural competencies and (ii) contractual arrangements between parties. It seems that it is particularly feasible to apply proactive responses at the business level – before project implementation – rather than wait until negative consequences emerge. It is posited that such a dual focus can be exploited by firms with their multi-level management cadres in the contexts of evolving, quite buoyant construction markets in the EU, Russia and Asia.

1. INTRODUCTION

The high value of the international business of the Finnish construction industry was over €15 billion in the year 2008. It is forecasted that this international growth will be continued in particular in Europe and Russia up to the level of €20 billion by the year 2013 (RT 2007). Thus, Finnish construction contractors and building product suppliers will face more uncertainty as well as more complex risks due to many mega-trends, e.g. life-time considerations of built environment, the networking characteristics of construction industries, and globalization of everything. On the one hand, this anticipated future provides Finnish companies with opportunities for profitable international business growth. On the other hand, companies need to find better and more proactive methods for risk management (RM) in multiple, challenging business growth situations.

In turn, the purpose of this paper is to study whether major risks are inherent in cross-cultural and contractual issues and whether such risks may jeopardize goal-attainment if not managed well. The results of the critical review of the relevant literature are presented in the second part. Therein, the early risk identification and the two particular types of risks, i.e. cross-cultural and contractual risks caught the authors' attention. The rationale and conduct of the insider actor research is clarified in the third part, followed by the presentation of the results of one of the nine longitudinal cases in the fourth part. The conclusions are drawn accordingly in the last part.

2. RISK MANAGEMENT IN INTERNATIONAL CONSTRUCTION

2.1 Uncertainty, risk management and pro-activeness

In general, uncertainty prevails when a decision-maker has no historic data (e.g. a group of instances) relating to a situation for an event, conditions, etc. to occur (Knight 1921, Smith 2003). Uncertainty is an everlasting framework of all future events, including risk events. In turn, risk is a possibility that expectations are not met (Lifson and Scheifer 1982). Risk is defined to arise from uncertainty by assessing, rationally or intuitively, a probability and an impact of an uncertain event (Flanagan and Norman 1993). Thus**,** uncertainty is converted to RM by setting the expectations, i.e. by assigning a probability to an uncertain event. In the basic, two-way approach, risk is assumed to have positive and negative consequences (see, for example, Lifson and Scheifer 1982, Smith 2002, Chapman and Ward, 2002). However, some authors consider uncertainty management as a project owner's means to tap opportunities, while RM is in the domain of project management (Langlo *et al*. 2007). This is understandable because usually an owner has to worry about project financing. The financial sector has traditionally – and well before the construction industry – grabbed opportunities as keenly as it has managed threats (see, for example, Buehler *et al*. 2008).

For the construction industry, an RM process is defined to include risk identification, risk classification, risk analysis and risk response (Palojärvi 1986, Flanagan and Norman 1993). Risk control may be added to emphasize a need of feedback and updating responses. Concerning RM strategies, pro-activeness, risk identification and responses are emphasized instead of assessing consequences based on the detailed mathematical analyses of probabilities and distributions (Lyons 2008). Thus, companies should direct their efforts toward effective response, calling for the sound competencies of key managers and a reliance on human expert knowledge, especially when time is a scarce factor (Palojärvi *et al*. 2008).

2.2 Emphasis on risk identification

In the context of construction, many authors have compiled the long, comprehensive lists of sources of risk such as success and failure factors in country/industry specific situations. Typically, Hansen and Millar (1997) note that "the dominant sources of risk arise from errors in the specification of requirements and a lack of coordination within a network of participants". The identification can be repeated within the limits of time and other resources when this is perceived necessary. 'Weak signals' or 'early warnings' with distant sources in prime events are used as the indicators of the expected occurrence of an identified significant risk (Nikander 2002).

It is herein recalled that each construction project is one of its kind. No prior history exists and all future events are uncertain. This uncertainty is amplified when a project type or a business environment, or both, is new to a focal actor, resulting in a high degree of complexity. In order to move from uncertainty to competent RM, one has to identify risks as well as to assess a probability and an impact of such an uncertain event. In turn, risk identification is built on predefined expectations. If expectations (objectives) are ill-defined or entirely missing, it will not be possible to define whether they will be met or not, and the respective risk cannot be identified or responded to.

Project-specific core objectives for its physical implementation are usually set in terms of scope, cost (and/or profit), time and standard. Additional objectives, particularly on the respective business level, may be expressed in a form of influencing a corporate image, disturbing competitors etc. (see, for example, Palojärvi 1986, Flanagan and Norman 1993). Causative events to immediate risks and their respective consequences need to be identified as early and deep as appropriate, allowing thus for pro-activeness. Managers can proceed from their defined objectives backwards to search for the sources of risk (i.e. possibilities that objectives will not be met). This way is more feasible than

to envision a myriad of possible but uncertain futures and then to try to determine their possible alternative impacts on objectives.

The aggregation of risks (or uncertainties) on the project level, based on, for example, Lichtenberg's (2000) theory and Monte Carlo simulations is not possible because every project is unique. Consequently, any response has to rely on human expertise. In addition, mathematical methods may provide some help when comparing alternative outcomes or responses (Palojärvi *et al*. 2008).

Moreover, it is herein posited that the standard risk identification approach is not enough vis-à-vis managing international growth projects. In other words, what effects do international business environments impose on risk identification in comparison with a situation where a stakeholder (e.g. a contractor) operates in its home environment? What kind of expert knowledge should be mobilized to identify risks that could jeopardize goal attainment? What competencies are needed for launching proactive responses instead of just waiting for the eventually fatal consequences of risks? The literature on managing project risks in foreign environments is scarce but some relevant references can be reviewed as follows. First, the recent references on international business in general stress two themes, the failures of expatriates and the inability by headquarters managers to appreciate local cultural challenges (see, for example, Johnson *et al*. 2006). Olson and Olson (2000) state that cultural differences form the single biggest factor affecting global projects. Mäkilouko (2003) concentrates on multicultural project leadership, i.e. relationship oriented project leaders (rather than the task oriented ones) may have a higher potential for leadership success since they tend to be able to maintain team cohesion. Organizational design can be used to mitigate multicultural problems. Fisher and Ranasinghe (2000) argue that people cannot have any competencies independent of context.

Second, what issues are considered decisive for success in international construction? Construction Industry Institute (1993) pointed out to leadership, efficient resource allocation, innovation, and organizational effectiveness. Flanagan (1994) brought up speed in innovation and delivery, flexibility in a delivery mix, environmental consciousness, HRD and deployment, automation and information, joint ventures, partnering, and financial engineering. In particular, he suggested flatter organizations to enable firms to move quickly into new markets. More recently, Langford (2000) has stressed the importance of cultures on projects. Fisher and Ranasinghe (2000) studied joint ventures as a cultural factor playing a role in uncertainty avoidance. Han *et al*. (2007) and Kim *et al*. (2008) emphasize that a contractor's abilities to manage functions are crucial. In particular, Ofori (2003) posits that a contractor must possess certain prerequisites and that managerial expertise is considered the most important factor (for competitiveness) because of the peculiarities and problems of overseas projects. However, he notes that there was no suitable framework for analyzing success in international construction (in the early 2000s).

Third, many authors – unfortunately without an international context but allowing for a high degree of complexity – focus on how to mobilize and exploit the critical competencies of contractual parties for high performance (Sakal 2005). Each contractual arrangement is a potential source of contractual risk, for example, in the context of project alliancing (Rowlinson *et al*. 2006). Some relevant references are given in section 2.4.

2.3 Partial focus on cross-cultural risks

The literature on international business stresses cultural issues on all levels of managing. On the contrary, the business-level competencies of managers have not been studied well in international construction related contexts. There are only some sketchy notes, for example on how managers should perceive future requirements. Likewise, success or failure factors are only seldom connected with business managers and their

competencies. Instead, the project-level competencies of managers and staff are covered to a large extent. In particular, Ofori's (2003) rare view on the availability of necessary expertise in managing cross-cultural problems and peculiarities in overseas projects is herein acknowledged.

It is thus posited that a managerial competence is a pivotal component of a firm's competence that helps a firm to attain its goals (aligning with Huovinen 2003 and Sanchez 2001). A manager's cross-cultural competency is herein defined as an ability to achieve a firm's goals by managing cross-cultural issues well (applying Sanchez and Heene 1996). A cross-cultural issue implies that at least two different human patterns of activity are present and active, e.g. in growth situations. A multi-cultural issue is seen more complex than an issue along only one cross-cultural dimension. It is proposed that a key manager's competency to manage cross-cultural issues, 'peculiarities and problems', may often turn out be non-sufficient in real situations. Moreover, it is proposed that any manager's competency to deal with cross-cultural issues can be assessed reliably by seasoned experts with their appropriate education and proven experience of similar conditions. To carry out such professional assessments is one of core management tasks.

2.4 Partial focus on contractual risks

On the level of managing businesses, many risks are typically arising from contractual arrangements in the case of mergers, post-merger activities, market entry projects, and joint ventures with local partners. On the level of managing construction projects, a contract – which is the core of contractual arrangements – identifies and distributes rights, duties, responsibilities, etc. between parties. In procedural contracts, it is stipulated upon how to deal with expected incidents which may or may not occur (Onishi *et al*. 2002). In such complex settings, industry and/or business specific conditions, the concurrent knowledge of general and/or local business practices as well as relevant laws and bye-laws are taken into account. All documents, specified activities, and other actions (to be complied with) are part of contractual arrangements. Contract management is a client's tool to ensure that his contractually defined objectives, specified in the documentation, will be met. In return, one of a client's obligations involves payments. The state-of-art contract management involves the design of an effective structure for a contract and its attachments, the selection of collaborating parties, and the execution of supervision and control tasks (Kiiras 2005).

The behaviors of parties include uncertainty and they are the source of contractual risk in projects (Onishi *et al*. 2002). Thus, a contractual risk is a possibility that a party's behavior will differ from the focal actor's (contractual) expectation. Earlier, Palojärvi (1986) has stated that project RM be based on (a) an equilibrium of parties' benefits, (b) the application and offering of incentives to other parties, and (c) the specification and adjustment of contract documents. Turner (2002) notes that the common approach involves a client who aims at achieving the lowest possible price from a vendor, i.e. a win-lose game. He prefers 'the correct way' where a client assembles parties and motivates them to achieve his aims. Shumway *et al*. (2004) argue that the biggest risks be inherent in contract clauses.

Many professional organizations offer frameworks, general conditions, or manuals for contextual contractual arrangements. For example, the Institution for Civil Engineers (2005) states in their manual that (i) it is normal for the interests of parties to be defined by contractual arrangements, (ii) it is important to ensure that arrangements take a full account of residual risks remaining after response actions have been taken, and (iii) a responsibility for each risk event, should it occur, is clearly defined. Others offer clauses, see for example FIDIC's (2005) list of "Employer's risks … (a-h)" and their consequences.

Changes and variations are seen as a structural source of disputes. Thus, incentives and means are needed, amongst other things, in order to mobilize and exploit parties' critical competencies for high performance (Sakal 2005), joint RM (Rahman and Kumaraswamy 2002) and project alliancing (Rowlinson *et al*. 2006). Humphreys *et al*. (2003) speak of trust, common goals and the understanding of all expectations and values as the prerequisites for success.

Contractual RM aims at the twofold goals of (i) how to mobilize parties' combined expertise earlier and better for better performance rather than to lean on the expertise of one party only, and (ii) how to trust other parties to deal with unforeseeable events, when they actually occur, in a fair and reasonable manner. It is herein proposed that the two goals can be attained by a contractual structure that allows for the aligned objectives and balanced interests of parties, including incentives, and the combination of expertise to manage proactively major risks in international construction. On the other hand, healthy competition should be maintained in all instances of combining the expertise of parties. Too close cooperation, e.g. between a client and a contractor, may turn out to be harmful in particular in the context of public procurement.

3. LONGITUDINAL INSIDER ACTION RESEARCH PROJECT

3.1 Project description and objectives as the research questions

The origins lie within the primary author's licentiate thesis on RM in the export projects of the Finnish contractors, i.e. the concept design and the case study approach (Palojärvi 1986). Our paper reports upon and discusses the initial findings of the primary author's ongoing study, i.e. the longitudinal insider action research. The research questions are "what are major risks in situations of international construction growth" and "how to manage them?"

3.2 Rationale of the insider action research study

The study involves a systematic analysis of nine real cases in various international project situations with the selected Finland-based building product suppliers and plant contractors as the focal actors. The rationale is clarified by addressing three key methodological questions as follows.

1. Why case studies? Since 1986 (i.e. the licentiate thesis), the primary author has carried out the systematic documentation of the overall management and RM of the relevant growth projects, by assuming a role of a part-time insider action researcher. This is one of the rare viable approaches to investigate the context of international construction where no research purpose can justify a major test project or a business transaction.
2. Why case studies with the author's direct involvement, i.e. the longitudinal insider action research? In reality, a possibility for the case documentation may not be available, or it is not easy in international construction. The primary author assumed a role of an action researcher with active and strong influence like 'an observing participant' (Alvesson 2003), because (i) it turned out to be impossible to collect case material on risks from outside cases, particularly if they had turned out to be failures of competitors, (ii) the cases presented in the early literature are thin and short and they did not render sufficient material for any deeper analysis, and (iii) the sampling (of a project population) was redeemed to be unreliable – it seems that this is the state of affairs within the recent research based on questionnaires and/or semi-structured interviews (e.g. Ahadzie *et al*. 2008). Thus, the rationale was designed in a form of a qualitative action research for solving severe, true management problems. The aim is to produce a novel, positive contribution to RM concepts and practices within the focal context (e.g. Ford *et al*. 2003). Aligning with Alvesson (2003), the investigated action must be

understood from the viewpoint of the actor or 'the observing participant'. In addition, this research is considered self-ethnographic where the author has succeeded in avoiding the common danger of remaining in 'his frozen positions'. Thus, the authentic case documentation is relied upon in order to come up with new and 'interesting material'.

3. Why these cases, i.e. what is common among the selected cases? The 2-3 cases were selected in the case of each of three principal Finnish corporations. The selection criteria are as follows: (i) the licentiate thesis pointed out to competencies of export management and contractual imbalances as the likely sources of major risks (Palojärvi 1986); (ii) the selection of both business level and project level cases deepens causally the longitudinal analyses, e.g. replying to a question like "can RM be(come) more effective when it is executed on the encompassing business level rather than only on the project level?" (iii) the selected cases were the pioneering ventures aiming for each corporation's growth within their host areas, i.e. South East Asia, Western Europe and Russia – any shortcomings within key managers' competencies and the building of new competences could be investigated and revealed in a reliable way. Similarly, the selection of the focal company's contractual roles and the arrangements to manage complexities could be extracted and evaluated; (iv) the cases could be documented in a reliable way including the decisions of the formal business management, so it is now possible to map and report on the setting and (non-) attainment of the business objectives, the decisions and their causal outcomes versus the key research questions; (v) the cases cover the typical risky situations of international growth; and (vi) the times of occurrence, the sizes and the outcomes of the cases vary between a crisis (and a possible disaster) and a true, significant success that together enable a valid cross-case analysis.

Only one case is reported in this paper, due to the limited space. The systematic, comparable documentation of the applied RM methods (i.e. defining objectives, identifying and assessing major risks, and launching responses) covered the periods starting with the idea presentation and ending with the near or full completion of each case project between the year 1984 and 2006. The documentation includes the minutes of the decision making meetings of the management teams, boards and/or Boards of Directors. Besides the direct case-specific data, the substantial amount of the books, the reports and the other documents was collected to explain the evolution of the key temporal issues of international construction. The initial 12-15-page case descriptions have been written. For the cross-case analysis, each description has been shortened down to include the five pages only.

3.4 Content of the valid case descriptions

All nine case descriptions have the similar structure consisting of the five parts: (i) the case in a nutshell and its background in light of uncertainty, complexity and RM, (ii) the actors' expectations (and their changes, if any) by stages, (iii) the RM actions (if any of them were carried out), (iv) some comments on the occurred risks and the actual risk-specific management, and (v) the discussion and findings of the case, including potential rivaling risks. Some crucial facts may have surfaced many years after the actual moment of the decision making (e.g. the reasons for Haka's bankruptcy in the PCE Sertolovo case and Partek Concrete's planned acquisition in the former DDR).

4. REPORTING OF THE OUTCOMES OF PCE SERTOLOVO CASE PROJECT

Herein, a summary of the results of PCE Sertolovo Case located in Russia near the Finnish-Russian border is presented as follows. The purpose is to lay a ground for the justification to develop more proactive and better models for contextual RM. Therefore, the reporting is focused on: (i) the use of the RM method as part of setting the business

objectives, identifying and responding to risks, and achieving the desired degrees of success, or all this resulting in the disappointing degrees of failure, (ii) the role of the key managers' cross-cultural competencies versus the degrees of a success or a failure, and (iii) the role and management of the contractual arrangements versus the degrees of a success or a failure.

4.1 PCE's business objectives for Sertolovo Case

The following three business objectives were set and attained as a whole or in part: (1) To make a considerable profit on the large single Sertolovo project. Its size was DEM 75 million (or 2 x PCE's turnover). The Nordic market was expected to suffer from the recession until the mid-1990s. (2) To grow PCE to become the number one pre-cast concrete technology supplier in Europe and to focus on solutions for attracting clients. (3) To avoid the exploitation of PCE's current resources in the Sertolovo project or the abandonment of PCE's other activities. It is concluded that this high goal-attainment was based to a significant extent to a fact that most identified risks were managed well and no uncertainties were turned out to become 'surprising risks' during the related years 1990-97.

4.2 Risk identification and management in PCE Sertolovo Case

In the tender stage, the identified five main risks were related to: (1) a loss due to the wrong German partner, (2) the winning of the tender and the possible consequent abortion of the project, (3) PCE's performance due to the exceptional scope and size of the project, (4) the project scope due to the turnkey contract form, and (5) the currency depreciation (the ailing Finnish Mark, the strong German Mark, and the unstable Russian Rouble).

In the implementation stage, the additional identified risks were related to: (1) the project abortion due to a political turmoil or a dispute of parties, (2) the builder's performance due to the last-minute change of the subcontractor, and (3) a lack of modern pre-cast concrete knowledge within the organization of the Russian owner and that of the German client.

Both project uncertainty and complexity could be reduced early at the monitoring phase with the available actions. After the project implementation became relatively certain, PCE applied the RM approach well both on the business level (tendering stage) and the project level (implementation stage). Some key managerial competencies had to be built for this project. *Ex post*, no rivaling risks could be traced – the major risks were only inherent in the cross-cultural and contractual issues. The outcomes of this case support the idea that the project RM approach can be applied to managing also business-level risks. It seems that the key prerequisites of a project success involve: (i) key managers' high-level competencies through all areas and levels of managing business fundamentals and local conditions, (ii) the specific competencies for managing cross-cultural issues, and (c) the specific competencies for the selection of a viable contractual role and the management of the arrangement among the parties. *Ex post*, PCE's hand-picked management (and Board) turned out to be competent.

5. CONCLUSIONS

The degrees of both uncertainty and complexity will increase across the construction globe due to many mega trends. All this implies that novel, highly proactive methods for managing international construction businesses, projects and the inherent major risks of growth are needed. In reality, the management of major risks takes time. We suggest that key managers would identify major risks proactively and launch responses early on the business level rather than to wait for project-specific implementations where the only

remaining option is to deal with the consequences of eventually occurring risks. It seems that many existing project RM techniques are also highly applicable to managing business level risks within focal contexts. Besides, we posit that there are major risks inherent in the areas of cross-cultural management and contractual arrangements that may jeopardize goal attainment, unless these two risk types are not identified and responded well.

The cross-cultural and contractual competencies of key managers are considered the likely sources of major risks in international construction business growth, for both contractors and building product suppliers. So far, the primary author has compiled the eight exemplary – but by no means exhaustive – groups of problematic cross-cultural factors besides the standard issues of general or project management, based on the lessons learned from during the numerous past cases. The eight groups include: (i) indigenous culture, (ii) visible signature projects for the local environment, (iii) corruption, (iv) national frictions, (v) the choices of local partners, (vi) the positions of expatriates, (vii) currencies, and (viii) geology, climate, and other natural conditions. In reality, these cross-cultural issues must be addressed concurrently to managing daily business or project issues.

Finally, complementary future research is called for to investigate whether managerial competencies in, for example, production technologies, general management and product design could be the sources of rivaling major risks in certain conditions of international construction. In turn, the primary author will test the applicability of the valid RM methods in some particular growth situations of the building product suppliers such as market entries, turnarounds, acquisitions, restructuring and capacity investment projects.

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JOINT RISK MANAGEMENT AS A DRIVER OF PROJECT PERFORMANCE IMPROVEMENT

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ABSTRACT

The paper presents a concept of joint risk management (JRM) that is about working together on managing project risks. Despite the fact that JRM is argued to be the best option when it comes to unforeseen and changing risks, the use of JRM is still uncommon in Sweden. The limited usage of collaborative tools in general and JRM in particular is obviously a weakness in current practice that negatively affects project performance improvements. Traditional construction culture and the lack of competence among the project actors are identified as the main obstacles towards effective collaboration and JRM. In order to overcome these obstacles, a number of factors must be successfully incorporated in the project. Two groups of factors, procurement-related and relationship-related, are described in detail. The main conclusion is that there is room for improvements regarding overall collaboration in projects and JRM in particular. However, the Swedish construction industry is not efficient enough to expect rapid progress. Last, directions for further research are outlined.

1. INTRODUCTION

Increasing cost, delays and quality deviations are common problems for construction industries in many countries (Al-Kharashi and Skitmore 2009, El-Sayegh 2008). Construction activities usually involve a significant amount of risk that affects the final output of these activities. As the size and complexity of construction projects have increased, an ability to manage risk throughout the construction process has become a central element safeguarding projects' final results (Maytorena *et al.* 2007).

The majority of literature on risk management (RM) highlights that effective RM depends very much on adequate risk allocation and efficient collaboration between the project actors. Risk allocation influences the behaviour of project actors and, therefore, has a significant impact on project performance in terms of total cost (Wang and Chou 2003). Unclear allocation of project risks leads to disputes between the client and the contractor. Several empirical studies on the subject show that efficient risk allocation can be a difficult task. One of the problems identified in the literature is the actors' different perceptions of to whom a specific risk or group of risks should be allocated (Loosemore and McCarthy 2008). In a survey study conducted by Hartman *et al*. (1997), the majority of the participants indicated enthusiasm to share risk, and not no allocate it to a specific project actor. Usually, contractors indicate that they have to bear the majority of project risks (Wang and Chou 2003), and price these risks through adding a contingency to the bid price (Andi 2006). Using contingency funds has been identified by researchers and practitioners as a significant source of cost overruns (Zaghloul and Hartman 2003). Evaluation and conscious allocation of risks to the appropriate actor under the contract allows reducing the bid price by decreasing contingency funds and, therefore, leads to lower total cost (Zack 1996).

However, even efficient allocation of the identified risks through the contract in the procurement phase does not guarantee that no conflicts occur in the project. During the project life cycle the nature and extent of identified risks may change and new risks may appear. Very often these unplanned changes and unforeseen risks may require joint efforts to be managed effectively. The concept of joint risk management (JRM) has been introduced by Rahman and Kumaraswamy (2002) and is based on the principles of

collaborative relationships between the project actors in managing project risk. Despite the fact that JRM is argued to be the best option to manage unforeseen risks, it is assumed that the usage of this collaborative tool is limited. No studies have been conducted in Sweden in order to explore if JRM really exists in projects.

There are three objectives of this paper:

1. to explore theoretical concepts and international experience in JRM;
2. to determine the most critical factors that contribute to successful JRM; and
3. to discuss why JRM is not widely used in Sweden.

Since JRM concept is still uncommon in Sweden, the paper focuses on the international research experience in JRM. An extensive literature review including an inventory of existing research and theory formation in the relevant areas is the main approach for this study. Deeper understanding of the JRM concept will allow further work for developing of a JRM model. The model can then be used by project actors and is expected to contribute to a more efficient risk management process and, in turn, a better project output.

2. RISK MANAGEMENT IN CONSTRUCTION – CURRENT TRENDS

It is widely recognized that construction projects involve a lot of uncertainty; and an ability to manage associated uncertainty is a key issue in safeguarding project objectives. Formally, RM can be defined as a systematic process of identifying, assessing and responding to project risk (PMI 2000). There are a limited number of studies quantifying the impact of RM on the project success. One example is a study by Raz and Michael (2001) that evaluates to which extent RM contributes to project success. On the scale from 0 to 5, the contribution of RM to the overall project success was around 3.9 which is a significantly high evaluation.

Existing research on risk management mainly focuses on two aspects:

1. RM is considered as a process, involving a number of activities and improvements are suggested by development of new models, methods and techniques for risk identification, assessment and response. Review of this area is presented in Osipova (2008).
2. RM is seen as an interactive process where project participants are in focus and play an important role in achieving successful RM. In this group researchers look for improvements in such areas as risk allocation, relationships, efficient organisational structures and collaborative tools. The focus of this paper is on this aspect of RM.

A number of empirical studies has been conducted in different countries in order to identify the current practice in RM (Akintoye and MacLeod 1997, Lyons and Skitmore 2004, Osipova 2008, Simu 2006, Tang *et al.* 2007, Wood and Ellis 2003, Zou *et al.* 2007). There are many similar findings in these surveys. The results indicate moderate use of RM techniques; mainly checklists and brainstorming are used. Moreover, current RM systems are argued to be very complicated and difficult to use. The main reason for the deviations in project performance is the lack of systematic approach to RM. The absence of systematic RM is especially noted in the early phases of the project, where it arguably has the greatest potential impact. Open discussions of possible risks in the early phases as well as collaborative management of risks throughout the project life cycle are found to be important drivers of effective RM. However, the communication of risks between the actors does not work. One reason for this can be that actors use different terminology for describing risk, which can cause inconsistency and incompleteness of risk communication (Tah and Carr 2001). Many participants in above mentioned surveys were agreed that in the current procurement practices the low bid price when signing the contract is more important than a thorough analysis of potential risks. The lack of JRM mechanisms was identified as a weakness in the current practice.

The actors often have their own management systems and do not use a joint database for RM documents. Despite of the visible advantages of collaborative work it is often the case that each actor is focused on his own part of the project and management of associated risks.

To summarise, the current RM is performed subjectively rather than analytically, individually rather than jointly and occasionally rather than continuously. If risks are to be properly managed, it is self-evident that the risk management process must be systematic and based on the efficient collaboration between the project actors.

3. PRINCIPLES OF JRM

Over the last decade, researchers and practitioners have recognised that the relationships between the client and the contractor play a significant role for successful project implementation. A study by Akintoye and Main (2007) shows that UK contractors are positive about collaborative relationships and believe they lead to cost and risk reduction. The results of another study (Drexler and Larson 2000) show that relationships in partnership projects are much more stable than in other types of projects. Adversarial and opportunistic behaviour that is common in the construction industry (Cox and Thompson 1997) leads to many conflicts and disputes when unforeseen events occur in the project. To overcome adversarial behaviour the concept of relational contracting (RC) has been explored extensively in the research literature and in practice. RC is a concept that focuses on the relationship between the contract parties and recognises mutual benefits and win-win scenarios through cooperation in the project. RC supports such cooperative agreements as partnering and alliancing and facilitates teamworking and JRM (Rahman 2003). Hartman *et al*. (1997) use the term 'dynamic risk management' for the similar approach of proactive and joint management of risks. The authors highlight the importance of project actors' beliefs in team efforts. Otherwise, it is impossible to achieve a win-win scenario.

The most extensive research on JRM has been conducted in Hong Kong by Rahman and Kumaraswamy (Kumaraswamy *et al.* 2004, Rahman 2003, Rahman and Kumaraswamy 2005, Rahman and Kumaraswamy 2002, Rahman and Kumaraswamy 2008). The main findings of this research are outlined below.

- The results of a survey of construction industry practitioners in Hong Kong show significant differences in perceptions of how risks are to be allocated in the project. At the same time they demonstrated a positive attitude towards the JRM concept. The majority of risk items listed in the survey were suggested to be managed through JRM to some degree.
- Both 'hard/technical' and 'soft/relational' factors play an important role and should be balanced when forming a project team for JRM. Some examples of 'hard' factors are technical capabilities, similar previous work experience, adequate resources, price, and quality of performance. The 'soft' factors include an approach to joint problem solving, attitude towards collaboration, creativity/innovation, attitude to continuous improvement etc.
- In order to create a successful collaborative environment, mutual trust, open communication among the actors, understanding each other's objectives and equitable and clear allocation of foreseeable risks were identified as the most important factors.
- Early involvement of subcontractors and main suppliers is important as their competence helps in effective risk identification and risk assessment. A project team involving clients, contractors and consultants should thus be formed before the final contract award. This helps in facilitating an effective project briefing that, in turn, leads to better understanding of the project's objectives by the actors.

- JRM was identified by practitioners as the best strategy for managing unforeseen risks and risks that change during the project implementation.

In order to create a collaborative environment that supports JRM, a number of factors must be taken into account and successfully incorporated in the project. To determine the most critical factors, the literature review on relationship contracting, teambuilding, partnering and collaborative agreements was conducted (Bayliss *et al.* 2004, Black *et al.* 2000, Cheung *et al.* 2008, Dagenais 2007, Drexler and Larson 2000, Kadefors 2004, Rahman 2003). The identified factors were grouped into two categories: procurement-related and relationship-related (see Table 1).

Table 1. Factors that contribute to successful JRM in the project.

Categories	**Factors**
Procurement-related factors	Clear contract Total cost perspective in partner selection Focus on technical expertise and managerial competence in partner selection Incentive to risk-sharing/problem-solving Joint objectives Team building activities at the early stage Long term agreements
Relationship-related factors	Mutual trust Openness of project participants Effective communication Good relationships and desire to maintain it Exchange of information Good teamwork in a dedicated team Commitment from senior management Long term perspective Commitment to quality and continuous improvement

The procurement-related group includes factors that are important to consider when choosing the procurement strategy, i.e. form of contract and payment mechanism. The purpose of clear contract is to ensure a formal risk allocation in the project. With a clear contract as a starting point, that formalises liabilities and responsibilities of each contract participant, further RM activities can be planned and performed jointly. The total cost perspective is about avoiding the low bid approach during bid evaluation phase and taking into account other factors that may influence the final cost. Technical expertises of the actors as well as competent and sufficient resources are of a large importance for the successful project. They facilitate efficient teamwork and create an environment where actors respect each other's competence. Incentives to risk-sharing/problem solving can be provided through different bonus schemes with monetary rewards for a successfully completed project. The main purpose of incentives is to motivate the actors to work jointly and proactively, and avoid shifting problems to each other. Team building process at the early stage includes different activities such as initial workshops, where

participants discuss their expectations about the project and learn to work as a team. The expected result of this process is a dedicated team with joint objectives and ability to collaborate. Taking into account the long term perspective, for example through strategic partnering agreements, the actors facilitate long term relationship that is obviously conducive for a successful collaborative work.

The factors in relationship-related group are of a soft nature and their success depends very much on how procurement-related factors are built-in in the project. Mutual trust is argued to be the most important factor that affects JRM and is not just given in the project. Long term relationship and previous work experience with each other are minimal conditions for creating trustful environment. Openness of project participants is crucial when it comes to discussions about risk, without it risk identification process will never be successful. Effective communication is another condition for JRM, project risks are required to be communicated between the actors as well as between the project phases. Exchange of information is included in effective communication and should assist quick decision making. Good teamwork includes many aspects and basis for it should be created during the early phases of the project. It is impossible to create an efficient collaboration without continuous commitment from senior management. Its role is to lead the process and provide all necessary assistance for project participants. Commitment to quality and continuous improvement are other factors that support ambition to create good relationship in the project.

Both groups of factors described above are important for creating a collaborative environment that supports JRM. However, current procurement practices in Sweden often do not provide appropriate conditions for incorporating these factors. Possible reasons for why JRM is not widely used in Sweden are discussed in the next section.

4. DISCUSSION AND FUTURE WORK

In recent years, the Swedish construction industry has shown a growing interest in developing collaborative relationship and joint project management. For example, collaboration through partnering has been introduced; and the three largest construction companies in Sweden, Skanska, NCC and Peab actively work with partnering projects and report positive results. JRM should be included in such partnering arrangements and contain the following activities:

- joint risk identification and assessment in the early phase of the project;
- joint preparation of the risk register and risk mitigation plan;
- continuously follow-ups of risk register and mitigation plan; and
- proactive and joint management of new and changing risks.

No studies have been conducted in Sweden in order to explore if these steps are followed in practice and if JRM really exists in projects. However, a number of studies about collaborative relationship show that the use of partnering in Sweden is still scarce. A survey conducted by Eriksson and Laan (2007) revealed very limited usage of collaborative tools in Swedish construction projects. The following main obstacles to increased collaboration are identified (Eriksson *et al.* 2008): conservative culture, adversarial attitudes, short-term perspective, traditional organisation of construction process and traditional procurement procedures. Without overcoming these barriers, a collaborative environment that supports JRM in the project will not be achieved.

The last government report (Gustavsson *et al.* 2009) investigates the current situation in the Swedish construction industry and states that during the last years no significant improvements were reached. There are low incentives for process improvement and development in construction companies, which, in turn, leads to difficulties in implementing changes and new concepts. Collaboration between different actors does not work satisfactorily and communication problems exist. These problems are argued to have a high impact on construction cost increase. On the other hand, the same report

criticises collaboration through partnering, pointing that the construction practitioners still do not have enough competence to work in partnering.

This study is a part of the research project that aims at developing and testing a JRM model that can be used for guiding JRM activities in order to facilitate project success. In the future work two case studies will be performed with a main purpose to explore how JRM works in practice. Case study data will be collected through document studies, observation of JRM workshops and interviews with the project actors, representing client, consultant and main contractor. The literature review findings will then be compared with the empirical findings in order to develop a JRM model that can be tested in two longitudinal case studies.

5. CONCLUSIONS

The findings show that different perceptions on risk allocation are common in construction projects and conflicts between the actors may arise and negatively affect the final result. Moreover, risks are dynamic, i.e. identified and allocated risks may change during the project implementation and new risks may appear. JRM is about working together on managing risk throughout the project. JRM requires an effective collaborative project environment, which is a weakness in the current practice. There is a limited use of collaborative tools and a number of significant obstacles that prevent the industry change towards effective collaboration. Both procurement-related (i.e. total cost perspective in partner selection, focus on technical expertise and managerial competence, long-term agreements) and relationship-related factors (i.e. mutual trust, openness and commitment) must be addressed if the JRM process is to be effectively used. The last government report, which investigates the current state of the Swedish construction industry, points at the lack of collaboration in projects but, at the same time, criticises such collaborative agreements as partnering. The main reason for criticism is the lack of competence among the project actors that makes partnering projects ineffective and, therefore, does not lead to construction cost decrease. Thus, research that increases the knowledge about how to perform systematic JRM throughout the project life cycle is of particular interest for the project actors. Conservative culture is other important obstacle that prevents development. Changing the culture is a time-consuming task and the progress cannot be made quickly.

The main conclusion of this study is that there is a room for improvements regarding collaboration in the project and JRM in particular. However, it is evident that the Swedish construction industry is not efficient enough to expect rapid progress. The further research in this area is needed in order to facilitate JRM activities that are arguably improving the overall performance of construction projects.

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THE USE OF REFERENCE CLASSES TO FORECAST RISK AND UNCERTAINTY IN ICELANDIC PROJECTS

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ABSTRACT

This paper describes how Icelandic publicly-funded projects have, in the past, been influenced by biased decision making. Decision makers from the ranks of politicians and others who determine public spending are victims of over-optimism and even deception. This leads to a sort of inverted Darwinism. Project ideas survive and are approved not because they are viable but because risk is downplayed and cost figures are unrealistic. The consequences are cost overruns and late schedules. We demonstrate examples to argue for the symptoms of the cognitive bias affecting many publicly-funded projects. To verify our arguments, some 70 projects are compared with respect to planned cost and actual outcomes. More than two-thirds of the projects suffer from cost overruns. We suggest reforms by using reference classes based on empirical data to improve project forecasting. To demonstrate how reference class forecasting works, an example is made based on the 70 projects. By calculating the distribution of differences between planned cost and actual cost for projects, in a particular reference class, decision makers can predict the necessary cost uplift for the project proposal based on historical evidence for statistically comparable projects. This method will contribute to more disciplined decision making, realistic planning and accurate forecasting and perhaps foremost – saving taxpayers' money.

1. INTRODUCTION

Few years back the legendry management tycoon Jack Welch addressed a small group of people at the University of Reykjavik. In those day's general optimism ruled. Risk was something people talked about a lot but not many were really concerned. The future was bright, and money, well, that was not considered an obstacle. Welch was answering questions from the audience. A young investment banker listened with admiration as the great men explained how he increased the market value of General Electric 38 times under his reign. Suddenly the young man asked a question; *"Mr. Welch could you please explain to me the best way to make money!"* Welch stared at the young man for a while. The banker obviously was not comfortable under the stern look from the management legend. At last Welch said: *"Son, the best way to make money is to stop losing it."*

In the period 1997-2007 the public sector expanded in Iceland. The increase is approximately 10% in terms of the GDP. It could be argued that this evolution will continue as the private sector is seriously hit by the world financial crisis limiting the possibilities for market funding. It has been declared that the government will invest in projects for strategic purposes as a resistance to unemployment and the radical decline of the private construction business. These projects are strategically selected to create as many jobs as possible.

Opinions may differ on this approach but there should be a consensus regarding the decision making process. It should be accurate and all means should be applied to bring plans as close to expected outcomes as possible.

Inaccuracy in planning cannot be eliminated. Planning is a prognosis regarding tasks which have not happened and will include errors. Planners and decision makers must therefore accept planning errors. In some cases the planner will overestimate and in some cases underestimate. It should be presumed that the majority of the expected

values will be close to the actual values. If this would be the case the differences would be levelled out and most projects would be close to the planned values.

This is not the case in reality. In spite of improvements in forecasting techniques and information technologies the planning accuracy has not improved (Flyvbjerg *et al.*, 2002). Furthermore the inaccuracy is biased in the direction of cost overruns. This can be verified by taking a look at the annual audit on the Central Government Accounts 2007 (The Icelandic National Office, 2007). A quarter of all accounts exceeded planned values. As will be demonstrated later 70% of public funded projects exceed planned values. This indicates that there is a room for improvement. This might be seen as critical when it is bearded in mind that official projects will presumably increase both in numbers and volume in the near future.

Bearing the words of Jack Welch in mind we suggest reforms by improving the disciplines of decision making. Our aim is to increase awareness of how the mind process information. When we face a decision we tend to play down risks and act overconfident of our abilities to control events. When pressure for results from shareholders, voters and other stakeholders is added to this mixture the result are project decisions and planned values out of context with what history indicates as the being the most likely values.

- The first objective of this research is to demonstrate some examples of public funded projects suffering from symptoms that have lead, or will presumably lead to, cost overruns on the tax payer expense.
- The second objective of this research is to identify that this problem truly exists in Iceland by comparing planned values and actual outcomes for public funded projects. The population is all projects, with the available attributes, retrieved from the Government Construction Contracting Agency web site in June 2007.
- The third objective is to use these project outcomes to demonstrate a method called reference class forecasting (RCF). RCF is suitable at the very beginning of a project life cycle when the project is approved for execution. RCF predicts the cost uplift necessary for a new project by establishing the link for cost increases in historical projects and the probabilities for cost overrun in the new project.
- The fourth objective is to lay foundation for further research in this field by establishing reference classes for Icelandic public funded construction project. This will provide the governmental agencies and decision makers with a tool that can improve the planning disciplines and forecasts contributing to more carefully selected projects.

Reference class forecasting is based on theories of decision making under uncertainty by Daniel Kahneman and Amos Tversky.

2. COST OVERRUNS

Why are cost overruns so frequent? This can be traced to cognitive biases and political pressure. The cognitive bias is in fact error in the way the mind process information (Lovallo and Kahneman, 2003). The cognitive bias contributes to over optimism, over confidence and the perception that the future looks brighter than the past indicates.

A demonstration of this is a survey conducted by the author among his engineering students in the fall of 2008. They were asked to value their various skills in compared to their peers. The talents to compare where the following:

- leader skills
- learning skills
- athletic skills.

When asked about their leading skills compared to their fellow students 74% believed that they were above average. When asked about their future grades 64% believed that their grades would exceed the average grade of their peers. When asked about their athletic skills 64% believed that their skills where above the average.

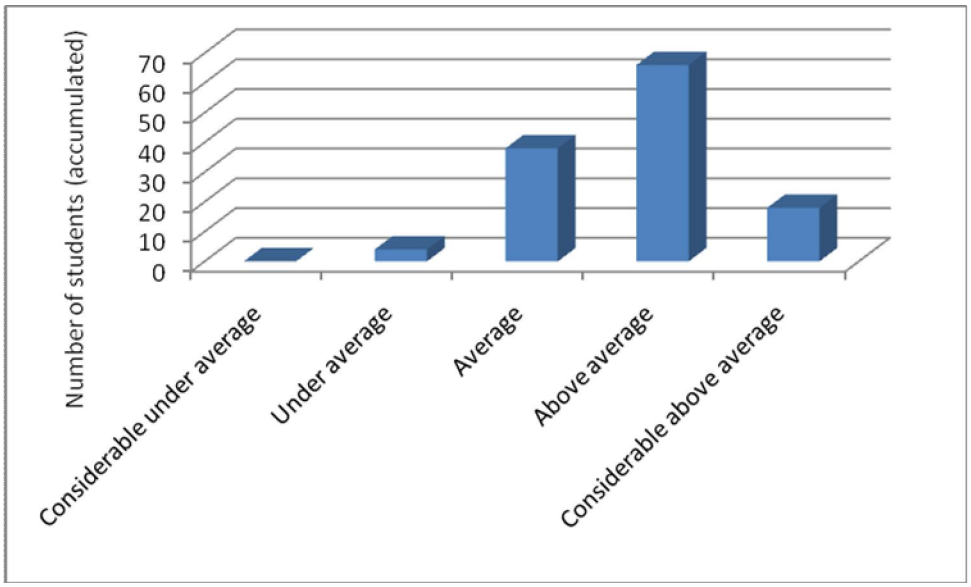

Figure 4. The combined result of a self-evaluation among the author's students regarding their skills compared to their peers.

This is of course statistically and logically impossible. The reality is that there is a mean value and a mode where most students will be found. It is impossible that the majority will excel in talents compared with others in the class

This study is based on other similar ones. A study of over one million students shows the same exaggeration of their own talents (Lovallo and Kahneman, 2007). So the result is in accordance with what is to be expected when cognitive biases are taken into account. People tend to overestimate their abilities and skills. People also show tendencies to take personal credit for something that is mostly due to pure luck. At the time of decision people tend to assume that problems in the project will easily be solved and rule out risk factors that will happen randomly in most projects. As a result people tend to downplay risks at the point of decision making leading to a planning fallacy. This applies to most people including individuals and teams responsible for project planning and budgets.

The political factor can be traced to pressure from the environment. In some cases it is in the favour of the decision maker to ignore or bypass the real conditions. This could lead to an intentional selection of values. The decision maker selects the optimistic number which is suitable for his purpose. The purpose is to ensure that a certain project is approved for execution.

To name an example how this can evolve it is interesting to study the discussions regarding an undersea tunnel connecting the Icelandic mainland to the Vestmanna Islands. A group of stakeholders was interested in this project and came forward with a forecast regarding the cost. A foreign engineering company projected the cost to be ISK 14-16 billion. This was the then introduced as the planned cost for the tunnel. Little later another forecast from another engineering office was published for this tunnel project. This forecast projected the cost to be from ISK 50-80 billion.

The interesting part is the response from a certain parliament member serving the constituency of Vestmanna Islands. He was quoted in a newspaper: "*This holds no arguments, these are just speculations*." (Frettabladid, July 28, 2007). Why does the parliament member respond this way? Why does he choose to favour the lower number but criticize the higher? Of course, it may be argued that the pessimistic value is a speculation of a sort but that also applies for the optimistic estimate. It is possible that the parliament member is motivated by pressure to get the project approved regardless the most likely cost?

Another project concerning transport improvements for the Vestmanna Islands indicates why the kick off of a project is so important. This project concerns a ferry harbour at Bakkafjara. The estimated cost is approximately ISK 6 billion and when this incident takes place the project had been approved just recently. Then some local stakeholders opposed this project and suggested another solution. They assembled signings on a protest list from the local residents urging the Minister of Transport to reconsider his decision.

This is how the Minister responded when the list was submitted to him: *"Surely we will take a look at this list but it is far too late for this discussion"* (Morgunbladid, April 17, 2008). When this is stated only a very small fraction of the projected cost is spent. The construction had not started. If the new proposals were indeed sensible sunk cost would be a small number. Furthermore; in this sense it really does not matter if the new proposals are viable or not. It has to be an overstatement on the Ministers behalf to argue that at this point the new ideas could not be considered. Unless of course this proves that a project that has been approved will not be easily stopped regardless of arguments. This might therefore explain the reactions of the parliament member in the previous case.

Other examples could be mentioned. The concert hall at Reykjavik harbour was decided on April 11, 2002 by a bilateral agreement between the government and City of Reykjavik. This project had been in the pipes for years and pressure had accumulated from various stakeholders demanding a music hall. The obstacle was the cost both in terms of building the hall and running it. The decisive number doing the trick was ISK 6 billion (approximately ISK 9 billion at fixed prices October 1, 2008). Before the bank crash in October 2008 a new number regarding the planned value had been published. The new planned value has escalated and is projected to be almost twice the original one.

Yet another example is a new University hospital. The original number mentioned at the first stages is at a fixed price approximately ISK 50 billion. This is, however, a citation from an ex-member of the project committee: *"...it would not surprise me if the cost would exceed ISK 100 billion"* (Vidskiptabladid, May 27, 2008).

A much discussed case in the year 2007 was a ferry serving the remote island Grimsey. When the ferry at last was brought into service in the year 2008 the planned cost had more than tripled!

These few examples indicate that there is a room for improvement. There lies a real danger that at the decision point there is a tendency towards unrealistic optimism leading to cost overruns. Budgets and plans must rest on true grounds not over optimism or self interests. After all it is the tax payers that will pay the bill eventually.

3. REFERENCE CLASS FORECASTING

Daniel Kahneman, the Nobel laureate in Economics in 2002, suggested the use of Reference Class Model (RCF) to create an objective forecasting method. This is called the Outside View.

By classifying enclosed projects by their statistical attributes in classes the difference of planned values and actual outcomes can be determined. These differences will form a distribution. When an estimate for a project is submitted for a decision it can be compared to the relevant reference class. This study reveals the risk for cost overrun. The following five-step procedure may be applied (Lovallo and Kahneman, 2003).

1. Selection of a reference class. The class has to be broad enough to be statistically meaningful and narrow enough to be truly comparable to the project at hand.
2. Assess the distribution of outcomes. This distribution shows the outcomes of previous projects.
3. Make an intuitive prediction of the project, under scrutiny, position in the distribution.
4. Assess the reliability of the prediction. This is a reality check on step 3. How well does the initial estimate correlate to the actual outcome based on historical predecents of comparable projects?
5. Correction of the intuitive estimate. Due to bias the intuitive estimate from Step 3 will likely be optimistic. It will probably deviate from the average outscome of the reference class. Higher deviation indicates more risk.

The first instance of reference class forecasting in practise is may be found in a study Flyvbjerg and Cowi (2004) did for UK Department of Transport and HM Treasury. Based on the study in the summer of 2004, it was decided to implement the method as a part of project appraisal for large transportation projects. Data were collected regarding costing of the projects with the objective to deal with optimism bias. On this basis it was possible to establish required uplifts for the projects based on emprical evidence. Furthermore this was used to provide guidance on using the required uplifts to encourage more realistc planning and forecasting in individual projects. All this is highly relevant in the current situation in Iceland.

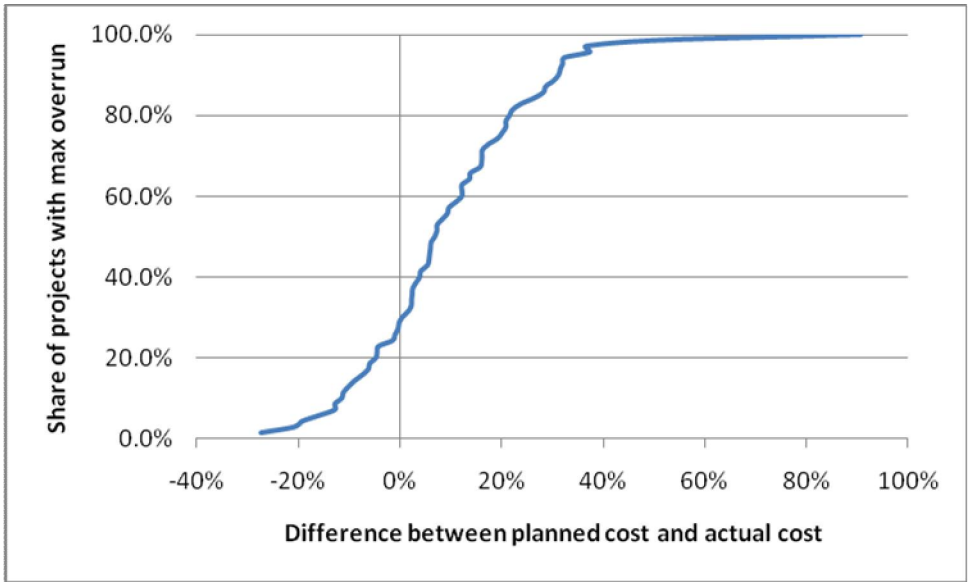

Figure 5. Probability distribution for all projects at the FSR website in June 2007 (n=70).

To demonstrate how this works we assembled close out reports from the Government Construction Contracting Agency (FSR) as published at its website (June 2007). FSR administers government construction projects as well as consulting on technical matters, procurement and preparation of projects.

In this demonstration example all projects are defined as a reference class. This example is put forward to explain how the RFC works and will not predict the bias for a particular project type. However, it can be used to predict the real outcome for any given project under the control of the FSR based on the project closure report at its website.

On average the project cost overrun is +10% and the difference between planned cost and actual cost is statistically significant (p=0.01). We can therefore assume that this cost overrun is normal. For the average project in this reference class this is therefore the expected cost overrun percentage. As this is the average cost overrun this implies that there is 50% chance of the budgeted cost being higher than the initial estimate and 50% chance of the budgeted cost to be lower.

When a project is proposed the decision maker must decide if the team of expert estimated the project cost under normal condition. Normal means that the budget is biased. If the budget is calculated in the same manner as other projects it may be concluded that this particular project should be placed in the middle of the distribution. In the case for illustration here this would mean a cost up-lift of 10% and a 50% chance of the cost being higher (including the uplift).

If this not acceptable the uplift needs to be higher than the average cost escalation.

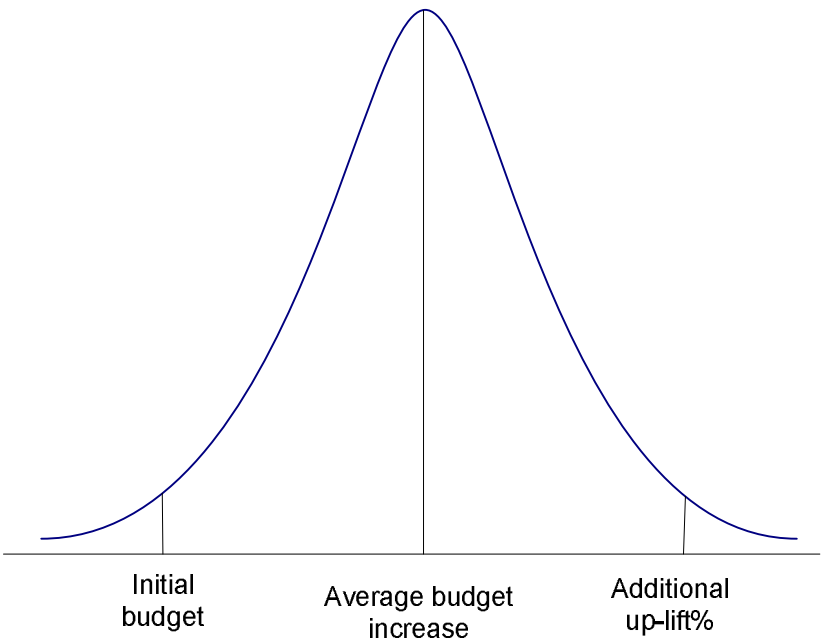

Figure 6. The average budget increase and the necessary up-lift. The mean is the average uplift required to have even chance (50/50) of the project being over budget and under.

The purpose is to increase cost awareness. Many projects are influenced by over-optimism as discussed earlier. By analyzing historical projects in this manner we are in fact looking at the budget from the outside. The opposite is the inside view referring to that the planners estimate is affected by factors from the environment that may distract his analysis.

It is debatable where to place a project into the distribution. A thorough risk assessment might limit the risk of cost overrun to name an example. However not many projects are processed this way. The majority of projects are planned and budgeted in a traditional way. In most projects the average increase must be added to the inside view, the initial proposed, budget, to ensure equality in terms of being over or under the estimated cost.

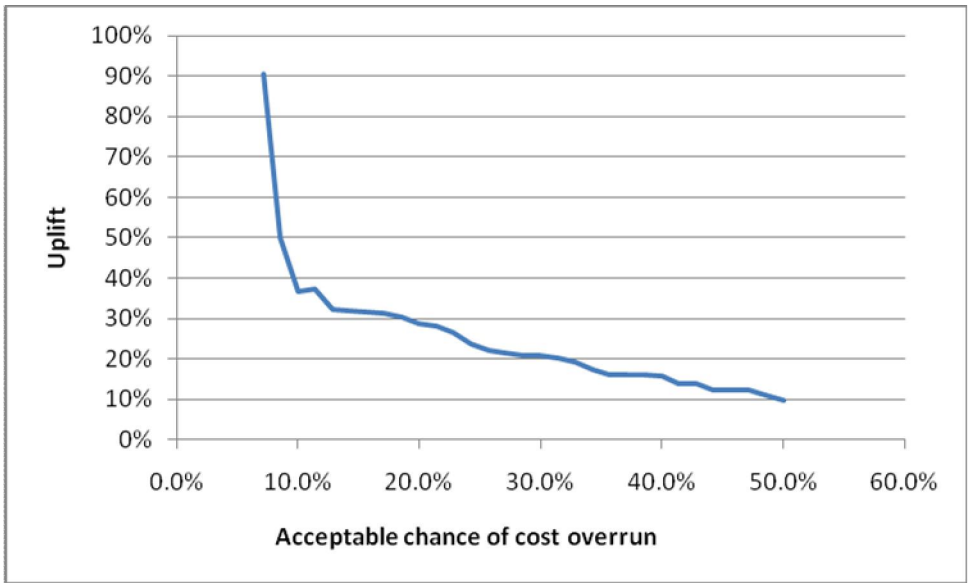

Figure 7. Required general uplift for all projects at the FSR website in June 2007 (n=70).

For the general project group used to demonstrate this reference class forecasting method it can be noticed that if the decision maker does not accept the 50% chance for cost overrun and sets the standard at 20% chance the necessary up-lift would be 30%. For a project with a initial budget of ISK 100 million this would result in a budget of ISK 130 million.

4. THE WORK AHEAD

The work ahead is further data gathering and procurement. Discussions have already been made to Ministry of Finance to cooperate in this assignment. Of all the public owned institutes it can be argued that our work will benefit the Ministry of Finance the most. Arrangements have been made to ensure cooperation of other Ministries as well. When access to data and information is ensured the following procedure will be enacted:

- Data sorting in reference classes in accordance to project scope and type.
- Identifying the statistical distribution observed for each reference class based on the empirical data.
- Identifying the necessary uplifts for the reference classes.

The selected projects will mainly be construction and transport projects but will be expanded to include other project types in the future. It may be emphasized that although our work is focused on public projects this method is equally valid for private projects. When ready our work will therefore form guidance for decision makers in the private sector and the public sector.

This results in critical questions being asked beforehand, risk awareness, more disciplined planning and forecasting saving the taxpayers' money – a vital issue in times of economical turmoil.

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INTERACTIVE RISK MAPPING FOR CONSTRUCTION

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ABSTRACT

This paper explores the opportunity and potential applications for a new risk management paradigm. It is considered that the conventional risk management paradigm is based too much around elements such universal definitions, standardization and presentation of risk management as a separate and mechanical task. Seemingly, this is narrowing our thinking and the capacity of resultant solutions. It is our ultimate target to make risk and uncertainty management an easy and fun task where both positive opportunities and averse risks are tackled in a balanced manner. An important finding from live risk management meetings is that the word 'risk' should be used only in the context of severe events. Otherwise, it can be difficult to separate risks and their management from regular management operations. The result is that the value of risk management procedures will be unclear and, finally, overall interest in risk management could disappear. This is an example of principles that are omitted in the conventional risk management paradigm. Human behaviour as an enabler of effective risk management meetings is another aspect of interest. Naturally, good facilitators play here an important role and thus it is worthwhile to study their performance and behaviour. Individuals who can be called good facilitators put emphasis clearly on creating common understanding, showing the current risk structure visually and updating all this continuously during discussions. Seemingly, such effort leads to proper dialogue, shared risk understanding and high commitment to necessary actions. Based on findings from live risk management meetings, a new type of tool for risk management has been developed. The tool is termed Interactive Risk Mapping (IRM) and is a computer program that takes advantage of interactive computer graphics to support human communication in risk management meetings. The paper presents this IRM tool with an example taken from industrial construction. IRM is based on *Flash* technology and it can be seen as a first instantiation of a new risk management paradigm. The paper is based on research that is complete and which demonstrates novelty in the face of the traditional risk management paradigm.

1. INTRODUCTION

Risk management forms an integral part of modern construction management. We can either understand the risk management operations as proactive planning tasks or continuous managerial effort for improving the chances to meet the objectives. As a proactive planning task the risk management appears as a piece of homework for understanding better the conditions and, then, for mitigating the potential problems (downside risks, threats, hazards, adverse events) and for improving the chances to meet the opportunities (upside risks, positive events). One should note here the terminological difficulties that still too often can make risk management difficult to approach or to apply it in real business situations. The terminological difficulties still remain as can be seen in the recent ANSI standard PMBOK® 2008 – A guide to the project management body of knowledge and its construction specific interpretation document (PMI, 2008 and PMI, 2007). Traditionally, and, as presented in these de facto standards risk management is still commonly understood as a separate, formal and rather mechanical pro-active task.

Risk management as a continuous managerial effort can be characterised with wording such as intuitive, informal and reactive. For experienced project and company managers the content and practical appearances of risk management are clearly beyond the

content of proactive formal risk management. This is proposing that there is imbalance between the actual risk management practices and the way how the content of risk management is presented in the literature. Thus, the current literature as a starting point can limit our thinking and guide the development of risk management practices to insufficient and inefficient solutions. Several researchers have pointed out such shortcomings and problems, for example Chapman (2006), Jaafari (2001) and Pender (2001).

Risk management tools, for example software packages and company specific guidebooks, are important appearances of current practices and they are naturally reflections of our overall understanding of risks and their management. Such tools represent a practical risk management implementation effort based on the currently acknowledged principles and assumptions. They can be very helpful for creating efficient risk analysis and management processes and for focusing on aspects of importance, practical example presented in Smith (2003). In the case of computer software packages the development efforts can be guided and limited by the existing technologies and programming paradigms which are many and can be of different overall development level. Specially, the predominant computer user interface paradigm WIMP i.e. window, icon, menu, pointing device is gradually developing toward a new user interface generation where examples of new elements are virtual reality, mixed reality, 3D interaction, tangible user interfaces, context-aware interfaces and recognition-based interfaces (Vijayan, 2004). This position paper presents results of a research and development effort towards new kind of software tools for construction risk management. The developed IRM prototype (Interactive Risk Mapping) is based on the characteristics of risk management that have been identified in a research project where risk management practices of five internationally operating companies were studied. This tool and its functionalities placed attention on (i) joint risk estimation, (ii) creation of shared understanding and awareness, and (iii) establishment of commitment. These functionalities are particularly applicable in modern networked construction business where risk management cannot be a one player game rather the risk management thinking models and corresponding tools need to meet working practices where various partners work together for reaching best possible shared understanding and actions.

2. STATE-OF-THE-ART REVIEW

2.1 Shortcomings of traditional risk management

Our thinking and industrial practices is still predominantly and in a rather concerning manner still anchored with the traditional risk management paradigm. Based on evidence from the literature, standards and practical cases it looks that traditional risk management is a thinking paradigm that is dominated by separate processes, formalisms and pro-active tasks. Leaps beyond these boundaries seem to be rare although needed (Jaafari, 2001). Discussions have addressed the broader concept of uncertainty management (Ward and Chapman, 2008), importance of incomplete information or knowledge (Pender, 2001) and organizational risk management aspects (Busby and Zhang, 2008). Furthermore, the following shortcomings can be linked to the traditional risk management paradigm.

1. Too much emphasis on mechanical risk identification, analysis and response cycle, i.e. it has normative nature.
2. Risk management understood as a separate additional process.
3. Use of universal definitions and model instead of situation specific approaches.
4. Risk management procedures are often too static compared with dynamics of the actual situations.
5. The traditional paradigm tends to lead to 'rear window' solutions instead of meeting the uncertain future based on foresight and proactive measures.
6. Single 'focal' company thinking model does not meet the characteristics of modern networked business.

7. Opportunities i.e. upside risks not included in a well-balanced manner or they are fully ignored.

Several issues listed above fall beyond the scope of this paper and chances for improvement. However, it looks obvious that alternative approaches are needed and the list above can be used as encouragements for disconnections if necessary.

2.2 Risk management tools

Good risk management tools can make risk management approachable, enable broad usage and efficient procedures. This is naturally the main reason for company people to be primarily interested in tools. In our (VTT) industrial risk management tool implementation efforts we have gained an improved understanding over the characteristics of valuable RM tools. The value of our risk management tools can be summarised as:

- encapsulates best practice and principles;
- customisable to meet the requirements of different institutional cultures;
- scalable to variety of projects; and
- easy to use without losing capabilities for the advanced usage.

We may interpret the term 'tool' in different ways. By giving a wide meaning one can include here all kind practices and processes that are likely to contribute to the management of risks in projects (Raz and Michael, 2001). Nowadays, risk management tools are usually in the form of computer programs. A study by Association of Project Management resulted in the identification of 43 different software products for project risk analysis and management that is clearly showing an evidence of commercial interest in this field (APM, 2004).

3. RESEARCH PROJECT

3.1 Global Project Strategies research project

This paper is based on results gained from GPS (Global Project Strategies 2003-2009) research project where the aim was is to develop management practices for complex and global projects that are implemented in challenging institutional and business environments with several participating organizations. An application focus around 'managing risk' existed in the GPS effort that provided the viewpoint for studying the characteristics of management practices. GPS was a joint research project by Helsinki University of Technology, Helsinki School of Economics and VTT in collaboration with Stanford CRGP program. Besides research partners, this effort enjoyed industrial support from five company partners which were Foster Wheeler, Nokia Siemens Networks, Outotech, Rambol and Wärtsilä. None of them cannot be seen a representative of construction sectors. However, most studied project cases represent so called EPC (engineering, procurement and construction) type of projects. In this context the company is contracted to provide engineering, procurement and construction services. This type of contracting is particularly typical in heavy industry and in industrial construction where the cost share of facility equipment and its procurement is clearly higher (70-80%) than in house building. However, the construction context is still there with its problems and challenges.

3.2 Research methodology

Main research effort of the GPS project falls into the category of case studies where live company projects were studied particularly for gathering data and understanding regarding risk management. These case studies provided starting points for risk management tool design that then produced hypothetical solutions. IRM is such a hypothetical solution that was next implemented into the form of computer program for understanding its potential benefits and limits. Thus, this research represents proof-of-concept type of research.

4. RESEARCH RESULTS AND INDUSTRIAL IMPACT

4.1 Support for joint risk estimation and risk awareness building

Risk analysis and management groups in action can show useful lessons how the progressive companies and their knowledgeable experts do these activities in real life. It is widely acknowledged that there are usually needs for risk management meetings which are participated by all key experts and possibly also by representatives of various project partners including the client as well. Such meetings are targeting towards an improved and shared risk awareness that is seen as a direct way towards desirable managerial behaviour changes or decisions on specific actions. Building shared risk awareness amongst different project partners is a challenging task due to a number of behavioural and contextual aspects which we are only gradually starting to understand better:

1. *Communication channels of traditional and virtual group work sessions*. Traditional proven group working techniques are build on group dynamics and successfully applying well-known principles such 'forming, storming, norming and performing' originally developed by Tuckman (1965) that still are perhaps the most cited source of group session processes. These four group session principles describe also the dynamics of risk management meetings participated by various project partners. Working practices that are essential for successful risk meetings and how the risk awareness gradually can be developed are neither existing in the current literature nor in the current project management standards. Things are getting even more challenging when we enter the world of virtual projects or meetings without physical face-to-face contacts (Delisle and Thomas, 2000)
2. *Risk perception by various project partners*. Perception of risk is both complex and subjective, where factors involved include an understanding of risk, a perception of loss and gain, cognitive biases and personality (Fenton and Soane, 2000). Risk perception research is an active community but at present a somewhat isolated from research and development addressing enterprise and project risk management. Thus also findings from risk perception research are not widely known expect this research society itself. Without a proper understanding and inclusion of this fundamental phenomenon it can be very difficult or impossible to reach shared attitudes, shared perceptions and unified managerial actions.
3. *Promise based commitment building*. Sull and Spinosa (2007) have raised the importance of promises by individuals resulting in organisational promises by stating that at its heart, every company is a dynamic network of promises. This is the ultimate and perhaps the most important target of joint risk management sessions as well. Risks and opportunities need to be expressed publicly that finally produce statements accepted by all members. Public expressions are a way to create individuals' and organisations' commitment (Figure 1).

We are increasingly facing situations where risk and opportunity management is actually a joint effort of project partners. Risk management methodologies and current tools can

provide very limited contribution to this kind of joint risk analysis and management studies.

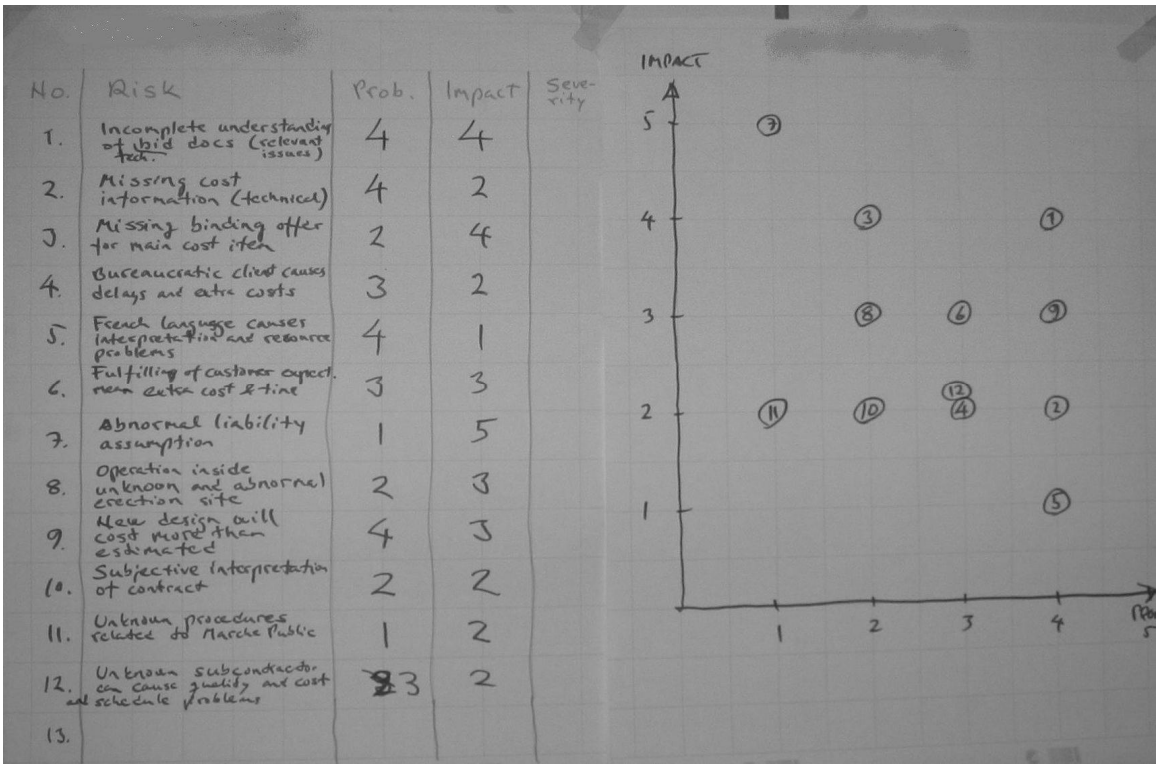


Figure 1. Example of manually-prepared risk map using flipcharts.

4.2 Interactive Risk Mapping tool

4.2.1 The IRM concept

Rather than putting attention of traditional documentation and reporting the modern projects are increasingly managed by instant situation specific interpretations and by building actions with other partners based on the gained new understanding. This phenomenon is now changing the content of project management education and is likely to have even more profound impacts later on (Hartman, 2008). Here the importance of well-timed and effective group work as a project management approach turns up again. Current project risk management tools can support in a rather limited manner the communication needs of joint risk management sessions. An ultimate goal is to have computerised tool that could be built of the psychological and physiological attributes of humans and group work. This is a new era to be entered with respect of risk management software tools.

Interactive Risk Mapping (IRM) is a research platform and concept in order to create 'electronic flipchart' that would resemble manual flipcharts (Figure 1) by providing support to group work interaction and its elements such as instant data input, structuring, vision and documentation. Moreover, this tool can include certain risk analysis and management methodologies, and, thus can make the use of them straightforward and easy for practical needs.

The starting point of using IRM is that the user has a list of risks/opportunities that are imported to this tool. The main functions of IRM assist the participants of risk management session to estimate as a joint efforts the probabilities and impacts of the risks and/or opportunities. The estimation process is carried out by moving graphical buttons each representing individual risk (red button) or opportunity (green button). The

instant interaction with the objects that directly represent risks/opportunities of interest is an important feature to support group decision making.

4.2.2 Development environment

Interactive Risk Mapping tool is based on Adobe Flash technology, a software development environment by Adobe Systems. Flash development environment is commonly used to create animation, advertisements, and various web page components to integrate video into web pages, and more recently, to develop rich Internet applications to the web and mobile devices. Flash is used in internet for example animations, picture galleries, educational programs and to create complex web-pages and games. Flash technology is used in players like MySpace and YouTube.

Flash can manipulate vector and raster graphics and supports bidirectional streaming of audio and video. It contains a scripting language called ActionScript. ActionScript 3.0 is an object oriented programming language allowing for more control and code reusability when building complex Flash applications. ActionScript 3.0 has also allowed for formal software engineering methods to be implemented when working with Flash, because of the object oriented programming approach.

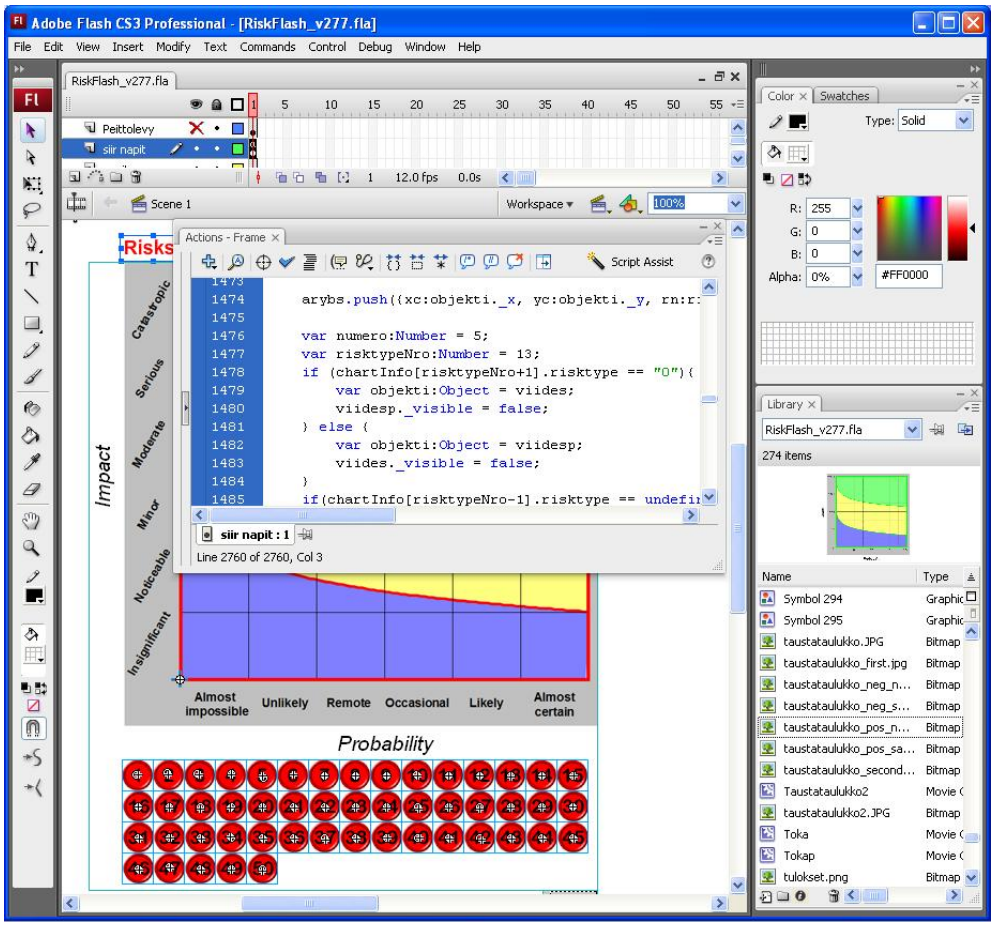


Figure 2. Interactive Risk Mapping tool in Adobe Flash development environment.

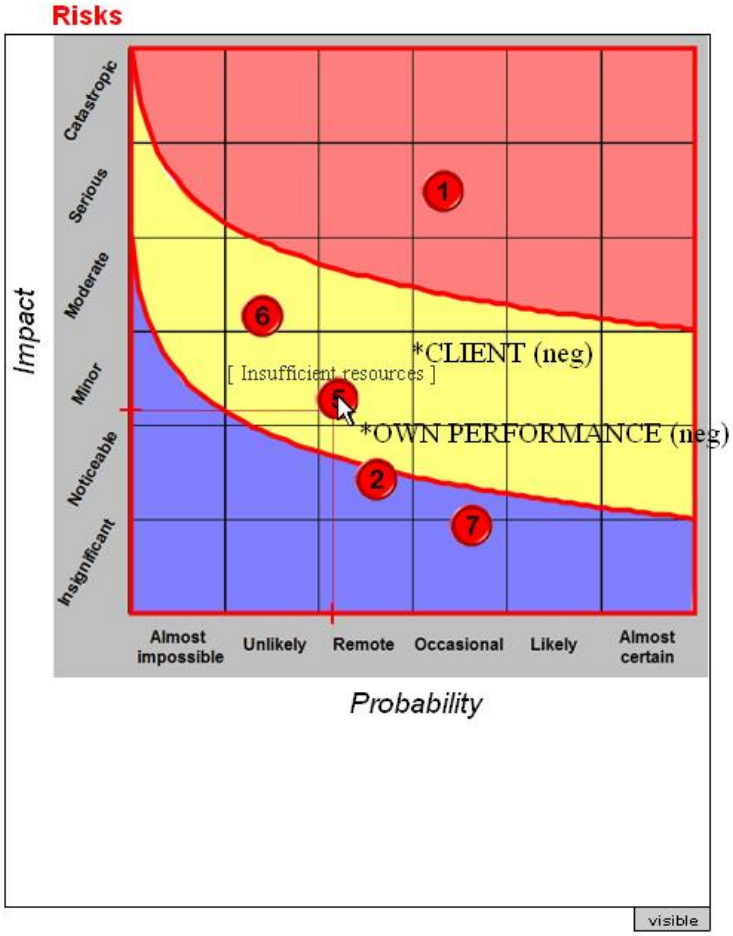
4.2.3 End user environment

Interactive Risk Mapping tool works in all common web browsers like Windows Internet Explorer, Mozilla Firefox and Google Chrome. Adobe Flash player needs to be installed in

browser to get Interactive Risk Mapping tool to work. Nowadays, Flash is so popular that most browsers has flash player as default. Interactive Risk Mapping tool is created to analyse risks that are imported from Temper System software by using file based interface. Risks imports from Temper System to create, middle of Interactive Risk Mapping tool, list of risks which are divided in groups.

Figure 3. Interactive Risk Mapping tool in Internet Explorer web browser.

Risks are linked to the buttons which program creates below risk maps. Analyse of the risks happens dragging buttons, by using mouse, in to the risk map to the place where user thinks risk should be. The Interactive Risk Mapping tool calculates risk severity by using probability (X-coordinate) and impact (Y-coordinate).



[Insufficient resources]

	Impact	Probability	Severity
CLIENT (neg)			
1. Customer satis. risk	4.7	3	**14.1**
2. Delayed payments	1.9	2.3	**4.4**
CLIENT (pos)			
3. additional order	1.9	1.8	**3.5**
4. Scope extension	4.6	2.4	**11.1**
OWN PERFORMANCE (neg)			
5. Insufficient resources	2.7	2	**5.4**
6. Incomplete designs	3.5	1.3	**4.6**
7. Unrealistic schedules	1.5	3.3	**5**
OWN PERFORMANCE (pos)			
8. Phase 1 Lower cost	2.5	3.9	**9.8**
9. Phase 3 Faster BS	2.9	3.5	**10.2**
10. Full incentives	4.9	4.3	**21.1**

Figure 4. Interactive Risk Mapping tool risk map and list of risks.

4.3 Functionality

The main current functionality of the Interactive Risk Mapping tool can be summarised as below.

Real time valuation of risks: Software calculates risks in real time by using positions of buttons in the risk map. Impact and probability axis creates severity value.
Group averages: Risks are divided in different groups. Program calculates real time average position of each group and shows average positions in the risk map.
Risk map/opportunity map: Software includes risk map and positive opportunity map.
Visibility: Risk map and opportunity map can be hidden if you want to concentrate only one of them.
Quantitative/qualitative: Interactive Risk Mapping tool can be used to use both quantitative and qualitative scale. By default Interactive Risk Mapping tool uses quantitative scale. Button changes scale and software calculates quantitative risk prices in real time.
Savings: Interactive Risk Mapping tool can save risk positions in the map. Discovering development of risks can be done comparing different savings.

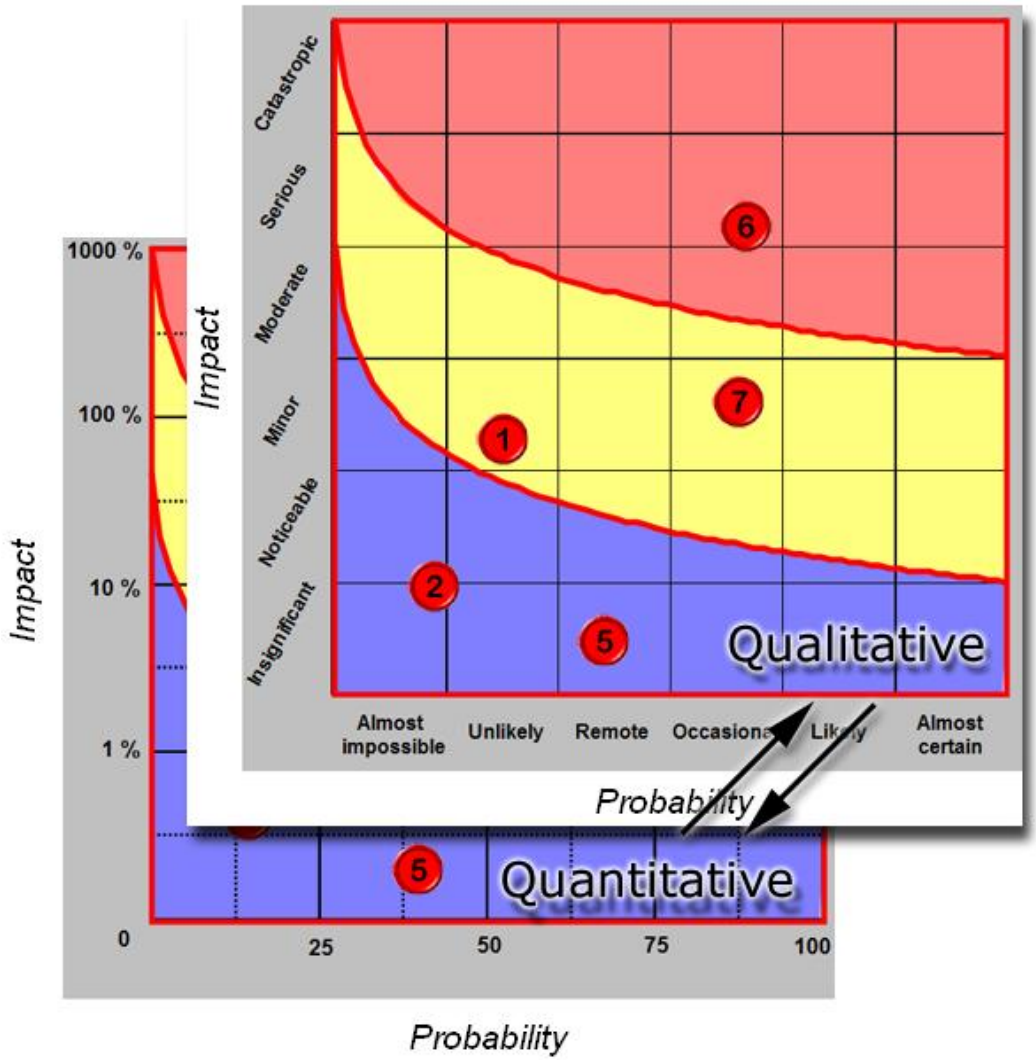


Figure 5. Current risk positions can be calculated based on qualitative and quantitative scales.

5. CONCLUSIONS

Current risk management methodologies and corresponding tools are omitting the joint risk analysis and management needs of modern increasingly networked projects. Lessons from such projects and their project teams in action have provided starting points for the development of software prototype IRM (Interactive Risk Mapping) that can be considered as a proof of concept study towards new kind of project risk analysis and management tools that are capable to support joint risk management efforts by various project partners. The IRM tool and its practical trials that are under way are expected to provide improved understanding of the joint risk analysis and management practice.

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SHAPE SHIFTING – THE STORY OF A 3D MODEL IN CONSTRUCTION

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ABSTRACT

In this paper, we are concerned with the specific effects of a 3D building model produced and reproduced in the planning and construction phases on a particular construction project. We contrast these effects with the policy intentions expressed within a state funded, public initiative that aims to promote so-called 'digital construction' in Denmark. One of the main objectives of this initiative is to ensure better coordination between the different phases of the building project through the application of 3D Building Information Modeling (BIM). The intentions are to improve the construction phase by providing pervasive on-site planning and logistics, where the 3D building model combined with process-data developed and maintained by the individual contractor should facilitate the production of detailed step-by-step production planning in the form of 'production cards'. The empirical findings from the case-study reveal a much less pervasive and more coincidental utilization of the 3D model than envisioned programmatically. We show how the 3D model is introduced into the construction phase in the form of paper based isometric drawings – as a supplement only to the existing practices. While this modest utilization may resemble a failure from the viewpoint of the policy intentions, we suggest that it allows the craftsmen on the building site to actively translate and contextualise the technology in a form relevant to their activities. We suggest that the top-down regulatory intentions of the policy program may be hampered if there is a failure to create room for such local 'contextualization' processes.

1. INTRODUCTION: FROM THE IDEAL OF SECTOR POLITICS TO THE ROCKY EXPERIENCES OF A BIM

Taking an Actor-Network approach, this paper explores factors that explain why policy strategies which perceive technology as an autonomous mechanism which may be thrown into social relations in order to optimize them cannot be maintained. In doing so, it examines how a 3D building model is simultaneously constitutive of and constituted by local practices in ways that is not envisioned in the political implementation scheme advancing the use of said models.

Danish construction has long traditions for strong political regulation in the form of public policy instruments aimed at improving the productivity of the sector. Focus has especially been placed on policies and instruments aimed at reconfiguring the problematic relations between the different actors of the sector (Bang *et al.*, 2001).

Latest, the large-scale policy program Digital Construction (approximately €6.5 million over a four year period) has set out to address the challenge from a new angle. Placing the construction client in the driver's seat, the vision is to develop a 3D building model, which can: *"…bridge the gap between the different trades/companies of the sector"* (Ministry of Enterprise, 2001:17) and *"…give the construction client access to digital data of relevance for the complete building lifecycle"* (*ibid*., 2001:17).

The politically expressed intentions are that 3D building models will enable the linking of information generated by the architects and the consulting engineers during design to the contractors' calculation, planning and production system. Reuse of the information

from design and construction in operation and maintenance is also a substantial intention. To realize this objective a three-stringed strategy is envisioned.

The first and third strings of the program concern the design/tender process and the digital hand-over of project material to the client when the construction project is accomplished. None of these strings are covered in this paper.

The second string, which is the main concern of this paper, concerns the logistics and planning of the actual construction process. The idea is that a given 3D model can be subdivided into specific 'production parts', which combined with data on the production methods provided by the individual contractors, supply detailed planning in the form of 'production-cards'. The production card is generated from the 3D building model and can be seen as a collection of information that the craftsmen need to have at their disposal when performing their tasks on-site (bips, 2006: 6) as it contains all relevant information about the completion of the specific production parts, including detailed instructions on the specific assembly procedures. Illustrated schematically, the envisioned strategy is depicted in Figure 1 below.

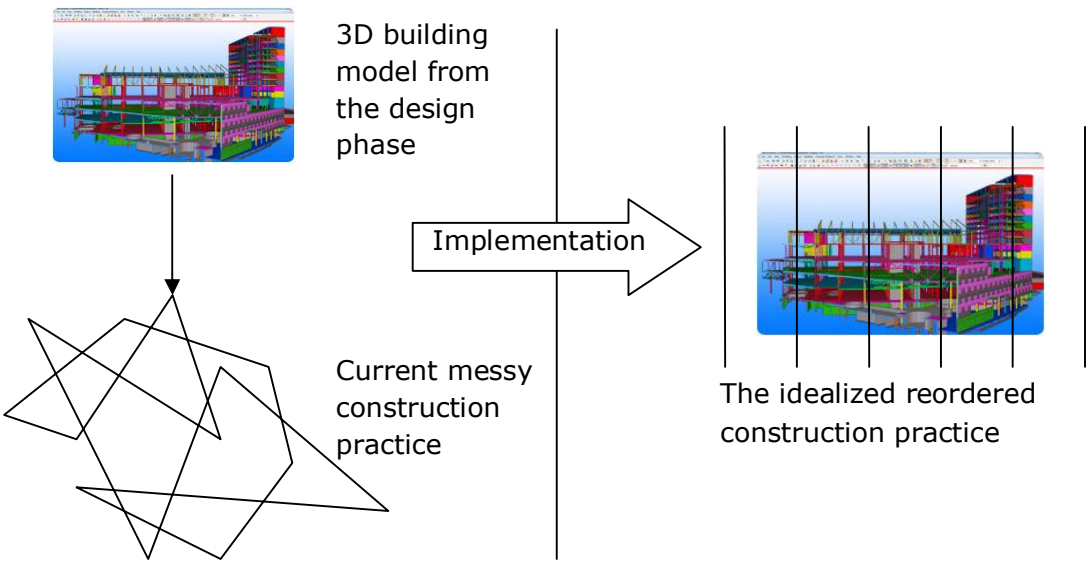

Figure 1. Idealized implementation leading to stratification of practices.

Figure 1 illustrates the rationality of the Digital Construction policy program, i.e. that the current 'messy' sociality or practice of the on-site construction process can be effectively ordered and stratified by the use of 3D building models, facilitating step-by-step production planning reducing uncertainties, redundancy and errors.

By the use of a case study, we challenge this assumption through an analysis of how an actual 3D building model was received and used in a specific construction project. Though this case was not part of the policy scheme we suggest that the case displays general findings concerning the relation between 3D building models and building process which policy schemes need to take account of. The analysis shows that the 3D building model effectively fails to take on the dominant role as it is met with destabilizing forces from the very parts of the project is was designed to re-organize. In particular, we find that for the 3D building model to be used in the first place it undergoes a series of translations that makes the model recognizable and functional in a local context. Thus, instead of constituting a bridge between the different companies of the sector built on the principle of conformity to the logic of the model, the 3D building model is remodeled according to the specific logics of the different actors. Whilst not posing a problem in

itself, as the model still is used and functions as an integrative device albeit in a different guise, this raises serious concerns towards the dominant way in which policy implementation is envisioned.

The remainder of the paper is organized into four main sections. Section 2 presents the methodological approach of the study, focusing on the theory, research methods and empirical basis of the study. Section 3 contains the case, which is presented in the form of three storylines. Finally, in sections 4 and 5 we discuss, along the dichotomy of intentional respectively co-incidental enrolment, the results of the study.

2. METHODOLOGY

In analyzing the effects of the 3D building model in the construction process, we draw on the theoretical framework of Actor-Network-Theory (ANT). As argued by Tryggestad (2005) this is an approach which aims to avoid so-called traditional 'human centered' conceptualizations of technological change strategies. Such 'human centered' strategy conceptualizations presuppose technology to be transparent tools which may be controlled and exploited in a predictable way by independent human plans, intentions and rationales. In contrast the actor-network approach suggests that technological artifacts together with humans define strategy as they are made to interact in practice (Tryggestad 2005:40). The approach is accordingly skeptical toward the capabilities of managerial top-down strategies in controlling technological change processes in a straight forward way.

The approach basically draws on the idea of a semiotic materially, meaning that social as well material identities are stabilized by the way they are put to use within a larger heterogeneous network of interacting entities. Thus, according to Law and Mol:

> *"(…) bits and pieces don't exist in and of themselves. They are constituted in the network of which they form a part. Objects, entities, actors, processes – all are semiotic effects: network nodes are sets of relations; or are set of relations between relations. Press the logic one step further: materials are interactively constituted; outside their interactions they have no existence, no reality"* (Law and Mol 1995:277).

An example would be that the identity of a hammer is only stabilized as it is actively put to use (enacted) within a heterogeneous actor-network of, for example, nails, wood, drawings, carpenters and production schedules. The heuristic of the approach accordingly goes that the identity of people and things cannot be taken for granted *a priori* but is always defined locally in specific processes of interactions and associations, which may either be forced or negotiated, and which may be either stable, contented, coherent, or fragmented. This implies that entities only exist performatively, i.e. if they play a detectable role within the production of some specific actor-network formation (Law 1993:131).

Within the actor network framework the concept of translation designates the dynamic evolution or transformation of actor-networks (Callon 1986). Translation designates the strategies (or coincidences) by which entities are enrolled, excluded, transformed or stabilized within the actor-network. Such processes of translation are dialectic processes in the sense that both the identity of the existing or remaining entities within the specific actor-network as well as the entities being enrolled or excluded are affected depending on the effect the translation has on the overall pattern of interaction. Translation is thus the mechanism by which the social and natural world progressively takes form.

Analytically we thus take the position that the 3D building model *is* what it does; how it is enacted in practice, in the actor network or actor world of the construction project. The analytical strategy is to disclose where and how the 3D building model actually manifests itself within the actor network, i.e. in and across the different phases and organizational contexts comprised by the construction project.

To examine this we grant the model a kind of intentionality, of agency, of 'actantiality'. We presume that it is an actor, or, if that is too much, an 'actant'. An actant in the ANT-perspective is an entity, which while being relationally defined is also able to suggest, impose and exclude interaction, i.e. to produce and transform identities by generating asymmetries. We suggest that while the 3D building model is formed as a result of its associations with other entities it also acts within the network.

We thus see actors as 'spokesmen' of performed asymmetries or 'programs' which produce and exclude certain patterns of interaction. Such actors may however be met by other actorial entities aiming to advance alternative and sometimes conflicting anti-programs (Latour 1992:251). Such anti-programs represent an integral part of the social world. They may be encountered head-one in an open conflict, but more typically actorial program face anti-programs through processes of generative translations, by translating itself in order to also translate its adversary.

2.1 Empirical strategy

In order to operationalize the methodological perspective outlined above, we make use of a qualitative case-study approach focusing on a single construction project, which utilizes a 3D model. Following Flyvbjerg (1991), we have adopted the case study approach as it allows us to trace the specific and local enactment of the 3D model presented in a series of narrative storylines. The approach thus positively allows us to avoid a too integrative and essentialist representation of the technology and it effects. The 3D model is accordingly studied from a semiotic or relational perspective in the sense that we investigate *how* it is constituted and translated through its specific relations to managers, engineers, construction workers and other technologies and strategies of organizing and producing order. From this semiotic perspective we follow the development, translations and effects of the 3D model both within and across the different phases and activities of the project.

Our case material stems from an ongoing study within a large Danish contractor and follows a building project that was organized as two separate projects in the same site accommodation. The primary object of the study was the construction of the first of four six storey buildings (238 apartments). The other project on the lot, and in the site accommodation, was the construction of six 6-storey buildings (144 apartments). The total budget of the two projects was €68 million.

The empirical data was collected from ethnographic observations of primarily the on-site processes. In total more than 80 observation days was carried out in a period from September 2007 until autumn 2008. An observer followed the daily execution of work at the building site. The starting point was the site hut and the work tasks of the contractors' project team. The primary focus was on the assembling of the pre-cast concrete elements as well as the installation phase. Data was collected from one-on-one observations directly on the site, from observing conversations in the site office and from attending the site meetings. Moreover a series of qualitative interviews was conducted including the members of the contractors' project team, sub-contractors as well as relevant consultants and suppliers. Furthermore a study visit was conducted to the factory that produced most of the pre-cast concrete elements for the main construction project.

3. STORYLINES – SHAPE SHIFTING

In this section, we outline three storylines from the construction project in question. We illustrate how the 3D building model was developed and enacted in a manner that was not in line with the way suggested within the program of Digital Construction.

The analysis of the empirical findings is used in a general discussion of the processes and strategies through which innovation programs should introduce and advance the use of artifacts like 3D models to complex and institutionalized production environments like that of the construction. This discussion is related to the strategy of the production card as it is envisioned within the program of digital construction.

3.1 The becoming of the model

While most actants come into being as predictable effects of widely performed 'actor-worlds', i.e. as effects generated through well established rules, procedures or taken-for-granted problem-solving strategies, the development of the 3D model was, in this case, most of all the deliberate and personal achievement of the head consulting manager. This is not to say that this head manager brings an entirely new or un-tested being into the world of constructions projects. The idea of building information models within construction can be traced back to the 70s (Eastman *et al.*, 2008); however, the use of such model has not yet been mainstreamed in the Danish construction industry. The decision to use the model is thus a deliberate choice by the head consulting manager, and represents an association in an ongoing and currently very open-ended innovation journey regarding the development and use of 3D building models in the construction industry.

The model is thus not being developed in an environment of activities which is critically dependent on its existence, and which would accordingly be threatened by disintegration in its absence. Rather the model is developed as a somewhat strange existence, which promises new opportunities, but only to the extent that exiting activities and identities is translated, either by force or voluntarily.

Thus, in order to bring the 3D building model into the actor-world of the construction project a series of relatively experimental translations and associations need to be established. Specifically in this case, the buildings are translated into a 3D representation in two software tools called *Tekla Structures* and *MagiCad* used respectively for the building structures and installations. These 3D models were generated from traditional architectural 2D drafting produced in *AutoCAD*.

Already in this very early phase of its becoming the 3D model begins to impose a new order onto the environment in which it is developed. During the 2D-3D translations by which the architectural drawings are translated into a structural model and a series of technical installation models, the traditional actor-world of the company is called into question as the relation between the engineers and the technical assistants need to be re-ordered. As a consulting engineer puts it:

> *"Back in the old days an assistant made the final drawing from the structural engineers sketch. This time the project was made in 3D. And when you design in 3D you must be able to think for yourself. The task is no longer to draw based on the lines on a sketch from the structural engineer. You now have to know what you're doing. Otherwise it won't work. So now it's more blurred who's doing what – and who is capable of doing what! The structural engineer is now also modeling".*

As the modeling process thus presupposes a translation of the existing responsibilities and the working division between engineers and technical assistants, the development of the model crucially depends on the flexibility of the existing associations within the company. As already noted the head project manager is the main advocate, and his ability to achieve the needed translations rely both on his formal hierarchical position within the company, and on his central position in relation to the architect. It may however also be noted that the modeling is primarily headed and performed by young engineers, which are not very strongly associated with the traditional actor-world of the company.

The 3D modeling does, nevertheless, not only translate the professional identities but also impacts on the level of specificity in the design. 2D drawings does not necessarily require objects to be unambiguously defined, whereas the 3D model imposes a binary ontology to the design process, as object can only exist as 'unambiguously geometrically defined'. In the design process the engineers and assistants are thus forced to cope with uncertainties which are normally handled in a later stage in the actual construction phase.

> *"At some point they simply couldn't see, what they were about to draw. It's when you look at the detail-level. It's hard enough to figure in 2D. But working in 3D you're forced to model the details. They simply couldn't see it, and I [the head consulting manager] had to model it for them".*

A crucial prerequisite for the development of the model is also the extent to which the software is developed and tailored to support the modeling process in a manner which is intuitive to the engineers and technical assistants. A destabilizing event is encountered as a software-update hampered the functioning of the software.

> *"We had a lot of problems. Especially when upgrading from version 12 to 13. Theory is one thing but it's something else when it comes to applying it to a large real life project. Normally it's a FAT40 [Human error: Fool At Terminal – 40 cm] but was a buck in the software. Our problem was that we didn't know where and when this failure appeared so we had to do some additional QA. But the building is standing as we speak, right!"*

The challenging binary logic, which the BIM imposes on the design-process however facilitates collision-control in the quality assurance (QA) process, and thus raises the quality of the material considerably. As the construction model is merged with the different installation models collisions between structural elements and installations are thus automatically identified:

> *"All the technical installations are created in 3D – and we've also build the structural model in 3D. We combine the models, and then you're able to see the channeling and pipes. From time to time we've been going through all of the holes in the horizontal division and the basement walls."*

Also the model re-orders the process by which the QA processes are carried out. Rather than carrying out the process on 2D plots and drawings the QA process is conducted directly in the model, and communication also takes place through screen-dumps.

3.2 Co-shaping of model and production world

The scope of ordering accomplished by actants like the 3D building model, i.e. their ability to generate widely distributed effects, critically depends on their ability to act and produce order across organizational borders. During such processes they are dis-embedded from their original performative environment to which they have been tailored and by which they are defined. As a relatively stabilized phenomenon they must be able to enter into alternative performative environments or actor-worlds. Often such processes presuppose that the actant is able to introduce itself in a translated and different version, in order to fit into these alternative performative environments.

As the construction project proceeds from the planning phase to construction phase the ability of the 3D building model to act and produce order across organizational boarders and performative contexts is tested. As a central coordinator of the construction process the executive manager of the main contractor can be seen as an obligatory passage point (Callon 1986). In order to distribute it's ordering effects to the construction phase the 3D building model thus needs to suggest a potentially useful ordering in the eyes of this manager. Critically for 3D building model this executive manager however declares:

> *"I can easily see things in 3D from 2D drawings, whereas other people can't. We have therefore not had any particular use for the model."*

The manager thus, very unfavorable to the model, defines his professional identity by excluding the model from the actor-world of the production site, as he declares himself a professional, because he is able to envisage the project in 3D without the use of the model. The 3D building model thus encounters a crushing anti-program, as it becomes aligned with needs of the unskilled construction worker. The manager also inserts a divide between knowledgeable and ignorant actors in order to uphold his own image of a social order in which the contractors retain their dominant position in the construction process, rather than having to conform to the requirements of the model, and a possible stronger dependence on the consultants.

The anti-program articulated by the manager however proves to be less fatal than it might seem. The main contractor's expectations are to receive the production drawings from the designers 'as usual', i.e. as 2D drawings. They are not the ones who have asked for a 3D model; however, at a common project meeting, the 3D model re-enters the actor-world of the production site in a translated form. On a preliminary plot of the project, the consultant engineer has added a 3D-view of some of the perimeter buildings as supplement to the traditional plan (see figure 2).

In this translated 'analogue' guise, the 3D model succeeds in re-entering the on-site production world of the construction project, as the contractor's project manager approves the design of the plots as the standard format for the project. By translation of format the model thus succeeds to re-enter, while the 3D model in its digital format is excluded from the further production process.

The new shape of the 3D model is a strategy by which it succeeds to cope with the initial anti-program by resembling the traditional ordering methods of the contractor and the project managers understanding of the construction process.

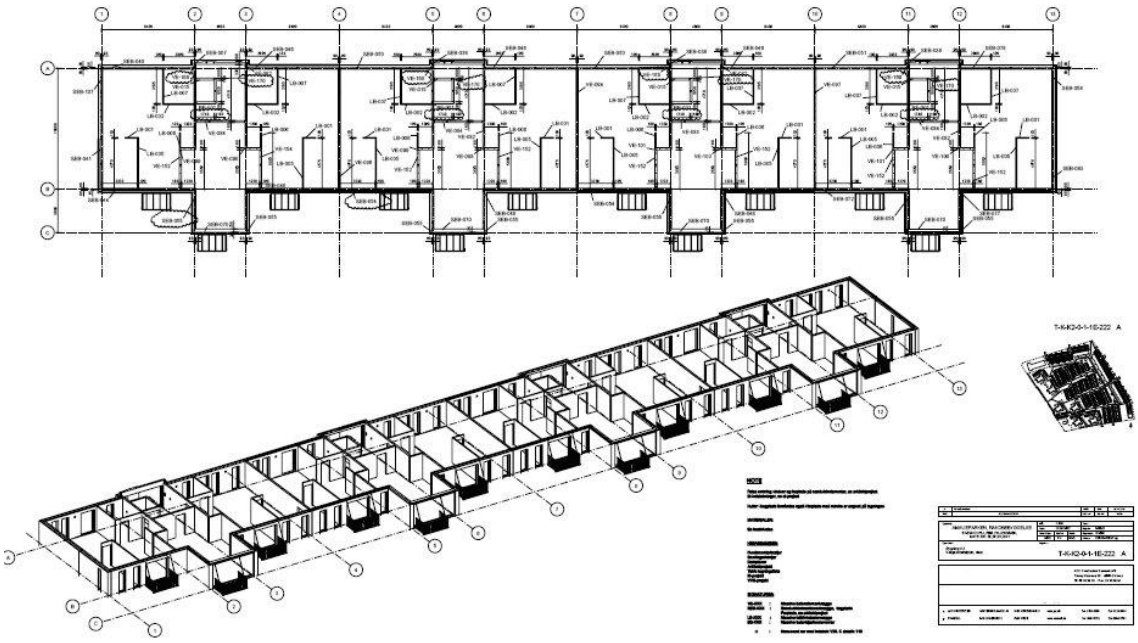

Figure 2. Example of a traditional drawing supplemented with a 3D view.

The ability of the model to perform across organizational boundaries is also tested in the coordination between the consulting engineer and the manufacturer of the precast concrete elements used in the construction of the carcass. In this example the model succeeds to produce a coordinating effect, not however as a digital model, but again as a paper based production-plot generated from the model. This time the 3D model faces another anti-program of a non-human origin as the programming of the machinery used at the manufacturers' factory cannot be controlled through digital 3D information.

Only as a paper plot does the model gain access to the working process and at the factory it is translated once again into the standard production plot that is used by the manufacturer. And so, yet again it is in a shape defined be the existing performative associations of the traditional actor-world that the model finds its way ahead in the building process.

During the process, in which the digital model is translated into 2D production plots an error which later has severe consequences for the construction phase, is produced. The 3D-2D translation requires a manual numbering process, and due to an error in this process the manufacturer is provided with a flawed production order. The entire production process becomes delayed due to this communication error.

3.3 The in-situ reception of the model

With the acceptance of a 3D drawing on the assembly-plots, the craftsmen on-site were offered a new additional actant by which to order their production activity. On-site it was, in strong contrast to the reception in the project management team, received very well by both the production managers as well as the foreman, who used the visualization as an aid in the planning and communication of tasks.

A weekly planning meeting, where all the members of the concrete assembly work gang participated, is an example of how this new actant was tentatively negotiated and performatively defined within the site production processes. Here the executive production manager placed the drawing on the notice-board, and informed the gang members of the specificities of the project and of the imminent tasks.

> *"They [the consultant engineers] have made all their drawings in 3D, so you can see them plotted in the corner of the normal drawings. This way it's easier to see what have to be done to the façades, partition walls, and sanitary cell units."*

The ground assistant to the crane operator then proceeded by taking the plots with him on-site, as the production manager argued that it is highly beneficial in that it enables the crew to quickly orientate the concrete elements the right way. The foreman was however more skeptical towards the 3D drawing and its possible ordering effects in the actual assembly process:

> *"…even though there is a 3D model, no one will look at it on-site."*

The foreman thus excludes the 3D drawings as a means to organize the assembly process of the concrete elements, and the concrete assembly work gang sticks to their traditional methods of how to order and organize the process.

As the gang has to assemble the precast concrete elements on the first floor they accordingly repeat the assembly patterns on the ground floor instead of consulting the 3D drawing for instructions. Unfortunately, the walls had been mounted the wrong way around on the ground floor by the previous work gang. Thus, even though the gang which assembled the ground floor had been replaced, their work still impacted the subsequent work in a somewhat unexpected manner.

In this situation, the gang thus fails to integrate the 3D plot as an actant which may help to order the assembly processes, although it has been suggested that the plot might

help to orientate the concrete elements. It is thus the traditional 'method of repetition' which orders the assembly activity rather than the new 3D plot.

4. DISCUSSION

Let us return to the topic of concern raised in the introduction of the paper: the strategic question of how existing social relationship may be developed by means of building information modeling; however this time discussed in the light of the previous three accounts of the actual use of a 3D building model in a specific construction project.

The analysis of how the 3D model actually *makes its presence felt* in the evolving actor-network may be illuminated with reference to the ANT-concepts of mediators and intermediaries. Intermediaries designate entities already stabilized within a specific type of actor-network such a construction projects. These are entities, which may be counted upon as tools for generating controlled and predictable effects. Mediators on the other hand, designate entities whose utilization and effects are contented or uncertain, as they have not been integrated into the 'normal' or institutionalized production within the actor-network formation. Thus according to Latour:

> *"Their input is never a good predictor of their output; their specificity has to be taken into account every time. Mediators transform, translate, distort, and modify the meaning or element they are supposed to carry"* (Latour, 2005:39).

We view the 3D building model as a mediator; an entity not yet constituting a mainstreamed tool with which to organize and order the actor-network formation of construction processes from design to the on-site assembly. In this perspective it is thus still an open question for what specific purposes the model should be developed and used throughout the construction process. The Digital Construction policy program on the one hand and the three storylines presented above on the other hand, represent two contrasting rationalities in translating the 3D building model into an intermediary.

In the three storylines, it is shown that the existence and the effects of the 3D model is highly unsteady and tentative. Thus, at the very beginning, the model does not exist, as the architect conducts the design in conventional 2D drawings. Only in the hands of the consulting engineers are the drawings translated into a 3D model.

For the consulting engineers, the model is perceived as a means to raise the quality of the project material as it allows for collision control between the structures and the installations of the building design. The 3D model also facilitates communication through 3D visualization and digital screen-dumps. A further effect of the modeling process is that the work division between the technical assistants and the engineers is displaced.

The 3D-model 'survives' the first meeting with the construction site by taking the form of a 3D-plot on the traditional production drawings; however the actual purpose and utilization of the 3D plot is uncertain and contested. It is thus suggested that it may be used for planning purposes and also in the specific assembly process of pre-cast concrete elements.

During the assembly process the 3D plot however fails to be recognized as a central ordering device. The concrete assembly gang thus only uses the 3D drawing, whenever they themselves judge it necessary. It is seen that in the first place the drawing is not used as intended, and subsequently it is the previously assembled work, which is used as a 1:1 scale assembly instruction.

With reference to French zoologist Pierre-Paul Grassé, Christensen (2007) and Kreiner (2008) the use of preceding work as a central ordering devise can be referred to as 'stigmergy', designating that:

> *"…the traces in the 'terrain' left behind by other actors, stimulate and structure the proceeding activities" (Kreiner, 2008:2; authors' translation).*

The 3D model fails to manifest itself as the central ordering device in conducting certain on-site activities, such as the precast concrete assembly, as it is met with a series of highly durable existing ordering devices, which is not effectively eradicated by the model itself. In other words, the model is continuously negotiated and translated on the basis of different existing institutionalized practices, constituting the normativity of the project.

This is also seen when observing the reception of the model by the different site managers, who believe that 3D visualization is a good idea; however, they also argue that models are of limited use in the practical work as:

> *"…there are too many things that don't work in practice. In the perimeter-blocks project, the engineers have not taken the different terrain data into account, and when you have three men working on the project at the same time problems arise. Drains and installation have, for example, been led out over the terrain."*

In these practical setting the intended use of 3D model is destabilized by the model's own demands for precision, which are difficult to honor in practice. The effects of the model thus cannot be centrally imposed and upheld. Rather, the model is continuously re-contextualized and utilized differently as it enters the various local actor-network formations of the construction project, as illustrated below in Figure 3.

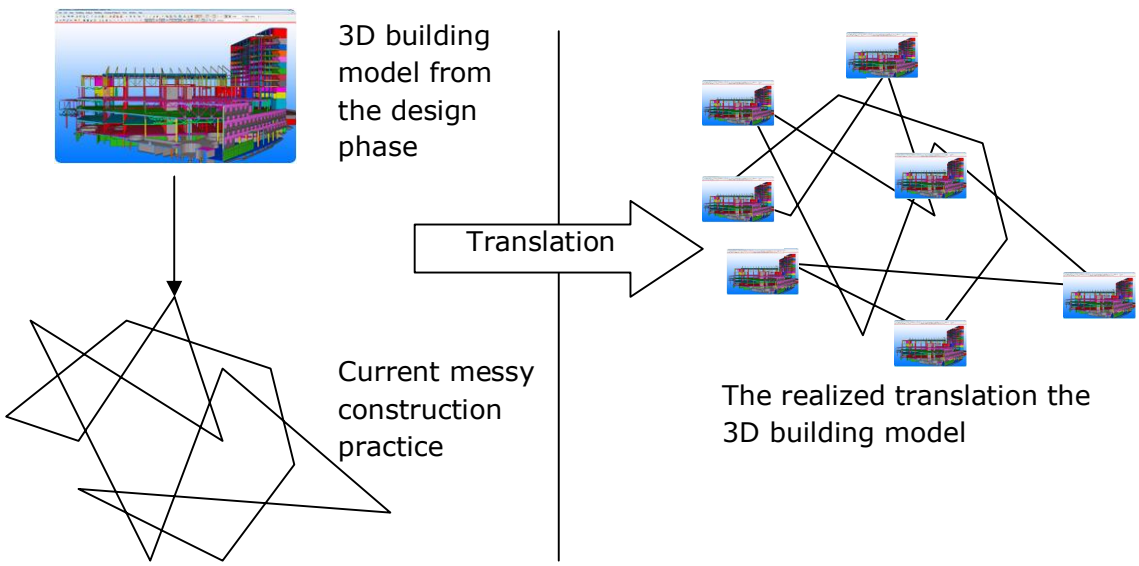

Figure 3. Disintegration of the 3D building model in the realized translation process.

In the communication activities with the precast concrete manufacturer, the model disintegrates even further into flawed 2D production plots, and although we from an ANT-perspective would maintain that the model, as an actant, still exists here, albeit in a highly modified form, it could be questioned, when discussing translation on the level of intentionality or rationality, whether the model has survived in a recognizable form conveying just a fracture of the intended purposes.

5. CONCLUSIONS

The program of Digital Construction may be seen as a strategy aiming to dispense with this lack of centrality displayed in case-study by forcing and prescribing the 3D building model into a pre-defined type of intermediary.

The prescriptive strategy however presupposes that centrally imposed demands will be able to silence the anti-programs voiced within the local actor-networks of construction projects. Very limited room is thus left to the local processes of 'contextualization' identified in the story-lines, which try to define in which specific form and to which specific proposes the 3D building model would be use-full in the specific context of the different local actor-network formation.

A more balanced strategy would probably combine the prescriptive strategy with more systematic processes of 'contextualization' which are less fragile and coincidental than those identified in the storylines.

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PRELIMINARY BUILDING DESIGN AND EARLY PROJECT INFORMATION MANAGEMENT – A CRITICAL REVIEW OF CONTEMPORARY BIM

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ABSTRACT

The context of this paper is in the earliest building project phases and the scope is design and construction with building information modelling (BIM). The paper presents an overview of contemporary BIM with a special emphasis on the early project phases. A building project is considered as a continuum of processes, tasks, management and also content issues. An architectural approach is emphasised, but other project participants are also included. The early building project phases comprise project management issues such as project planning, budgeting, scheduling and team gathering. Various project requirements are usually referred as the first step to formally structure the project constraints. Additional to project planning, architecture related issues are often also considered in the earliest project phases to perform site analysis and building shape massing, to create alternative design proposals, and to exemplify design possibilities, content and constraints during the earliest project phases. The thesis of this paper is that contemporary building information modelling fits well for later detailed design and construction phases, but it does not fulfil all the assigned participants' needs in the earliest project phases, hence an information management framework for early building project and preliminary design is proposed. The research objective of this doctoral study is to review critically building modelling related material emphasizing the early building project phases. This will be done by documenting the state of the art of contemporary building modelling. Despite the concentration on early building project phases and modelling, the paper reveals also more generally those contradictory and somewhat abstract hopes, which building project participants have in regard to modern information and communication technology.

1. INTRODUCTION

Building design and construction with digital support is developing towards more comprehensive virtual building environments and building models. Model based tools and methods are used more and more throughout the design and construction process, in design development, in visualization, in design evaluations, in detailed design and in construction planning and simulation. Geometrical 3D-modelling of the building shape, has commonly and most often been used for presentation and visualization purposes (Samuelson, 2008:9). When geometrical 3D-models are enhanced with additional information on building components, often called attribute data, models should be called building information models, BIMs (Eastman *et al*., 2008:15).

Preliminary building design has already long been supported with visualization with 3D-models, anyway plain 3D models without attribute data connected with modelled components are not yet BIM. Currently available BIMs are seemingly suitable for later detailed design and construction phases, where detailed data has already been defined (Eastman *et al*., 2008:99). Still the most meaningful and cost effective project decisions are made in the earliest project phases, project planning and early design (Baker *et al*., 1988). Essential for early building project phases are also the various project constraints and requirements which form the project plan or guideline for further design and, finally, for construction. Constraints and requirements have been studied for instance by Kilian (2006) and Kiviniemi (2005) but they have not yet been connected to contemporary digital practice too well (Kiviniemi, 2005:8). Such important architectural design related themes as sketching (Do, 1996), conceptual design and design proposals, can also be

digitally supported in the early design framework, but mostly these fields have not been fully implemented into contemporary CAD-tools, which are technical and detailed design (Pranovich, 2004:1) and drawing production (Asanowicz, 2002:37).

Figure 1 illustrates the scope of this work within a building process. Having emphasis in preliminary design, means forming and launching the project and defining essential constraints and prerequisites for it. Alternative design proposals are created and various what if -assessments are performed on the design proposals. Traditionally these design phases are called feasibility studies, pre-design, schematic design and conceptual design (Eastman *et al*., 2008:151-2). Moum (2008:14-5) has addressed project briefing and negotiating being an essential part of design. This early project phase forms a framework preliminary design and building information management. The framework content has also to be transferrable further to be used in later design and construction phases.

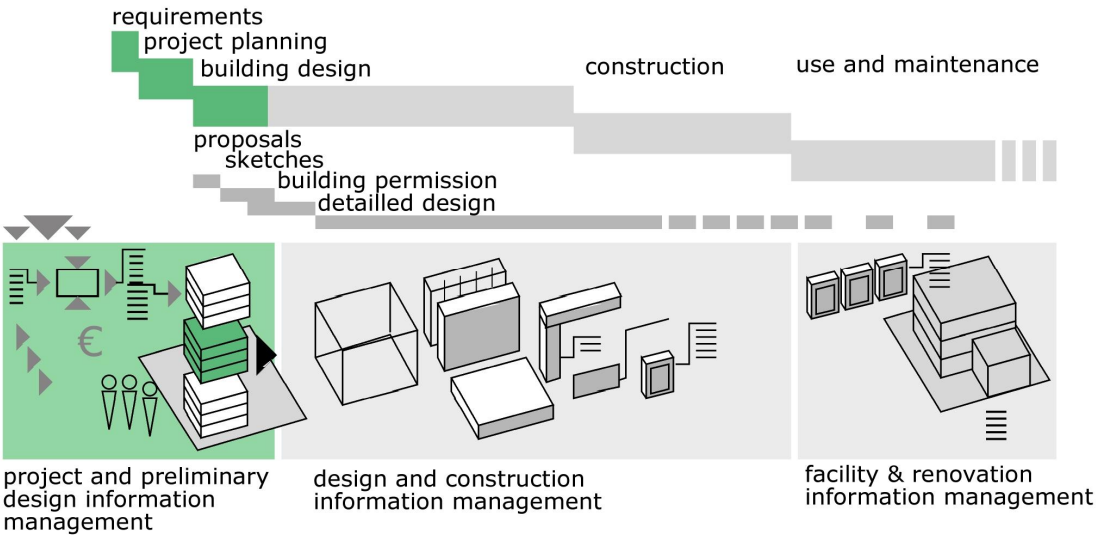

Figure 1. Building project definition and preliminary design formed as a domain for early design information management.

When the building project proceeds with one selected design proposal, all building systems and their detailed components will be defined to describe and document a buildable design solution, which will be built in the process chain. This detailed design and preliminary construction phase is a seemingly proper stage for contemporary BIM solutions. And yet further, the use and maintenance of buildings forms again another information management domain within this chain of the building's life cycle. Feasibility whereas the information delivery gap between construction and facility management is described for instance by Eastman *et al.* (2008:94-5).

2. STATE-OF-THE-ART OF BUILDING MODELLING

2.1 Short history and evolution of CAD and building modelling

Design related computing is often regarded as being established with the Sketchpad system, a graphical user interface to a computer which allowed the user to manipulate design graphically in real time (Sutherland, 1963). Modifiable geometry, one important factor in digital design, could first be expressed in the early 1960s. The foundations for architectural computing were established in the 1970s, when architectural design concepts and methodology were merged with computers, and well documented by

Mitchell (1975). Essential themes in the early approaches to architectural computing were design representation, design optimization and problem solving (Gero, 1985). Another profound theme concerning design objects, the buildings, was well stated by Lavette Teague. A computer-based information system could, by Teague, contain "all the conceivable data relevant to any building problem" (Teague, 1968:210). The need for comprehensive management of building information was clearly expressed already 40 years ago.

In the days of early computing during the 1960s and 1970s, all the demonstrations of building representation and modelling were done in experimental laboratory settings with a strong research impact and with computers of that time. Early modelling efforts were also mostly standalone projects implemented into CAD systems but without integration with other systems (Eastman, 1999:47). Computing capacity of the first personal computers in the 1980s was still not enough to manage the entire volume of building data until the early 1990s, when design computing actually started to expand. Building design made a digital breakthrough during the 1990s when PCs were affordable and capable enough and CAD-systems eventually replaced manual drawing. Already for 10 years a vast majority, currently some 80-90%, of building drawings are produced with CAD systems (Samuelson, 2008:7).

Simultaneously with two-dimensional drafting systems (2D CAD), three-dimensional modelling systems (3D CAD) have also been used, most often descriptively in presenting and visualizing the designs. CAD systems, the actual design and engineering working platforms, have evolved from graphical drafting tools towards model based, object oriented, parametric, generative and analytic building modelling tools during the last 10-15 years (Burry, 2005:21).

The common understanding of 'building modelling' refers most often to geometrical 3D modelling of the shape of buildings. 3D visualization has already long been an important and well known of building modelling (McDuffie, 2006). Building information modelling refers, more widely than just 3D, to methods and tools which can manage building related information comprehensively. Building models often represent a detailed component-based approach to building information. If building-related objects in the models can be supplied with relevant data, the models can provide a wide variety of calculations, evaluations and simulations for various purposes.

The popular acronym, BIM (building information modelling), is rather new, appearing in the past five or six years. Still, the concepts relevant to BIM have already been apparent for more than 30 years. Previous evolutions of BIM were computer models for buildings (1970s), building product models and product data models. An elementary foundation for building information models is the description of 3D geometry, which has a close connection with design and engineering practices. Charles Eastman has recently published more profound definitions for BIM (Eastman, *et al*., 2008:13).

Modelling the functional aspects of buildings, rather than building form, offers a different approach to building modelling. Building performance and behaviour has not been very popular with pragmatic designers, especially with architects (Maver, 2000:333), where representational form in CAD-modelling has dominated. A computational approach to building modelling comprises computational and mathematical aspects of building information, the final objective being various functional building performance simulations and analysis. Typical computational simulation domains are, for instance, energy consumption, thermal comfort, airflow, lighting, acoustics sustainability and life-cycle assessment LCA although they are not widely used in design practice (Mahdavi, 1999:427).

More extensive digital building and building process frameworks have been presented since the advent of computing. The wide framework has long been called CIC, computer-integrated construction (Björk, 1995:12) and recently also VDC, virtual design and construction or VBE, virtual building environment. By definition VBE is a physical place or location where virtual buildings can be created with an integrated set of various software

tools (Bazjanac, 2004:4). BIM is considered an elementary data management domain within these larger frameworks, forming a comprehensive and consistent model of all information related to a building. Bazjanac defines BIM being an instance of a certain building implemented into software applications (2004:2). Chuck Eastman's definition is closely related with tools when he defines BIM technology (2008:13). A recent Erabuild report defines BIM being an object-oriented digital representation of a building facilitating interoperability (Kiviniemi, *et al*., 2008:12). Moum (2008:201-3) has collected BIM definitions in her thesis.

2.2 Approaches on BIM

The contemporary pragmatic approach to BIM was preceded with a long period of scientific research, standardization efforts and software development activities for almost 30 years. The early research years were distinguished with conceptual and semantic clarifications and definitions of building information and modelling domains. National and international research organizations, as well as standardization bodies, were the first development forums for building modelling frameworks and concepts. National influences in fostering and supporting building modelling and information technologies were active for instance in the US, Scandinavia, Australasia and The Netherlands. Early modelling efforts and their meaning have been documented for instance by Björk, Galle and Eastman (Björk, 1995; Galle, 1995; Eastman, 1999).

International co-operation accentuated for instance the development of early building model related data exchange standards PDES/STEP. STEP's de-facto predecessor, a software independent IFC standard (industrial foundation classes) for BIM, was initiated by IAI, the International Alliance for Interoperability, a joint consortium of CAD vendors and researchers. IFC is an open, software independent data exchange standard to carry building model data, separating it from software specific data exchange methods. IFC implementation status is recently reported in Kiviniemi *et al.,* 2008. IFC-based model servers, or building model repositories (Eastman, *et al*., 2008:88), have been proposed to solve the multiple modelling dilemma (Kiviniemi, *et al*., 2005:38), but so far solid industrial solutions to integrate various software environments have not yet been used in practice (Fox and Hietanen, 2007:290) meaning that construction field model integration, or rather interchange, is still widely based on file transfer.

Information integration aspect is profoundly built into the BIM-theme since interoperability between software tools, but also between various project participants, is one of the initial origins for shared building models (Björk, 1995:51-3). Enhanced collaboration via model based data exchange and streamlined information management have always been important and elementary objectives in BIM efforts. Even if the collaboration with BIM has often been described as occurring via a central and shared building information model, discipline specific information models for various stakeholders' purposes are as well extremely important.

Another important thematic objective in model-based development efforts is a need to enhance inclusive building information management over the whole life-cycle of a building. A necessity to avoid data redundancy over the building lifecycle (Björk, 1995:50-1) could even be called data recycling: there should not be a need to retype building data after it has been typed in once.

Additional to the descriptive and functional approaches to BIM, a collaborative project management approach emphasizes project information aspects of building models. The focus in project management BIM is in project tasks, activities and resources and how they fit into the design-construction-maintenance chain. The methodical definitions for project and process modelling framework have started rather recently. Scherer states that although product models are well developed and applied in design, they are not yet mature with production processes (2007:11). Thomas Froese has underlined the importance to first define the project information management framework, being a

necessary pre-condition to more complex ICT such as BIM (2008:239). Project management with BIM has also common aims with lean construction in finding the proper ways of acting effectively and rationally in project management and in processes (Howell, 1999:2).

2.3 Practical applicability of BIM

The relation between tools and technologies, such as CAD, with design practice, has been described two-folded; tools have been developed to solve pragmatic problems but on the other hand technology has also formed the appearance of practice. Chastain *et al.* do claim that contemporary design practice has changed because of computing technology (2002:237). Chastain *et al.* also adds affordance to this technology adoption i.e. technology is absorbed if it can simply enhance something. Finne claims, that the value of digital information, for instance design documentation, is created in the design process and especially when using the information (2008:127). Digital information itself is not meaningful but it becomes valuable through usability.

Technological changes, such as the shift from CAD drawings to BIM, have been driven by a combination of pull, arising from needs to solve problems, and the push of technological innovations and opportunities, defined by Froese in his evaluation of Finnish Vera-technology programme 1997-2002 (2002:10). International and national development and standardization projects then, tend to transfer to companies via software tools. Pragmatic implementation in companies and project practices does occur if clear advantages are recognized to improve and streamline the actual work processes. Another driving force is a clear must: new methods and tools are adopted only if one has to or is forced to. For instance, digital project delivery and 3D models have become a mandatory requirement in larger public projects in Denmark since January 2007. Danish integrated project guidelines contain a general description of a model based design and construction process (Karlshøj *et al*., 2008:18-25).

Since the millennium shift the fruits of BIM development (tools and methods) have started, first slowly to be transferred and implemented from research, demonstrations and pilot projects, into design and construction practices (Figure 2). The adoption of BIM is led first by large organizations and then followed by smaller ones. Important construction field players and building project participants in many countries have committed themselves to model-based methods. The General Services Administration, GSA, in the US and Senate properties in Finland, both started requiring BIM delivery in their projects during 2007 (Senate, 2007). Both organizations have provided project delivery guidelines in their web pages. The role of a project owner is noted to be one of the elementary factors in fostering and implementing BIM. Large construction companies have also promoted BIM adoption during the last few years, usually in their own production where the role of project owner has been dominant. Widely used acronym 4D (3D models added with a time factor) emphasizes builders' approaches in using models for construction planning and simulation (McKinney and Fischer, 1998:433-4).

The Gartner Group has used the curve in Figure 2 to assess technology maturity since the mid 1990s. It has also been used to describe the maturity of the IFC standard (Kiviniemi, 2006:38).

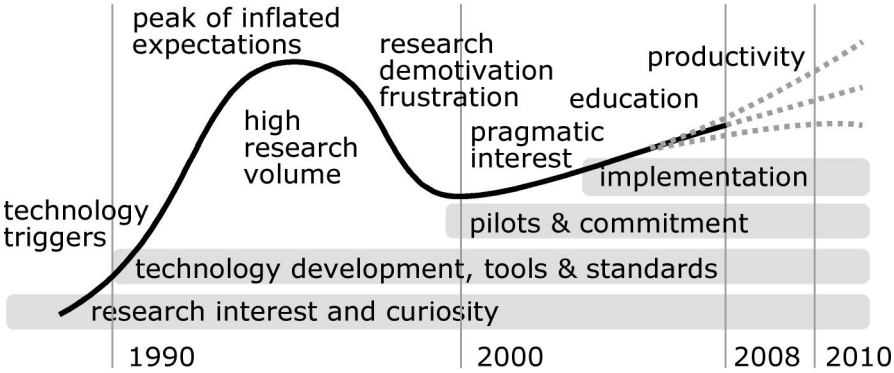

Figure 2. BIM is evolving from research to practice.

While model based applications become implemented into practice, certain openness and publicity in knowledge distribution of BIM starts to fade and the phenomena attracts protective features. It is understandable, though, that information about BIM adoption becomes regulated and restricted when it concerns companies' core business. The subsequent step in BIM evolution after pilot projects seemed first to emphasize the affectivity and financial control over building projects. A second wave in BIM adoption seems to enhance quality related issues. Reducing design errors with BIM will, for instance, result in better design quality.

Implementation guidelines and tutorials for model based integrated project practice have recently been published nationally but also by companies (Penttilä, 2009). Objective in public communication has most often been to establish and promote best preferable BIM practice. Organizations such as The American Institute for Architects (AIA) (2007) have also supplied more discipline specific guidelines. Practitioners' skills are fundamentally important in adopting such new technologies as BIM successfully. Learning has a remarkable role in introducing and adopting model based tools, methods and processes (Moum, 2008:187-8).

Model-based practices of the building domain differ from other, although closely related domains. For instance, infra-domain (roads, streets, city facilities, earth and underground structures) models are widely incompatible with buildings, if the project partners are not operating within the same application environment. Also detailed mathematical models of various mechanical engineering domains, such as acoustics, do not necessarily have a very close connection with architectural and structural design, but the collaboration and data needs have to be defined on project level. Staub-French and Khanzode have documented this being for instance schedule and data exchange coordination between project participants (2007:390-2).

2.4 Critical aspects of contemporary BIM

Various discussion and promotional forums and blogs in the web are currently actively reporting about the distribution of BIM. The generally positive attitudes towards BIM may partly be derived from the vast desires the AEC-community has settled for it during the last 20 years. 'BIM-hype' can also be caused by the pressure within research and development projects, where the objectives have been to make BIM work. Uncovered promises about IFC during the development have also caused inflated expectations over modelling, criticized Kiviniemi (2006:7). Nevertheless, potential benefits and disadvantages of the modelling methodology will be estimated and discussed very carefully by the adopters before actual implementation. The pros and cons of BIM are evaluated, because they simply cause expenses, which then have to be shared between

project participants. In this, the role of the main builder, the project owner, is fundamental.

BIM critics have often been concerned with technical immaturity of the methodology, such as IFC-based data exchange, which has often reported to have incompatibilities (Plume and Mitchell, 2007:35). Mainly because of this, for instance final documentation in Senate properties' projects are required to be saved in parallel both in IFC and native CAD formats. Despite the collaborative objective of BIM, inter-organization use of building models has also been reported to have frailties in field case studies (Fox and Hietanen, 2007:292). For instance, some Finnish construction companies do still create models for construction planning by their own, even if design models would be available, because only this way they can fully rely on model contents. This unsatisfactory situation can be improved by sharpening modelling specifications and enhancing the project discipline, which furthermore is crucially important to establishing BIM projects.

The concept of a model in general, profoundly contains the assumption that some selected essential and meaningful features or parts of reality are included into the model, meaning that some other features or parts are on the same basis excluded and left outside the model. A model is never a fully comprehensive replica of its object, but just a description. The inclusive and exclusive aspects of BIM – what it can contain and what it cannot – have not been discussed in any detailed way in the literature.

Yehuda Kalay from Berkeley has analyzed BIM critically claiming that BIM only enhances project efficiency by the cost of overall design quality. He also suggests that design and construction is more of an interleaved process than a sequential one (2006:361), which BIM seems to support better. Chrabin *et al.* addresses a single building model paradigm (2004:167) being a fundamental obstacle to be used in early design phases. They argue that pre-defined object classifications, which apparently increase effectiveness in later design and, especially in construction phases, do restrict the profound objectives of earlier design: the exploration of form and the testing of variations. The majority of architectural design tools and building modelling tools have been developed for drawing automation and for detailed object based modelling. In particular, modelling applications are becoming more and more complex to use, whereas the need in early design would urge for lighter and more flexible tools.

BIM has also raised legal discussion about project participant contracts. Since contemporary design agreements are often based on drawing documentation, usability rights and copyrights for model-based information need to be updated. The value of design documentation in BIM form is usually seen much more expensive due to its versatility. Liability issues in using model-based data, instead of drawings, may also cause conflicts between information providers (designers) and information users (builders) who have traditionally been separate contract partners (Ku *et al*., 2008:477). Ku *et al.* claims that despite geometric form finding, model-based approach facilitates also radical changes in project practice and business models (2008:483).

3. RESEARCH PROJECT ON EARLY BIM

3.1 Research domains

The domain for this research is architecture, which is regarded as a multi-disciplinary field where various diverse research methods are valid (Groat and Wang, 2002). Architectural design is, in this study, regarded as a pragmatic, collaborative and performance issue, which deals both with design content and tasks to be performed, to process and manage design content. A pragmatic view of design is often emphasized when design is discussed. For instance Dana Cuff has described and defined the pragmatic organization and discourses of the architectural profession (1992). The essence of architecture consists also of 'designerly' thinking, managing tacit and silent knowledge (Schön, 1983; Lawson, 2005) and merging various simultaneous contexts. Since design practice always includes co-operation with other parties, the wider context

of AEC, architecture, engineering and construction, includes important collaborative aspects which are highly relevant for this work.

The main research area for this work is architectural computing, a digital design environment where both design intentions and content are managed with methods and tools supplied by computing and information and communication technologies. After the early definition of the foundations for architectural computing, Yehuda Kalay recently updated the foundations to fit into contemporary architectural design (2004). An important topic in architectural computing has always been design representation. The topics of design collaboration and shared information management have also been noted as trends. The cross-disciplinary and multi-modal nature of architectural computing integrates design content issues, graphical representation, problem solving, analysis and synthesis with modern digital media.

3.2 Research objectives, process and methodology

The objective for this research work is, first, to document how early building design and early building project is currently performed in digital environments, with special emphasis on model based design methods and tools. A subsequent objective, then, will be the definition of an ideal framework for the mentioned early design and project information management.

The first task of this research project was a literature survey, to document the state-of-the-art understanding of BIM in contemporary research and practice. As a part of this survey, professional interviews of various project stakeholders were performed during 2008. The second research task will be the collection of research material from early design related case projects, of which one example is presented in Figure 3. The final and conclusive research task will be the evaluation of literature and case project findings to complete a proposal (a model) for early building design and early project information framework.

Methods of case study research and exploratory surveys will be used, since they suit practice-oriented research, which tries to describe and document contemporary phenomena (Yin, 1994:13). According to Yin, case studies can help in revealing the essential in this phenomenon, i.e. early design BIM, by asking 'how' this phenomenon is occurring and 'why' it actually happens (1994:8). Methods and strategies of participatory action research may also valid in this work, since the research results will also affect and enhance the existing project practices.

Figure 3. An example of a preliminary building modelling case project – a public day care centre.

Despite the visual characteristics of 3D design proposals, the evaluation and proposal selection was based also on various key figures of total area, spatial divisions and plan/envelope ratio, which were produced from BIM-models. Site analysis and functional evaluations were done traditionally (LPV-Architects).

3.3 Criteria to evaluate this research

An important qualitative criterion for early building project and early design framework is how it supports the later design phases. Contents of the proposed framework should be transferable to BIM models. The framework should cover all those essential topics and factors and all information, which is present in early building project environments. The content of these topics and factors will be defined detailed later in this research project.

Björk has proposed that the criteria for building models should fulfil both formal and content dependent requirements (Björk, 1995:47-9). He defines a building kernel model as being the common data repository and also building aspect models as being the participant dependant content repositories. Lam calls a unifying building information model SOM, a shared object model, which stores all common building objects, and then discipline specific models are called DOMs, domain object models (2002:199-200). Lam's and Björk's theoretical definitions are identical. Yehuda Kalay's recent domain documentation for modern architectural computing (2004) is a comprehensive one; hence, it will also be one of the elementary criteria premises.

A controlling criterion for this framework will also be, how well it supports the early project requirements definition and later follow up of these requirements. It has been stated by Kiviniemi, that project requirements are usually not updated nor managed in real building projects after their initial definition (2005:4); hence, they are proposed to be implemented into software as well (2005:238-9).

3.4 Research results and validation

The result of this work, the proposed definition for an early design related information management framework, is a lighter, leaner and confined version of BIM. Validation for this framework comes from comparing model-based practice findings to non-modelling design practice. The existing design project practice will settle the comparison level for quantitative evaluation for this work. Stakeholders of early building project and early design will be the estimators who finally decide about the usefulness and necessity of the proposed framework.

Reliability and objectivity of the research results has as well be tested by reviewing the framework with design professionals and in pilot projects. Trust, reliability and risk management issues within construction have a growing interest in the sector. Measurement units for this work will be:

- ability to contain early design and early building project data, information and knowledge;
- ability to fulfil early information management needs;
- ability to support interoperability between project participants of the earliest phases; and
- compatibility with further BIM models and with IFC.

4. FURTHER DISCUSSION TOPICS

The importance of architectural drawing and sketching is elementary in design representation and it has been discussed widely, most often with a presentational approach (Do, 1996:6). Sketching has also been seen as a graphical memory, a kind of

a language which is used in internal meditation of the designer (Kalay, 2004:100). Sketches are media in generating design solutions. Sketches do also include personal and non-structured design knowledge, which is essential to be included in the early design framework. A case study on transferring design intentions of a renowned architect, Frank Gehry, into model based project practice was reported by Ku *et al*. A geometrical master model was used in a complex project case, to guide architectural form giving (2008:464-6). Unorthodox CATIA software, which was originally designed for aerospace use, was used as the master modelling platform.

A versatile, yet holistic framework of early architectural design sets a demanding criterion for formalizations, such as models, since several diverse, even unknown 'systematics' and modelling methods have to be tolerated and accepted. Meniru *et al.* have defined criteria and specifications for computerized conceptual design in the early design, but as he proposes (2003:70), the field is currently evolving rapidly, thus it needs constant updating. Complexity of the early design domain is an essential characteristic and criterion for information management (Tuncer *et al*., 2001:35).

5. CONCLUSIONS

Existing BIM frameworks need regular updates, because the concepts, methods and tools are in continuous change. BIM has also sometimes been discussed loosely in contemporary forums without precise definitions, which has lead to misunderstandings, and unachievable hopes and aspirations. As presented in this paper, those various approaches to building modelling have differing aims and priorities, hence the conceptual foundations for various BIMs need to be focused. This is especially so when BIM is apparently spread into project practices at an accelerating speed.

Based on personal interviews which were done during the spring 2008, a socio-political aspect of construction was recognized. It is an important enabler for building projects. The actual prerequisites to launch projects are created in political decision making which guides the development of built environment. Important premises to start a housing project are for instance the local need for apartments, preconditions to have public support for the projects and loan interest rates. Contemporary building modelling methodology does not have any means of coping with these requirements, which have to be located within the early building project framework.

6. ABBREVIATIONS AND CONCEPTS

AEC architecture, engineering and construction
BIM building information modelling, building information model
CAD computer-aided design, 2D refers to CAD drawing, 3D refers to geometrical modelling, 4D refers to construction planning with modelling
CIC computer integrated construction
ICT information and communication technology
IFC industry foundation classes, data exchange and information modelling standard
ITC information technology in construction
VBE virtual building environment
VDC virtual design and construction

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ADOPTION AND USE OF BIM IN ACTOR NETWORKS

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ABSTRACT

By viewing adoption and use of BIM as the inter-linkage of actors, the aim of the paper is to uncover mechanisms facilitating and constraining the creation of actor networks in which BIM is adopted and used. The aim is pursued by 1) a study of construction project in a major Swedish construction company, 2) interviews with actors involved in development and use of BIM in the studied company, 3) an analysis of the empirical data by the application of concepts from actor network theory. The data has been collected through extensive participant observations at a construction site and 17 semi-structured interviews with actors on different hierarchical levels and functions in a major Swedish construction company. The adoption and use of BIM has been facilitated by the emergence of technologies acting as mediators between actors involved in the construction process and the succeeding of black boxing of BIM among some actors in the adopting network. The features of BIM have eased the implementation of the technology in context characterized by a temporary and disruptive nature, and actors' demands for immediate benefits of new technologies deployed. By viewing the adoption and use of 3D-based BIM as the creation of actor networks it is possible to map the actors needed and their motives for forming a network in which BIM is used. The analysis of networks and actors roles and relationships in the networks provide us with important knowledge about actors' potential motive for not accepting their assigned roles in the network. However, because of building and construction projects have definite and disruptive nature the challenge is to maintain and re-establish the network in consecutive projects.

1. INTRODUCTION

During the last decade the potential of building information models (BIM) to transform work process in the building and construction industry has been recognized. However, as in case of other technological innovations, there has been a considerable time lag between the emergence of visionary expectations of a technology's transformative potential in an industry, and the deployment of the technology in the industry's daily practice. The first reports of the potential of BIM (or 3D models) to transform processes in the AEC industry emerged in the late 1980s and early 1990s (see, for example, Eastman, 1992). It took, however, almost one and a half decade before more frequent reports appeared regarding positive outcomes of deployment of BIM in the AEC industry (see, for example, Olofsson *et al.,* 2008). Before that, single stakeholders in projects had taken advantage of the technology. But due to incompatibilities among systems used by stakeholders there have been technical obstacles to the use of BIM in an integrated manner in building and construction projects.

However, even if there are expected benefits with technological innovations, this is not a guarantee for transfer and diffusion of technological innovations (Latour, 1987). Furthermore, the networked disruptive character of the AEC industry creates challenges for transfer and diffusion of ICT (DeFilippi and Arthur, 1998; Wikforss and Löfgren, 2007; Linderoth and Jacobsson, 2008). Against this background, original expectations about outcomes of BIM deployment might be redefined and reinterpreted. From the comprehensive research in the field of information systems it is well known that the introduction of new ICT into an organizational context often drifts away from original intentions, no matter who defines them (Ciborra, 1996). This drift can be seen as an outcome of the interaction between a not wholly 'dis-ambiguitiated' technology (Ciborra,

1996) and multilayered context (Walsham, 1993), where learning and knowledge development have a significant impact on the technology's adoption and use (see, for example, Rosenberg 1982; Andersson and Linderoth, 2008). Moreover is the technology's adoption and use is situated in an organizational setting where for example norms, actors' frames of references, industry characteristics, rules and regulations, company culture shape the deployment of the technology (Orlikowski, 1992; Orlikowski and Gash, 1994). Deployment of technology is also shaped by features of ICT (Monteiro and Hanseth, 1995), i.e. technology designers' assumptions about the context for use and futures users' roles, relationships and competencies will shape the ICT deployment. Thus, the adoption and use of BIM will be shaped by the interplay between the context and technology features. Accordingly is a central issue how the adoption and use of BIM can be framed? By viewing adoption and use of BIM as the inter-linkage of actors, the aim of the paper is to uncover mechanisms facilitating and constraining the creation of actor networks in which BIM is adopted and used. This objective will be pursued by 1) a study of construction project in a major Swedish construction company, 2) interviews with actors involved in development and use of BIM in the studied company, 3) an analysis of the empirical data by the application of concepts from actor network theory, including semi-structured interviews and an ethnographic inspired study of a partnering project.

2. BIM IN A NETWORK PERSPECTIVE

In recent studies of BIM a number of benefits and challenges have been identified from studies of BIM deployment in practice. For example have Manning and Messner (2008) identified six benefits of using BIM in early conceptual stage: 1) Rapid visualization, 2) Better decision support upstream in the project development process, 3) rapid and accurate updating of changes, 4) Reduction of man-hours required to establish reliable space programs, 5) Increased communication across the total project development team (users, designers, capital allocation decision makers, contracting entities, and contractors), 6) Increased confidence in completeness of scope. Benefits of outcomes from early conceptual stages are reported by Kaner *et al.* (2008) who report that use of BIM has implied a clear improvement in engineering design quality, in terms of error free drawings and a steady improvement in labour productivity. In the production process benefits are reported for construction managers by Leicht and Messner (2008) who concluded that one of the areas found where BIM added value was the planning and the transparency of the process. Finally, Khanzode *et al.* (2008) report BIM induced positive outcomes in the production process like for example significantly less reworks and zero conflicts in the field installation systems. However, in order to reach befits by use of BIM, Dehlin and Olofsson (2008) argue that a shift in focus is needed, from that of cost/benefits for individual stakeholders, to costs/benefits for the project, which can give a momentum to optimize the use of new ICT tools in the AEC industry. All project stakeholders seems to gain benefits from the use of BIM, but Olofsson *et al.* (2008) argues that that the client is the greatest beneficiary, implying that BIM should be evaluated on the project level and costs and benefits should be shared among all stakeholders.

The benefits reported from the adoption and use of BIM into practice, are clear evidences that visions of benefits with 3D based BIM technologies are becoming realized. However, what is important to bear in mind is that benefits are achieved in temporary coalitions of actors forming the building and construction project. It is well known from research on projects and project-based organizations that one key challenge is the transfer of knowledge among projects and to the permanent organization (see, for example, DeFilippi and Arthur 1998, Gann and Salter 2000). In practice this implies a challenge for the permanent organizations involved in a project is to transfer and routinize benefits achieved in one project to consecutive projects. Thus the issue is how the temporary coalitions of actors using BIM can be framed and conceptualized in order to enhance the

understanding of current challenges of adoption and use of BIM in building and construction projects.

2.1 The need for networks

In the literature focusing on diffusion of innovations (see, for example, Rogers 1995), there is a basic assumption that there should be a fit between the characteristics of an innovation and an appreciation of these characteristics among potential adopters. This view has been criticized for neglecting the role of actors when innovations diffuse (Latour, 1987). Thus instead of viewing the diffusion of innovation as a phenomenon originating from a centre giving the innovation enough energy to diffuse, the transfer and spread of innovations is claimed to occur in networks of actors linked to each other (Latour, 1986:267):

> *"The spread in time and space of anything – claims, orders, artifacts, goods – is in the hands of people; each of these people may act in many different ways, letting the token drop, or modifying it, or deflecting it, or betraying it, or adding to it, or appropriating it."*

The process when innovations diffuse can be regarded as process of translation. The process can briefly be understood as process where spokespersons for an idea try translate the idea into the interest of other actors indispensable for mobilizing the network (Callon, 1986), where BIM should be adopted and used. The spokespersons try to make their idea, using BIM, into an obligatory passage point for indispensable actors, which would allow actors to recognize that they will reap benefits from their involvement in the project (Callon 1986:205). This implies that the idea, or visions for a new technology, has to be broad enough to be interpreted by a diversity of actors as the solution to a range of problems (see also Wagner and Newell, 2006). Moreover, when analysing the networks in which technology use is transferred, not only social actors are to be taken into consideration (Callon, 1987:93):

> *"…the actor-network is reducible neither to an actor nor a network. Like networks it is composed of a series of heterogeneous elements, animate and inanimate, that have been linked to one another for a certain period of time … the entities it is composed of, whether natural or social, could at any moment redefine their identity and mutual relationships in some new way and bring new elements into the network."*

The ideas in the above quotation are directly transferable to the adoption and diffusion of BIM in the AEC industry. Because every time a project is terminated and a new one is started up, new actors with new experiences will shape the network. In order to facilitate the diffusion of BIM in the ever changing networks, the challenge is to create a contained network of relationships where room for individual maneuver will have been limited for the entities concerned (see also Callon 1986:214). This network of tightly linked relationships is also an expression of a black box, defined as a situation where many elements are brought together and act as one (Latour 1987:131), or where things put in the black box become transparent, or taken for granted (i.e. using BIM in each and every time a new building and construction project is initiated).

2.2 Taking technology into consideration

When an actor network is analyzed, technology and other artifacts are regarded as actors shaping roles and relationships in the network. Latour (1992) is arguing that artifacts can take human form and shape human action by replacing humans. The consequences of outcomes of technology deployment can be seen as a combination of actors interpretations of a technology and patterns of action, or programs of actions, inscribed in technological artefacts. Programs of action originate from technology designers' assumptions about the potential user and the context for use. The inscribed

programs of action delegate roles and competencies to the components of a socio-technical network, including human and non-human entities of the system (Akrish 1992, Latour 1992).

However, the concept of inscription does not advocate technological determinism, while actors in the setting where the artifacts are introduced are already following their own programs of action (Latour, 1991). Instead, inscribed programs of action can in turn be strong/inflexible, or weak/flexible. An example of an artifact with weak inscriptions is the hammer, while the assembly line in Chaplin's movie "Modern times" is an example of an artifact with strong inscriptions (Hanseth and Monteiro, 1997). Nevertheless, the strength of an inscription is not apparent on beforehand. Latour (1991) describes how an inscription can be strengthened, and exemplifies this with a managing director of a hotel who wants the guests to follow a desired program of action. They should bring back the keys to the hotel room doors, instead of following an anti-program that is keeping the keys in their pockets. After a series of translations, the director's wish is finally inscribed in a metal knob attached to the key. In this way, the inscription will be strong enough to encourage the guests to follow the desired program of action (bring back the keys), instead of the anti-program (keeping the keys in the pockets). Thus, with regard to BIM the issue is what programs of action does BIM impose on its users and how can a network of actors using BIM be stabilized, implying that the technology is used in consecutive projects?

3. METHODOLOGY

The main purpose of the collection of the empirical material has been twofold. First, a deeper understanding of the context in which BIM would be adopted and used was needed. In research into the adoption and use of ICT in an organizational context, it is of crucial importance to understand the context in which the ICT is deployed in order to enhance the understanding of outcomes of the interaction between the context and the ICT (see, for example, Barley, 1986). Interviews focused on gaining an in-depth understanding of process in the building and construction industry and to get an overview of what kind of ICT that is used and how it is used. In order to meet the objectives of the paper and deepen understanding of the industry, especially of the context of building and construction projects, an ethnology inspired study of a project was undertaken. The project studied was the re-building and expansion of a public multi-activity arena. The existing building contained indoor swimming pools and an arena for indoor sports such as basketball and handball. The expanded arena will contain an adventure pool, new swimming pool, a gym, and a bowling ground. The project is a partnering project worth €50 million over two years.

The collection of the empirical material was undertaken by semi-structured interviews, participant observations and document analysis and the material was interpreted against the theoretical frame of reference. The approach chosen implies that a straight account of the respondents' answers to questions, or observations made, would not bring any deeper knowledge about the process. The interpretive approach, on the other hand, was expected to enable an organizational member and/or a researcher to see his or her world with new eyes (see also DiMaggio, 1995). Therefore the results should be organized in a manner that is based on the researcher's interpretations. Interpretative case studies are a recommended method when the researcher is seeking to understand an emerging process of organizational transformation through IT (see, for example, Markus and Robey, 1988; Orlikowski and Baroudi, 1991; Orlikowski, 1992; Walsham, 1992; Robey and Azovedo, 1994). At issue was whether interviews with open-ended questions could allow the interpretive oriented researcher to uncover contextual elements, something that is stressed by Coffey and Atkinson (1996:80):

> *"...the analysis of narratives can provide a critical way of examining not only key actors and events but also cultural conventions and social norms."*

A total of 18 interviews conducted with actors on different hierarchical levels in a major Swedish construction firm form the basis of the study. Interviewed persons are for example the CEO of the company, the head of a regional unit, the head of a business district, site managers, ICT managers, project managers and managers in an R&D department working on the development and use of BIM. The empirical material, collected through participant observation in a building and construction project, necessitated attending 45 meetings, encompassing a total of 80 hours.

- Production meetings at the main contractor's production site involving the site manager, deputy site managers, foremen, and representatives of construction workers.
- Projecting/design meetings with representatives of the main contractor, the subcontractors and their consultants, and the client representatives.
- Meetings of the quality group with responsibility for internal quality audits.
- Internal 'check meetings' by the main contractor including the site manager, deputy site managers, purchaser, cost accountant, project manager, planning manager.

Additional data were collected by following a deputy site manager during one day at the construction site, as well as from the project's document database and all minutes from internal meetings.

4. RESEARCH RESULTS

In this section, the results from the case study will be analyzed. The first issue is why actors using BIM are enrolled in the network constituting the building and construction project. Second, there is the issue about the redefinition of roles and relationships caused by BIM in the network analyzed. Finally, will the contextual influences on the use of BIM as cooperative tool in projects be analyzed?

4.1. Bringing the actors together

According to both the literature on the deployment of BIM and interviews conducted with R&D managers working on BIM-related issues, incompatibilities among systems used by actors involved a project has been one main obstacle for wider adopting and using BIM as a cooperative tool in building and construction projects. However, in some networks composed by sub-contractors, the use of 3D models has already become an obligatory passage point if actors would remain competitive. For example, the ventilation consultant in the project studied stated that he draws everything in 3D, and about 90% of components needed are available in 3D and supplied by material suppliers. Furthermore, he also states that the material suppliers have realized that they do not have a future if they cannot deliver components in 3D for computerized models. However, he concludes that the use of 3D technologies in a project is an issue of client's and contractors' possibilities to use the technology. This issue has for a long time been plagued by the search for a common standard in order to make different systems communicate with each others. But like other industries actors have been locked into their existing technology infrastructure. However, by the emergence of NavisWorks, an intermediary has been available, that can interlink earlier isolated networks. But these networks will not *per se* be interlinked, i.e. NavisWorks has just created the conditions for cooperation in the network constituted by the building and construction project. But the issue is if there are some incentives for cooperation and if some actor wants to facilitate the creation of a cooperative network?

It can be argued that actors previously working with 3D based BIM not are in a power position that enables them to be the driving force for the adoption and integrated use of BIM in building and construction projects. Instead, as one R&D manager argued, is it the client, the main contractor, or regulative authorities who must demand that actors involved in a project use BIM. In the case studied, the building and construction company has decided that BIM should be used in all projects under own management. Due to this decision BIM becomes an obligatory passage point for all actors who wants participate in the design and projecting stages of a project. This decision can furthermore be claimed to be aligned with the main contractors strive for reduction of production costs. When interviews are conducted with actors involved in projects using BIM, coordination of installations, and the costs saved by avoiding clashes, is the first argument when advantages of 3D based BIM are discussed. However, the deployment of BIM has triggered knowledge development that is obvious when managers involved in the design and projecting stages are interviewed. In the first project the visualization of installations in order avoid clashes was the most appreciated benefit, whereas in later projects, managers also witness of advantages in the production stage.

4.2. Roles and relations redefined

As in the case of adoption and use of other technologies, the implementation of 3D based BIM will imply a redefinition of roles and relationships among actors involved in a project. The R&D manager interviewed states that the process becomes much more transparent and consultants cannot longer hide behind their drawings. This a well known problem in the design and projecting stage. For some consultant groups it may be beneficial to withhold information until others has presented their solution. For the single consultant can this behaviour render in time savings, i.e. the final solutions can be made at once, but for the project this behaviour can be counterproductive (see also Söderholm, 2006). However, with the 3D based BIM it becomes immediately obvious if an actor not has performed what s/he is supposed to perform. The increased transparency of the process also requires more collaboration among actors involved. In this sense it can be claimed that the contractual form by which a project is regulated will reinforce or restrain collaboration among actors. For example, can it be assumed that a partnering project will facilitate collaboration?

For projecting managers the use of BIM and the increased transparency has implied a different mode of thinking when for example installations are reviewed. A projecting manager states that the increased transparency initially has caused some problems when he should review the project. Because many consultants start to upload documents before they are accomplished, there seems to be more problems than it is. The manager states that is important to wait a while before starting the review, because consultants internally solve many of the initial problems shown in the model. However, this has been a conscious strategy when the studied company made the decision to make use of BIM compulsory in project under own management. Projecting managers were taught that they should demand that sub-contractors uploaded their models before a projecting meeting, in order to visualize the progress of their work.

Another consequence of the BIM use is that the projecting manager has to decide what kind of information s/he wants from the model. Should it simply be used for detecting clashes in installations, or should it be used as a more encompassing support in the production process? A projecting manager states that a more encompassing use of the model requires that some decisions are made early in the process. If the model should be used as a support in the material requirements planning, than it has to be inscribed in the model how the process proceed, i.e. in which order are the different parts of the building built. The projecting manager, who also is site manager, exemplifies this with two connecting walls where one is built in an early stage of the project, and another three months later. If it should be possible to schedule the purchases of materials, both the volumes of material needed have to be inscribed in the model and when the walls

should be built. The manager states that the use of the BIM model has given him a much deeper understanding of the processes from design to production. Except for the benefits of materials requirements planning, there are also benefits when the production of different parts of the building is planned together with the construction workers. When the work is planned the model is a very powerful tool for visualization, which facilitates the understanding of the production process. When 2D is used, people think that they understand, even if they really not do, the manager states.

At the time being when the interview is conducted with the manager states that there is still a relatively large degree of freedom regarding how BIM is used in projects where BIM is compulsory. In interviews with managers involved in BIM usage it is obvious that the use has been more encompassing during the last years, from coordination of field installations to a more encompassing use where technology also is used as a support in the production process. However, what managers state is that it is of crucial importance that routines are developed for use of 3D based BIM in the design, projecting and production stage.

4.3. Contextual challenges

When adoption and use of new ICT is analysed it is well known in research that the interplay between the context in which technology is deployed and the technology itself will have a significant impact on the further deployment of the ICT. Accordingly, what are the characteristics of the context and technology under study?

When on-site observations are made at a construction site two related factors characterizing operations soon emerge: the focus on time and the focus on action. This is however, not surprising since operations are organized by projects with set budgets and timelines regulated by contracts. These conditions have lead to the demand for immediate benefits, or actions, which a characteristic of the whole project-based part of the industry. In an interview, a development manager stated that more time should be spent on planning before the production starts, but in practice this may not be the case. Instead is the focus on immediate action which the manger illustrates with the following example: A client calls the business area manager to ask why the production not yet has started, because the client has not yet seen any excavators at the construction site. The business area manager calls the site manager and asks why they have not yet have started to excavate. The site manager takes action for action's sake, by ordering an excavator to dig a hole, even if the hole not will be correctly excavated.

The focus on time and action is not only a concern for managers on different levels. It is a focus of crucial importance even for the construction workers, as the following episode illustrates:

> At a weekly production meeting, held each Monday morning, a carpenter suddenly comes into the meeting room, furious because there are no scissor lifts available and the deputy site manager has to arrange for one immediately. The manager calls the local outlet of the machinery and equipment rental firm, and 45 minutes later the scissor lift is delivered. After the incident the manager says that he thinks that it is good that people are engaged in their work and always want the process to move forward. However, when we discover, directly after the delivery, that there is another scissor lift on the floor below where the scissor lift was needed, he adds that people sometimes ought to spend some extra minutes and communicate with each other in order to find out if the missing equipment is available nearby, instead of demanding immediate action in order to solve a problem.

Thus, the focus on time and the focus on action can be claimed to have lead to demands for immediate benefits if technologies would be adopted and used. In the case of 3D based BIM the technologies fields of application can be implemented step by step, which is a desirable technology feature in contexts where demands for showing immediate

benefits are high. Against this background, the use of the technology for detecting clashes in installations is one area where immediate benefits can be showed. Detecting clashes in the design stage, instead of the production stage leads to significant cost savings for the main contractor. However, when it comes to applications concerning scheduling and material requirements planning benefits are not immediate. In this case, it can be claimed that actors introducing the technology need to convince and show site managers the potential benefits of the extended use of BIM. The most important feature that makes 3D based BIM suitable for implementation fragmented context, like building and construction projects, is that fields of applications can be implemented incrementally. For example, in the project under study a rather basic 3D model became available half a year after the project started. The intended use was to detect clashes in field installations. After a while the projecting managers realized that the model could also be used when installations should be planned in confined spaces.

Finally, there is the issue of how networks of BIM use are maintained. For some of the actors in the network, BIM has already become an obligatory passage point. But the challenge is to make BIM into an obligatory passage point for all actors concerned in a building and construction project, and in consecutive projects. From observations in the case studied it can be claimed that it is a responsibility for the top management in line organization to decision about making BIM into an obligatory passage point in their projects. But an issue that needs further research is to investigate the role of the client and what their attitudes and motives are for whether or not promoting the use of BIM.

5. CONCLUSIONS

By viewing the adoption and use of 3D-based BIM as the creation of actor networks it is possible to map the actors needed and their motives for forming a network in which BIM is used. Does the analysis of networks and actors roles and relationships in the networks provide us with important knowledge about actors' potential motive for not accepting their assigned roles in the network? Furthermore, does the analysis of actors' roles and relationships in a network provide us with important knowledge about the need for creating new routines connected with the implementation of BIM in construction projects? Since building and construction projects have definite and disruptive nature the challenge is to maintain and re-establish the network in consecutive projects. This will be the major challenge for the main contactors line organization, clients and regulative authorities.

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BIM AND DESIGN AND CONSTRUCTION INTEGRATION – THE ROLE OF RELATIONSHIP MANAGEMENT AS THE CATALYST

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ABSTRACT

The extent to which relationship management enhances the rapidly developing disciplines of architectural technology and design management is the subject of this paper. The interface of people, technologies, policies and processes within a project environment is the main theme. How relationship management (RM) can improve project performance through the adoption (and adaptation) of collaborative communication technologies is also considered. These issues and the framework within which cooperative and collaborative design, moderated by BIM, is developing in Hong Kong are discussed with reference to two case studies. The cases show that the uptake of BIM is characterised by proactive and reactive approaches. BIM operates most effectively within a 'no blame culture' where no one loses 'face', an important cultural concept in Hong Kong.

1. INTRODUCTION

The construction industry lags behind other industries in adopting and integrating ICT. However, it is apparent that, at the level of both the firm and project team, there are indications that an increasing number of construction industry participants are moving beyond the mere automation of manual tasks. If construction projects are to be more effective, this will come as a consequence of greater integration of communications across the temporary project organization; that is the construction team. While the industry is still a long way from sector-wide performance improvements, there are enough ICT-mediated projects to make it possible to describe the attributes that a project and its participants require to create value at multiple levels across a project supply chain into which ICT has been integrated. Croker and Rowlinson (2007) recently pointed out that research on the adoption and use of ICT in the construction industry often fail to distinguish between permanent organizations and their project-based counterparts. They however confirm that in construction project settings the implementation of ICT is shaped generally by forces emanating from four contexts: external, internal, situational and organizational (Croker and Rowlinson, 2007).

Value creation by members of a temporary project organisation requires the involvement of the entire project supply chain including architect (ARC), mechanical, electrical and plant consultants and contractors (MEP) and main and trades contractors (STC) as shown in Figure 1. From the suppliers of raw materials upwards, inter-organisational business processes should be designed to facilitate the free exchange of information necessary for optimal flow of goods and services. Members of the supply chain who positively contribute to this process should expect to be rewarded through a combination of increased/repeat business and increased margins. Though the precise nature of the reward will vary from user to user and at different levels within the project supply chain, the concept should remain true throughout the project team. Such an integrated approach is built on the incremental capability improvements of individual project team members, who close the communication gap with other team members.

One such tool for closing the communication gaps among project participants is Building Information Modelling (BIM), a methodology for managing the essential building design and project data in digital format throughout the building's life-cycle (Penttilä, 2006). Although BIM is a promising catalyst of change (Bernstein, 2005), with the potential to

reduce the industry's fragmentation (Dawson, 2005) as well as lower the high cost due to inadequate interoperability (Gallaher *et al.*, 2004), such a sea change in the culture of the industry cannot be brought about by technology alone: it is essential that processes and procedures are put in place on top of the procurement system in order to facilitate this change. Indeed, Succar (2009) recently made a case for the development of a framework that positions BIM as an integration of product and process modeling. The cooperation and collaboration which is shown schematically in Figure 1 depends to a great extent on the management of relationships within the temporary multi organization which is the project team. Although this was recognised many years ago (Cherns and Bryant, 1984) the social infrastructure, relationship management (e.g. Rowlinson *et al.*, 2006), and the technological infrastructure, visualization and BIM, were not well developed (Rowlinson and Yates, 2003). As these infrastructures now are starting to coalesce the opportunity for true cooperation is now beginning to emerge (Anvuur and Kumaraswamy, 2007).

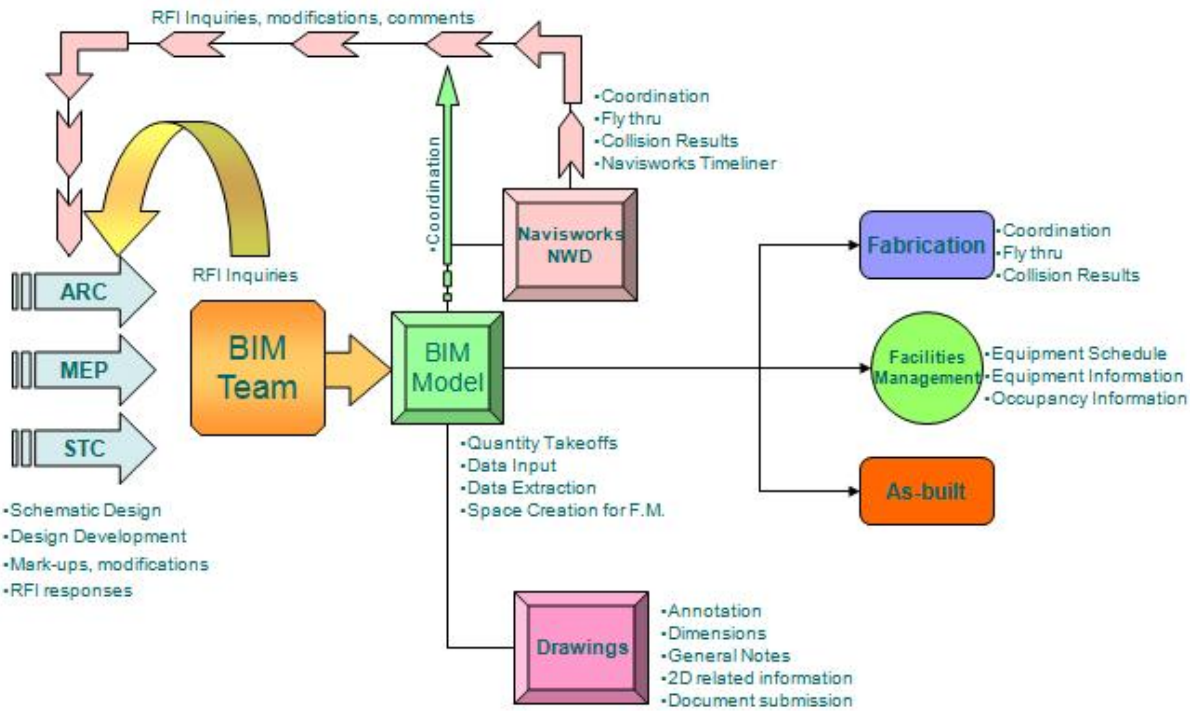

Figure 1. Implementation of BIM in the temporary multi-organisation.

Sustainability is also becoming an increasingly important issue when considering how a building will use resources over the course of its useful life. Government regulations, environmentally conscious construction clients, and the general public are driving demand for buildings with less reliance on external municipal services in addition to a reduced carbon footprint. BIM technology, when paired with ecological sustainable design (ESD) software, allows for extremely powerful models to be developed which accurately represent most aspects of sustainable design.

However, the uptake of BIM in construction projects is slow. The key to the adoption of BIM by major construction clients can be achieved by highlighting the benefits due to cost savings from less rework, increases in interoperability and accurate estimation of future facilities management (FM) costs by utilities consumption modelling. The BIM process requires a complete model before construction begins where clashes and other problems can be resolved virtually before encountered on site. Resistance to BIM will

occur in situations where architects and engineers, who traditionally expect the majority of the workload to be in the latter half of the design phase as RFIs are issued, have their workload shifted towards the beginning of the design phase. This undoubtedly requires a culture change and this may be achieved through relationship management. BIM reduces the workload later in the project by reducing the RFIs during project construction. This will likely modify the cash flow structure of these consultants and lead to additional management challenges. However, the benefits of this approach will outweigh the costs as total workload will be reduced over the project construction period. It is far faster and cheaper to modify a computer model than to modify a semi-constructed building. This will typically result in cost savings for architects and engineers as they can get things right first before construction starts and saving for the client as they have fewer disruptions due to RFI and cost overruns.

This paper makes a case for a relationship management approach to BIM implementation and illustrates how such an approach is evolving in the Hong Kong context. The BIM philosophy is first presented, followed by a review of how relationship management can facilitate BIM implementation. Two Hong Kong cases are then presented to illustrate the challenges and opportunities that a relationship management approach to BIM presents.

2. BIM PHILOSOPHY

As the development of new materials, construction techniques and technologies, and architectural ambitions increases the complexity of major construction projects, so too must the manner in which such projects are conceived and managed. Clients are beginning to move away from the traditional methods of project management with the desire to use modern technology effectively. The need to complete projects quickly and cost effectively and the competence to do this is what will continue to differentiate companies from one another. In the past, 3D technology had been used to create a conceptual visualization of a project, but failed to significantly change the traditional process of construction design and project management. The technology has been regarded as simply another form of demonstrative artwork with no real on-site application or practicality and no ethos of cooperation amongst team members to drive its use.

BIM has taken this concept to the next level by using actual engineering and architectural data to create the 3D models as opposed to creating the models directly with artistic 3D design software. This allows for a 3D model to be updated by way of changing the database containing the specifications and not the actual model itself. The model is simply an end result of the input data. Architects, structural engineers and other team members can then work independently using the same centralized dataset in a systematic, collaborative manner. The aim is to create a centralized shared knowledge resource that contains all the necessary design and operational information about a project. For example, as a structural engineer updates the model with new specifications, the architects will be automatically notified of the changes which can then be viewed in their own formats or as a 3D model. Traditionally, the structural engineers and the architects would work on separate sets of schematics which would need to be updated and coordinated as problems are identified, requiring a great deal of organisation and paperwork. The BIM approach also helps eliminate or reduce the need for graphic designers to update the model with data from professionals using vastly different design formats as the process is largely automated, being built into the functionality of the system.

BIM uses actual structural and architectural data that can be used to identify and reduce the number of errors and design conflicts and requests for information (RFIs) before the project ever breaks ground. Centralizing the dataset also has the benefit of maintaining a consistent format of data which reduces the confusion experienced by different specialists interpreting information. The resulting 3D model is not only a highly accurate

visual representation, but also a model that contains accurate structural, sustainability, energy use and other information. This allows for various project professionals to use the same data set to achieve different goals.

Recently, BIM has progressed beyond 3D visual representations to 4D representations of the entire construction process. This allows it to be an incredibly useful tool not only for participants in the design process, but those involved in the building process as well. For example, by simulating the build process, risky construction methods can be identified and designed out before it becomes too late and costly, with obvious occupational health and safety benefits. Costs can be reduced with the prefabrication of certain elements if the specifications are known well enough in advance, as this typically requires very long lead-times (say, up to 9 months). If requirements for materials are known far enough in advance, structural and architectural elements can be manufactured and delivered to the project using a just-on-time schedule to reduce the need for storage and delays.

3. BIM AND RELATIONSHIP MANAGEMENT

Major construction projects involve several key parties that require a great deal of direction in order to complete a project effectively. Firms need to continuously adapt and utilize new technologies, products, services and processes that can allow them to improve efficiency and remain competitive players in the market. Collaboration between key parties, such as architects and structural engineers, is critical in accomplishing this goal. The use of BIM technology is proving to be the facilitator of truly cooperative construction project management teams, allowing for a unified master dataset which all members of a project can use in the accomplishment of their specific tasks. While projects continue to increase in complexity and new construction materials continue to be developed, clients require projects to be completed in less time and more cost effectively than ever before. This is leading to modern technology being utilized in ways that facilitate an increase in the communication between traditionally segmented parties in the construction process. However, this is not automatic, the cooperation still has to be nurtured through relationship management techniques and facilitated through BIM. The need for a relationship management approach to BIM implementation is apparent from Succar's (2009) view of BIM implementation as comprising three interrelated and mutually reinforcing fields that require management; the policy, process and technology fields. Here the policy field can be interpreted as aligned with the procurement arrangement or governance framework while Succar's (2009) original process field is relabeled 'players field' and the process filed depicted as representing facilitative processes. These fields as shown in Figure 3 bring together a myriad of players or stakeholders and deliverables which then require effective management and coordination. While the emphasis has always been on the integration of the players, Succar's (2009) adapted framework suggests that effective BIM implementation will require going beyond the players field to integrate the players with the technology, process and policy fields. This is because the new context in which BIM will operate effectively will be characterized by blurred roles, changes in responsibilities, shifts in potential liabilities and demands for new contract models and instruments of services (Bernstein, 2005). A relationship management approach should therefore help in resolving the tensions that will surround knotty issues such as efficiency, definition of roles, information value, innovation, business value, risks, contract models and sustainability of designs (c.f. Bernstein, 2005).

Since the demand for BIM is being driven by the potential for cost savings resulting from shorter project time horizons, less RFIs being issued on the project site which in turn results in fewer delays and cost overruns, the adoption and utilization of the BIM process will require top management support and ultimately need to be demanded by the client. In the past, consultants in the design and construction process had very little impact on the demand for BIM as they acted passively, subject to the requirements of the client. Through engagement, and empowerment, brought about by relationship management

techniques this situation is changing and effective design management is beginning to flourish, with the obvious advantages as shown in Figure 2.

Relationship management in construction has its roots in relationship marketing and strategic network competition (see, for example, Christopher *et al.* (2002) and Grönroos (1990)). Relational contracting is based on the concept that self-interest motivates parties to enter into contractual relations but competition between parties is necessarily bounded by acceptance of the need for cooperation (see, for example, MacNeil (1985, 2000)). Relational contracting provides a framework for cooperative and collaborative contractual relations; alliancing and joint ventures are examples of this approach which can promote and engender innovation. Relationship management is the organizational behaviour which provides the infrastructure to stimulate and maintain collaborative relationships. Partnering is a policy or process to enable relationship management over a range of procurement forms which seeks to improve project performance. This is the glue which binds the project team, the temporary multi organization, together and provides the impetus for culture change and a move towards cooperative relationships.

In discussing their conceptual model of partnering and alliancing, Anvuur and Kumaraswamy (2007) note "several issues raise serious difficulties with … partnering within and across different national and organizational settings". To date, partnering has been implemented in Hong Kong as a process with little attention being paid to the impact of culture on the outcome of these processes: one size does not fit all and there is mounting evidence that partnering must be implemented in a culturally sensitive manner in order to be successful. Hence, culture, both organisational and national, affects the effectiveness of the partnering mechanism; a fit is required between the cultures and the mechanisms. Building on the work of Phua (2004) and Phua and Rowlinson (2004) on ingroup and outgroup cooperation Anvuur and Kumaraswamy (2007) propose a 'contact hypothesis' as a means of explaining how collaboration and cooperation can be brought about. They conclude that optimal collaboration requires "(1) equal status and respect (2) common goals (3) cooperative workgroup interaction (4) support from authority and egalitarian norms. As for industry change, a long term goal of the partnering process in Hong Kong is to change the culture of construction.

Implementing BIM with a relationship management philosophy in projects as discussed above can therefore lead to greater collaboration and cooperation. Succar (2009) makes this link more explicit in advocating the development of a BIM framework and espouses a *BIM maturity continuum model* that identifies a fixed starting point (i.e. pre-BIM, the status before BIM implementation), three fixed maturity stages and a variable ending point (i.e. integrated project delivery denoting an approach to or an ultimate goal of implementing BIM that accounts for unforeseen future advancement in technology). Through the integration of the technology, process, players and policy fields, Succar (2009) outlines the three stages of BIM maturity as: object-based modelling, model-based collaboration and network-based integration which are indicative of increasing need for forging better relationships among stakeholders.

From a relationship management perspective, the pre-BIM stage requires that collaborative practices among stakeholders be made a priority with the removal of linear and asynchronous workflow between the stakeholders. The realization of the need to invest in technology and promote interoperability is often evident at this stage (Dawson, 2005, Gallaher *et al.*, 2004).

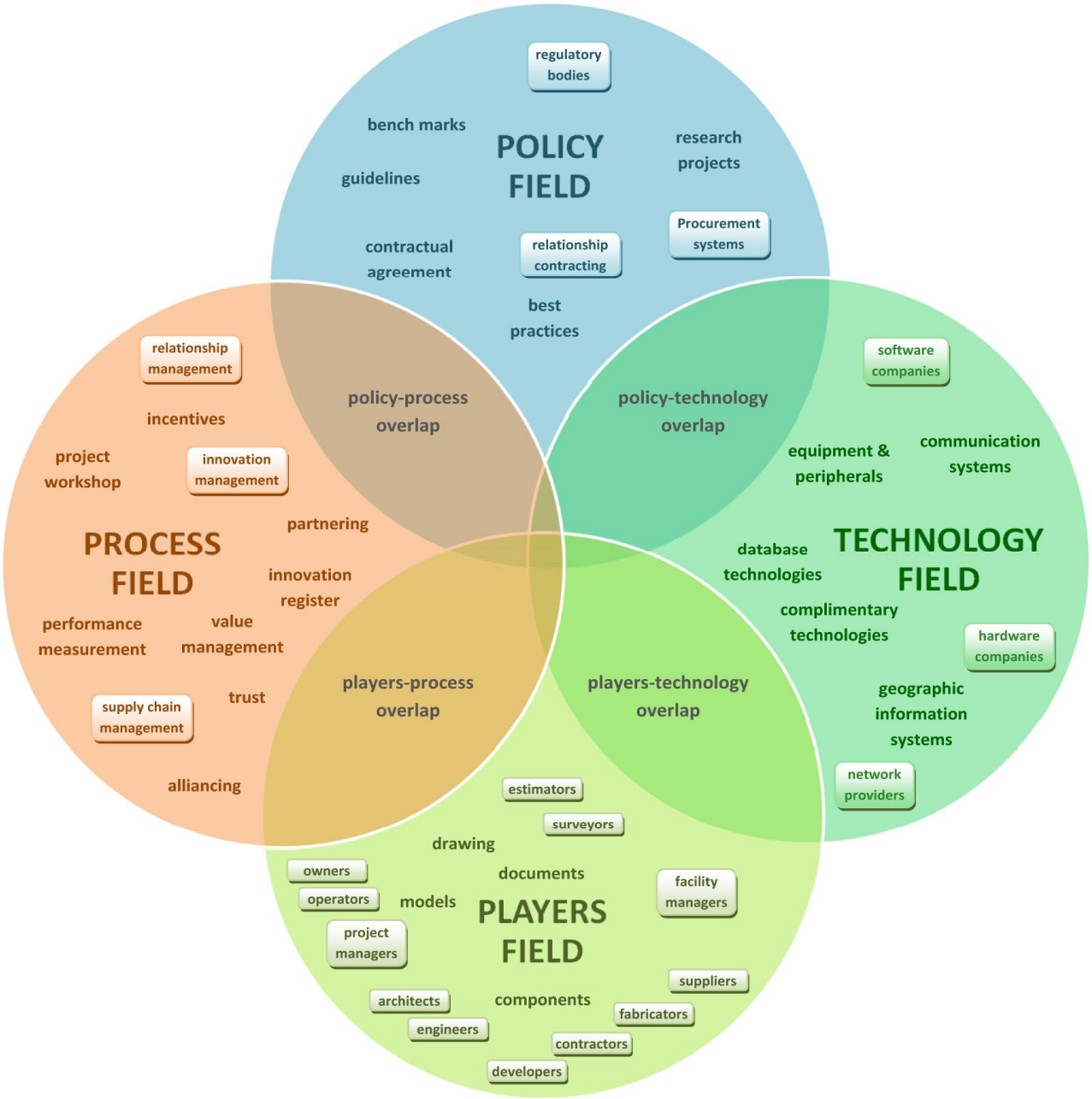

Figure 2. Interlocking fields of BIM implementation (adapted from Succar, 2008).

At the object-based modelling phase when BIM is initiated, collaborative practices are often limited as there are no significant model-based interchanges between different disciplines, data exchanges are also still unidirectional and communication is also asynchronous and disjointed (Succar, 2009). However, as BIM begins to bring up design and construction issues that require resolution the need to engage key stakeholders becomes apparent. This way, the object-based phase evolves into the model-based collaboration phase where stakeholders engage in interoperable exchanges. At this stage, model-based interchanges begin to augment and replace document-based workflows resulting in 'fast-tracking' of the project and greater need for collaboration and cooperation (Succar, 2009). When the BIM implementation reaches the network-based integration maturity stage, a more interdisciplinary approach to developing models for managing the construction process would have evolved where more complex analyses of the early stages of virtual design and construction is undertaken, going

beyond semantic object properties to include business intelligence, lean construction principles, sustainable policies and whole lifecycle costing (Succar, 2009). Due to the demands for collaboration at this stage rethinking of contractual relationships, risk allocation models and procedural flows are necessary. The management of these changes and the resulting tensions can be facilitated by an application of the principles of relationship management. This should then push the implementation of BIM towards an integrated project delivery phase with innovative procurement systems as the ultimate desired end.

Although Bresnen and Marshall (2000) and Fisher and Green (2001) question whether relationship management principles such as partnering can change the culture of construction, the results which are flowing from BIM moderated projects suggest that, in Hong Kong at least, this may be possible. A key issue here is that the BIM model does not lay blame; it merely identifies clashes, issues or problems which can be solved participatively. In essence, no one loses 'face', which is an important cultural concept in Hong Kong. The success of partnering is mediated by the influence of culture, procurement systems and the process of relationship management. Thus, this paper builds on the work on the impact of culture on project performance (see, for example, Rowlinson *et al.* (in press)) to outline the efficacy of the relationship management approach and how innovation, in the form of collaborative working through 3D and 4D visualization and BIM, can lead to collaboration and cooperation. The case studies below illustrate these points.

4. CASE STUDIES

The adoption of BIM processes on Hong Kong projects has evolved in an ad-hoc manner to date with a number of different parties providing BIM services and software solutions. The Hong Kong construction industry has been influenced by developments in the United States and Europe in the past five years. A number of large client organizations specify that their design consultants and contractors must adopt BIM technologies for their projects. In one such case, the client invested directly in the implementation, training, and management of the BIM technology. In contrast, other developers only specify BIM and allow the consultants to offer suitable BIM solutions for each project. In these cases the architects, engineers and contractors have engaged independent BIM consultants to assist in the planning and management of the BIM processes.

Larger design consultancy firms have also invested in developing BIM solutions within their respective firms. The goal has been to improve design co-ordination and drawing production efficiency on specific projects. Although the companies do not appear to have a corporate directive to make BIM software tools mandatory on all of their projects, they have made the technology accessible to all of their staff. As observed in Europe and the United States, management contractors have been the fastest adopters of these collaborative tools. These firms use BIM and 3D CAD solutions to improve building services co-ordination. They use 4D virtual construction simulations (3D models digitally linked to a programme) to review construction sequences and to communicate planned tasks to the sub-contractors and local authorities. Recently, representatives from client organizations, developers, design consultants, BIM consultants and contractors founded the Hong Kong Institute of Building Information Modeling (HKIBIM). The objectives of the HKIBIM are to promote and advance the education, understanding, appreciation and interest in BIM in Hong Kong. The Institute will enable the different parties involved in building projects to develop strategies for a project and provide and maintain standards for BIM practice locally.

Against this backdrop two projects that have recently adopted BIM are discussed to demonstrate the proactive (4.1) and reactive (4.2) approaches to BIM process implementation in Hong Kong so far.

4.1 Case Study One – Cargo Terminal

Located on the south side of the Hong Kong International Airport platform this cargo terminal facility, costing roughly USD$500M, is possibly the largest project in Asia to implement BIM technology. The facility will be the largest air cargo terminal in the world (when measured by tonnage per square metre) with a target throughput capacity of 2.6 million tonnes of cargo per annum. At peak times, the cargo terminal will process more than 75 flights per day with each flight containing up to 110 tonnes of cargo from silver bullets (converted 747 cargo carriers) or up to 25 tonnes from passenger planes.

The client specified that the design must be coordinated using the BIM process from the very beginning of the design stages. The client was determined to use the latest technology available to reduce the risk of delays and cost over-runs on the complex fast-track building. The cargo facility is a structure with a very specific purpose that requires extensive mechanical, drainage, ventilation, electrical, and specialised mechanical systems. As the design, drawings and specifications for these systems are incorporated into the BIM, a detailed clash detection analysis matrix can be implemented to identify and eliminate any design conflicts between various systems (cargo handling, structural, architectural, municipal systems, specialised systems).

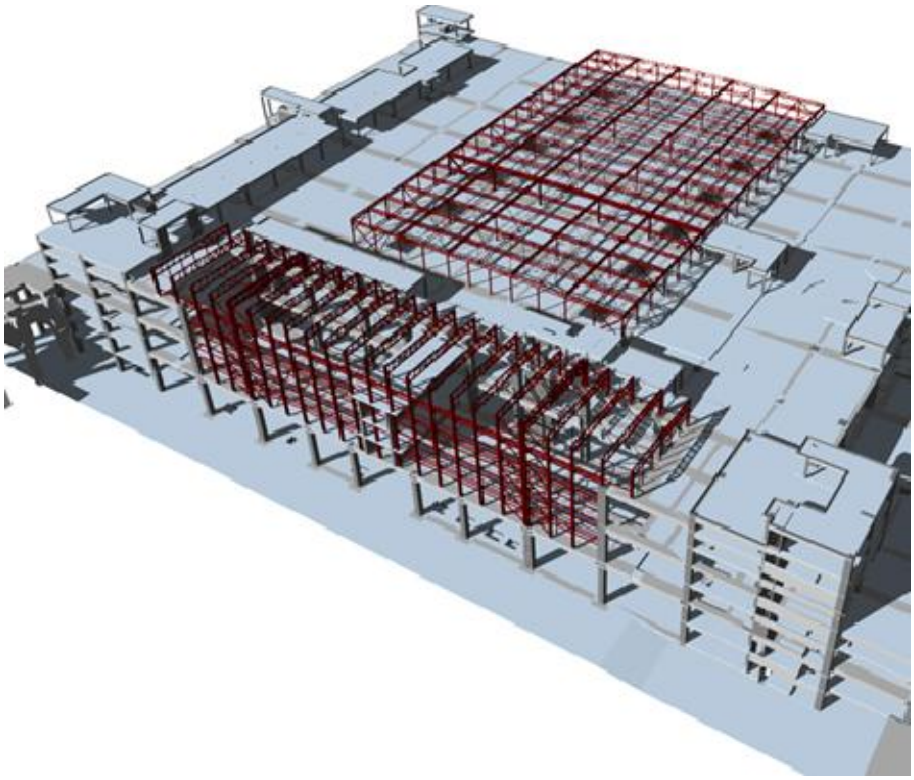

Figure 3. Schematic showing the complexity of the new CX cargo terminal.

There are different types of clashes that must be indentified in a project such as this. A hard clash will exist where piping or other systems are passing through or otherwise interfering with structural or architectural elements. This could cause a delay on site that might require an RFI if overlooked during the design process. Cargo enters the facility on 6 tonne pallets which are then processed by the Materials Handling System (MHS). The MHS consists of a semi-automated assembly of roller-decks, which move the cargo pallets laterally while large hoists are used to raise or lower the pallets vertically between levels. This requires the BIM to account for the different systems that may have

a clearance clash with the 'kinetic envelope' of the cargo pallets as they are moved and process throughout the facility.

Clashes can be identified using a specialized clash matrix that incorporates design specifications and operational requirements (headroom, mechanical handling system (MHS) specifications, structural and architectural co-ordination, and mechanical, electrical and plant (MEP) co-ordination) into the analysis. The analysis is done on a priority basis and issues are resolved before any construction ever begins. This is a continual process and a dedicated engineer works on this continuously through-out the design co-ordination process. This has resulted in far less on-site requests for information (RFIs), cost over-runs, and delays. It is difficult to imagine this project being successfully completed in the given time-frame without using BIM process management.

The proactive approach adopted by the client in this project has resulted in smoother operation and forced traditionally segregated elements of the design process (structural engineers, architects, MEP, etc) to collaborate in a systematic fashion from the outset. This has required the extensive retraining of key personnel to use standardized systems and software platforms to ensure that there is consistency in the design and format of data. As one might imagine, there has been significant resistance to the change in process, but the resulting outcome benefits all parties involved in the construction design and build process. Indeed, the approach appears to be bringing about the intended culture change in the industry.

> *"We believe that 3D design is an essential tool for a project such as ours. Its introduction has required a commitment from designers and contractors and at times we have had to insist that sliding back to 2D methods is just not acceptable. Now all parties are able to see the benefits of BIM and I believe that for most of us there is no going back."* [Client's Project Director]

4.2 Case Study Two – Casino (Parcel 5 & 6)

The construction of the Casino was managed a management contractor. During Phase One of the development, there were a number of complex design co-ordination issues between the architectural glass reinforced concrete (GRC) façade panels and the in-situ structural concrete frame. The issues were causing delays on site while RFIs were issued to the engineering and architectural consultants for resolution. In reaction to the challenges on phase one, the client supported the adoption of BIM 3D CAD modeling during the detailed design phase and construction documentation stage before the specialised façade contractor was appointed. A 3D modeling consultant was appointed to work in parallel to the architects and structural engineers to build 3D CAD models to identify design conflicts where structural elements were clashing with architectural elements of the façade. These issues were then resolved by the designers before the drawings were issued to the contractors. The design for the development of Parcel 5and6 involves a podium façade with a design reflecting Balinese styles. The 250m long elevation consists of 18 different themed facades which are all inter-connected. The facades are constructed using GRC precast panels which are supported by a cast in place reinforced concrete frame structure. During the design, tender and construction of the first phase of the Casino, there were a number of design integration problems between the Casino's themed GRC facades and the concrete structures. The design issues contributed to delays during the tender and construction stages.

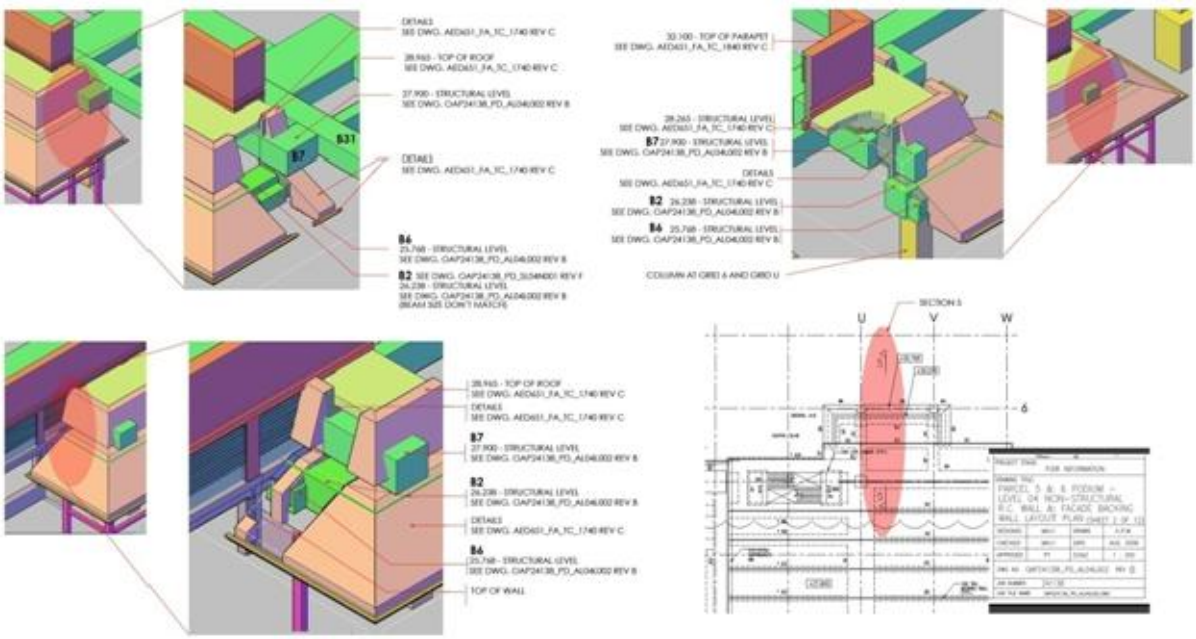

Figure 4. Clash and error detection on the Venetian project.

At the commencement of the 12 week detailed design and tender documentation phase for the Parcel 5 & 6 Façade project, the management contractor appointed a 3D modeling consultant to provide 3D CAD models assembled from the architects and structural engineers 2D CAD drawings. The 3D modeling consultant's co-ordination engineers were instructed to identify design clashes, conflicting information and missing details on the consultant's drawings. A schedule of work was developed with the design team to integrate the 3D CAD design validation review into the overall design co-ordination process. The 3D structural modelling team assembled the structural frame model from the designer's 2D CAD drawings. The 3D architectural modelling team built the GRC façade models from the architect's 2D CAD drawings.

As the design for each of the 18 themed facades was completed, a report was compiled by 3D modeling consultant identifying issues which required the attention of the architects and engineers. These issues included conflicting information between architectural plans, sections and elevations, misalignment and setting out issues between the structural framing and GRC panels and many other technical queries. These issues were previously discovered by the main contractor on site.

The architect and structural engineers issued drawings to the 3D modelling team on a weekly basis. One week later a design co-ordination workshop was facilitated by the management contractor to review the design progress and to resolve the technical queries raised from the 3D modelling process. The 3D models were used throughout the design co-ordination process to review details and to illustrate different design conditions. The 3D models became the focal point for discussions between the client, architect and engineers. The architects and engineers made design changes and revised their respective 2D drawings according to decisions made during the co-ordination work-shops. The updated drawings were then incorporated in the 3D CAD models to ensure that the issues raised previously were fully resolved.

There was an initial resistance from the architects and engineers to the inclusion of an independent check by the 3D CAD modelling team. However, after they witnessed the benefits of the models and technical query process, they were able to quickly understand co-ordination issues illustrated by the 3D models. The designers quickly became fully engaged in the process. At the end of the scheduled 12 week tender documentation process, the architects and engineers produced a set of fully co-ordinated design

drawings and the 3D modelling consultant produced a detailed interactive model of the podium façade. The 3D model was included with the tender documents issued to the specialist façade contractors. It was noted by the management contractor that the tender was quicker to complete than on the previous phase.

5. CONCLUSIONS

Business success alone is insufficient as a driver for managers to justify the implementation of integrated ICT strategies, unless there is strong support for such change from ICT champions (preferably senior management within the organisation). Indeed, being motivated only by profit maximisation (or other desirable financial objectives) is not enough. Many firms adopt ICT tools and systems for profit-motivated reasons and fail due to underestimation of cost, i.e. successful ICT adoption depends on the 'politics of technology' in its management in the organisation (Tantoush *et al.*, 2001) and shaped generally by forces emanating from external, internal, situational and organizational contexts (Croker and Rowlinson, 2007).

A change of culture is necessary and the implementation of BIM in project delivery must be accompanied by a relationship management approach and a move towards more integrated procurement systems, such as alliancing and design build approaches. With such prerequisites in mind, the feasibility and decision-making process of implementing a change/new ICT system within an existing organisation can be made easier by maintaining openness and honesty throughout the planning, design, development and implementation process. A relationship management approach can encourage participatory planning in defining goals, objectives and in influencing the design or procurement of the new ICT system in ways the enable the smooth integration of the technology, project processes and policies.

Managerial support, involvement and commitment are therefore necessary in driving the changes necessary from the beginning to the end of the planning and implementation process. A clear management vision for the implementation of BIM will also enable clear articulation of the goals for the change so that they are better understood and viewed positively by all concerned. Overall benefits from BIM implementation can be maximised if greater effort is placed on coordinating the goals of the new system with the existing goals of the organisation. As resistance to change often arises from lack of adequate knowledge or information and inexperience, there must be enough opportunities for education and training on using the new system as well as positive incentives for it.

As the Hong Kong cases show, resistance to change will often characterise the uptake of BIM. Thus, the process will continue to be driven by both reactive and proactive approaches until such a time that clear benefits to all stakeholders in the construction process can be demonstrated. However, relationship management will continue to be a key ingredient in the successful integration of the stakeholders for success in the application of BIM.

6. ACKNOWLEDGEMENT

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CHALLENGING THE INTERFACE BETWEEN GOVERNANCE AND MANAGEMENT IN CONSTRUCTION PROJECTS

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ABSTRACT

The purpose of this paper is to explore and challenge the existing, unclear interface between the project owner's perspective (associated with governance) and the executing party's perspective (associated with management). This interface frequently creates difficulties in construction projects both in the private and public sectors, due to unclear roles, responsibilities and expectations from both the owner and the executing party. The interface may include overlaps, gaps and grey zones. Based on empirical indications of problems in a limited case study and a sample of major construction projects, the interface between governance and management is investigated. Findings from literature on governance and management of projects are included. Clarity in concepts and terms, as well as deeper understanding of roles and responsibilities, may improve both the process for the parties involved and the economic outcome for key stakeholders. The results reported in this paper are tentative and will be explored further. Both the project owner and executing party of construction projects are expected to benefit from improved understanding of governance and management through the development of better role models and procedures in the future. A more explicit and well-defined interface will help both sides make better choices in organizing and controlling the construction project. This paper intends to add to improved understanding of the interface, but it is the parties themselves that have to secure the improvements through their interactions.

1. INTRODUCTION

The purpose of this paper is to explore and challenge the existing, unclear interface between governance and management. This interface frequently creates difficulties in construction projects due to unclear roles, responsibilities and expectations of both the project owner and the executing party. With a more explicit and well-defined interface, both governance and management may benefit.

The interface can be defined in at least two dimensions: (1) Organisational level – the interface between the governing party (the project owner) and the executing party (the project organisation). The organisational dimension stems back to the Cadbury report (Cadbury 1992); the roles of the governing body and the operational management should reflect separate spheres. (2) The use of means – the interface between governing mechanisms and administrative mechanisms. 'Boards govern and managers manage' (Otto 2005). In this paper the author simplifies the picture is by associating governance with the owner's perspective and management with the executing party's perspective, inspired by governance literature more than by management literature.

The terms governance and management are similar in the sense in that both are associated with control and being in charge. In general management literature it may seem that governance functions are part of management. In this paper we use the term governance differently. Governance and management are held to be related, but there is an interface between them where they interact. This interface may include overlaps, gaps and grey zones. Exploring this interface is the idea of the paper.

The success or failure of a project is a question of value creation, but value for whom? The project results may be valuable to the executing party (the supplier receives

payment when delivering the right quality in time). The users may be happy or not, depending on how they assess the new building, road or other asset (the output). Then there is the project owner, who should focus more on the long-term outcome. The value placed by the owner may be significantly different from the value placed by users and the executing party. This indicates that a project can be both a success and a failure at the same time.

Do construction projects tend to be less than successful? Judging from media and project management literature one might think that this is the case. Reports on project failures are plentiful and reports on successes are few; unless presented by the involved parties themselves, of course. Although recent research in Norway indicates that current major public investment projects are rather successful in the executing party's perspective (Olsson and Klakegg 2008), they often show signs of failure in the owner's perspective (Samset 2008). What might the fundamental reasons be?

In order to cast light on this issue, the first research question is: What problems occur in the interface between governance and management (as defined here)? This question is wide and the answer given here is limited to what this author regards as the most significant problems from the perspective of this paper. The next question is: How can we improve the understanding of this interface? The paper is limited to indicating possible directions of future development. There is not a ready answer to how project actors or the research community can correct every problem indicated in the main section of the paper.

2. STATE-OF-THE-ART REVIEW

This section gives an overview of literature forming the basis or starting point for the discussions in the research presented in this paper. The areas studied in this research are wide and consequently this section is not a complete overview of significant contributions in any of these areas.

2.1 Governance

Different authors define the term governance differently and use the term with many meanings and in many settings. There is a need for a clearer understanding of governance and its consequences.

Some authors seem to hold that governance is a hierarchical phenomenon (Hirst 2000; Driessen 2005; Kaufmann and Kray 2007). The hierarchical aspects of governance are visible in the definitions of levels in any organization, from the assembly of owners and/or shareholders and the boards of directors in corporations, down to corporate management, middle management, teams, and individual employees in departments at the 'bottom' of the organizational pyramid. In projects the hierarchical pattern is similar, with formal command structures top-down through the organization and reporting lines returning upwards.

Other authors describe governance as only a network or transaction-based phenomenon (Rhodes 1997; Winch 2006). The network aspect of governance is exemplified by the fact that many actors (organizations, groups and individuals) are connected in several ways (formal and informal). In the project context this is normally through contract arrangements. The hub of the network is important, and there may well be sub-nets and several hubs. Matten and Moon (2008) point out several interesting aspects of this relational governance: national business systems are different and influence the way governments and corporations act. The power of the state is different, being weaker in the USA and stronger in Europe. Unlike in the USA, in European countries other stakeholders than shareholders are important actors. They also point out that economic relations are dominantly market-based in the USA and based on alliances in Europe.

Along the lines described by Jessop (1997), Lynn *et al*. (2000), and Abbott and Snidal (2001), I will argue that the concept of governance is not limited to either the hierarchical, 'multi-level' governance which was predominant several decades ago, or the network-based, relational 'multi-actor' governance that has dominated the contributions of recent years. The reality is complex, and so too is governance: governance works through both hierarchical arrangements and network arrangements. It is this understanding of governance that is used in this paper. The following formulation sums up what I believe governance fundamentally is about:

> *"Governance can be understood as the use of institutions, structures of authority and collaboration to allocate resources and coordinate or control activity in society or the economy"* (World Bank).

2.2 Governance of projects and the project perspectives

Governance has become a fashionable term in connection with projects over the last decade or so. Referring to Williamson (1992), Miller and Floricel (2000: 136) point to economists' search for optimal governance structures: efficient contractual relations may range from markets for standard products to bilateral governance for recurrent products and hierarchical governance for specific assets. This provides a link to projects.

Governance has attracted growing attention in project literature. Miller and Hobbs (2005) pointed out that project governance is an important new trend and Patel (2007) even uses the phrase 'governance movement'. The attention has been focussed on Project Management Offices (PMOs) (Aubry *et al*. 2008). Miller and Lessard (2000), Flyvbjerg *et al*. (2003), and Altshuler and Luberoff (2003) have contributed to the understanding of governance in connection with large infrastructure projects. The Project Management Institute (PMI), in cooperation with the Concept Research Programme, recently performed a study of the function of governance frameworks established in the UK and Norway and their effect on projects (Klakegg *et al*. 2008).

Governance (the use of governing mechanisms) may be recognized at all levels of management, and is obviously relevant for projects. It is also relevant in all sectors, whether public or private. The two concepts 'governance' and 'management' are related as follows: Governance includes developing visions and strategy, establishing frameworks for business, making decisions and giving priority, empowering and maintaining follow-up of management, and confirming compliance with requirements. Management is concerned with the specific planning, organizing, resourcing, directing, and controlling of an organization's efforts for the purpose of accomplishing goals. The functions embedded in management are often more specific and fill the need for following up strategies and priorities with actions, and keeping track of and utilizing resources to their full potential.

Frequently, governance is associated with higher level perspectives. For example, governance in a corporation is typically associated with the board of directors, while governance of projects is associated with the project owner's perspective, often represented by a project board or steering committee. The understanding of governance as explained above is wider and includes functions beyond the responsibilities of boards and top-level management.

Samset (2003:12) concludes there are three important perspectives needed to have successful projects: the owner perspective focussing on the long-term outcomes of the project; the user perspective focussing on the immediate effects of using the results of the project; and the executing party's perspective focussing on the deliverables or outputs from the project. Focus in project management literature has changed from viewing project success as delivering the right quality at the right time and cost, frequently referred to as the iron triangle (Atkinson 1999), to focussing on the contribution to value and benefits by choosing the right projects and delivering them right, again and again, such as Shenhar *et al*. (1997), Cooke-Davies (2002), and

Dinsmore and Cooke-Davies (2006). This change in understanding of the success of projects indicates a stronger position of the owner perspective.

Several authors have discussed project organization in terms of roles and responsibilities, for example Stinchcombe (1985), Packendorff (1995), Söderlund (2004), and Crawford and Cooke-Davies (2007). Crawford *et al*. (2006, p. 723) point out that there is confusion about whether a project manager by definition is concerned about project execution, or involved in project development in the front-end. Other researchers, including Cleland (1986), Jergeas *et al*. (2000), Karlsen *et al*. (2007), and Olander (2007), points out there are many stakeholders and suggest a stakeholder perspective is needed to ensure that projects are successful. While I acknowledge this, the discussion in this paper will be limited to the perspectives of the three main stakeholders, as pointed out by Samset, and the focus will be on the interface between owner's perspective and executing party's perspective.

Project management reflects the perspective of the executing party and is a discipline with strong and explicit connections to corporate governance – a branch of governance specific to the private sector. The Association of Project Management in UK has established a special interest group (SIG) which focuses on the governance of project management. They illustrate the contents of the concept with an intersection between corporate governance and project management (APM 2002). The following definition of governance of projects (Klakegg *et al*. 2008:29) is based on APMs definition:

> *"Governance of projects concerns those areas of governance (public or corporate) that are specifically related to project activities. It consists of formal and informal arrangements by which decisions about projects are made and carried out. Good governance of projects ensures relevant, sustainable projects and alternatives will be chosen, delivered efficiently and cancelled when appropriate."*

The concept governance of projects is equally useful in the public and private sector. It is limited to project activities, and the purpose of the concept is to make sure that such projects are chosen wisely among relevant alternatives, executed efficiently without spillage of resources, and deliver an outcome with sustainable effect. This indicates the success criteria for projects used in this paper.

2.3 The interface between governance and management

Reading management literature the general impression might be 'management is everything'. In such setting governance would be a part of management. This paper does not suggest this is wrong, but its point of departure is different; here management is limited to the role of being responsible for an operation (in this case typically the project), as opposed to the role of governing. It mirrors the separated spheres mentioned in the introduction. Other authors have studied this interface before.

Governance literature points out the purposeful principle of a clear division between buyer and provider roles in public management (Christensen *et al*. 2007). On the buyer side there is a financing party similar to the 'sponsor' defined by the PMI, and a commissioning party similar to the 'customer' according to the PMI. The interface between the buyer and the provider is part of the issue here. Shirley Otto (2005) has studied the roles of chairs of governing bodies and managers in different sectors. She concludes these roles are not so very different, although there are principal reasons to make a distinction. Separation of governance (the role of the governing body) and management (the role of the operational managers) is fundamental to accountability. Empirical research show that the behaviour is less clear cut. There is ambiguity, confusion and conflict. Governance includes paradoxes like working as partners with senior staff and at the same time monitoring and controlling them (Comforth 2005). Some even question whether we need governing bodies (Harris 1996). This author's

position is that governing bodies are fundamental and governance is of vital importance for all organisations, permanent or temporary.

Traditional views on governance and management are based on the notion that empowerment and control is situated top-down in a hierarchy. Top level defines the objectives and strategies, chooses measures and initiatives (including investment projects), delegates them to lower levels for execution, and constructs control measures to make sure the results are as expected. This notion is also the origin of classic project management. Robert Simons (1995) has argued that this is no longer sufficient – the dilemma created is that strict control will restrict the flexibility, innovation and creativity needed to survive in today's business climate.

Project management literature has developed from the basic control concepts of the 1950s. The project management discipline has expanded into programme management, acknowledging there might be important benefits from managing several projects towards a development objective not obtainable by any single project (Maylor *et al*. 2006). Portfolio management addresses the management of a set of multiple projects and programmes, typically within one area of responsibility (Artto *et al*. 2002). The development towards management of multiple projects and programmes is characterized by the quest for ever more sophisticated methods and tools to help managers at all levels do a better job of coordinating and performing project tasks with multiple projects (Kerzner 2006; Martinsuo and Lehtonen 2007). PMI offers a set of definitions and descriptions of the basis for project management which are widely regarded as a good practice standard today (PMI 2004). Similarly, the focus on programme management in the UK has produced management systems such as Prince2 which has a strong focus on the programme level (OGC 2002). How such standards may be implemented has been examined by Stawicki and Müller (2007).

Simons (1995) described an important balance between governance and management expressed by the terms 'empowerment' and 'control'. Empowerment enhances an organization's potential for flexibility, innovation and creativity. It gives individuals and groups a mandate and the possibilities to make decisions, and create results without having to wait for decisions and acceptance at higher management levels. In this context, control means setting limits for the activities of individuals and groups, investing rigidity into procedures, and making sure the performance and results are according to expectations. How is it possible to exercise adequate control in organizations and settings that demand flexibility, innovations and creativity? Simons described four 'levers' or management systems which encompass the system needs of a conscious owner:

1. *The diagnostic control systems*. These help managers track the progress of individuals, departments or production facilities towards strategically important goals. This represents a relatively narrow control focus highlighting efficiency and goal achievement.
2. *Boundary systems.* The minimum standards and 'off-limits', embedded in, for example, standards of ethical behaviour and codes of conduct. This represents a control focus establishing important rules of the game.
3. *The interactive control systems*. Systems created to share emerging information and to harness the creativity that often leads to new products, line extensions, processes, and even markets. This represents a wide perspective opening up for creating new opportunities and learning.
4. *The belief systems.* These articulate values and direction that senior managers want their employees to embrace. This represents a wide perspective on the business contribution to value – its purpose.

When describing a complete system, these levers should help clarify the interface between governance and management in permanent organisations and in projects.

2.4 Permanent and temporary organisations

The project definition used to focus the project as a means for performing unique tasks. The current (dominating) definition of a project is (PMI 2004:268):

> *"Project – a temporary endeavour undertaken to create a unique product, service, or result."*

This definition points to a challenge that are vital to the interface questioned in this paper: the governing party (owner) is a permanent organisation whereas the executing party (project organisation) is temporary. This implies challenges to both sides. Incentives are not the same on organisational or individual level. This influences the motivation, choice of means, use of governing mechanisms, and even the way the mechanisms work.

The fundamental challenge in this respect is that the representatives for the permanent organisation has got (at least should have) long term goals and value creation (outcomes) in mind whereas representatives for the temporary organisation inevitably have got a shorter time perspective. Their primary incentives are limited to the time of the project duration and the project goals (deliverables). Even though they may be aware and even well aligned to the permanent organisation's strategic goals, this leads to a gap in expectations, potentially to communication challenges and influences priorities during project execution.

As shown in section 2.2 there are several perspectives including the owner's and executing party's perspective. Project management started out as a management tool-box for controlling unique tasks and developed into a management philosophy aiming at optimal control of the iron triangle. One assumption was that an undisturbed project was better at securing the iron triangle and thus more successful. This way the project put distance between itself (the temporary organisation) and its owner (the permanent organisation). This resulted in projects keeping cost, time and quality frames, but with a tendency to lose sight of their purpose. The development then shifted towards a new recognition of the need to serve a purpose and focus the owners' strategic goals over the iron triangle. This development illustrates some of the reasons why the interface between governance and management is so complex, but also why the roles of the governing body and the operational management in projects are so important.

2.5 Strategy alignment and ownership in projects

In the following, the perspective is based on seeing projects as entities for value creation, rather than merely the execution of tasks. Projects and programmes are strategic tools for conscious project owners. The question of how strategy and projects link together is discussed by, among others, Cleland (1990), Turner (1999), Artto *et al*. (2004), Morris and Jamieson (2004), Shenhar *et al*. (2005) and Clegg *et al*. (2006). However, the issue of strategy alignment of projects will not be pursued further here, due to the limitations of space.

Crawford and Cooke-Davies (2007:270) focus on the executive sponsor as the link between corporate and project governance. They hold that the role is not well-defined, but pivotal in achieving 'the right combination of the right projects done right'. They consider the executive sponsor to be 'the governor' of the project, an individual role that includes also being owner of the business case, harvester of benefits, champion of the project, and its 'friend in high places'. This sums up governance on an individual level, frequently associated with sponsorship. Other authors have contributed to this subject area, such as Wateridge (1995), Wright (1997), Cooke-Davies *et al*. (2006), and Bryde (2008). This literature surely indicates what governance and ownership is about, but at this point I will return to the institutional level.

Olsson *et al*. (2008) looks at project ownership and concludes that responsibility and ownership is a much more complex issue than previously assumed in the project

management literature. Important functions embedded in governance include developing strategies, making ultimate decisions on priorities and choice of directions, financing, commissioning of new assets, and disposal of existing assets (Klakegg and Olsson 2008:361). These are important issues relating to ownership. Put simply, ownership gives control and responsibility. In economic terms, ownership gives control rights, and profit responsibility (Foss and Foss 1999). *Control rights* give an owner full right of use, possession and disposal of a resource. *Profit responsibility* means that the owner is responsible for both the cost and income related to the resource. In a project context, this means that a project owner bears the owner rights and responsibilities of the project. Most literature on project management seems to assume that one organization has all the characteristics of an owner. This may be true in some private sector projects, where a single owner takes the risk relating to the cost and future value of the project. However, this is not the case in the public sector (Klakegg and Olsson 2008). We will return to this matter later in the paper.

3. RESEARCH PROJECT

3.1 Project description and objectives

The state-of-the-art section indicated what current literature says about governance and ownership in connection with projects. The literature indicates this is an emerging area that is still not fully understood. In this paper we will continue to explore the interface between governance and management and indicate the direction of future development. The paper is limited to some of the most significant problems relating to the interface.

3.2 Research methodology

This paper has resulted from combining the findings from several limited studies performed as part of a PhD project. Each study had a different purpose than this paper, but when combining elements across several different issues, an additional theme emerged and this theme is reported here. Consequently, this result is not the result of one research project but a combination of several.

The problem area studied here is wide and complex. Increased understanding is important and gives the paper an exploratory nature. This indicates that a wide range of methods may be relevant. To improve the understanding of concepts and practice, and also identifying the need for future development, calls for a multi-method approach. Some normative elements will also be identified as part of the study, but there is insufficient empirical proof of the conclusions' validity at this stage.

The state-of-the-art section has discussed the results of literature studies designed to map wide areas of interest. The literature study alone gives some indications of where governance and management are not well connected. This was the starting point for the present study and directed attention to several important issues.

To identify the problems, a wide mapping of indications may have been achieved through a survey or a large number of interviews. This approach is resource demanding and likely to give much the same indications as the literature, and hence it was not chosen. Instead, an approach based on case studies was chosen. The case studies are based on project documents (document studies) and in-depth interviews. Documentation from a significant number of major public investment projects are available at the Concept Research Programme This was chosen as main source of information, although only a small number of the case studies are explicitly mentioned here. Private sector cases were added as required. Thus, the paper reflects a study that drew heavily on literature, moderately on cases, and did not involve a survey.

4. RESEARCH RESULTS AND INDUSTRIAL IMPACT

Do we have an adequate understanding of the interface between governance and management in projects? The state-of-the-art section revealed there are many contributions on each side of this interface. Some contributions address how to handle the governance side as seen from the project organization's perspective and vice versa, but few address the interface directly. In the following sections, more details will be added on issues addressing important aspects of the interface between governance and management in projects, identifying some weak points and issues for further debate.

4.1 Empirical indications of problems in construction projects

Studies by the Concept Research Programme and others have given several indications that there are problems in the interface between governance and management. Samset (2008) found that 12 projects in a sample of 25 major public projects in Norway had severe issues from the owner's perspective, making them potential failures already before they had started. Of the remaining projects, there were indications that 5 may have led to failure too. Samset also makes the point that there are many ways to fail and very few ways to achieve success.

Olsson and Klakegg (2008) show several examples of problems in projects related to the definition of goals and design of project strategy. Project definition is the process of defining the objectives of the project, and project design is the process of defining the means of obtaining those objectives (Turner 2006:93). Their sample was composed of 51 major projects in Norway (with some overlap with the sample used by Samset described above). One conclusion from this study was that most projects have structural flaws; the goals and means are not a consistent description of a fundamental logic in the projects. Only 30% of the projects were well-defined and designed; approximately 25% of the projects lacked goals in one of the three important perspectives (owner, user or executing party). The remaining 45% had even more severe issues, seemingly mirroring the political process and arguments used to secure financing, rather than any logic useful for ensuring a successful project. Olsson and Klakegg also found indications that projects may be well managed on a single project basis, but there still seems to be indications of lack of control on the multi-project level (programmes and portfolios). Both of the aforementioned samples included, but were not limited to, construction projects.

Table 1 shows a summary of four cases indicating specific examples of problems in the interface between governance and management. The cases are not covered in full detail and only some of the issues addressed here are shown in the table.

Examples of problems identified in the interface between governance (the governing body) and management in projects include the following.

- Wrong choices not corrected, projects not adjusted or stopped.
- Bottom-up initiatives accepted without considering alternatives.
- Dialogue between the parties not good.
- Objectives unclear, missing or misunderstood.
- Priorities misunderstood or not adhered to, or unclear.
- Wrong delivery or bad quality of delivery.
- Responsibility not taken.

The problems indicated here may have many and complex reasons. Some of them may be found in very fundamental issues. The remaining part of the paper will highlight some of these reasons and issues.

Table 1. Cases[4] illustrating challenges in the interface between governance and management.

E18 GRIMSTAD-KRISTIANSAND Construction of new highway Indications of issues: • Many incidents (e.g. accidents with explosives) and conflicts with Norwegian road authorities due to management planning failures • 3 managers sacked in a short period. Cultural differences. • The suppliers in conflict over contracts (roles and responsibility). • Limited transparency Success indication in three perspectives:			**GARDERMOBANEN** Construction of new high-speed railway Indications of issues: • Unrealistic assumptions (economic, utilization) will never be met • Tightly associated with another project (unrealistic progress) • Unclear roles and responsibilities • Difficulties in handling problems occurring during construction Success indication in three perspectives:		
Owner:	User:	Executing party:	Owner:	User:	Executing party:
Failure?	**Success?**	**Failure**	**Failure**	**Failure**	**Failure**
OLKILUOTO 3 Construction of new EPR Nuclear power plant Indications of issues: • Misaligned objectives (short v. long time perspectives) • Unclear roles and responsibilities • Lack of trust between parties • Action or inaction based on assumptions, not facts Success indication in three perspectives:			**COASTAL FORTRESS, MALANGEN** Renovation of existing coastal fortress Indications of issues: • Commissioned based on outdated strategies. • Bottom-up pressure from users to keep this part of the Navy • Closed down on the day of delivery (a predictable surprise). Success indication in three perspectives:		
Owner:	User:	Executing party:	Owner:	User:	Executing party:
Failure	**Failure**	**Failure**	**Failure**	**Failure**	**Success**

4.2 Fundamental understanding and definitions of terms

Fundamental understanding of governance. As identified in section 2.1, there seems to be a division between contributions which base their world view on a hierarchical order (e.g. principal-agent theories, multi-level governance) and those which see the world as based on networks and negotiation (e.g. transaction cost theory, multi-actor governance). However, both perspectives are helpful in explaining some issues of principal and practical importance. In terms of understanding the reality of a complex world, though, both of these world-views of governance are too simplistic. Hence, we need to base our understanding on the co-influence of both; we need complex

[4] All information courtesy of the Concept Research Programme, except Olkiluoto 3 (Ruuska *et al*. *in press*).

governance. Figure 1 shows symbolically how the change in focus adds new depths of meaning to the concept of governance.

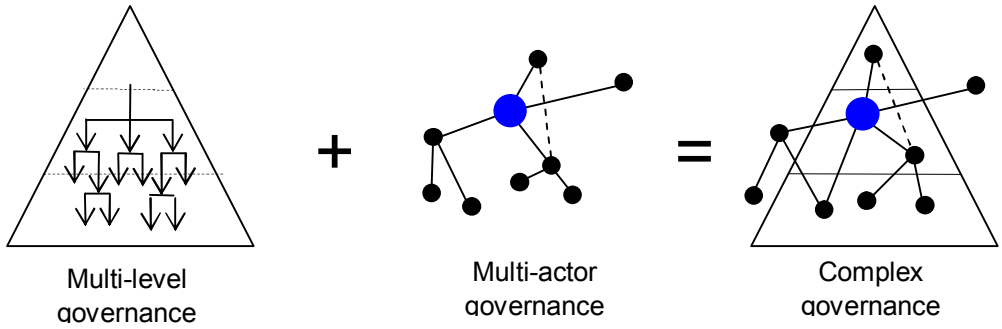

Figure 1. The multifaceted meaning of the governance concept.
(Complex governance is based on both hierarchical and network based means)

The consequence of this understanding may be more complex discussions on governance. It does not necessarily make the choice of governance means easier, but it offers an improved opportunity to understand the limitations and shortcomings of governance means such as evaluation criteria on choice of concepts and alternatives, delegation arrangements, definition of objectives, and project design. The complex understanding of governance also offers an understanding necessary to perform good stakeholder analysis. Only by understanding the stakeholder's position, both in a hierarchical and a network perspective, may their influence and needs be fully understood.

Project-related definitions. The current definitions of project, programme and portfolio (PMI 2004) are reciprocal by nature and they lack an explicit connection to the owner's perspective. Still today these levels; project, programme and portfolio, and their different management schemes, seem poorly integrated. In addition, current academic trends and practices in project management can be seen as breaking with the current definition of a project. An example comes from Agile Project Management, where a project is broken down into several consecutive short 'projects'. From a structural point of view, the institutional framework dimension is missing in project terms. Over the last decade, governance of projects has had increasing attention (see section 2.2) and thus the institutional framework has entered the picture (Klakegg *et al*. 2008). Still today project management good practice standards like the PMBook etc. do not mention this level. Maybe not a surprise, since it emerged from governance, not from management.

Klakegg and Artto (2008) addressed the governance issue by expanding the discussion using the concepts introduced by Simons (1995). Their paper developed a concept of governance by suggesting an outline for an integrated management framework for multi-project management. Table 2 shows how Klakegg and Artto addressed Simon's concepts, and included the institutional dimension.

Table 2. Project concepts at different levels: Project, programme, portfolio, and the institutional framework (Klakegg and Artto 2008:1132).

Level	**Definition encompasses**	**Aim of management concept**	**Means added**
Project	Temporary endeavour	Deliver results	Control
Programme	Grouping of projects	Added benefits and control	Coordination
Portfolio	Collection of projects and programmes	Obtain strategic business objectives	Evaluation criteria
Institutional framework	Institutional anchoring, superstructure and clarity in concepts	Meet the purpose	Processes and rules

Programmes and portfolios are management concepts that seem to scale up a collection of activities from single project to multi-project levels. The institutional framework has a different approach, coming from governance and comprising all activities, including all projects on institutional level. A conscious project owner is expected to have installed some form of management system on all the levels shown in Table 2, but usually the systems do not form a consistent whole. We suggest that each higher level defines the context for the level below. To make them consistent, new definitions are needed.

The understanding of management systems. With reference to the levers of systems suggested by Simons (1995), how well does each level of management system cover the management system levers defined by Simons? Current project management systems cover parts of Simons' levers on the four levels shown in Table 2. As illustrated in Table 3, the project management system and programme management system cover the diagnostic control system, tracking progress. This is implicit in portfolio management systems since the definition of a project portfolio refers to projects and programmes. The institutional framework also covers the control aspect. For many institutional frameworks this is a core function. The function as a boundary system is a main focus in institutional frameworks as well and this is also partly covered by the other levels by setting standards for performance in specific tasks and activities. The function as a belief system is important on an institutional level, also intended implicitly in portfolio management ('strategic business objectives') and in programme management ('obtain benefits'). The lever that seems to be missing in the definition at all levels is the interactivity: the sharing of emerging information. This should at least be covered by the institutional framework.

The lack of consistency in management systems described above indicates that a better understanding of the interface between governance and management is needed. Klakegg and Artto (2008) do not yet have the final answer to how project management systems should ideally correspond with the levers defined by Simons. Governance, as represented by the institutional framework, is an 'environment' in which management functions/operates. Governance comprises the rules and regulations, the basic values and structure embedded in the way we work – in short, it defines the way we do business.

Table 3. Simon's (1995) four system levers and current project management systems (Klakegg and Artto 2008:1132).

Simon's system levers	**Contribution to management**	**Project management**	**Programme management**	**Portfolio management**	**Institutional framework**
Diagnostic Control System	Track progress	Full focus area	Full focus area	Implicit focus area	Full focus area
Boundary System	Set professional standards	Partial focus area	Partial focus area	Partial focus area	Full focus area
Belief System	Articulate value and direction		Implicit focus area	Implicit focus area	Full focus area
Interactive Control System	Sharing emerging information				

4.3 Governance functions and management follow-up

In this section the governance functions, and subsequently the interface between governance and management will be clarified. The purpose is to indicate where the problems may be found, and indirectly to indicate the potential for improvement.

Table 4. Governance functions and management follow-up to support decision making.

Governance function	**Description**	**Management follow-up**
Design of the decision making process	Define decision gates. Ensure political control with fundamental go/no go decisions	Adapt to the defined process and make sure the relevant basis for decision is prepared
Clarity in priority of issues	Decide on an evaluation – or design criteria. Focus on essential matters, not on details.	Develop documents in accordance to the evaluation – or design criteria
Make resources for planning available	Give adequate mandates and resources (budgets) for the necessary planning and preparation of the basis for decision making	Secure efficient planning processes in accordance with professional standards and expectations, and the mandate
Quality control of documents	Ensure an adequate basis for decisions, making sure professional standards are met	Secure adequate identification of relevant alternatives and proper consideration of their consequences

Governance functions are performed by a governing body. Relating to projects this may be a body at any relevant level within the established business structure, or a separate body established for the project in question, i.e. a project board or steering group. The core governance functions are: to develop visions and strategies, establish the institutional framework, make decisions and give priority, empower and maintain follow-up, to confirm compliance with requirements, and maintain the position as governing body. The focus here is on the governance functions to support decision making and to support planning and execution of projects. Table 4 shows a description of governance functions to support decision making in general, but is obviously relevant to projects as well. Decisions are accepted as a key element and driver of any project. The key here is to understand the difference in roles between the governance side and the management side.

Focussing the interface between governance and management, problems are identified in all of the four functions listed in Table 4 and examples include the following:

- Preparing the relevant basis for decisions is a well-known problem. The basis may be irrelevant, incomplete, too detailed, skewed towards a preferred conclusion, etc. There may be several reasons for this, including limited transparency, inappropriate role-definitions, and lack of clear understanding of the roles or tactical dispositions from the management side.
- Lack of clarity in priority may haunt projects through all phases. Criteria to evaluate alternatives for decision in the front-end and to evaluate project success after a project is finished are often missing, unclear or not consistent with what is actually communicated or decided by the governing body.
- Realism in planning and estimation of cost and benefits is identified as a problem in many cases. In this area, however, we find the problems on one side or the other, or in the trade-off between the parties involved. The interface itself is not the problem.
- Effective control of documents is a crucial governance function. This may be seen as the governing body's answer to challenges the management face in producing a relevant basis for decisions.

The most important issues from the perspective of this paper (interface between governance and management) seem to be connected to lack of clarity in priority of issues. This makes it unnecessarily difficult for management to understand the intentions of the governing body and follow up in a constructive way. This is the case even when the roles and decision making process are clear and both sides do a good job. There is obviously a communication challenge between the governing party (the project owner) and the executing party (the project organisation).

Table 5 shows a description of governance functions to support the planning and execution of projects. These functions are directed towards projects. The functions described here are viewed from the governance perspective on an institutional level. Looking at the same issues from a project management perspective on an individual level may produce something close to what is described in section 2.4 as the role of the project sponsor.

Table 5. Governance functions and management follow-up to support planning and execution of projects.

Governance function	**Description**	**Management follow-up**
Decision on project definition	Choose the relevant objectives and communicate priority.	Secure alignment of objectives; operationalization into goals and targets, develop a consistent project design, realistic cost estimates, strategies for execution, and an adequate plan.
Decision on project financing	Make the necessary resources available (budget), with clear terms and preconditions (requirements and assumptions).	Secure access to the decided resources; secure accountability and transparency in their use.
Approval of project design	Approve the choice of appropriate means to achieve the objectives.	Secure the appropriate means are used in an efficient way, producing the intended output.
Draw up the mandate for commissioning of new assets	Adequate mandate needs to be given for the commissioning of the project, committing the project owner.	Secure efficient execution in accordance with professional standards and expectations, and the mandate.
Monitor progress	Continuous awareness of the development, ensuring progress is as planned.	Keep track of progress in delivery (quality, cost, time), measure progress and report.
Being prepared to make changes	Watch for signals of unexpected development, early warning signals, look for potential added benefits. Keep an emergency plan.	Inform the owner when there is information indicating potential need for significant changes, and also their implications. Assess the consequences of change. Execute changed mandates.
Benefits realization	Ensure potential benefits (both anticipated and new ones) are being followed up and made a reality.	Prepare to phase outputs into operation.

The purpose of Table 5 is to make the interface between governance and management clear. Problems are identified in all seven functions:

1. The alignment of objectives is a fundamental problem due to the fact that the positions and incentives of the governing party and executing party (management) are never the same. The problem increases with the perceived difference in position. The challenge is to reduce the difference in position and secure clarity and consistency in objectives.
2. The availability of budgets and accountability in use of funds may undoubtedly be a challenge. Given that there is transparency in the system, the problem is not

attributed to the interface but to the performance of the parties on the governance and management sides.

3. Choosing the right means to achieve the objectives has proven a challenge in many projects. When it comes to the strategic choices, the problem seems to lie in the way management supports the decision making, as mentioned above. On a more detailed level, this is mainly a management problem.
4. Even though some cases of unclear or missing mandates are reported, this does not seem to be a dominating problem area in the interface between governance and management.
5. Monitoring progress is also a challenging task, especially in complex projects and cases of less measurable production. From the perspective of this paper, this is not a dominating problem (in the interface).
6. Preparedness to make appropriate changes seems to be a challenge that is of vital importance. The issue is addressed in discussions on how to handle flexibility, uncertainty, benefits realization, and other issues. As shown above, there tends not to be any systematic approach to emerging information. This questions the interface between the governing body and management in terms of distance and transparency.
7. Realization of benefits depends on the right concept being chosen and preparations for operations being in place when construction is finished. This is not always the case. This is clearly the responsibility of the governing body, but clarity in project management's role in this is lacking.

The most important issues from the perspective of this paper (interface between governance and management) seem to be connected to achieving and maintaining alignment between governance and management. This is a main concern for many of the governance functions listed in Table 5. In addition, the two last functions seem often to create problems: The ability to read early warning signals and make appropriate changes during a project is not well developed. Benefits realization is also known to be a significant challenge which should receive more attention. This is also one point where the interface with the third of the main perspectives comes in: the user perspective. Due to limited space, the user perspective is not pursued here.

4.4 Cost and benefit focus

Klakegg and Olsson (2008) have presented a new descriptive model for public project ownership based on seven Norwegian cases. This model has also been tested on private sector construction cases and found to be transferable. The model includes a definition of strategic and tactical owner functions which are necessary to ensure projects are successful (relevant, efficiently delivered and with sustainable effect). Strategic owner functions include the financing party (decides whether to invest or not), the commissioning party (defines and issues a mandate to plan and execute), and the judicially administering party (decides how public assets should be employed). Tactical owner functions are the planning party (responsible for supporting decisions), the executing party (responsible for project delivery), and the operating party (responsible for ensuring long-term benefits). The main features of the model are shown in Figure 2.

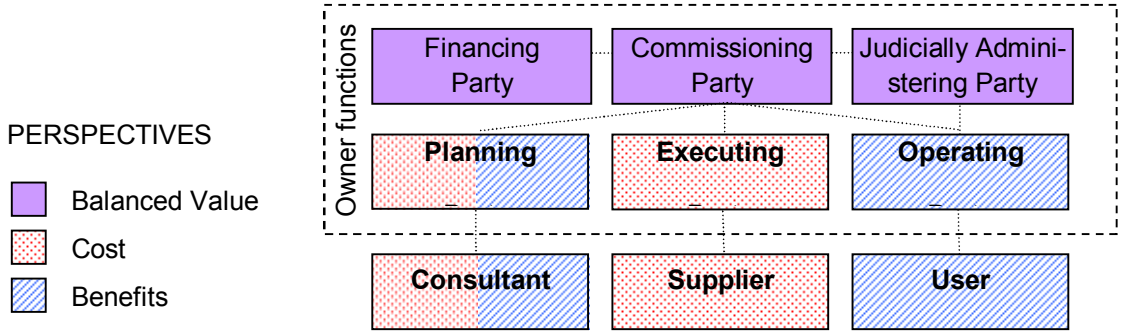

Figure 2. Dominating perspectives: cost or benefits versus value (adapted from Klakegg and Olsson (2008)).

The model highlights additional challenges to the interface between governance and management. As the responsibility is limited, so too is the perspective of the party, and the corresponding cost or benefit focus. The planning party naturally takes a cost focus when planning for construction, and a benefit focus when planning for operation. The corresponding focus of their consultants is the same. The executing party and their suppliers have a cost focus. Given that most contracts are some form of fixed price and suppliers are often chosen based on lowest price, this is a very strong influence on the results. The operating party has a benefit focus, as do the users. Klakegg and Olsson (2008) suggest defining the responsibilities and roles may offer some improvements to the process; making the parties responsible for both cost and benefit. This points back to the need for a clear definition of roles and responsibilities and indicates the pattern seen in construction projects today is not optimal. To have better results we need to have a value focus based on understanding the position of the key stakeholders. This will reduce the distance between the permanent and temporary organisation and improve the dialogue across the interface between governance and management.

4.5 Implementation and exploitation

These findings are hypothetical and several questions have yet to be answered. To date, the proposals discussed in this paper have not been developed into practice. The foundations should be strengthened by developing and implementing a new set of consistent definitions, as well as integrated levels of management systems, including roles and responsibilities that make the interface between governance and management more clear. Then, a value focus should be developed.

The problems indicated in sections 4.1 to 4.4 are not unique to construction projects. They are found in other types of projects as well. The reason is that it is not the characteristics of construction which is the reason for many of these problems. The reasons are more fundamental. In the perspective of this paper it is more about the understanding of concepts and definitions, the use of governing and management mechanisms, inconsistent systems throughout permanent and temporary organisations, and lack of clarity and understanding of the roles as governing body and responsible for execution.

Changes as indicated in this paper may improve the performance of both governing bodies on the owners' side and project management, not least through improved dialogue and understanding across the interface discussed in this paper. We expect these changes to improve the success rate for all types of projects. Hopefully, it will result in better ability to choose relevant alternatives, delivering them efficiently, and making sure the effect is sustainable. Construction projects are also expected to benefit from these improvements. We should be able to remove most of the problems identified as examples in the cases in section 4.1.

We need to acknowledge the limitations in terms of how much influence agreeing on concepts and terms will have on practical life. Obviously this is not enough to change the world alone, as pointed out by Cicmil and Hodgson (2006:12). In the end it comes down to whether the actors involved really take the consequences. In a network perspective, including power-relations and negotiations there is always a chance that actions neglecting the deep understanding of terms and definitions seem more rewarding than other actions.

Other aspects or perspectives may also be used to draw attention to the weak conceptual framework underpinning project management theory. Clegg *et al.* (2006) use a case study – construction works for the 2000 Sydney Olympics – to show how organisational culture in some instances are more important than strategies for the project success. This perspective gives additional arguments why we should look again at the fundamentals in construction management.

5. CONCLUSIONS

This paper has shown that literature frequently addresses governance and project management without discussing how these two perspectives interact. There is an interface between the project owner's perspective and the executing party's perspective, as described in this paper. Project management literature has until recently given little attention to this interface. This paper has explicitly discussed issues concerning this interface and identified several issues that call for further clarification. The discussion identified the following areas of improvement as important in order to optimize the interaction between governance and management.

- The understanding of governance as both hierarchical and network based.
- Consistency in multi-project related definitions.
- Further clarification of roles and responsibilities of the governing party and project management. Improve unclear or supply missing governance structures.
- Definition and priority of the functions of the governing party and project management. How to implement good governance principles.
- Balancing cost and benefit focus in construction projects – how to keep a value focus.
- Integration of management systems on all levels, and between organisation and project.

We may continue to try to build more sophisticated systems and tools into the profession of construction management without considering or strengthening these fundaments for the development. On the other hand, we might choose to make sure we start with a more solid platform. The conclusion of this paper is that the latter is the right way to go. The consequence may be that we need to redefine several fundamental elements of construction project management for consistency and clarification as well as better communication.

This contribution is an invitation to debate these issues, rather than to present final conclusions as to what the optimal future will be. The answers to the questions are not yet tested in a practical setting and the empirical proof is not complete. There are, however, indications of significant potential for improvement.

6. ACKNOWLEDGEMENT

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IMPLICATIONS OF PROJECT ORIENTATION ON THE CONSTRUCTION CLIENT'S GOVERNANCE OF THE CONSTRUCTION PROCESS

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ABSTRACT

The purpose of this study is to investigate how a project-oriented approach affects the construction client's governance of the construction process. A survey was conducted among construction clients in Sweden to examine the relation between how construction clients manage the construction process and barriers that can obstruct the governance of the construction process. The results show that the barriers, faced by the construction clients, are affected by how the construction client chooses to govern the construction process. Identified barriers are divided into three levels: individual (attitudinal), industrial and institutional. Attitudinal barriers (adversarial attitudes, greater lack of ethics and morality, focus on projects instead of processes and a short-term focus) and industrial barriers (traditional organization of the construction process, conservative industry culture, industry structure and traditional production processes) were perceived to be important, whereas institutional barriers (rules, laws and traditional procurement procedures) were not perceived to be critical. Each different level of barrier was tested against the use of internal or external project management and the use of formal documentation. Attitudinal barriers were perceived as more critical by clients using external project management. Furthermore, the use of systems, such as formal documentation, does not affect any of the perceived barriers. The result suggests that the client should but more emphasis on the interaction between the individuals involved in the construction process to increase the chances of project success.

1. INTRODUCTION

The purpose of this study is to investigate how a project-oriented approach affects the construction client's governance of the construction process. The construction client has a key position to affect the outcome of the construction project through proper choice of procurement methods and management processes and thereby sets the basis for the governance of the project (Egan, 1998, Yngvesson *et al*., 2000, Ericsson *et al*., 2002).

The construction clients do not act alone in the construction process, however, as there are several actors involved. According to Dubois and Gadde (2002) the high specialisation in different sub-trades leads to huge number of actors involved in the on-site assembly interacting together. This interaction, together with severe time restrictions that most projects experience, creates strong interdependencies among different actors. A complex production process has a large number of complicated individual parts brought together in an intricate operational network to form a work flow to be completed within a stipulated production time, cost and quality and achieve required function without necessary conflict between the numerous parties involved in the process.

2. STATE-OF-THE-ART REVIEW

One view of how the construction client should governance the construction process is given by Bertelsen *et al*. (2002). They stress the importance of a more systematic approach with a higher attention on processes. Processes that are based on industrial thinking, that is, it is the actual process (how) that needs the attention, not typical solutions (what). Due to that the construction process exposes the values about building,

about its organisation and about people, as it involves actions and experience outside the norms. These values alongside the industry norms and values determine the means (the process) and ends (the product) of a commitment and puts pressure on the client organisation and the people involved.

According to Eriksson (2007), the transaction characteristics, high asset specificity and uncertainty coupled with long duration require low focus on price. This should lead to a lower attention on price (with output control) and a higher attention on trust and authority regarding the governance of the construction process. Furthermore, Eriksson (2007) suggests that social control of the process is suitable when there is limited knowledge of the transformation process and where output measurability is low (with high asset specificity). Consequently, creating a common organisational culture encourages self-control.

In the construction process, the project manager has a central role in managing the project, whether s/he is from the client's own organisation (internal project management) or from an external organisation (e.g. a construction management company). The current project manager-based paradigm adopted in professional and academic settings is inadequate for developing construction executives who are ready to face today's business challenges (Goodman and Chinowsky, 1997, Pries *et al*., 2004). In the construction industry, the management perspective is still mainly technical and the management profile remains as engineer-manager.

As seen in these previous descriptions of the construction process, there is a strong emphasis on a process approach to facilitating a proper governance of the construction process. At the same time, the environment where the construction client acts is normally defined as a project, especially when it comes to the construction sector. Definition of projects comes in different shapes. The most common descriptions contain three factors, however. A project is regarded as a temporary event with limited resources and time and has a defined purpose (Engwall, 1995). This is achieved by coordination and steering allocated resources. Meredith and Mantel (2006) add some more factors, such as the project's importance and uniqueness. The definitions suggest three key targets of the project, i.e. time, cost and quality, to be in centre of attention when undertaking the project. It also highlights the importance of efficient organisation of available resources in order to achieve a good final result.

The organisation of a project is often hierarchal and usually also based on a self-contained unit, the organisation usually act autonomous (Winch, 2002, Engwall, 1995) . This means that the organisation and staffing differ from project to project. A project view can also affect the strategy for how to organise and steer the organisation. Alvesson and Sveningsson (2007) think that the 'top to bottom' view implies that there is a belief that there is conformity between intentions and prognoses and the actual outcome. Alvesson and Sveningsson (2007) further argue that a project-oriented view can be characterised as a role-differentiated team type, with sequential relation and limited demand for communication and cooperation. A role-differentiated team is also composed of different competences that are specialists in their own areas**,** and such a team is appropriate when the task is specified in advance.

The benefit of using projects as an organisational form seems to be the possibility to allocate specific resources to a specific task, combined with the possibility to keep firm control of time and budget. Project-oriented organisations are also result-minded, that is, they are oriented on to delivering the solution to a specific problem. That is, a project organisation is hierarchically based with a focus on a specific task, time and budget.

2.1 Governance of the project process

According to Kotter (1995) there is a difference between management and leadership. The difference is displayed in Table 1.

Table 1. The difference between management and leadership.

Management	**Leadership**
Planning and budgeting	Establishing direction
Organising and staffing	Aligning people
Controlling and problem solving	Motivating and inspiring

Management creates a certain degree of predictability and order, but leadership creates an environment that supports and facilitates change (Kotter, 1995). Management gets things going by planning, organising, supervising and controlling, while leadership is more concerned with what people think and feel and how this can relate to the environment, the department and the task (Alvesson and Sveningsson, 2007).

There is a difference between a management oriented view and a 'leadership oriented' view. The former sees contradictions and polarities as potential problems, whilst the latter sees them as a potential for development (Alvesson and Sveningsson, 2007). The essence of leadership has to do with influential increment which goes beyond routines (Katz and Kahn, 1978). Leadership steers purpose and meanings rather than the concrete behaviour. The amount of effort expended by the construction client on supervision is closely linked to the satisfaction at the construction stage (Love *et al*., 1998). This suggests that the control of the process cannot be total, because it develops its own momentum and its own interconnected consequences as a result of external and internal forces and knock-on effects that cannot be foreseen.

In order to handle insecurity, organisations usually create an administrative structure where the problem area is divided into different areas of decisions. The need of information and structure for handling the information increases with a higher degree of the non-programming nature of the decision (March and Simon, 1993). Barrett and Stanley (1999) argue that construction clients often seem to 'manage the margin', that is, they buy something they cannot see until it is finished. Furthermore, Barrett and Stanley (1999) argue that the journey from uncertainty to certainty is a transition from a vague notion to tangible artefacts.

2.3 Barriers for governance of the construction process

In this section, different barriers that affect the construction client's attempt to governance the construction process are presented. The barriers are divided into three main groups: attitudinal barriers that are concerning individuals' beliefs, organisational barriers that discuss what effects a change might have on the organisations in the construction process, and the type, industrial barriers, where the regulations and institutions are discussed.

Attitudinal barriers

In the construction industry there are many *attitudinal* aspects that can arise as critical barriers to change (Childerhouse *et al*., 2003, Post and Altman, 1994). Kululanga *et al*. (1999) argue that a lack of a learning culture, where existing *values and beliefs* are not open for questioning, is characteristic of the construction industry, thereby constituting a general barrier.

The construction industry is characterised by a 'project culture' in comparison with manufacturing, which can be characterised as more of a 'corporate culture'. The culture of the project team comprises different contracting parties in a project and can also

include company-wide interdepartmental members. The predicament for both the external commissioner (i.e. the project manager) and the external contributor (i.e. the contractor, subcontractor and supplier) lies in the formulation of project mission and the internal efficiency of a project (Engwall, 1995, Aulakh and Gencturk, 2000). This can be especially problematic since client requirements are frequently tacit in nature and can only be understood through a prolonged process of socialisation (Green *et al*., 2004). Attitudes are also dominated by short term financial considerations, reflected in uncooperative and suspicious relationships (Shammas-Toma *et al*., 1998). Thus, relationships have been focused on the short-term, with actors attempting to lever what they can out of the existing contract, leading to opportunism (Cox and Thompson, 1997).

Organisational barriers

Childerhouse *et al*. (2003) argue that lack of competence often constitutes an organisational barrier in general. A case study made by Cheng *et al*. (2007) shows that lack of senior management commitment and inadequate training and support is also vital barriers regarding implementation of a new management system. Their recommendations are that a key person, with excellent knowledge of the new system, should champion the change and facilitate it. Effective communication is also a key requirement of the implementation strategy. Another organisational barrier is the traditional use of competitive tendering arrangements in construction procurement since it decreases commitment and flexibility (Bayliss *et al*., 2004, Ng *et al*., 2002). The contractor bids low and then changes from a cooperative win-win approach to a win-lose profit protection attitude.

A third barrier is the traditional organisation of the construction process. Traditionally, a comprehensive specification is made by the client side before the procurement of contractors. Then the highly specified work is divided into distinct packages that are allocated to different specialists to complete individually (Barlow, 2000). This situation is derived from clients' competitive tendering habits, which hamper integration of work tasks and actors (Briscoe *et al*., 2004).

Industrial barriers

Industrial barriers (e.g. competitive pressures, governance regulations and industry practices) are derived from the organisation's industrial environment and may serve as serious barriers to change (Post and Altman, 1994, Okumus and Hemmington, 1998). In most countries, public sector clients are very important actors in the construction industry. These clients must follow laws regarding public procurement, which are intended to facilitate competition and non-biased procurement decisions. Since procurement cannot then be grounded on trust-based negotiations and prior experience of one another, these laws are often argued to work against collaborative relationships (Naoum, 2003, Ng *et al*., 2002).

Furthermore, a deep-rooted practice in the construction industry is the heavy reliance on formal standard contracts, established by third parties. Barlow *et al*. (1997) and argue that the presence of a standard contract may prevent cooperation between different actors since it brings a formality that stifles good relationships. To rely heavily on extensive and formal contracts may therefore increase opportunism.

3. RESEARCH PROJECT

3.1 Project description and objectives

This research is about how a project-oriented approach affects the construction client's governance of the construction process. The construction client has a key position to

affect the outcome of the construction project through proper choice of procurement methods and management processes and thereby sets the basis for the governance of the project. This study examines the relations between how the construction client's manage the construction process and barriers that can obstruct the governance of the construction process.

3.2 Research methodology

A questionnaire was sent to 104 construction clients who are members of the Swedish construction client organisation. 87 responses were received, resulting in a response rate of approximately 84%. The inquiry was carried out to identify the relation between perceived barriers and use of external/internal management. The use of a questionnaire is practical for the purpose of measuring, identifying causalities and generalising (Hair *et al*., 2003). The questionnaire was sent to construction clients that are members of the Swedish construction client organisation.

The main question for the respondents to answer was "what are the greatest obstacles to attaining a change of the construction sector so that the construction client can have more influence on the desired result of the construction process?" The questionnaire, furthermore, asked for general information about the client organisation, such as the use of external or internal project managers and in what extent the respondents have formulated/documented general program documents specifying demands on different types of premises/activities.

4. RESEARCH RESULTS AND INDUSTRIAL IMPACT

To make it possible to analyse the findings from the survey, a principal components and factor analysis (PCFA) was conducted. PFCA analysis addresses the problem of analyzing the structure of the interrelationship among a large number of variables by defining a set of common underlying dimensions, known as factors. Table 2 presents the factors regarding barriers to change (loadings less than 0.3 have been suppressed).

The PCFA grouped the individual items regarding *barriers to change* into 3 factors. The first factor that was formed was the attitudinal barrier, consisting of four items: short-term focus, adversarial attitudes, lack of ethics and morality, and focus on projects instead of processes. This factor has a Cronbach's Alpha of 0.694 and a mean value of 4.74, which suggests that it is perceived as the most critical barrier. The PCFA did not form an organisational barrier factor. The industrial barrier construct suggested in the literature study was divided into 2 factors in the PCFA. They were labelled into 3 categories: industrial barriers, consisting of four items: traditional organisation of the construction process, conservative industry culture, industry structure and traditional production processes.

Table 2. Factor analysis of barriers for change.

Barrier items	**Items mean values**	**Factor 1 Industrial barriers**	**Factor 2 Attitudinal barriers**	**Factor 3 Institutional barriers**
Traditional organisation of the construction process	4.530	0.816		
Conservative industry culture	5.500	0.762		
Industry structure	5.023	0.613	0.349	
Traditional production processes	3.859	0.558		
Short term focus	5.081		0.804	
Adversarial attitudes	5.163		0.714	
Lack of ethics and morality	4.442		0.649	
Focus on projects instead of processes	4.291		0.629	
Rules are obstacles for change	2.341			0.832
Traditional procurement procedures	3.517	0.367		0.694
Laws are obstacles for change	3.692			0.691
Factor eigenvalue		3.057	1.966	1.398
Percent of variance		27.788	17.873	12.709
Cronbach's Alpha		0.715	0.694	0.611
Factor mean value		4.728	4.744	3.183
Factor standard deviation		1.093	1.088	1.336

The third extracted factor is labelled institutional barriers, consisting of 3 items: rules, traditional procurement procedures and laws. The 3 extracted factors have a KMO Measure of Sampling Adequacy (MSA) = 0.629 and they explain 58.37% of the total variance. The constructs formed in the factor analysis (Table 1) were then used (as average summated scores) to test any correlation with the use of internal and external PM. One-way ANOVA was used to compare means between the groups using internal or external project management – see Table 3.

Table 3. Compared means internal/external PM.

Industrial barriers	**N**	**Mean**	**Std. Deviation**	**Sig.**
Internal project manager	57	4.6754	1.1820	0.534
External project manager	29	4.8319	0.9052	
Attitudinal barriers	**N**	**Mean**	**Std. Deviation**	**Sig.**
Internal project manager	57	4.5658	1.16738	0.032
External project manager	29	5.0948	0.8248	
Institutional barriers	**N**	**Mean**	**Std. Deviation**	**Sig.**
Internal project manager	57	3.0760	1.34816	0.299
External project manager	29	3.3943	1.31161	

The result shows that there are significant differences (at the 0.05 level) between the two groups regarding their perceptions about attitudinal barriers. The mean value for the external project management group is 5.09 which are larger than that of the internal project management group. This indicates that organisations using external project management perceive the attitudinal barriers as more critical than organisations using internal project management.

To investigate if there were any differences between local and national clients, concerning the perceptions of the two most critical barriers, a one-way ANOVA test was conducted. The factor 'sphere of activities' (market size) was re-coded into two groups, where local, several local and regional markets formed one group (local). National and international clients were re-coded into a second group (national). Table 4 represents the result of compared means between local/national clients regarding the two most critical barriers (industrial and attitudinal).

This indicates that national clients regard both industrial and attitudinal barriers as more critical than local clients do. This supports the view that local clients select participants in the construction process at a more personal level, whilst national clients depend more on formal tendering arrangements when selecting participants/suppliers.

Table 4. Comparison of means – barriers versus local or national client.

Barriers to change				
Industrial barriers	**N**	**Mean**	**Std. Deviation**	**Sig.**
Local clients	56	4.5201	1.134	0.015
National clients	30	5.1167	0.909	
Attitudinal barriers	**N**	**Mean**	**Std. Deviation**	**Sig.**
Local clients	56	4.5402	1.189	0.017
National clients	30	5.1250	0.747	

To further understand if there are any relations between the use of systems and the barriers to change, a comparative mean test was conducted. In the survey the respondents answered a question regarding whether they have a systematic approach to stating demands at the briefing stage. The answers in the survey were then tested by comparing means with the perceived barriers. The result is displayed in Table 5.

Table 5. Compared means between the use of systems and barriers.

Industrial barriers	**N**	**Mean**	**Std. Dev.**	**Sig.**
Formulated programme documents	58	4.76	1.157	0.786
No formulated programme documents	26	4.69	0.995	
Attitudinal barriers	**N**	**Mean**	**Std. Dev.**	**Sig**
Formulated programme documents	58	4.75	1.131	0.928
No formulated programme documents	26	4.77	1.034	
Institutional barriers	**N**	**Mean**	**Std. Dev.**	**Sig**
Formulated programme documents	58	3.09	1.284	0.467
No formulated programme documents	26	3.32	1.480	

The result shows that there are no significant (<0.05) differences between the groups that have a systematic approach to stating demands during the briefing stage and the perceived barriers. This suggests that the systematic approach with formulated/ documented general programme documents specifying demands on different types of premises/activities does not affect the different barriers.

4.1 Quantification of results

The quantitative study has shown that attitudinal barriers and industrial barriers are perceived as critical obstacles for greater client influence on the end result of the construction process. Furthermore, clients relying on external project management during the construction process perceive attitudinal barriers as more critical than clients with internal project management. This result supports earlier studies claiming that external project managers are more concerned on delivering the project (on time and in budget) than on the product (e.g. to achieve the most satisfactory product for the client). It is therefore not surprising that higher use of external project management leads to more individual obstacles, and construction clients who outsource this role find attitudinal barriers more critical.

The nearness to the market (e.g. individuals) also affects the perceptions of the barriers. In addition, clients with a large 'sphere of activities' (large market size), that is, national and international clients, perceive both attitudinal and industrial barriers as more critical than clients active in local or regional markets. This supports the view that the construction business is a local affair, and local clients have a benefit of the closer connection to the actors. Furthermore, the use of a systematic approach at the briefing stage of the construction process has no significant impact on either of the perceived barriers. This supports the view that it is not enough to have a structured approach to the project to affect the individuals.

4.2 Implementation and exploitation

The result from this research is implemented in to the industry mainly through education, both to under graduated student and trough education to active construction clients. The results are presented and discussed in a program for active construction client called *ByggherreClass*.

5. CONCLUSIONS

The project-oriented approach to the construction process with hierarchical organisation and focal point on time and budget has its limitation for the construction client's governance of the process. The approach to 'steer' the process by formal systems and documents has limitation when it comes to affect the individuals in a certain direction.

The construction clients are, however, in a position that supports initiatives. To facilitate a proper governance of the construction process, there has, however, to be a mind shift among the construction clients. Instead of seeing the construction process as a straightforward process of problem solving that ends with a product, the view must be changed to being more leadership-oriented, with higher attention on the alignment of individuals. Since the construction process has character of a 'fuzzy' journey, from idea to completion, the construction client cannot solely rely on formal systems to governance the process. Especially in the early stage of the construction process the benefit of a more process-oriented approach can contribute to a successful project, since the early stage is where the project is defined. To increase the knowledge of how to overcome critical barriers, further research in this area should be encouraged. Qualitative research in close collaboration with construction clients would be suitable for investigating how clients with the desire to implement change and innovations can go about overcoming critical barriers through purposeful procurement and project management procedure

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PROJECT GOALS IN CONSTRUCTION PROJECTS – DEFINITION AND USE

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ABSTRACT

The purpose of the study was to investigate the extent to which project owners: (i) formulate project goals in the front-end phase; (ii) communicate their goals to contractors; (iii) use their goals actively during planning and construction; and (iv) benefit from active use of goals. In this paper, goals are related to the effectiveness and satisfaction of actual user needs in the operational phase. This is a wider approach than just focusing on traditional project objectives relating to cost, time, quality and scope. Empirical material was collected through semi-structured interviews with the project managers of three building projects. The projects and respondents were selected on a strategic basis. The projects had professional owners, and based on experience from earlier collaboration it was anticipated that they had put a lot of effort into formulating and communicating their goals. A literature survey was conducted, with special focus on sources which stress the importance that project goals have for project success. Ideally, a project owner should formulate goals during the front-end phase so that it can form a basis for the programming phase. The three case studies indicate that project owners focus on project objectives, and there is a lack of formal goal formulation processes. Owners do not formulate clear project goals from the users' perspective. As a consequence, there are no clear goals to communicate to the project organization. When confronted, the respondents were aware that a stronger focus on goals and the bigger picture in the front-end can contribute to improved projects. If buildings are adapted to actual needs, the users' business potential will be higher than if owners only focus on project objectives. Hence, owners have to shift their focus from project objectives to project goals. Both private and public owners tend to emphasize relatively narrow project objectives instead of user needs. This paper argues that more focus on project goals is required. The study presented here will be continued was part of the study towards a PhD, and will try to give an answer as how to follow-up effectiveness during front-end, the planning phase, the execution phase and the operational phase in building projects. The results will be used to give a description of best practice for following-up effectiveness.

1. INTRODUCTION

Unlike other large material procurements, a construction project has a limited period of time for defining success which is not related to its usage in terms of real objectives. It is the degree of success during the procurement process that receives the greatest focus (efficiency–price ratio, delivery date, quality, and scope). Theory states (for example Norad, 1999) that in addition to efficiency the success of an investment is the result of the following factors:

- effectiveness
- impact
- relevance
- sustainability.

These factors form the basis for the satisfaction of actual user needs.

General operating parameters for companies and organizations change continuously, implying great demands on the flexibility and usefulness of buildings. In order to increase the probability of achieving commercial long-term objectives, theory states that

it is necessary to establish clear goals as supplemental requirements to technical standards and spatial needs.

In a project's early phase, the premises are set for the project strategy through the choice of approach to project development. This may be architect-focused, with the main emphasis on decisions based on proposed solutions with regard to framework demands, or it may be analytical engineer focused, where the solution comes as a result of a worked out concept in which unambiguous goals are presented hierarchically in relation to the owner's business expectations in terms of the project's results and its importance for their own operations.

The risky approaches are when one person alone, generally the architect, attempts to interpret the requirements from the users' expressed wishes and initiates a process that locks the choice of concept. The correct approaches are those in which all stakeholders, project owners, users, consultant engineers, architects, and prospective contractors join forces in order to define the real needs in terms of business sense and use this as a basis for a solution.

In an ideal project a multi-perspective hierarchy for goals is established up-front, and any subsequent decisions may also be related to these goals. A project's success will result from the ability to maintain an overall perspective and continually evaluate degrees of attainment of goals in the development phase, execution phase and operational phase. The overall perspective approach also carries an expectation concerning taking up project changes that arise as a result of changing market conditions. Contractors that succeed in establishing a multi-perspective goal hierarchy will benefit from such a hierarchy.

The general awareness of the importance of concept development and strategic processes in a project's front-end will increase though documentation of how goal-oriented management processes lead to measurable business effects for users. It is in the projects owners' and users' interests to ensure that the project attains its overall goals. Goal attainment linked to quality, time and cost are only indicators that individual activities in the process as a whole have succeeded. Contractors who continually evaluate degrees of multi-perspective goal attainment in their projects will benefit greatly.

2. STATE-OF-THE-ART REVIEW

It is worth reflecting on the extent to which project owners perform the following.

- Formulate project goals in the front-end phase.
- Communicate their goals to contractors.
- Use their goals actively during planning and construction.

The objective of this investigation is to map out the extent to which goals are formally included in a project's goal-setting processes, and to determine whether a logically compiled structure for the goals of a construction process exists to support a project's long-term profitability, from the initiation of a project to development and execution, and ultimately to completion.

A project arises from a need. Based on this need, the project will have a final objective or vision to follow in order to solve a problem – allowing expansion – higher earnings – to create more flexibility and room for change. The project will be considered a success according to the extent to which these goals are able to be met over time.

Primarily, a need arises as a consequence of a business question: How will the enterprise meet new demands relating to productivity and increase competitiveness? In the studied context, what is state of the art and to what degree have theories been developed that systematize processes for the definition of goals and goal attainment with regard to the impact for users?

The superior objective or vision alone will not be sufficient to lead a project to successful completion, as the latter also depends on establishing a set of goals that cover the project's many phases from start to finish. According to Næss (2004): "The ability to formulate, intermediate and follow up on one's goals is a useful management tool".

The basic goals of a project will differ depending on the viewer's perspective. Samset (2001) has defined three main perspectives or ways of viewing a project, with different goals (see Table 1).

Table 1. Three perspectives from which to view a project and its goals in a state-run project (adapted from Samset, 2001).

PERSPECTIVE	GOAL	ROLE	COMMENTS
The perspective of the emptor (the owner)	Societal goals	First order user of the project's services or result	Value-creation on behalf of society by achieving success
The user's perspective	Goals	Initiating party Interest in results	Benefit for users by achieving results
The supplier's perspective	Goals relating to results	Responsible for execution In terms of contracts or on own behalf	Achieving defined target figures.

Klakegg (2006) formulates the purpose of goals as follows:

> *"We formulate goals as instruments to help us achieve what people are expected to do. The purpose of formulating goals is to transmit them, which means communicating these within an organization. A decisive premise of any goal is that it gives the results intended for it."*

Blyth and Worthington (2001) describe implementation of programming processes and their need for continual management and communication with regard to meeting the business goals in relation to the results for users. The project owners' goals are formulated in a strategic programme where overall goals are established with regard to the building project's expected results from the owners' and users' perspectives. A strategic programme includes quality assurance of processes in order to reduce uncertainty with regard to goal attainment and to establish collaboration between a company's (business) goals and the project team's goals. The programme will present the company's priorities, define essential demands relating to the project, and communicate these to the project team.

The purpose of strategic planning is to achieve structured and effective goal-oriented management whereby decision makers in a project relate to the common goals and constructively develop the project towards this end.

Blyth and Worthington (2001) identify significant challenges to establishing cooperation between a company (its goals) and a project team (its goals). The strategic programme should present the company's priorities and goals, define essential requirements for the building in question, and communicate these to the project team so that the programming material has a robust structure which can be applied to the later developmental and constructional phases. Communication between owner and the project team can be characterized as a meeting point between two different programmes: the commercial and the strategic programme from the owner's side and the technically-oriented building programme. On this basis, an evaluation of significant

success criteria depends on defining a common language during the programming process to avoid misinterpretation of ambiguous or confusing statements.

Determining the extent to which a project is successful or not will depend upon which interests are affected by the project and the perspectives from which the project is considered. Due to the temporary structure of projects, most often evaluation will occur at the end of the implementation phase. As a rule, at this stage it is not possible to ascertain whether a project has been successful from a user's or society perspective. However, Samset (2001) has documented a positive correlation between high costs during the early phases of a project and a higher degree of achievement in terms of desired results.

After benchmarking investment projects, Andersen (1999) reached the following conclusions with regard to successful projects.

1. The preliminary phase(s) lasts a long time.
2. The concept undergoes a number of revisions.
3. Problem-solving is systematic and comprehensive.

The overall perspective is greatest in a project's early phases and gradually reduces throughout the project's lifetime. If this is missing at the highest levels, there is no reason to believe that it will emerge later. The building programme should convey a clear and unambiguous overview of the project strategy. This is important with regard to being able to evaluate the relevance of changes for a project's end results at any point in time. At the very least it will provide input for whoever is responsible for implementation, enabling them to react appropriately and strategically.

3. RESEARCH PROJECT

A case study was made of three recently completed building projects, for which documentation still existed and the interviewed respondents still had a close relationship with the projects. In the case study it was decided to focus on three professional project owners' perceptions of the development and execution processes. This was based on the fact that it was the owners' organization that had to initiate project-specific as well as user-related goal formulation processes and prepared strategies.

Based on Samset's (2001) perspective analyses and the fundamental management question of how to increase productivity and competitiveness, it is appropriate to evaluate the extent to which the expectation that achieving results will benefit users is common in the development and production phases. In the case study, it was decided to focus on investigating the project owners' perceptions of strategy and goal processes in the early phase, the communication of these goals in the implementation phase, and their relations to real objectives.

Empirical material was collected through in-depth semi-structured interviews with the owners' project managers. The three projects and respective respondents were chosen on a strategic basis. These three cases were a university building, a culture building and an administration building. These projects had professional owners, and based on experience from previous collaboration, it was anticipated that they had put a lot of effort into formulating and communicating their goals. A literature survey was conducted in advance, with special focus on sources that dealt with project goals. Some of the sources focused on the physical buildings while others focused on organizational structure when formulating project goals.

The university building

This was a public works project for the university, where most of the area was intended to be used for student study space and a smaller share of the space was allotted for use by the University library. Construction was completed in 2006.

The culture building

This was a private construction project that created a space for cultural and educational activities. This building was meant to attract citizens and increase activity in an urban development area in the neighbourhood. The project was a rebuild and extension of a historical building worthy of preservation, located in a former shipyard in Trondheim, and where the users were allowed to participate in the final aspects of the project development. The building was completed in 2006.

The administration building

This building was specially adapted for public agencies. It was a non-governmental project with a public tenant who had a 20-year lease contract, with option for a 10-year contract extension. The user prepared a specification of requirements that formed the basis for a project bidding competition, for which the winning criteria comprised location, price, architecture, and solutions. Construction was finished in 2003.

4. RESEARCH RESULTS AND INDUSTRIAL IMPACT

The building profession has four clearly defined roles: approval of decision-making, decision-making, decision-making formulations, and influence. These are important in relation to understanding what mandate is given and what is expected in terms of results among the different stakeholders. If the administrative management (decision-makers) and committee (those who approve the decision-making) are not aware of what the objectives are then a lack of goal formulation and/or decisions will be a very limiting factor for the project. A lack of description of goals beyond quality, time and cost will result in the implementation stage only delivering what was actually decided, namely a given number of square metres, ready on time, and at the agreed price. Thus, success is dependent upon decisions, but highly uncertain with regard to the objectives and returns in a lifelong perspective.

Accordingly, the formulation of decisions is largely a matter of preparing and clarifying project resolutions and thereby gives the necessary scope for action in the implementation phase. This also comprises an instructive and pedagogical process with regard to making decision-makers aware of need to shift focus from individual project goals to the project's results in terms of its own operations and for users. When such processes are difficult and complex they may prove demanding for contractors. Ideally, one should not underestimate the wishes of traditional project management to be valued according to the completion of a building in terms of time, cost and quality by using traditional project goals.

In the investigated cases, all commissions from the owner in principal were based on specific project goals. This is clearly apparent with regard to the university case, but also for the administrative building. The culture building stands apart through a somewhat more open commission due to a society goal defined through the owner's holistic approach and that desire that the project should contribute to developing the area as a whole.

The projects have had varying consequences, although these have been the greatest for the university which carried out a project with documented deviation to some extent regarding to the overall goals. In the other two cases, there is no evidence of a lack of functionality in the buildings. The fact that there was awareness that the process clearly had shortcomings as a consequence of a lack of objectives confirms that the potential existed for a better building.

In the cases, there was an explicit lack of formulation of objectives and it became apparent in the investigation that project managers understand that clear objectives would have contributed to improved processes. Even though the respective projects

were regarded as well executed, to a greater or lesser degree it was considered problematic that there were no overall and visible objectives which the different project goals could have adapted to. It is of vital importance that owners give such authority to their organization in the initial stages and that this is specifically formulated in addition to traditional objectives.

No deliberate strategy for the communication of results goals was found in the researched case studies. In the administration building project, the process linked to the communication of project goals in the implementation phase is regarded as having been successful. The project owners' awareness that the use of communication of goals is a strategic means for ensuring good processes proved to be significant.

In the case of the culture building, the objectives were in focus in the development phase and were known to the project members as a consequence of the project's 'intimacy' and relatively small scale.

On the basis of the three case studies, it is concluded that the lack of established objectives was a hindrance to optimal processes and hence optimal solutions. All of the studied projects were regarded as 'good' by their respective owners, while simultaneously the project owners' expressed that the fact the overall objectives were not visible or governing in processes was a problem. It was also concluded that a stronger focus on objectives and communication of these by owners would have improved the development process. First and foremost, this would have been of importance with regard to giving priority to customizing the design for the users instead of responding to the technical requirement specifications. The study also found that project evaluation was primarily directed towards attaining project-related performance goals and that only basic and unsystematic investigations were carried out in relation to users.

As owners, all three organizations had high-level visions and strategies. These were not brought forward to the project organizations and the three investigated projects each lacked a formulated concept with goals and strategies.

The three projects reviewed concept-formulating processes, but the reviews were related to project objectives. All orders from the owners in principle were based on the specific project objectives, and as a consequence all of the projects had strictly defined objectives for final results in the form of established budgets, time schedules and thorough specification requirements with stipulated standards for quality. This is readily apparent in the case of the university and administration buildings. The culture building project had a somewhat more open ordering process, due to of an expressed project purpose and that the project should contribute to development of an entire neighbourhood. However, the culture building project only communicated the project objectives to the contractors.

In the case of the university building, there was limited time during the project development phase because of an unalterable completion date. Consequently, the formulation of any goals was limited to preparing the budget and making a progress plan. The developer was of the opinion that the lack of a clear definition of goals did not have any significance regarding the execution of the project. However, one investigation that was conducted after completion concluded that on average only 10% of the student study space was used, which indicates low utilization in relation to the cost of the project. The developer later realized that the front-end phase had been used to solve problems relating to project goals and conflicts with the contractor instead of finding solutions that would be beneficial to the university's strategic goals.

The cultural building had a basic requirement of non-commercial activity through public planning regulations. The developer had not defined which activity was most desirable for the culture building, but there still was a distinct relationship between activity there and development of the area around the building. The proper form of activity in the culture building would have given the developer more rental income from surrounding

areas. The developer of the cultural centre considered the project to be successful in terms of economic project goals and the area's attractiveness, but later realized that greater awareness of desired goals would have been a suitable tool for keeping the focus on the superior quality of the delivery. The tenant's success had an even greater significance for the developer's earnings than successful project execution.

The users of the administration building defined their own requirements for the building in the form of technical specification of requirements. The specification of requirements did not give the developer insight into which problems the users needed to solve. Based on the specification of requirements, the users were not involved in the planning of the front-end phase. The developer later thought that achieving goals would have been more likely if there had been more user influence, based on mutual participation. The developer understood that it would have been desirable to have had clearly defined goals from the users, beyond the technical specifications, so that the actual user needs would have been more clearly communicated to the project organization. Such clarification could have contributed to a strategy for achieving such goals**.**

The three building projects examined were all characterized by an explicit absence of formulation of goals, and the investigation showed that the project managers believed that clear goals would have contributed to improving the processes. Even if the projects were individually perceived as well-executed, to a greater degree it was considered a problem that no superior and visible goals existed. To what extent the final projects and buildings investigated actually would have changed if a concept had been developed early on is hard to be certain. The fact that the owners were aware of deficiencies in processing when actual goals were clearly lacking is a confirmation that the potential existed to make better buildings.

No conscious strategy was found for how goals should be communicated in the projects examined. The culture building project had its goals in sight during the developmental phase, and project participants were conscious of these goals because of the limited number of persons involved, and the project’s small scale. Such communication was absent from both the administration building project and university building project. The respondents that were interviewed characterized this as a very limiting situation regarding the utilization of the opportunities existent in the projects.

The developers of the examined projects assessed the execution processes as good, even if the project managers considered it problematic that processes for visible overall goals were not for guiding the projects. The owners understood that a greater focus on the communication of goals would have improved the development process. This would first of all be significant for prioritizing designs adapted to user needs instead of simply responding to technical specification requirements. Project evaluations subsequently were mainly directed toward the project objectives, while users were only informally concerned and in general the owners only made unsystematic investigations of effects.

5. CONCLUSIONS

In summary, the case studies revealed that the researched projects did not implement systematic processes with the purpose of describing the main business goals or objectives, communicate these from the decision-makers and owners to the implementation organization, or undertake evaluation of goals in the operational phase. Theory and literature clearly indicate that objectives are of large significance for a project’s success, and that contractors must place great emphasis on both formulating them and following them up.

The research gives a clear indication that project goals and objectives are controlling in building projects. A project’s success is evaluated in terms of its ultimate quality, timeliness and cost. It was recorded that the question of objectives was very central in the development phase of one of the projects. In that particular project the project goals

were moderated in the processes and the owner had no special requirements in terms of returns.

From the study it can be concluded that the lack of formulation of objectives in the management perspective in general and in the end results in particular, was a hindrance to optimal processes. Project goals were highly controlling in the case of both the university building and the administrative building. In all projects it was found that a stronger focus on objectives on the part the owner would have improved the development process and formed the basis for dimensioning in the operational phase.

In the case of the university building, real user goals were not formulated, and hence could not be followed up in the process. In the case of the administrative building basic measures were found which in principal were not communicated to the project. The objectives were formulated, but were not used in the process and hence had significantly less impact for the project's end result. In the case of the culture building awareness of the multi-perspective goal was made active participation by the users and owners throughout the whole process. The goals were governed informally and they resulted in benefit for users and hence for project owners. A fomalized application of a multi-perspective goal hierarchy would have improved the project considerably.

Based on the conducted interviews and pilot study it has been found that an owner who commissions a project (the business owner) must be made aware of the business potential that lies in having a structured process wherein the main focus is on establishing real objectives relating to the user and also on the effect of the project on the organization's core activities.

Communication and follow-up of project owners' objectives in the building profession constitute a little focussed area. With the exception of large state-run projects established general systems, which should control the quality of this process, do not exist to any great extent. Project owners and/or users are also partly unaware of the importance of implementing a process involving the preparation of a strategic programme for the project and thereby controlling the quality of the end result and long-term profitability.

6. IMPLEMENTATION AND EXPLOITATION

This work will be continued with a PhD study, which will aim to determine how to follow up effectiveness during the front end, planning, execution, and operational phases in building projects. The results will be used to provide project owners with a description of best practice for following up effectiveness.

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