

# CHALMERS



## Information Handling in Construction Projects

A Study in Swedish Construction Companies

*Master's Thesis in the MSc Design and Construction Project Management*

ABOUZAR GOLYANI

HOI-YAN HON

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CHALMERS UNIVERSITY OF TECHNOLOGY

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Master's Thesis 2010:135



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Examensarbete / Institutionen för bygg- och miljöteknik,  
Chalmers tekniska högskola 2010:135

Department of Civil and Environmental Engineering

Division of Construction Management

Chalmers University of Technology

SE-412 96 Göteborg

Sweden

Telephone: + 46 (0)31-772 1000

Chalmers Repro/ Department of Civil and Environmental Engineering  
Göteborg, Sweden 2010

To my family and all friends

致我的家人和朋友

Hoi-yan Hon

To my family, thanks for all the love and support

تقديم به پدر و مادر عزیزم، برای همه حمایتها، زحمات و عشقشان

Abouzar Golyani



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HOI-YAN HON  
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Division of Construction Management  
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## ABSTRACT

Desired result for construction projects would be high quality at minimum cost and time. To achieve this result, construction project managers integrate project phases such as planning, design, and construction. Further, construction managers coordinate different participants involved in the construction process. For this matter, effective information flow is especially important in the construction industry considering the diversity of participants involved in projects.

Research in the field to improve the information process had suggestions such as integration of IT and re-engineering construction processes. However, construction industry is still infected by inaccurate and untimely information flow and it is unable to facilitate the value delivery that often results in additional costs and time delays.

The purpose of this research is to study how the information handling affects the value delivery for construction projects. This was done by nine face-to-face interviews conducted with managers of construction companies active in Sweden and all along that a literature review was done to fulfil the purpose.

The information handling in construction is infected by more wasteful and less value adding activities. This problem observed in activities such as collecting data, communication, decision making, and sharing information. Authors may highlight indefinite understanding of the value stream creation as the core reason leading information handling deficiency and cost for project efficiency and project performance. Construction companies' initiative should be training sessions for construction managers and providing them appropriate information on this respect. Further, proper trainings for project managers and users of the information systems must be underpinned. Moreover, since an external project management consultant facilitates communication among parties and eliminates unnecessary information process of the projects, the companies can exploit construction management contracting more and get benefits of this type of the coalition. Furthermore, meetings waste lots of time, therefore managers should critically think and find the right alternative medium that suites their purposes. Finally, project managers not only should get the work experience related to the construction process, and managerial training but should also develop their skills related to the information handling.

Key words: Value, Information, Communication, Value-added activity, Project management, Construction







## FOREWORD

In this master thesis, we divided the work equally. Generally, we did the work together. The work includes reading literatures, writing the content, doing interviews, and presenting and defending the thesis. We worked in pair because we believed two thoughts are better than one thought. Two individuals easily make discussions with different voices and minds, while one individual is often alone.

The idea of this master thesis came from a lecture which was related to the lean production concept. The guest lecturer pointed out that there were many undiscovered wastes in management which were quite invisible and were hardly indentified or removed. Despite some researchers argue lean concept is inapplicable in construction industry, another believe there is possibility to do so. This thesis topic is a challenge for us.

At the beginning, the thesis idea was very vague. We did not know how to define the scope of the thesis, neither where the thesis should specifically focus on. Even, we used to doubt whether it was not feasible to do this thesis topic. Fortunately, we solved this problem after reading several literatures. We felt more confident to continue on studying this topic.

When we contacted companies for interviews, luckily we could find enough interviews and the interviewees were willing to conduct the interview in English. We took two and a half months to complete nine interviews. Then, we spent more time on writing the thesis. This was a very exhausting step. A more detail and specific theoretical framework was constructed in order to support the finding and the discussion parts. We rewrote those parts several times so as to make a good connection between those.

Finally, during the thesis presentation we have received both positive and negative comments. We appreciated those who gave comments. The comments helped us to finalize the thesis better.



## PREFACE

This master's thesis has been carried out from January to June 2010. We faced many difficulties when doing this thesis such as specifying the thesis's idea, designing the interview questionnaire, searching companies for interviews etc. These problems may seem usual as the others groups face the same, but dealing with these problems are not easy tasks. We describe writing this thesis is like a journey of adventure. During the journey, we got helps from different people. They are our supervisor Lasse Björkman, friends including but not limit to Ivet Cordero, Meysam Cordi, Jenny Friberg, Jenny Gustafson, Malin Widerlund, and Saman Saffarian, as well as all the interview's respondents.

We would like to thank our supervisor Lasse Björkman who guided us the right direction and gave us a large freedom for developing the idea. Thank all the friends who supported us in all aspects like encouraging our morale, giving valuable comments on the thesis, introducing interviewees for the thesis. We would like to special thank to Ivet Cordero who provided us interview contacts with companies.

Last but not the least, we truly thank all the respondents for their remarkable contributions to our thesis. Their enthusiastic attitudes toward the thesis offer great latitude for sharing their experience.

Thank you so much.

Best regards,

Abouzar Golyani

Hoi-yan Hon

June 2010, Gothenburg



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## 1 Introduction

Some construction associations, for example Construction Excellence, Lean Construction Institute and Construction Industry Steering Committee, advise construction companies to make use of Lean concept for improving project productivity and quality. Construction Excellence suggests the construction companies can make improvements by taking advantages of lean thinking. Lean thinking is a broad and generic philosophy (Hicks, 2007). Its meaning to construction production and management is focusing on value, and striving to remove all non-value adding activities in processes whilst adding more value back to the processes. First, the companies have to define the value in customer terms. Secondly, the key points which are related to the value will be identified in the processes. The integrated processes are called value stream. The goal of lean thinking is to ensure the products flow on the value stream and finally deliver the products to customers. Accordingly, the customers are very critical since they pull the value stream. The customer's needs determine the value of the processes (Constructing Excellence, 2004; Gabriel, 1997; Gabriel, 2004; Mascitelli, 2002; Hicks, 2007).

Now the question is how to make the lean thinking work in the construction industry. Constructing Excellence (2004) suggest the companies should consider their design and production development, production, and supply chain management & supplier relationship. The fields of application are design, procurement, production planning, logistics, and construction. Specifically, the construction term here refers to clear communication of project plans, training, teamwork, multi-skilling, daily progress reporting and improvement meetings, as well as fully engaged workforce. Senaratne and Wijesiri (2008) have a suitability and acceptability test on lean construction. Their study has found that the construction industry is suitable to adopt lean approaches for example Just-in-time and Kaizen. Senaratne and Wijesiri's study (2008) also reveals people have started to accept lean construction because they believe lean approaches can be implemented. There has been many successful cases given. Those are mainly related to the design, procurement, and production planning. For instance, applying 3D design system, developing tools in sub-contractors, pre-fabricated or pre-assembled materials (Constructing Excellence, 2004). Yet, there are not many cases regarding how to improve the part of communication, teamwork, as well as daily progress reporting and improvement meetings. How can the construction industry improve this part? Gyampoh-Vidogah et al.(2003) suggests integration of IT and re-engineering construction business process can improve the communication efficiency. However, there is no clear answer how to implement integration of IT and re-engineering business process. Therefore, it is needed to study how to improve such parts.

### 1.1 What is the Value of Projects?

From a client's point of view, a construction project is a capital investment, because the construction project provides an opportunity for client's business (Goodpasture, 2002). The client desires better quality while spending less cost and time on the project. Hence the project productivity is proportional to the project quality and in inverse to the project cost and time. The combination of cost, time and quality represents the value of a



project. Therefore, the balance among cost, time and quality of the project is connected to productivity (Mawdesley & Al-Jibouri, 2010; Pheng & Fang, 2005).

## 1.2 What are Today's Problems?

Although importance of the value of a project has been known for a long time, in many cases the construction practices do not facilitate the value delivery. One usual example is when design problems occurred in the project and the design team is constrained to the original briefing and conceptual design of the project. The design team does not concern about the relationship between the decision making and the value expectation of the clients. The decision the design team made is more focused on fulfilling the technical and performance specifications. This is because the project team takes for granted that the briefing has captured all client's requirements and expectations. In fact, the client's expectation might not be the same as in the briefing when problems occurred. Especially if the client is not experienced with the construction project and cannot state the requirement specifically in the briefing. Then, it leads to the overall construction process does not align with the client's expectation. The concern of the client's expectations should not stop after the planning and design stage. The project team should continue to consider what the client wants during the entire construction process (Thomson et al., 2006).

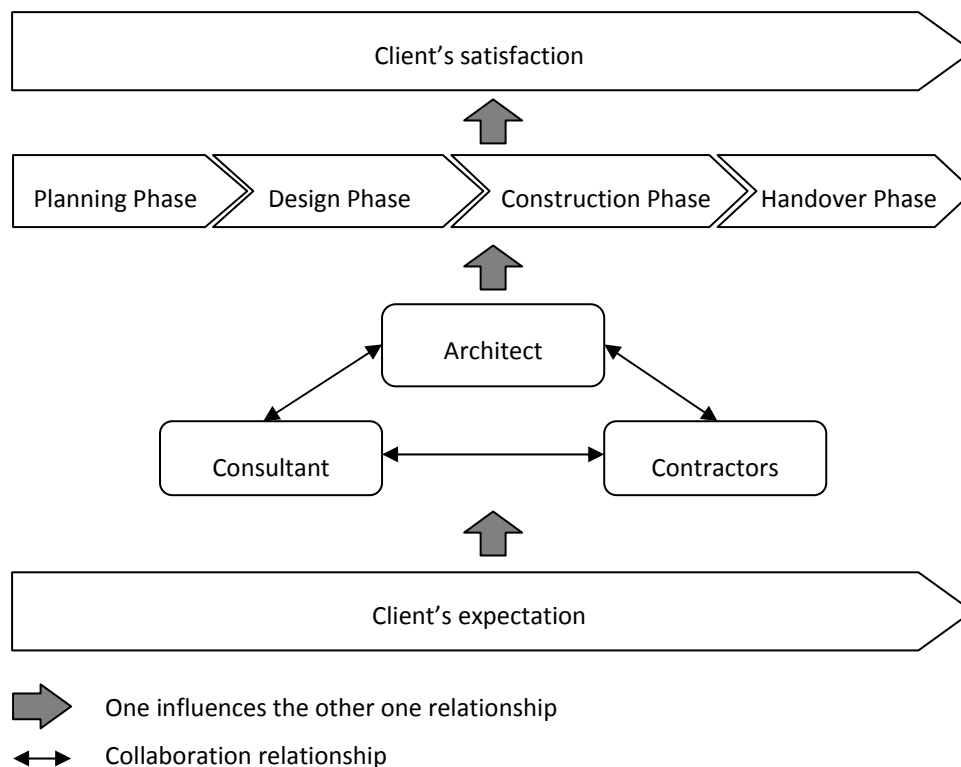


Illustration 1-1 The relationship between client and project participants on the construction process

### **1.3 What Aspects should be Focused?**

According to Peansupap and Walker (2005), the relationship between the client and the construction process is highly complex, fragmented and unique, see Illustration 1-1. It is due to the many phases and the many different participants in the process. In general, the phases include planning phase, design phase, construction phase, and handover and maintenance phase. The common participants can be the client, the architect, the technical consultant, the contractor, and probably the external project management consultant. During the phases, the participants produce and communicate the project information such as drawings, specifications, contracts etc. This collaboration requires a high degree of communication of knowledge and coordination between the participants. At the same time, a high level of information processing is required for decision makings. The information processing refers to the process how the information is collected, analyzed and transferred (Peansupap & Walker, 2005). Generally, the communication and information processing is the inevitable time consuming activities. This kind of activities forms a part of the project cost. This cost is called the transaction cost, since this cost is spent on the managerial activities for the transaction of information, (Mascitelli, 2002). So, there are three main goals when improving the communication:

- 1) Efficient information processing,
- 2) Effective communication,
- 3) Reducing the transaction cost.

### **1.4 Lean Concept Contribute to the Project Value for Construction Productivity**

Theoretically, the philosophy of lean thinking aims to improve system efficiency or process efficiency through eliminating wastes and ensuring value flows (Hicks, 2007). All activities involved in a project consume cost and time (Mascitelli, 2002; Senaratne & Wijesiri, 2008). Non value-adding activities should be reduced, whilst the other activities in the system or process (i.e. both value-adding and partial value-adding) should be re-engineered to be more efficient (Senaratne & Wijesiri, 2008). The purpose of lean thinking is to improve project productivity, quality and time (Hicks, 2007). So the Construction Industry Steering Committee encourages construction companies to implement lean concept and industrialize the construction process. (Pheng & Fang, 2005; Senaratne & Wijesiri, 2008). Nowadays, many construction companies have noticed reducing non value-adding activities for the construction process is necessary to increase project productivity (Serpell & Alarcón, 1998).

### **1.5 Implement Lean Concept in Managing Information Flow**

Many researchers have attempted to identify the non value-adding activities in construction. According to Senaratne and Wijesiri (2008), it is necessary to identify the causes of non value-adding activities in prior to eliminate those. There are many causes found related to how organizations handle project information in terms of poor information flow (i.e. late information, defective information and unclear information), ineffective management control, and poor decision making, see Figure 1-1.

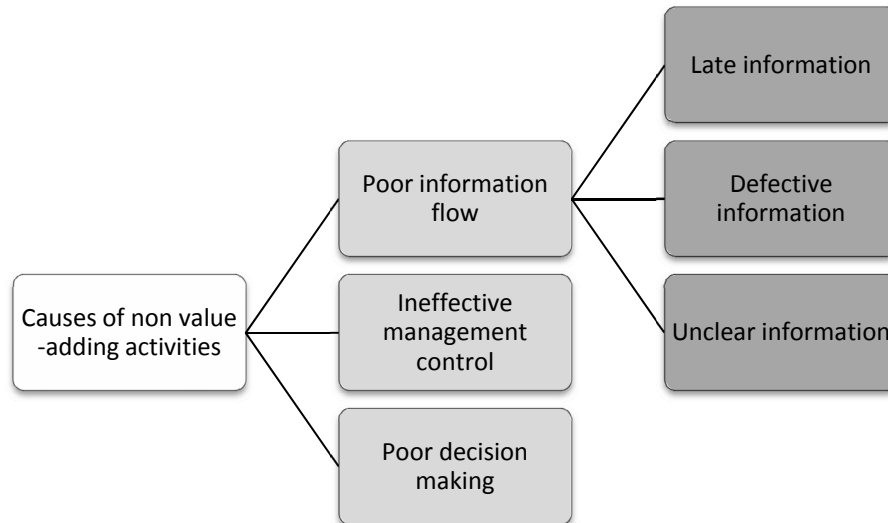


Figure 1-1 The causes of non value-adding activities in organization management (Senaratne & Wijesiri, 2008)

Similarly, Serpell and Alarcón (1998) consider eliminating the non value-adding activities in construction information flow and management process. The construction information flow refers to information transaction activities between the participants. The management process is a mechanism that processes information in the way of handling, exchanging, and storage for management processes and decision making. They influence the performance of the construction process (Serpell & Alarcón, 1998).

Just-in-time information is an ideal information flow which has no time batches. The time batches refer to the time delays within the information transaction activities (Mascitelli, 2002). Mascitelli (2002) says Just-in-time information approach can eliminate non value-adding activities from information transaction. It can improve time efficiency for information flow. Subsequently, the performance of information transaction becomes more efficient. Since the Just-in-time information approach affects the information transaction, the management process is changed simultaneously for supporting the Just-in-time approach. Effective management process can minimize the time and cost associated with transaction. It involves communication aspects like choice of media, shared language, documentation, information overshoot/undershoot, and communication distance etc (Mascitelli, 2002). Therefore, efficient information flow and effective process information go hand-in-hand for improving project performance (Gabriel, 1997; Hicks, 2007; Serpell & Alarcón, 1998). The theory here will be explained in detail in Section 2.4.

## 1.6 Project Managers are the Key to Trigger an Efficient Information Flow

Project managers play a core position that process project information. Generally in a project team, the project manager manages project cost, time, and quality. In a construction project organization, many participants are involved such as client, architect, consultants, contractors and subcontractors. In general, there is a project manager who oversees the overall performance of project on behalf of client. For the other participants, they represent their roles and professions in the project organization. Hence it is important that for every single project the project manager thinks about how

the project participants can communicate project information efficiently and effectively in prior to facilitate efficient information flow. Firstly the project manager decides what and when the project information is needed. Secondly the project manager consider from whom the project information can get, and how to put such information into the project communication system in a good manner so that the project manager and other project participants can easily extract the information from the system. Thirdly the communication between the client and the project team is via the project manager. So how the project manager designs the communication affects the effectiveness and efficiency of the information flow (Gabriel, 1997).

### **1.7 Theoretical Conjecture**

The whole construction process should change to be more customer-focused. It enables the project team to align the construction process with the client's expectation. Since it is the client who determines the value of project, the value-adding activities and non value-adding activities during the construction process can be identified (Thomson et al., 2006). However, the relationship between the client and the construction process is highly complex, fragmented and unique. It requires a high level of collaboration between the project participants. The collaboration involves high degrees of communication and information processing. In the context of collaboration, information flows and management process affect the decision making (Peansupap & Walker, 2005). Poor information flows and ineffective management lead to poor decision making. As a consequence, it affects the project performance (Senaratne & Wijesiri, 2008; Serpell & Alarcón, 1998). Just-in-time information approach enhances the time efficiency, while effective management process improves both the time efficiency and the cost effectiveness. Both Just-in-time information approach and effective management process are important for improving the project performance and project efficiency (Mascitelli, 2002).

Furthermore, project managers are critical participants in the project organization. The project managers oversee the project performance and are responsible for all decision makings in the project organization on behalf of the client. The project managers ensure the client's expectation is captured. The project managers facilitate effective collaboration between other participants in order to fulfil the client's requirement. The client's satisfaction is firstly determined by how good the project managers supervise the collaboration and is secondly affected by the ability of the project managers for decision making (Gabriel, 1997).

### **1.8 Research Purpose**

The purpose of this research is to study how the information handling affects the value delivery for construction projects. It will be focusing on how project participants facilitate the project collaboration regarding the fields of application of information flow and management process.

### **1.9 Limitations**

Due to the time limitation of this master thesis, we are unable to study the whole project life-cycle in a great detail. Additionally, since we could not find a company for doing

this research, we are also unable to study a specific stage of project life-cycle. Finally, the customers are the owner of the construction project. The end users will not be considered.

## 2 Theoretical Frame Work

In this Section 2, we define the theories for the thesis. From Section 2.1 to 2.2, we briefly introduce the project value stream and construction management. Section 2.3 to 2.6 further tells the possible field of applications. Finally, in Section 2.7, the project manager's required abilities will be mentioned.

### 2.1 Defining Value and Waste in Construction Projects

In general, the value of a project is what the customer is willing to pay for. All activities that occur in a project add cost to the project. In a delivery process, there are the deliverables, the activities and the final product. Deliverables are like the components for producing the final product. The activities work out deliverables which deliver the final product, see Illustration 2-1. For example, if the final product of a construction project is a building, the drawings are the deliverables for constructing a building. Further, the activities which work out the drawings can be the communication between the client and the project team. Since the customer pays for the final product, the customer is willing to pay for the activities which add value for working out the deliverables in a way that the customer recognizes the transformation of the deliverables. These activities are called value-adding activities. On the other side, the customer does not like to pay for the activities which do not add value for working out the deliverables, nor does the customer not recognize the transformation of the deliverables. These activities are called non value-adding activities. However, in reality, the final product includes both value-adding activities and non value-adding activities. As the result, a part of the cost for the final comes from non value-adding activities. The satisfaction of the customer decreases because the customer does not want to pay for such part of the cost (Mascitelli, 2002).

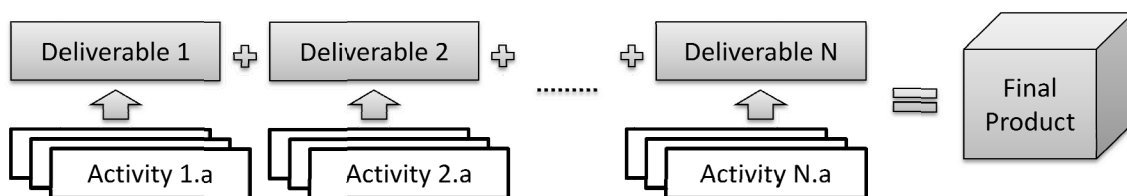


Illustration 2-1 The Delivery Process

According to Mascitelli (2002), activities can be divided into three types. Type One is the pure value-adding activities. Type Two refers to the activities that are necessary for working out deliverables but they are the partial non value-adding activities. Type Three is for purely non value-adding activities, and is called "Waste" (Mascitelli, 2002).

Applying this thinking on construction projects, all activities make up project cost. Similarly, the three types of activities occur in the construction process (Serpell & Alarcón, 1998; Senaratne & Wijesiri, 2008). Both Type Two and Type Three activities should be considered. The non value-adding part of Type Two shall be removed and Type Three shall be completely eliminated from projects. (Mascitelli, 2002; Serpell & Alarcón, 1998)

### 2.1.1 Project Value Stream

Projects are unique (Sears et al., 2008; Winch, 2010), so the project value stream varies from project to project. Project value stream refers to a sequence of deliverables that deliver the final product for the customer, see Illustration 2-2. The deliverables are produced by activities. The activities are like a pivot. The activities are value-adding activities which leverage the value rolls smoothly down the lever toward the customer. The project value stream creation is very important, because it identifies the value-adding activities of the project. The activities other than the activities defined on the value stream can be potential non value-adding activities. As the potential non value-adding activities are indicated, it is possible to remove them (Mascitelli, 2002).

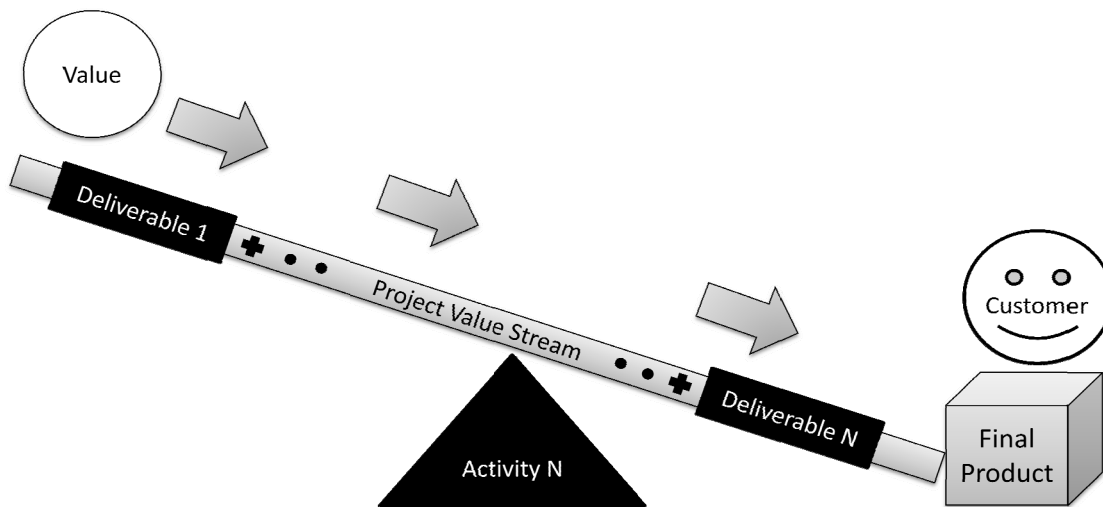


Illustration 2-2 Project Value Stream

## 2.2 Construction Management

In construction management it manages the coalition relationship and processes that are highly complex, fragmented and unique. Construction projects consist of many phases from planning, feasibility study, designing, tendering, construction, handover, and sometimes maintenance (Peansupap & Walker, 2005). Since construction projects require multiple professionals from different functional areas and disciplines (Anumba et al., 2008), this results in construction project management is project-based nature of activity and multi-organizational setting (Bresnen & Marshall, 2001). Similarly, Winch (2010) mentions the challenges of applying lean production concept for improving performance are largely organizational. The challenges are about how to increase the quality of co-ordination and collaboration between parties. Therefore, effective and efficient communication of project information is not only highly required in both inter-organizational and intra-organizational management, it is also required between the project participants (Bresnen & Marshall, 2001; Anumba et al., 2008).

With comparison to the manufacturing system, the manufacturing sequence in construction industry is far too complicated than the one in manufacturing industry. Imagine the construction collaboration is the manufacturing sequence. The collaboration involves many people from different organization (Bresnen & Marshall, 2001).

### **2.2.1 Construction Information and Management Processes**

Construction management is a process to handle construction project information in the ways of communication, information storage, information exchange, decision making. Management actions and decisions will affect the value of projects (Gyampoh-Vidogah et al., 2003). According to Serpell and Alarcón (1998), the causes of non value-adding activities in information flow between the participants are unclear information, late information, lack of planning, and information quality problems. The quality of collaboration between parties for effective and efficient communication of construction information is critical for decision makings. Particularly when making decision related to changes, the participants should communicate the construction information in a more problem-solving oriented way. Information refers to the changes, programming, cost control, risk analysis, and other project reports. Both formal and informal communications of project information affect the project control and decision making process. In particular to the information related to changes, this kind of information implicates project quality, cost and programme. Decision making regarding changes ought to be focused and immediate (Gabriel, 1997).

### **2.2.2 Effective Construction Information Collaboration**

Information of construction projects are mostly in form of document like design drawings, specification, meeting's minutes, invoices etc. Construction information is changing all the time throughout the whole construction process. This is because the information produced in the early stages such as planning stage and design stage is incomplete. Therefore, though the design is based on client's requirement, many problems and changes occur in the later process. This affects the value of the project. Project managers require efficient and effective information from different participants to make decisions on those problems and changes (Gyampoh-Vidogah et al., 2003).

According to Gabriel (1997), external project management consultants are vital for ensuring the value flow smoothly towards clients. It restates Winch's (2010) consideration that external project management consultants play a vital role on maintain the integrity of the product. Traditional project coalitions like general contracting or total contracting are poor at managing the process. It affects the integrity of the product. As the consequence, it affects the value delivery on the process. The client's expectation is distorted and the client's satisfaction is then influenced.

The project coalition associated with external project management is called construction management contracting. The role of it is to manage the design and the construction of the project on behalf of the client (Winch, 2010, p. 112). The collaboration relationship of construction management contracting ensures the client's expectation is captured and fulfilled during the project execution (Winch, 2010, p. 468). Furthermore, the construction project manager defines the communication mechanism for project participants (Gabriel, 1997). The manager defines an information and communication strategy and facilitates the effective and efficient communication (Winch, 2010, p. 468).



## **2.3 Potential Non Value-adding Activities in Construction Management**

As mentioned before the importance of the time efficiency of communication between individuals, the following it will look at the potential non value-adding activities in construction management.

First, it starts from considering some potential non value-adding activities induce time batches that affect the project efficiency. The potential non value-adding activities are functional departments, executive gate meetings and approval cycles, fire-fighting and expediting, changing requirements, and management interference. Just-in-time information approach is applied. It improves the time efficiency of information flow (Mascitelli, 2002). In Section 2.4, it will explain Just-in-time information approach in detail.

After that, the management process for information flow should be considered in order to process information flow effectively and efficiently. The communication effectiveness of the management process is critical for the success of communication. The factors of the management process considered are the use of media and overshoot/undershoot information. It ensures the time efficiency and affects the transaction cost (Mascitelli, 2002).

### **2.3.1 The Potential Time Batches When Processing Project Information**

When proceeding project information, the management process is required (Sears et al., 2008). Mascitelli (2002) mentions that the deficient management process induces time batches to the project. Potential non value-adding activities refer to the management actions which may be the possible time batches. Since the time batches consume project time, the potential non value-adding activities will negatively affect the value delivery of the project (Mascitelli, 2002). The followings are some possible non value-adding activities:

- **Regularly Scheduled Meetings/ Meetings**

Regularly scheduled meetings have existed in work culture that are used to reporting work, problems, and reviewing the project. It seems that regularly scheduled meetings are presumed in a fixed time interval (i.e. weekly, monthly, or quarterly etc) and some team members are obligated to participate. Examples of meetings are weekly team meetings, coordination meetings, departmental meetings, and general meetings etc. Not all these meetings are necessary to put on one's schedule. So, meetings are somehow essential but not necessary all the times (Mascitelli, 2002).

- **Analysis Paralysis**

Analysis paralysis refers to one's not making timely decisions or even not making decisions will slow down or stop the information flow respectively. The vital point is to let the project information keep flowing. The information generated from wrong decisions can be corrected. However, if no decisions have been made, then no information can be corrected. Analysis paralysis occurs. It may induce time batches causing the extension of project time. Particularly when the projects are in high levels of risk and uncertainty, this kind of time batches can be commonly found (Hicks, 2007; Mascitelli, 2002).

- **Work Queues**

Work queue refers to how one does prioritize its work. People usually wrong prioritize their work according to the severity, workload, time-limited, or first-in-first-out. Additionally, when they prioritize the work, they are more likely to consider how the department would be affected by the work. However, the project teams are formed by members who are from different departments and different organizations. A smooth value stream requires all team members work effectively toward delivering the value of project. As a result, team members may prioritize their work without considering how the work affects the value of the project (Gabriel, 1997; Hicks, 2007; Mascitelli, 2002).

## **2.4 A Time-based Approach: Just-in-time Information**

Construction management process is nothing more than a generic management process (Bresnen & Marshall, 2001). The above potential time batches can also be commonly found in construction. In order to reduce the potential time batches, Just-in-time information (JIT) approach can be used. It requires the team members to work in a more time-efficient way. It also emphasizes on individuals to be more self-motivated and be aware of non value-adding activities in the management process. It not only improves individual performance, it also increases the team performance (Gabriel, 2004).

This approach attempts to increase the time efficiency of the management process by means of:

- **Efficient and Effective Meetings**

Meetings shall be held in a contingent mode. The number of regularly scheduled meeting is hence significantly reduced. Since the purpose of regularly scheduled meetings is to reviewing, reporting, and checking the progress of the project. It can be done through exchanging documents among the parties. Meetings should be held only if there are problems/ changes happened. The participants to the meeting should share the same agenda and do problem solving discussion (Mascitelli, 2002).

There are some useful skills for running effective meetings. First, project managers confirm the purpose of the meeting and make the purpose be very specific in order to avoid distractions from the main purpose. Second, project managers invite the minimum numbers of participants for the meeting. Third, circulate the detail of the meeting like the location, time, agenda, and some background information for the discussion. Forth, the duration of meeting should not be longer than 2 hours. The level of attention of participants decreases after the first 20 minutes. Participants are more likely to agree all points in order to finish the meeting. Finally, summarize the minute of the meeting with action plans in an A4 paper. The summary should send to all participants and become the basis of the next meeting's discussion for following up the action plans (Maylor, 2005).

- **Decision Making**

Due to the high level of uncertainty in project life cycles, information is most likely incomplete. This is the central paradox in construction management (Winch, 2010, p. 474). Also, when managers make a decision, this is not possible for managers to possess all the information that influences the decision. The alternative is that managers shall gather the highest value information as quick as possible and evaluate the information to

make a boundedly rational decision and then keep the information flow moving forward (Mascitelli, 2002). However, Hicks (2007) points out there is a lack of understanding of the value of information. Highest value information means the information which affects the customer satisfaction the most. In order to identify the highest value information, the correlation of information and project value is established based on customer expectation (Thomson et al, 2006). Hence, the information flow from the customer to the decision making process is very critical.

- **Work Queue**

First, managers should consider the efficiency of resource utilization when prioritizing the work queue (Mascitelli, 2002). This is because the work queue influences the information flow efficiency. Hicks (2007) states four causes of wastes in information flow. One of those called “Flow demand” regards the time and resources spent trying to identify the information that needs to flow. It tells that the next uncommitted resource should do first. Second, managers should refer to the value stream map and check whether the work is a value-adding activity. Third, managers should create a work queue that ensures efficient utilization of resources in association with an adequate lead time. The tasks should be done within the lead time (Mascitelli, 2002).

## **2.5 Management Information Transaction Process**

Management information transactions belong to Type Two activities. Though the transactions enable the tasks for working out the deliverables but the customer does not know the transfer of information, so that the transactions are partially non value activities (Mascitelli, 2002; Maylor, 2005, p. 380). Consequently, transactions are said to be enabling but non value-added. For this above reason, it is critical to consider the management process for information transactions. Poor management process wastes time and cost associated with the transactions. The efficiency and performance of the project are thus affected negatively (Mascitelli, 2002).

Just-in-time information approach and modification of management process are inter-linked to each other. It is necessary to modify the management process in order to support the implementation of Just-in-time information approach. Furthermore, in a project environment, a vast amount of information transaction occurs for sharing knowledge between participants. Therefore, the purpose for the modification is to improve the efficiency of collaboration. There are two main aspects when modifying the management process: (Mascitelli, 2002)

- **Use of Communication Media**

Communication media refer to letter, report, fax, telephone call, e-mail, delivery, exchange data interchange, all kinds of meetings for information transaction between parties. To decide what technology is appropriate for communication, it is important to understand the communication usage of the media in terms of one-way media or two-way media. One-way media like letter, report, fax, e-mail transferring information without the presence of receiver. Two-way media such as telephone call, meetings, and video conference require both the sender and the receiver for information transfer. The distinction of one-way and two-way media is the responding time of interaction. For the two-way media, they allow a real-time interaction. The responding time is relatively shorter. Consequently, two-way media are suitable for discussion, negotiation, getting

feedback. However, the timing issue is very problematic in two-way media. It requires both parties to simultaneously be engaged to the topic discussed to succeed the information transaction. For example, a project manager makes a phone call to a site manager for confirming the work schedule. If the site manager is not in the office, the site manager does not have the work schedule to answer the project manager. The information transaction fails due to the wrong timing. For this case, the project manager can send an email to the site manager. One-way media allow a time-lag interaction. They need relatively longer time for getting responses (Mascitelli, 2002).

Another distinction for choosing appropriate media regards the number of participants involved in the interaction. One-to-one interactions mean the transaction requires one sender and one receiver. One-to-many interactions say the transaction between one sender and many receivers. Similarly so on for many-to-many, few-to-few interactions etc. Hence, the bandwidth of the communication media is concerned in order to allow the number of participants. The bandwidth of the communication media refers to the capacity of the media. Different purposes of information transaction require different levels of bandwidth, see Table 2.1

Table 2.1 Suggested use of communication media, source from (Mascitelli, 2002)			
Purpose of information transaction	Type of Communication interaction	Bandwidth required	Appropriate choice of media
<b>Project Coordination</b>	Few-to-few Two-way	Moderate	Face-to-face Meeting
<b>Distribution of Documents</b>	One-to-many One-way	Low	Internet
<b>Approval of Documents</b>	One-to-many Two-way	Moderate	E-mail
<b>Negotiations</b>	One-to-one or Few-to-few Two-way	High	Face-to-face Meeting
<b>Project information Discussions</b>	Few-to-few	Moderate	Face-to-face Contingent meeting

- **Undershoot or overshoot information**

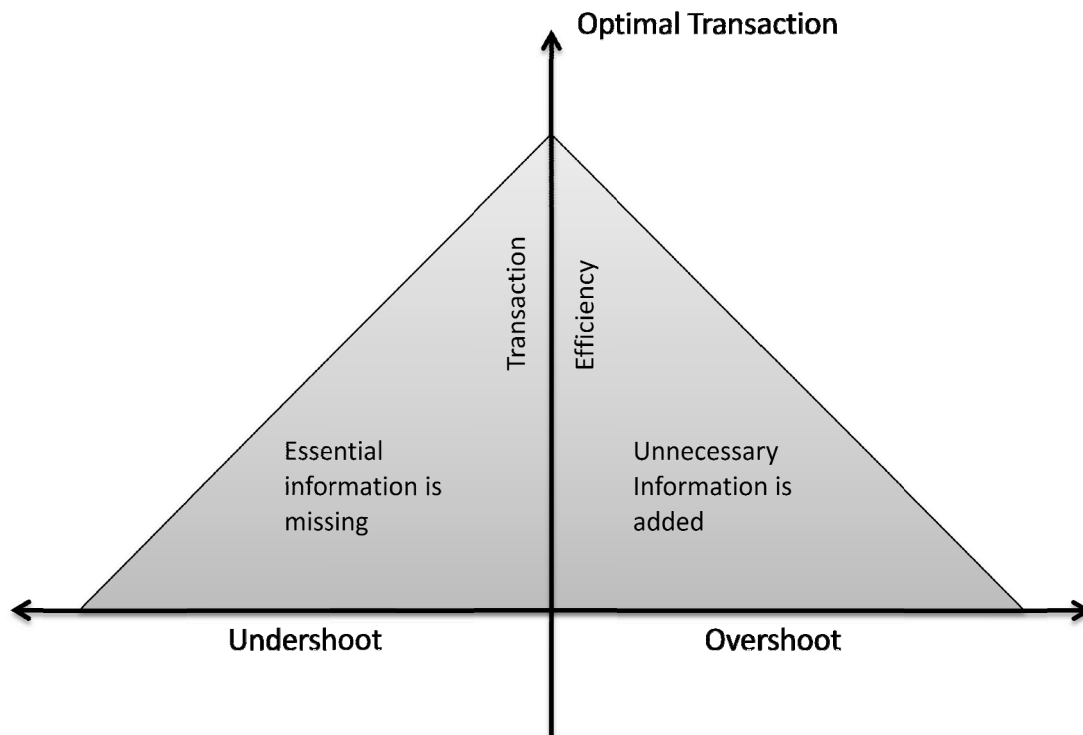


Figure 2-1 Optimal Information Transaction, sourced from (Mascitelli, 2002)

Two causes of wastes in information flow stated by Hicks (2007). Those are called “Failure demand” and “Flow excess”. Failure demand refers to resources and activities that are required to overcome a lack of information. Flow excess means resources and activities that are required to overcome excessive information. Mascitelli (2002) was previously named these terms as “undershoot” and “overshoot” of information. It implies that the quantity and quality of the information for transaction is critical. Too much information wastes time of both the sender and the receiver. Less information also wastes time for seeking the missing information. In short, all project communication should be brief, précised, focused, understandable and clear. Efficient information transaction is defined as the optimal transaction that the information contained is just enough, see Figure 2-1 (Mascitelli, 2002).

## 2.6 Application of Information and Communication Technology (ICT)

Construction project management manages large quantities of information flow on a project. The information and communication technology refers to the information systems for processing the project information flow. There are two basic categories of information systems, see Figure 2-2: Engineering Information Management System (EIMS) and Enterprise Resource Management System (ERMS). EIMS concerns the information about the product while ERMS focuses on the information about the process. Moreover, an information system is developed called project management information systems (PMIS). PMIS refers to the interface between EIMS and ERMS. Therefore, there are mainly three information systems involved in ICT (Winch, 2010).

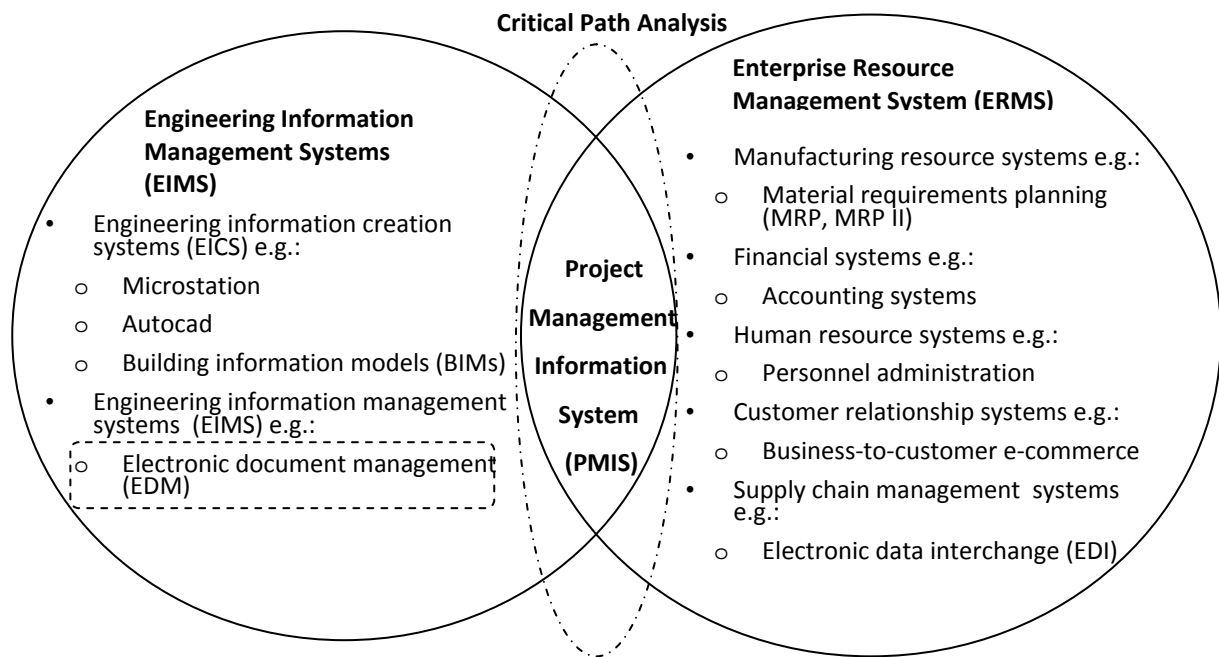


Figure 2-2 Information and Communication Technology (ICT) systems for construction project management (Winch, 2010, pp. 379-404)

In the context of the engineering information management system (EIMS), it comprises of two sub-systems which are Engineering Information Creation Systems (EICS) and Engineering Information Management Systems (EIMS) themselves, see Figure 2-2. The EICS creates information for the design discipline while EIMS interchanges project information between project participants. Besides, the enterprise resource management system (ERMS) manage the process in resource-based-orientated. It includes many sub-systems in terms of material requirements planning, accounting system, personnel administration etc (Winch, 2010, pp. 383-388).

### 2.6.1 Electronic Document Management Systems: Project Extranets

Project extranets are a technology widely used for exchanging, sharing, storage, and retrieval of project information. Project extranets make use of web technology connecting project participants to each other. They provide track ability and transparency in terms of information flows between project participants. The project extranet technology allows provision for time-efficiency. The extranet operates 24 hours every day. The average document approval time is seven days using extranets compared to nine days for hard copy documents. Additionally, it slightly improves the communication through integration with MS outlook. A notification email will deliver to defined e-mail address when the information is updated on the extranet (Winch, 2010, pp. 392-393).

## 2.7 Construction Project Manager

Construction project managers offer professional services from the initiation to the completion of the projects. In fact, the objective of construction project management is to integrate project phases such as planning, design, and construction. Furthermore, construction management should coordinate different participants involved in the construction process. Project managers may lead a whole project or only a part of the project like field construction. They give such services like coordinating subcontractors or taking broad responsibilities like planning and design, construction scheduling, field cost monitoring, and value engineering. And to deliver these services project management works with the project participants (Sears et al., 2008). This means the construction manager must be able to establish reliable working relationships with participants such as owners, designers, other managers, and supervisors. For this respect good oral and written communication skills are vital in addition to leadership skills (Jakson, 2004, p. 53).

The construction manager coordinates elements related to his/her project and deals with individuals and organization to deliver objectives. According to framework project manager works in it, if he has responsibility of the project he should simultaneously has authority over all elements of the project. Working in such a rapidly happening events industry not only demands manager's ability to take quick actions but also seems necessary to be encouraged to do so. All individuals working under project manager supervision should have him as only person to get orders related to the project. In addition the project manager should be the only one who raises issues of the project to the organization or the owner (Sears et al., 2008).

### 2.7.1 Construction Project Managers Qualification

Construction project manager to well perform responsibilities mentioned earlier and as a key individual that is interface between the project and other participants should have some qualifications:

- Problem-solving ability and results orientation. Qualified managers are commonly possessed of above average intelligence. They have abilities of performing chains of actions to achieve desired goals by analysing the situation and solving complex problems (Dainty et al., 2006, p. 40).
- Energy and initiative. Effective project managers are able to face and work under pressure environment of the industry and at the same time this does not stop them of taking the initiative in resolving difficulties (Dainty et al., 2006, p. 40).
- Self-assurance and self-confident, is another important quality that a project manager should have in order to perform his/her abilities in the project and to inspire his/her team members to do so.
- Perspective. Project managers must be able to see beyond the scene. They should be aware of effects the project has on the organizations. Also, they should be able to see discontinuities in the management systems being applied

on the managing project activities (Dainty et al., 2006, p. 41). Construction project can be very tricky and daily construction operations can make construction manager very busy. However, it is critical for a manager to always have a look to the future and upcoming events and activities. He should be prepared for material or manpower demands on the site and possible changes of the work to avoid any inconvenience for construction operations (Sears et al., 2008).

- Negotiation ability. This ability will help project managers to get what the project needs from other managers of the organization. Also it helps them to discuss on sponsors' expectation of the delivery.
- Communication, ability of communication in all levels, from the project sponsors on top to the junior members of project team and specialist disciplines, is a must for project managers (Dainty et al., 2006, p. 41).

Communication ability is a key connection and necessary for the achievement of the all other mentioned competences (Dainty et al., 2006, p. 41). Construction managers are positioned between the productions focused process and supporting and management focused processes performing by design and client team. Therefore so much information flows through them in both directions, so effective performance of information process will likely result in success and desired outcome (Dainty et al., 2006, p. 41). The ability of sharing information both in writing and verbal format is one of the top skills required by a project manager (Henderson, 2008). Project managers must let their teams know about a common goal and big picture. They should motivate team members to work towards a common goal. Effectively, they can take steps to achieve this goal without waiting for further instruction throughout the day if they know what the goal is for the day (Dainty et al., 2006, p. 229; Hanley, 2010).



### **3 Methodology**

Research methodology provides a procedural framework for how this research is conducted. In this procedural framework, it describes firstly the philosophical stance of this research method. Secondly, the research strategy is designed for acquiring the reliable and credible evidences for the research purpose (Remenyi et al., 1998). This research is to study how project participants handle project information which is related to business and management involving range of social science areas such as organizational behavior, management science, strategy, and organization studies etc (Bryman, 2008).

#### **3.1 Philosophical Stance**

The philosophical stance of this research includes the epistemological consideration and the philosophical approach. For the epistemological consideration, the empirical research theory is chosen for this research since empirical research paradigm is more dominant than theoretical research in business and management research. Empirical research refers to the research is based on, or guided by, what is experienced or observed. The empirical research studies the reality through observing experiments or relatively passive observation of what is happening. Related evidence is collected from the observations. On the other side, theoretical research is defined as the research is the contemplatively study of ideas, especially scientific ideas. It collects evidences from studying related writings of others and discourses without any direct observations and experiments. The theoretical research is implemented in a way that collecting relevant evidences, and reflecting on the evidences, and then constructing a new or different view of situation. For both empirical and theoretical research, the conclusions can be drawn, and value can be claim and added to the body of knowledge (Remenyi et al., 1998).

Although empirical research and theoretical research are different, these two kinds of research are not completely distinct. Empirical research requires sufficient and thorough understanding of what the related theoretical issues of the research subject and which evidence will be collected. Therefore, empirical research indispensably and primarily rooted in theory, and has a specific theoretical standpoint. Besides, the theoretical research collects evidence from literatures which to some extent are the results of empirical research (Remenyi et al., 1998, pp. 31-32).

Moreover, the positivist approach is applied for this research. Positivist approach means using the methods of natural sciences to observe objective physical social reality. It produces results which are the derivation of laws or law-like generalizations. The researcher is independent of and neither affects nor is affected by the subject of the research. The evidence can be obtained are able to generalize.

To decide the philosophical stance for this research, it is highly dependent on the background of researchers (Remenyi et al., 1998, pp. 32-38). Since we are all in sciences background, positivist empirical approach is more appropriate for us to conduct this research.

## **3.2 Research Strategy**

Research strategy is a plan that designs the research process. It contains the methods used for collecting data for the research purpose (Biggam, 2008; Bryman, 2008; Remenyi et al., 1998). For this research, it starts with a rough definition of research purpose. A theoretical sampling is developed based on the research purpose. Theoretical sampling is an iterative process of data collection for generating theory. Subsequently, the methods of data collection are designed in order to satisfy the hypothetical explanations (Bryman, 2008).

### **3.2.1 Research Purpose**

The research purpose involves in key participants (i.e. managers) in the project organization. The research domain is about collaboration, communication, information flow, decision making, management process, and the ability of managers.

### **3.2.2 Research Constraints**

Concerning the research constraints (i.e. cost, time, skills), the method of data collection is limited (Remenyi et al., 1998, p. 45). First of all, since we both cannot speak Swedish, Swedish language can be a barrier to get the right information. The research time is strictly confined approximately six months are available (from January to June). The research location is fixed in Gothenburg, Sweden. The studied companies are limited in Gothenburg. The academic background of us is mixed of construction engineering and management disciplines, and we both have working experience in both managerial and engineering aspects.

### **3.2.3 Cross-Sectional Research**

Since the time constraint of this research, it is more proper to carry out a cross-sectional research. Cross-sectional research studies the situation in short period of time. It examines the evidences which already exist at the time of the research study. The collected evidences attempt to find the differences or consistence amongst other relevant studies (Remenyi et al., 1998, p. 47).

### **3.2.4 Data Collection: Qualitative Methods**

Qualitative methods tend to collect data by understanding of experiences from the point of view of the people involved. It collects data from physical reality through conducting interviews, text analysis, surveys, and participant observation. It stresses on understanding processes and meanings (Rudestam & Newton, 2007, pp. 35-36). Given that the research purpose is highly related to the project manager's experience, it is more appropriate to use qualitative methods which allow the research to study project manager's experience.

There are some characteristic differences between qualitative and quantitative methods, as shown in Table 3-1. For this research, it may take more advantages from choosing qualitative methods. Provided that the research requires acquaintance of project manager's experience and the experience varies from project manager to project

manager since different background and organization they belong, qualitative methods allow understanding holistic view of phenomena in their naturally occurring and contextual. Furthermore, the data is difficult to convert into numerical data but can be easily expressed in words. Finally, the data analysis and discussion comprise of description, exploration and search for meaning (Rudestam & Newton, 2007, pp. 35-36).

**Table 3.1 Differences Between Quantitative and Qualitative Methods, sourced from (Rudestam & Newton, 2007)**

Quantitative	Qualitative
Data expressed in numbers	Data expressed in words
Hypothetic-deductive	Inductive
Controlled research situation	Naturally occurring and contextual
Isolation of operationally defined variables	Holistic view of phenomena
Seeks objectivity	Interested in subjectivity
Emphasis on prediction and explanation	Emphasis on description, exploration, search for meaning
Researcher directs, manipulates, controls	Researcher participates and collaborates
Statistical analysis	Text analysis

### 3.2.5 Data Collection: In-depth Survey

Given that the subjects of the research purpose requires collecting data from manager's experience, in-depth surveys provide a great advantage of allowing interviewees freely speak on the subjects (Remenyi et al., 1998). Also, in-depth surveys can easily map the concept and theory on the empirical observation (Ghauri & Grønhaug, 2005). First of all, literature study was carried out in order to build up the concept and theory. The literatures were searched from databases and E-book provided by the library of Chalmers University of Technology. Those databases and E-book are Emerald Library, Science Direct, ProQuest, and Books24x7. Lately, a questionnaire is designed for acquiring empirical data, sees Appendix I. The research topics are covered in the questionnaire (Bryman, 2008). The interviewees were encouraged to elaborate in detail and, if any, to answer followed up questions when the issues were particularly investigated (Remenyi et al., 1998). During the interviews, hand notes were taken. The interviewees were informed that the interview was recorded. The interviews were semi-structured. The interviewers can ask some more questions that are picked up on things said by the interviewees. The semi-structured interview process is more flexible. The interview process relies on how the interviewees apprehend the issues which are

important. Two interviewers were present for all interviews. One interviewer asked the questions and the other one took notes and observed the interviewees (Bryman, 2008).

### 3.2.6 Interview Sampling

Since purposive sampling is adopted for this research, the informants are not chosen in a random basis. Instead, the informants are strategically chosen in order to provide appropriate samples for the research purpose. The advantage of the purposive sampling is to give a good correspondence between the research purpose and sampling and a good variety in sample members (Bryman, 2008). For studying the collaboration between project participants, various roles of interviewees are required such as client, consultant, contractor, and external project consultant, see Table 3.2. Different companies are interviewed so as to seek for the similarity and reduce possible biases of data due to different organizational cultures (Remenyi et al., 1998). For that reasons the purpose sampling is suitable for this research as informants are relevant to the research purposes (Bryman, 2008).

<b>Table 3.2 A summary of interviewees</b>			
<b>Interviewee</b>	<b>Nature of company</b>	<b>Position</b>	<b>Represented role in the thesis</b>
<b>A</b>	Contractor	Senior manager in top management	Contractor
<b>B</b>	Contractor	Manager of process development	Contractor, communication mechanism development.
<b>C</b>	Contractor	Senior manager in top management	Client
<b>D</b>	Consultant	Junior project manager	External project management
<b>E</b>	Consultant	Senior project manager	External project management
<b>F</b>	Contractor	Senior project manager	Contractor
<b>G</b>	Contractor	Site manager	Contractor
<b>H</b>	Contractor	Site manager	Contractor
<b>I</b>	Consultant	Project manager	External project management

### **3.3 Data Analysis**

The data analysis process began from theoretical sampling which provided a preliminary theoretical framework for what kinds of data were looking for from the interviews (Bryman, 2008). After the interviews, data was collected. We carried out data reduction. We summarized the field note by seeking the similarity of data from different interviews. The data were then reduced after the process of selecting, simplifying and transforming the data from the field notes. The data are categorized into different topics which we will discuss later on (Ghuri & Grønhaug, 2005).

## 4 Findings

### 4.1 Brief Overview

Data for this thesis is collected by nine interviews. First, after preliminary reading about our subject we found areas that should be considered. Second, the questionnaire is designed. Questionnaire contained ten questions (see Appendix I). Interviewee should answer them in face-to-face interviews. We predict that some of the questions may need to describe more because those contained terms from theory. Finally, interviews took place during two and a half months. Our target was to interview construction managers. These managers should be from different parties of construction projects, like contractor, client, and consultant. We interviewed people from large-size and middle-size companies. Except one company all the interviewed companies are Nordic-countries based. They all have an office in Göteborg. To achieve extensive understanding of the information handling in the construction industry we chose that broad range of interviewees.

Interviewee A is a manager of building department (Avdelningschef Hus). Interviewee is supervising six business units in Västra Götaland area. Construction of apartments, schools, offices, building industries are active within this business unites. He had almost 30 years of work experience started from a small construction company at Borås and he continued to upper management levels. Interviewee has civil engineering academic background. The company develops residential, commercial, industrial and public properties, and infrastructures. The company is one of the leading construction and property development companies in the Nordic region with approximately 21,000 employees.

Interviewee B is a manager of process development (PU/Kompetenscentra). His main responsibility is concerning concepts like quality, environment and strategic matters. He has 16 of years work experience in different positions in the company. He was not construction project manager but he had experienced managing internal projects like managing strategic projects, computer projects and developing systems for the construction company. His academic background is related to land survey and geo-information engineering. He works in the same company as interviewee A does.

Interviewee C is a manager of commercial development (Projektchef Kontor). He works with office buildings in Göteborg and Oslo. He has client position for other division of the company, and he has more than 35 years work experience. The company develops offices, homes and public-private partnership projects and is a multinational construction and development company with more than 50,000 employees.

Interviewee D is a project manager, and she has different projects such as Swedish churches and administration buildings. She has six years of work experience, started as an assistant project manager. Her academic background is the bachelor of construction design. The company is a branch of international group active in 35 countries with over 9,000 employees. The company provides management and consultancy services to building industry. The division interviewee works contains other 30 project managers.

Interviewee E is a construction project manager, and mainly works on infrastructure such as heat power plant, natural gas research plant, warehouses and tunnels. The interviewee had a variety of work experiences such as contractor, consultant and client. He has 30 years of work experience. His academic background is within mining engineering. The company is a branch of a large engineering consultant with approximately 9,000 employees. The Swedish branch of this company has around 1,400 employees and it is active in engineering and design, and project management.

Interviewee F is a project manager (arbetchef). He is responsible for certain type of building construction like industrial, health care, offices and specifically not housing projects. His team members contain site manager, purchasing and procurement support. He has 21 years of work experience. The interviewee is graduated from civil engineering. The company is a construction and civil engineering company. It operates in Sweden, Norway and Finland with approximately 13,000 employees.

Interviewee G is a site manager, and he is now site manager for a commercial office building project. The interviewee has 20 years of work experience. His academic background is civil engineering and master in quantity surveying. He works for the same company as interviewee C does.

Interviewee H is a site manager. He has work experience as foreman for four years, and eight years as site manager. The interviewee mostly worked in a variety of projects such as industrial buildings, offices, schools, hotels and health care buildings. His academic background is in practical construction studies. He works for the same company as interviewee F does.

Interviewee I is a group leader of construction, or Teamledare Projekt in Swedish. He works for several housing or renovation projects. He is representative of owners in the projects and he is involved in the construction process from early stages. He has 20 years of work experience. His academic background is in technician civil studies. The company is a branch of an international company with approximately 1,650 employees. The company is active in planning and design, consulting in variety of fields. Project management department of Göteborg headquarter contains six other employees.

## **4.2 Management Process in Construction; Use of Media**

Interviewee A said that he mostly uses personal visits and meetings and interviewee C added reports for information transaction. They mentioned that information was often provided by emails before a meeting and then they discuss on the meeting. Interviewee A said that he usually writes minutes of meetings. The minutes contained instructions and orders for other participants. However, he was not sure if this way of transaction was an efficient way but he was satisfied for results.

Some construction companies used in-house information systems they developed. Some others used systems developed by external consultants who were specialists in IT. Those specialists designed and managed intranet, extranet and other web-based software for construction industry. If a company was using an external system, it often was a kind of portal for sharing information among stakeholders.

Interviewee D said that they used an information system based on PMI standard which was developed by the company. This system was a portal and it provided templates such

as report formats. Moreover, this system provided guidelines and a sequence of the tasks. The sequence was used to prevent missing important tasks that should be performed by the project manager.

The information system exploited in different projects depends on project duration, goals of the project, and participants. A predominant part of the interviewees have used other ways to search and get information besides what is provided from the systems. Further, interviewee E underlined a current importance of email system for exchanging information. He thought the email system was a fair solution to exchange information. For example, if he had a question to ask from a designer, usually he needed to ask the designer when he was behind his desk, so he could open drawings and documents to answer the question.

Moreover, people who were working in the office checked their emails very often or even immediately after they got the emails because of the hints software sent to a computer desktop. So there would not be long time between asking information and getting answer, if the other side were responsible. Importance of emails to exchange information can be clearer when interviewee F mentioned that average of emails he got was more than 20 per day. However, there was not defined policy for sending emails in his company, therefore some information he got from emails were not relevant to him.

Interviewee F divided documents handled in the information process to two electronic and hard copy types. He mentioned in some projects information was exchanged only by electronic documents but in some others there were a mixture of both electronic and hard copy.

### **4.3 Sharing Information**

Internet and intranet were available in all working places. Therefore it was possible to send information such as newsletters by emails to all persons involved in the projects, interviewee B mentioned. However, some information needs clarification and it is not enough sending it by newsletters. He said that in such cases, first high level manager shares this information in a meeting with managers under his supervision. Then those managers present the information to people under their supervision. So chains of presentations were performed to inform all employees about the subject.

To maintain efficiency through the projects, effective integrated information systems are preferred, highlighted by some interviewees. Interviewee F stressed that the information system should contain all information instead of having different programs for different areas. For example in a company there were administration system, project portals, shared space and email system. Moreover, if the project is small and with short time, accordingly organization does not put that much budget to develop information systems for it and some of these systems will be missing.

### **4.4 Decision Making**

Interviewees did not agree on a single definition for critical information to make decision. Some of them thought information related to time is more important and some of them thought information related to cost or quality is more important. In cases that there is a fixed deadline for the project, a company even should choose costly methods



to meet deadlines. Therefore, in this case time was more important. Interviewee F also pointed out information related to different options to take actions were important. He had to know about different consequences according to time, cost and quality if a specific solution was chosen.

Construction managers who were interviewed had different types of customers. A majority of the managers believed that public or private customers sought different objectives. For some public customers quality came first and this factor affected time and cost.

Interviewee G stressed that information should be filtered to get to the project manager. He is a site manager and said that there is no need to send all information to the project manager and only useful information should be shared to higher level of decision making. Similar to this, interviewee B mentioned a solution for spreading information. In this approach information shared by reports and newsletters is labelled by 'must know', 'important' and 'just for information' and so on. This would save time for audience to get to the main points very fast by looking at those labels they were and not reading the whole text.

Value stream map is used to indicate the value-adding activities of projects, and also sort out possible non value-adding activities. All interviewees were unfamiliar with this term and definition. Only interviewee A knew about the lean concept. He got knowledge of it from a workshop that was held by a consultant. This top manager perceived that in the near future everyone should work based on the lean concept. However, interviewee E after listened to the definition of value stream said that it was vague for him and asked how he could follow such a system.

During searching for same objectives as value stream mapping, two interviewees mentioned project execution plan. Project execution plan contained goals of the project. Those goals came from discussion by client, and were connected to quality, time, design, environmental factors, safety protection, and energy efficiency. Experienced clients actively involved to the process of defining goals rather than inexperienced one. Later, those goals were discussed in the project kick off meeting and everybody in the project was responsible to keep those goals. Interviewee D stressed that goals were different in different stages of the project. For example during construction focus was on cost but at the end, for delivering project quality was more important.

Interviewee H mentioned that if the building constructed based on the goals defined in the project client would be satisfied. Though, project manager can contribute to saving money or time by exploiting successful practices from previous projects. He said there was not any process to collect his ideas that could increase quality or decrease cost in the project. However, interviewee G mentioned that the company gathered feedbacks from other projects to identify value-added aspects. Further, interviewee H said project managers do not contribute adding values to projects since it was time consuming, increasing load of work and responsibilities.

One other important argument was about making decision when there is not enough information available. Two experienced project managers mentioned this problem. They said that decisions should be made quickly and can be changed later during the projects if necessary.

Interviewee G stressed importance of informal communication in Swedish culture. Fika, a coffee break, is the time that people in workplaces gather to have a drink and snack. During this event they have a possibility to talk about work. He said if somebody did not participate in those breaks, that person would miss many important discussions and information. Even some decisions were made during those pauses from work. However, he highlighted the danger these kinds of handling information contained. There was possibility that important information disappeared in those informal communications.

#### **4.5 Efficiency of Meetings**

It seems meetings are very important for exchanging information in construction business. Meetings are settled to establish and retain contact to exchange and receive information. Managers' schedule is full of different types of meetings. Those meetings are about how construction is performing in daily basis, progress, changes, strategic view, budget, safety and contractual aspects. The number of meetings the project managers attend is dependent on the complexity of the project and the number of projects they manage. Meetings are planned before or sometimes unplanned. Unplanned meetings are often about deviations from project plans and practical issues.

Managers use meetings to collect information to do decisions and solve problems. Sometimes the participants come to meetings with their solutions to the problem. They discuss and achieve to a common solution. Finally the agreed solution satisfies different parties of the project.

Meetings are face-to-face media for exchanging information. However, for some cases face-to-face meetings are not applicable when the participants are from different locations. The communication methods and tools should be changed to e.g. video-conferences. Interviewee B mentioned that the company had defined travel policy for meetings. For the kick-off meeting all the key personnel should present the meeting. But for the rest of the project, the communication method must be cheap and efficient. Therefore videoconferences or teleconferences are other choices in this matter.

Agenda of a meeting clearly state what subjects will be discussed in the meeting. To be able to have effective and rewarding meetings common agenda are prepared before and subjects are prioritized in certain orders based on importance. According to our interviews, the agenda of the meeting is sometimes predefined and sent before the meeting. On the other hand, the minute of the last meeting is accepted as agenda for the next future meeting. Participants should deliver the tasks mentioned in the minute for the next meeting. Few interviewees would send extra materials to participants and ask those to be prepared for discussion on a specific issue.

Meetings with site managers and site staff are critical. Usually coordinating those meetings is difficult. Those meetings should be early in the morning, so setting time and date that is appropriate for all is difficult. Face-to-face meetings are more efficient than other ways of communication, the interviewee D said. Usually if a lot of questions regarding to construction work comes up, she calls for a short meeting earlier than next scheduled meeting. She stressed that important issues in the meetings is putting down decisions and solutions on the minutes. This method helps her to keep record of the project and prevent to forget. Moreover, only interviewee H brought up that they have casual meetings before the weekly site meeting. During the casual meetings, he gives

some information about what they will be going to discuss in the weekly meeting. He claims that this action helps the participants to collect information needed for the weekly meeting.

All interviewees were aware of non efficiency of long meetings. But they had different expectation and definition of long meetings. Most of project managers agree that after two hours meeting attendances cannot concentrate on the discussions. Interviewee B said two to three hours are ideal time for a meeting. While interviewee E mentioned exact one hour and 20 minutes is his ideal. He mentioned that usually one hour is short to finish a discussion and two hours is too long to be efficient, so he always tries to keep meetings less than two hours. Despite of this fact, some managers mentioned that meetings with client are sometimes long meetings and continue up to four hours.

Some interviewees had suggestions to avoid long meetings. First, detailed technical discussions should be discussed in separated meetings, so it will not waste the other's time and the meeting is more efficient. Second, visualization of information is a solution that two construction managers mentioned for the efficient and effective communication. The information can be easily understood through an A3-size report, a very simple highlights, and some notes on the drawing. Finally, interviewee E mentioned some contractors requested to attend a part of the meeting which was only related to their agenda, and left after their part. However, he did not accept this arrangement because there is always a possibility that those contractors were involved in other agenda. In many case, it is necessary that the contractors sit for the whole meeting since the decisions made would affect those contractors' work. Moreover, those participants can get overall understanding of the whole project that may help them to keep the same speed as other parties involving in the construction.

Another issue about keeping meetings efficient is about the participants. Interviewees mentioned some did not contribute to discussion. However, sometimes there are participants that only take information for their own sake. They do not need to involve in the discussions. Construction managers said they always tried to invite as few team members to the meetings as possible. The flow of discussion will be faster and easier. Further, several of the interviewees mention that they often try to invite the right team members to the meeting. Therefore they can gather the right information to do the right decisions. Furthermore, interviewee E said that the number of representative from different parties should be even in the meetings, since sometimes they use a voting system for decisions. In addition, when a problem is on the table if only one person represents a party he or she should respond to questions and he/she cannot blame the other like when they are more than one. In fact, most of the construction managers are chairmen, and are responsible to invite people and keep discipline. Only interviewees F and G mentioned that participants to planned meetings are named in the execution plan document.

Interviewee G highlighted poor meeting discipline in Swedish construction companies. Meetings should have time limit. Since solutions are achieved by discussion among participants in the meeting, everybody should be prepared enough to finish meeting based on time limit. Further, interviewee G said that by following up before meeting manager could keep people prepared for meetings. Furthermore, some extra questions always come up in the meeting. Those should be kept on the table for next meeting.

#### **4.6 Information Process for Organization**

Whenever a system is developed, the company should persuade that every user gets enough knowledge related to the system. Four interviewees stressed that understanding is through training sessions, meetings, intranet and newsletters. They thought they had good systems but they had problems with the systems' users. First, some users did not use the common system in the company. Those users liked to use other available systems that they had experience of working with. Second, some users did not use information systems correctly. They put information in wrong places. Third, some others were not aware of all features and facilities that the systems provide. Forth, there was too much information saved on the system that sometimes made finding what managers needed time consuming and slow. Finally, some put uncompleted data on the system. So they concluded that company should have three actions to handle this situation. First, good training should be provided for users. Second, all staff of the company should be forced to use the common system in the company. Third, there should be instructions as a backbone to refer to in case of difficulties for using the system. Finally, there should be search engines to make finding information easy.

Interviewees A and C that were top managers, claimed that priorities in information process to managers was dictated by the organization. Moreover, project managers used project descriptions and project plans that contained goals and priorities. The goals were adjusted to fulfil the clients' demands. Moreover, meetings were places where managers could set time limits and priorities for their team. All managers clearly said that they do not follow first-come first-out method for information handling. Interviewee G clearly said he thinks about his work and gives priorities to tasks.

#### **4.7 Collaboration and Information Process**

Interviewee B highlighted relation between stakeholders in the project and an efficient way of collecting information. For example, interviewee D said that channels of communication in her projects were defined. Contractors could not directly contact or send information to the client, and she was a centre of any communication. She also said, it should be considered that process of making decision would be different if the client was involved or not. If the client was involved, he or she should be informed about the situation and then the project manager should wait for response from the client and then take an action. The way interviewee H from contractor side was working contradicted what interviewee D said. He could exchange information with the client in the project.

Interviewee H highlighted the way that he collected information in different type of contracting. He answered that for design-build contracting he needed to contact the architects to get the right information and drawings. Further on, he said that contractor in the general contracting gets information provided by the client.

#### **4.8 Project Managers' Ability**

Almost half of our interviewees claimed that work experience is vital for managing information flow. Some referred to social competence and leadership skills to communicate with participants in the projects. Interviewee B mentioned the necessity of

work experience for sorting information. The project manager as a centre of the information process gets lots of inputs from a project. So he should be able to recognize and keep only useful information, otherwise after a while he or she could not find what he wanted among the large amount of data. Concerning this subject, interviewee G mentioned that not only keeping information is important but construction manager should filter information before sending it to others.

Further on, another skill for project manager is putting important information on documents for the project record. Reporting is one of the most important ways to transfer information. So the ability of preparing clear, on point reports and writing skills are very important for construction managers. Moreover, visual information is easy to understand and easy to communicate. Therefore managers should exploit a visualization of information, according to interviewees B and H.

Every construction manager kept his/her own diary or journals. Those diaries were very simple like notebooks or a combination of notebook and schedule. Only two interviewees, B and G, used computer and cell phone for this respect. The way construction managers kept notes and information from the project on these notebooks is very simple, without any sorting or organization. It was only based on sequence of events or tasks they should do in the future. Interviewee F claimed that using notes and paper are less time consuming compared to putting this information on electronic devices. Moreover when information is on the paper it gives a clearer overview than on a screen. However, interviewee A said that the way they use paper or computer depends on the organization they work ins.

Another important aspect that should be considered was while interviewee A named his notebook as a journal of secrets, the others, interviewee G, said that all important information for a project should be documented and the journal was only for his sake.

## 5 Discussion

The following discussion session will discuss the collected data with reference to the theory.

### 5.1 Re-Thinking the Collaboration Relationship

Since the construction industry is project-based and multi-organizational and the production of construction is human-dependent, the productivity is highly relied on the collaboration between the project participants (Bresnen & Marshall, 2001; Anumba et al., 2008). Interestingly, from the interviews there are three types of collaboration observed. The collaboration is fundamentally affected by the project coalition. Different collaboration communicates construction information among parties in different way (Winch, 2010). Two of those are the traditional collaboration relationships like general contracting or total contracting. It includes participants such as client, architect, consultants, and main contractor. In general contracting, architect or consultant is mostly the project manager and is representative of the client, whereas the general contractor is the project manager in the total contracting. The other coalition is called construction management contracting which is basically formed by the same participants as the traditional collaboration. But it additionally involves external project management consultant. In this collaboration relationship, the external project management consultant manages the whole project performance on behalf of the client (Winch, 2010). Since the external project management consultant represents the client and is more involved, it pulls the value in the process (Mascitelli, 2002). The external project management consultant links all participants to work together more time-efficiently through facilitating effective and efficient communication of information which are related to the value-adding activities of the projects. It is vital to consider the activities in the process in order to find out and eliminate the non value-adding activities. Looking into the activities in the construction process, it contains massive activities for collaboration and communication of information among different parties to proceed with the construction work (Peansupap & Walker, 2005; Winch, 2010). With engagement of external project management consultant, it facilitates the effective and efficient communication among the parties through eliminating unnecessary or excessive communications and information from the project. As the result, the time efficiency of the project will be improved. Furthermore, the cost spent on those unnecessary or excessive communications and information can be saved.

### 5.2 Decision Making and Communication

Although all interviewees know what the value of the project is, nearly all interviewees do not know what a value-adding activity is. Not surprising that they all do not know the concept of value stream creation. Nevertheless, interviewees try to think about value-adding issues and connect the value to project goals and to customer satisfaction. Undoubtedly dealing with project goals and customer satisfaction are what the project managers are working with. The direction of their thinking is correct. To certain extent the client expectation is the benefit what the client wants to get from the project, so that the client expectation represents the value of the project (Goodpasture, 2002). Also, the

expectation is captured during the planning stage and is transformed to become the project goals (Thomson et al., 2006). Even though the interviewees are able to catch the broad view of value stream creation, their understanding of its context is indefinite. They do not know how to define the value-adding activity and non value-adding activity for a project. The project managers' lack of knowledge of the value stream creation is very problematic for decision making. It affects the project efficiency and project performance in the way that 1) from where they can get the highest value information to make decision, 2) they may overshoot or undershoot the information, 3) many unexpected consequences occur causing further problems in the future and affecting the overall customer satisfaction (Gyampoh-Vidogah et al., 2003; Mascitelli, 2002).

The way how the project participants collaborate and communicate is also controversial. One interviewee says the information should be filtered. The interviewee means the senders should make the information more precise and brief. Then the interviewee also filters the information for the next receiver in the same manner. Again, the mindset of the interviewee contributes to improve project efficiency (Mascitelli, 2002). However, the interviewee cannot further explain clearly how to filter the information. The interviewee says it is based on the working experience for filtering. Perhaps the interviewee can successfully filter the information and contribute to project efficiency, but without the knowledge of value creation, it is very difficult for the project manager to filter the information. Furthermore, the project manager not only needs to possess this skill, but the other participants should also learn this skill. But since this skill is based on one's experience, teaching other participants to learn this skill seems challenging. Consequently, the information coming into the project manager cannot be brief and precise. Furthermore, the communication between the participants becomes inefficient. Sometimes too much information, it makes the receiver spend more time on reading and comprehending the information for decision making. When essential information is missing, the receiver takes additional time for finding the missing information (Mascitelli, 2002). Therefore, the communication between the participants becomes inefficient. As a result, it decreases the project efficiency and induces an increase of the transaction cost (Mascitelli, 2002).

### **5.3 Efficiency of Meetings**

All interviewees filled up their schedules with different types of meetings such as weekly construction site meetings, monthly client meetings, purchasing meeting, and progress meetings etc. Those meetings are defined in the project plans in which the time interval of meetings and participants are mentioned. This is a common phenomenon happening in construction (Mascitelli, 2002). The interviewees see meetings as very important for exchanging information. Based on the information, they discuss issues and make decisions in the meetings. By this action, the decision made will satisfy different parties of the project. There are generally two types of meetings: planned meetings and unplanned meetings.

#### **5.3.1 Planned Meetings**

Planned meetings are regularly scheduled meetings. Those are used for reporting, checking and reviewing the project status. Some interviewees showed the planned

meetings are defined in the project plan. For a planned meeting the purpose, the chairman, the participants, and how often the meeting is holding are defined mostly from the beginning of the project. For example, every week meetings to control progress status of the project are planned meetings. Though the planned meetings serve their own purposes which are necessary to keep the project on the right track, it does not have to be in form of meetings. Meetings waste lots of time. It is critical to re-think what the right medium is for the purpose. The right medium should be more time-efficient. For instance, exchanging information like reporting or reviewing can be done in another ways such as sharing documents via emailing (Mascitelli, 2002).

### **5.3.2 Unplanned Meetings**

Unplanned meetings are used to discuss the issues like deviations from design or specification, design changes, technical problems etc. The discussions carried out in the unplanned meetings aim for solving problems. So, the decisions drawn are problem solving solutions. The purpose of the unplanned meetings is to settle a solution by discussing the problem among involved parties, so unplanned meetings are categorized as contingent meetings (Mascitelli, 2002). However, the time efficiency of meetings is important. There are some factors affecting the time efficiency of meeting. All interviewees agree on that inviting the right participants to the meeting is the most critical factor. Second, all participants should discuss the problems in accordance to the agenda set by the project manager. Third, participants should gather critical information for discussion or prepare a solution for the problem before the meeting. However, according to the comments from interviewees, there are some issues taken for granted. Those issues are “right participants”, “same agenda”, and “be prepared for the meeting”. In order to improve the time efficiency, it depends on the chairman’s ability to manage meetings (Maylor, 2005). But the chairman of meetings is not all the times the project manager of the project. Therefore the project manager should define rules for meetings. With reference to Gabriel (1997), it is essential for project managers to set up a communication mechanism in the project team. Creating a good communication mechanism is also a challenge. It highly relies on the project manager’s ability and experience for setting up the mechanism. The project manager’s ability will be discussed in later section.

### **5.3.3 Other Concerns Regarding Efficiency of Meetings**

There are some concerns raised by interviewees regarding the efficiency of meetings. First, visualization of information helps the others to understand the problem/issue easily. Especially the technical problems which are difficult to interpret by words for the management can be easier to communicate with drawings. Some of the interviewees point out that there is a travelling policy in their organizations. When meetings are held in other place where the traveling hours is over the limit set by the policy, videoconference is recommended in order to avoid unnecessary long traveling. Nevertheless, sometimes this practice may not be applicable if the meeting is required to be face to face (Mascitelli, 2002).

Besides, concerning the efficiency of participants’ minded concentration decreases with the length of meetings. The length of meetings should not be more than 2 hours (Maylor, 2005). Some interviewees mentioned that if during the meeting there are some



technical problems or other problems not related to the agenda, those will be remarked and discussed in a separated meeting within a sub-group. The chairman of the meeting should keep the discipline in a way that all participants follow the agenda, not distract the issues out of the agenda. Participants shall present their opinion on the issues, and nobody should leave earlier.

#### **5.4 The Project manager's Ability to Facilitate Efficient Information Flow**

Information transfer includes at least two individuals, one acting as a sender and the other as a receiver. According to Gabriel (1997), project manager is at the core of the process of transferring information, so given the fact that the project manager usually stands in one direction of the transferring information. Further, he/she is the one that decides who must receive the information, when and the format of the information. Therefore the effects project managers have on the process is considerable.

The question is what affects the project managers' ability has on handling information? What personality or techniques can help them to add more value to the process of information handling despite the information system they use, and if there are shortcomings in this area.

The result showed that managers did not use first-in first-out method to prioritize which information should be processed first. Although some of them were keeping notebooks that included their tasks without any specific order, but when time for actions came they thought about priorities and prioritized their work based on deadlines, cost and benefits, subject or receiver of the service. However, we could not judge factors that affect priorities they were giving to information management. We could not say which one is more important. But it was obvious that those factors are different for different level of managers. High level managers were looking beyond the scene and considered issues related to the organizations as important issues to address. This issue will be discussed with another point of view in next the section.

According to Sears *et al.* (2008) work experience is one necessary qualification that a construction manager should have. Related work experience to construction execution can help project managers to carry out their responsibilities. Along to this, almost half of our interviewees highlighted importance of work experience to manage information flow. Project managers should be able to see interruptions in the management process (Dainty *et al.*, 2006) and take actions to get the smooth flow of the information. However, work experience can be dangerous in some extent. Some may get used to the way they do their responsibilities and this may become an obstacle for change and improvement. For example to answer a question if they could address other efficient ways of dealing with information except the way they had exploited, some of them answered that they used these methods for a long time, there were probably some other ways that they did not know.

Moreover, only two construction managers used computer and electronic devices actively. Rest of them still believed in notebooks. Construction industry and its managers can indeed increase their use of information technology. If the industry has changed media of information transaction from hard copy documents, fax mails and telephone to emails, extranets and portals (Dainty *et al.*, 2006), then managers could utilize available technology more as well.

## 5.5 Construction Management in Organization

It is interesting to discuss how the construction companies do information and management processes for construction projects. According to Gyampoh-Vidogah *et al.* (2003), the way the organization handle project information determines its management actions and decision making processes. Consequently, this will affect the project value delivery in terms of time efficiency and transaction cost (Mascitelli, 2002). When the interviewees mentioned how they processed information and took management actions for making decisions, there were some similarities. Although they used different ways to process information and to take management actions, they tried to be more time efficient. For example, all interviewees replied that the meetings should not be longer than two hours. Furthermore, the interviewees attempt to prioritize their work queue and make their own to-do list. This is an important task. The interviewees prioritize the work according to its importance, time limit, impact likelihood. However, it never says that how they organize the work queue can improve the time efficiency of the project team or even improve the project's value delivery. According to Mascitelli (2002), the work queue should consider the resource utilization and the value stream map. Furthermore, managers can determine an adequate lead time for the work, and then prioritize the work. Because they based their experience to apprehend on the work's importance, time limit, impact likelihood to do the work queue. Apparently, the theoretical and practical work queue shares a bit similarity. For instance, time limit refers to lead time, importance and impact likelihood may talk about the resource utilization. Additionally, it seems that the interviewees do not possess the theoretical knowledge to do the work queue. Instead, they used their common sense and work experience to prioritize their work in the ways like problem solving, predicting upcoming impacts or events. Therefore, the interviewees tried to improve time efficiency. Nevertheless, they may not succeed to improve the value delivery if they do not understand the relation between work queue and resource utilization and they do not know how to setup a value stream map. It is not only that they are not familiar with the terms since those terms were described to the managers.

Besides, the use of communication media not only can affect the time efficiency, it can also affect the transaction cost of projects. The interviewees responded that they basically communicated project information through meetings, emails, phone calls, and reports. They are most likely to have meetings and emails. Nearly all the interviewees said that meetings are good as they allow many people to face-to-face discuss the matters. Decisions can be made after the discussion. On the other hand, the interviewees mentioned emails were also frequently used since emails give an advantage that information is transferred in a written form. Information like construction drawings or other documents can be presented easily. According to how they make use of communication technology, those show that the management processes used by the interviewees are appropriate (Mascitelli, 2002). But the transaction cost will only decrease if the project managers know how to choose a right communication media and at the same time ask others to do so. For example he should ask his team members to send specific information by email or call him to share some information.

Today's many companies have adopted Information Systems for better information communication. Some interviewees mentioned that they used an extranet to communicate the project information. This is an electronic document management

system called project extranet (Winch, 2010). The interviewees described the project extranet was like a common platform for different parties to upload and download information. The information includes drawings, contracts, reports, minutes of meetings, schedule. From this reason, the project extranet tends to be more like an Engineering Information Management System (EIMS) since it provides provision for information interchange (Winch, 2010). In addition to the extranets the companies use email, intranet, extranet, shared space and some web-based software to share information in the project and within the organization. However, instead of having different types of systems for different areas it will be more productive to collect and share all information on a single system. Moreover, even utilizing a unique system by all parties can form a better collaboration within the project. Though, this may require extra costs or long term collaboration. In fact, by providing an easy method to communicate information, it may reduce the time spent on asking for the latest information that one can download from the project extranet.

Furthermore, interviewees were satisfied by the services that the ICT systems provide. However, one may claim that the project managers' expectation from the information systems was elementary because of their lack of knowledge about ICT or their desire to use traditional methods. On the other hand, one may stress that the reason project managers are not acclimated to the systems is because services provided by current systems are often as basic as traditional methods and copying those methods. The systems do not add so much value to the management processes, so the managers still prefer traditional methods.

## 6 Conclusion

The purpose has been to investigate effects of the information handling on the value delivery for the construction projects. For that reason, nine face-to-face interviews conducted with managers of the construction companies active in Sweden and all along that literature review was done to fulfil and answer the purpose. Information process in the construction companies were infected by partial or purely non-value adding activities. This problem observed in collecting data, communication, decision making, and sharing information. Communication between participants was deficient due to many wasteful activities and unnecessary transaction costs. Authors may highlight indefinite understanding of the value stream creation as the core reason leading information handling deficiency and cost for project efficiency and project performance.

Our study shows that all interviewees accept understanding about the value of the projects but they are incapable to define value-adding activities and they all do not know the concept of value stream creation. However, the direction of their thinking is right. We discussed how this can be problematic in the process of decision making. It affects project efficiency and project performance since there is a chance of missing the highest value information to make decision and information overshoot or undershoot. Indeed, we try to tell people it is very important to consider the non value-adding activities in the construction management. Such non value-adding activities not only consume a part of project cost but also affect the project efficiency. Construction companies' initiative should be training sessions for construction managers and providing them by appropriate information on this respect.

Observations and interviews show that the companies have proper infrastructure to support ICT services inside their offices and outside on the field and they use variety of information systems. Accordingly, two suggestions are provided. First, integration of information systems can increase productivity and time efficiency in the information handling of the companies. Second, proper trainings for project managers and users of the information systems must be underpinned. This will help them to better utilization of the current systems and may lead them to asking for better services beyond the traditional methods.

In this study, we have found that the project collaboration will affect the communication channel. It is the fundamental cause which determines how the project information will be handled and communicated among project participants. As a result, the project efficiency will be affected. An external project management consultant facilitates communication among parties and eliminates unnecessary information process of the projects. Moreover, it pulls the value in the processes. Therefore the companies can exploit construction management contracting more and get benefits of this type of the coalition.

The contribution of project managers in the information process is significant, since they can use their experience to filter information and to share and communicate precise and brief information. Further, other participants should also possess partly the filtering skill to contribute to the information process. However, owning this skill seems challenging in view of the fact that it is based on the personal and practical work experience. Once again, knowledge of the value stream creation comes to mind, while

without the awareness, it is very difficult to do right filtering of the information. For this respect, the construction companies should facilitate knowledge sharing and trainings for construction managers and other participants.

Meetings are very important for exchanging information and decision making. Although meeting is just one media from a variety of options project managers have to share information, it is used frequently and occupies much time of the project management and his team. Our first suggestion related to meetings is to not hesitate to call off the planned meetings if there is not critical information to share or decisions to make. Second, meetings waste lots of time. Managers should critically think and find the right medium that suites their purposes. Third, inviting right participants to the meetings is very critical. Next, all participants should agree and stay focused on the same agenda and should be prepared for the meeting. Respecting Swedish culture, a coffee break (Fika) is a good opportunity to exchange information and follow up before meetings to get prepared. Finally, the chairman of the meeting, that usually is the project manager, should keep the time and discipline in the meeting.

Project managers should not only get work experience related to the construction process and managerial training, but should also develop their skills related to information handling. Those can include using information systems and different gadgets that the current technology provides. Only a few interviewees were actively using those technologies. Moreover, as mentioned in the discussion, visualisation of information can increase efficient and effective communication. Visualisation helps the message to be transferred easily and received correctly. Therefore project managers should develop verbal communication, writing and reporting skills. The construction companies should consider these aspects when hiring project managers or promoting staffs to be project managers.



## Appendix

### Appendix I - Interview questions

1. Can you please introduce your current position in this company, types of projects you handle, work experience and academic background?
2. Can you describe the management information system you use to manage project information? like how you gather information to do decisions? What do you think is the most efficient way to get the information?
3. Can you give one suggestion about how to improve the system to be more efficient?
4. Beside the information provided from the system, do you need to search for information on your own?
5. How you define the information which is critical for making decisions?
6. Value Stream map is used to indicate the value-added activities of projects, and also sort out possible non value-added activities. My question is first do you used value stream map for projects? How do you set the value stream for projects? and whom in the project will know the use of value stream?
7. How many regular meetings do you have per month or per week? Can you describe what information you exchange in these meetings? How do you decide who shall come to the meeting? On average how long is the meeting?
8. Can you tell if you have documents that go through approval cycles and need more than four signatures? for what purpose?
9. How do you prioritize your work? How do you coordinate your work priority with the project manager?
10. What skills do you think are useful for managers to handle information efficiently?





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