NTNU – Trondheim
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Project Time Planning in Norwegian Construction Industry

An Empirical Study

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Project Management
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This thesis is dedicated to my beloved parents,

Ali and Farzaneh,

who lovingly have supported me through my life

تقدیم به پدر و مادر عزیزم که عاشقانه مرا درطول زندگی حمایت کرده اند

Preface and acknowledgement

This thesis was completed as a part of the mandatory work to fulfill the program MSc project management in the Department of Production and Quality Engineering at the Norwegian University of Science and Technology (NTNU).

This research is related to SpeedUp project, which is one of the research projects in ProsjektNorge. SpeedUp focuses on reducing project execution time with minimum 30% in comparison with 2013 level and several academic institutes and companies are involved in it (ProjektNorge, 2014).

Before starting to work on the SpeedUp project and collaborating with the researchers in SINTEF, I was supposed to work on another topic with another supervisor. Once I was searching in the SINTEF website in where I got to know about SpeedUp project. I had a discussion with Bjørn Anderson and Agnar Johanesn and finally I joined the project. Being involved in SpeedUp and working with many researchers in SINTEF is one of my best experiences during my master study at NTNU and I am continuously thankful to God for providing me this opportunity.

I have taken efforts in this project; however, it was not possible without the support and help of many individuals to complete this report. I am using this chance to declare my gratitude to all those who provided me the possibility to pass this journey and supported me throughout the accomplishment of it.

I would like to express my special appreciation to Agnar Johansen, my supervisor at SINTEF, for supporting me and having trust in me during this work. He has guided me whenever I asked for it and showed me the way to fulfill this project. I am thankful for his aspiring guidance and advice. He is a great person who have taught me so many things that I will never forget.

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I would like to thank my parents Farzaneh Rezaei and Ali Hoseini for their supports not only through my study but through my whole life. I owe every single achievement in my life to them and I can never pay them back for all their love and support.

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Abstract

Literatures investigation reveal that poor project planning is cited by many authors as a delay factor in the construction projects. Project planning have many different aspects and this research only addresses time aspect of project planning in the Norwegian construction industry.

To capture the 'real word' experience of experts in Norwegian construction industry about project time planning and to find out how poor time planning lead to delay, a survey questionnaire was conducted. The survey was distributed among the experts in construction companies, which are in partnership with the SpeedUp project. Totally, 62 complete responses were gathered and survey response rate is 44%. Respondents were asked different questions about their background, project time planning personnel, project time planning tools, and the relation between project time planning and project delay. The result shows that more than 90% of the respondents agree that poor project time planning may lead to delay. Almost all of the respondents mentioned 'poor project management' as a reason of poor time planning. Besides, most of the respondents cited more experienced people as the most important enabler of time planning improvement.

Based on the literature, a model is presented which shows that poor project time planning has a harsher effect on delay in the execution phase. Moreover, the best phases to improve the project schedule is in the planning phase of the projects.

Due to the relationship between delay factors, start of one delay factor may trigger other delay factors as well. This situation can be like a domino where initiation of one of the factors may activate other factors and the final consequence may be project delay. Therefore, to avoid delay, the whole system should be considered and controlling only one of the factors is not sufficient.

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List of Acronyms

CII	Construction Industry Institute
IPK	Department of Production and quality Engineering
NTNU	Norwegian University of Science and Technology
PMI	Project Management Institute
PMBOK	Project Management Body Of Knowledge
SINTEF	Foundation for Scientific and Industrial Research
CM	construction management
CCM	Critical Chain Method
WBS	Work Break down Structure
KPIs	Key Performance Indicators
LPS	Last Planner System

Chapter

1 Introduction

This chapter provides the background information about the importance of the research topic and formulates the problems existing regarding the topic. In addition, the chapter describes the research objectives, research questions, and research scope for this study. Next, limitations of the study is explained. This chapter finishes by providing a figure illustrating the whole report structure.

1.1 Background

Each country relies on different industries to keep its economy growing. One of these important industries is construction. The unique nature of construction industry makes it different from most other industries. One can name many countries that do not have specific industries like car manufacturing, but one cannot name a country that does not rely on the construction industry to some extent. Even though, it is possible and common to import equipment, raw and prefabricated materials, and human resource to a country but the construction project should be accomplished in the country and one cannot import building, road, tunnel or bridge as final product. This emphasizes on the significance of the construction industry.

Significant role of projects, as a tool to implement companies' strategies, is quite well known and companies, in different industries, rely on projects to achieve their goals. In addition, the project outcome may result in success or failure of a company. Governments implement construction projects to achieve strategic goals such as economic and financial growth. Besides, many industries are dependent, directly or indirectly, to infrastructure made by the construction industry. Therefore, failure of construction projects will probably influence on other industries as well.

Succeeding in a project does not mean signing a contract and expect that the project finish on time, on cost and according to the scope. To succeed in a project, it requires accurate project planning in all aspects. According to (Chan et al., 2004, Shenhar et al., 2002) project planning is considered one of the major contributors to project success and as the first step under the responsibility of project managers (e.g., Office of Government Commerce (OGC), 2007 and PMI Standards Committee, 2013 in Zwikael et al., 2014). Project planning has undergone reasonable development over the past two decades (Radosavljevic and Horner, 2007). Literature emphasizes that appropriate planning increases project performance in terms of time, cost, quality, and results in clear project scope definition, and reduction of changes (CII, 1988, Lines et al., 2015, Lovett and Stauffer, 2009). Good planning can reduce or eliminate bottlenecks and facilitate the procurement of critical activities, thereby ensuring timely completion of the project (Conlin and Retik, 1997).

1.2 Formulating a research problem

This thesis pursues the work performed in the specialization project by the author on a topic about time-thieves (factors that steal the time) and bottlenecks (factors that make projects go slower). These two terms were studied under the term ‘delay’ in projects and common factors that may cause delay in construction projects where identified. Therefore, the purpose of this research is to investigate ‘poor project planning’ as one of the main factors that can cause delay in construction projects. The coming section formulates the connection between ‘poor project planning’ and ‘delay’ in construction projects.

1.2.1 Problem formulation

The construction industry plays a significant role in any country’s economy and it is a backbone for other industries (Muya et al., 2013). Construction projects, whether simple or complex, are frequently behind schedule due to various uncertainties. Even today’s advanced technology and understanding of project management techniques have not solved the problem of delay (Sweis et al., 2008, Yang et al., 2013). Any delay in a project can lead to cost overruns since time and cost are linked (Sambasivan and Soon, 2007). Delay results in either extension or acceleration of projects and therefore, incur extra cost. (Ramanathan et al., 2012). Furthermore, delay affects the project by losing competitive advantages and market share and increases conflicts, disputes, and claims and results in dissatisfaction of all involved parties (Ramanathan et al., 2012, Yang et al., 2013, Odeh and Battaineh, 2002). For the project owner, delay may lead to loss of revenue through lack of production facilities and rentable space or a dependence on present facilities.

For the contractor, delay may result in cost overrun due to longer work period or penalties, higher material and labor costs (Assaf and Al-Hejji, 2006, Khoshgoftar et al., 2010). Over the past years, a significant attention is given to identification of possible factors cause delay in construction projects. One of these factors, cited by many authors, is 'poor project planning' (see Appendix I).

Project planning is a familiar topic for those working on a project and it is a vital element of project success (Chan et al., 2004, Shenhar et al., 2002). Even though project planning has undergone some reasonable development over the past two decades (Radosavljevic and Horner, 2007), project teams frequently do not incorporate effective planning methodologies, typically citing a lack of time or capability to conduct detailed planning (Lines et al., 2015).

When a problem rises during the life of a project, the first hunch would be that the project was not planned properly. Most of the time this feeling is correct and inadequate planning is one of the reason for project failure. Inadequate planning can be due to project manager or other team member impatience (Mantel, 2001). While some say the sentence 'Ready, Fire, Aim' is the way a project works, literatures show that adequate and timely planning is strongly associated with the project success (Mantel, 2001, Chan et al., 2004, Shenhar et al., 2002). If a project is not properly planned, there might be lack of understanding of project charter or scope and there may be lack of contingency plans to control possible problems (Herroelen, 2005, CII, 1988). Poor project planning makes delays more likely to happen and less likely to be noticed and dealt properly (Keil et al., 2003). Therefore, understanding the reasons behind poor project planning and factors influencing it is crucial. Based on this argument, next section explains the research objectives, research scope, and research questions in this report.

1.3 Research objectives, research scope, and research limitations

Many studies are done to find the delay causes in construction projects. In particular, the purposes of this study is to examine 'poor project planning' as a delay factor and identify the reasons behind this issue. Poor project planning can be investigated based on different understanding. For example, poor project planning can be interpreted as lack of plan and/ or faults and mistakes in the plan and/ or too much/ too details plan. In addition, project planning can be seen in different knowledge areas such as time planning, quality planning, resource planning, risk planning, etc. This report will only highlight time aspect of the project planning (yet, project planning, as a general term, will be covered in the theory chapter). Based on what

is stated, the term 'poor project planning' in this thesis means faults in time planning and/ or too much/ too little details time planning.

While one can name planning in different areas (e.g. production) or industries (e.g. IT), this report only focuses on project planning in construction industry. In addition, the report limits its scope to tactical level planning of projects and strategic planning of organizations or projects is not considered. Moreover, scope of this research is limited to construction industry in Norway and thus other industries or countries is not covered. Norwegian construction industry is one of the major industries in Norway, with a turnover of 330 billion NOK and roughly 300,000 employees (Kolltveit, et al. 2004). According to a research study at the Norwegian School of management (BI): "The Norwegian building and real estate industry emerges as one of the largest industries in the country, ranking number 1 in terms of number of companies, and ranking number 2 in terms of value creation and number 3 in total sales. (Espelien et al. 2007, page 6)" cited in (Anandasivakumar Ekambaram, 2010).

One of the limitation of the study is the number of the responses collected. Since the number of the respondents is 62, it is not possible to make strong statements about findings of this research. In addition, most of the respondents have long years of experience with management position. This make it impossible to compare the results based on different years of experience and investigate if years of experience can affect the results. One more limitation to name is the number of the companies the survey is sent to. The survey was only sent to seven companies related to Speedup project and not all of the companies participated in the study.

1.4 Research questions

Based on the argument in the previous sections, a wide range of research questions can be extracted. Following key research questions are extracted based on the author's interests, supervisors' opinions and available resources for conducting the research:

- **Research question 1**: What is the 'real world' experience of Norwegian construction industry about project time planning?
- **Research question 2**: What can result in (causes of) poor project time planning?
- **Research question 3:** What factors do contribute to better project time planning?
- **Research question 4:** What are the factors influencing project time planning?

As explained earlier, this report aims to investigate the reasons of faults and/ or too much/ too little time planning in projects. The purpose of the research question one is to find out how

companies do the time planning, who does it, what tools they apply, and why they use a specific tool. Research question two seeks to find out the reason behind deficiencies in time planning and research question three identifies the factors that may improve those deficiencies. Research question 4 purpose is to detect factors that can influence (regardless of negative or positive consequences) project time planning.

1.5 Report structure

This report contains of eight main chapters: (1) introduction, (2) delay in construction projects, (3) project planning concept, (4) methodology, (5) survey design and distribution, (6) analysis and results, (7) Discussion, and (8) conclusion. Chapters 2, 3, and 4 cover the theory parts of the report. Chapter 4 discusses different methods in social sciences and explains the method selected for this study. Chapter 5 explains creation and distribution of the survey questionnaire, and the connection between research questions and different parts of the survey. Chapter 6 explains the results extracted from the data analysis of the survey. Chapter 7 will be the report discussion and has two main parts. The first part is discussion based on the results from the survey. The second part is the discussion based on the literatures, which are provided in the previous chapters. This report starts with introduction in chapter 1 and ends up with a conclusion in chapter 8. Following figure illustrates the structure of this report.

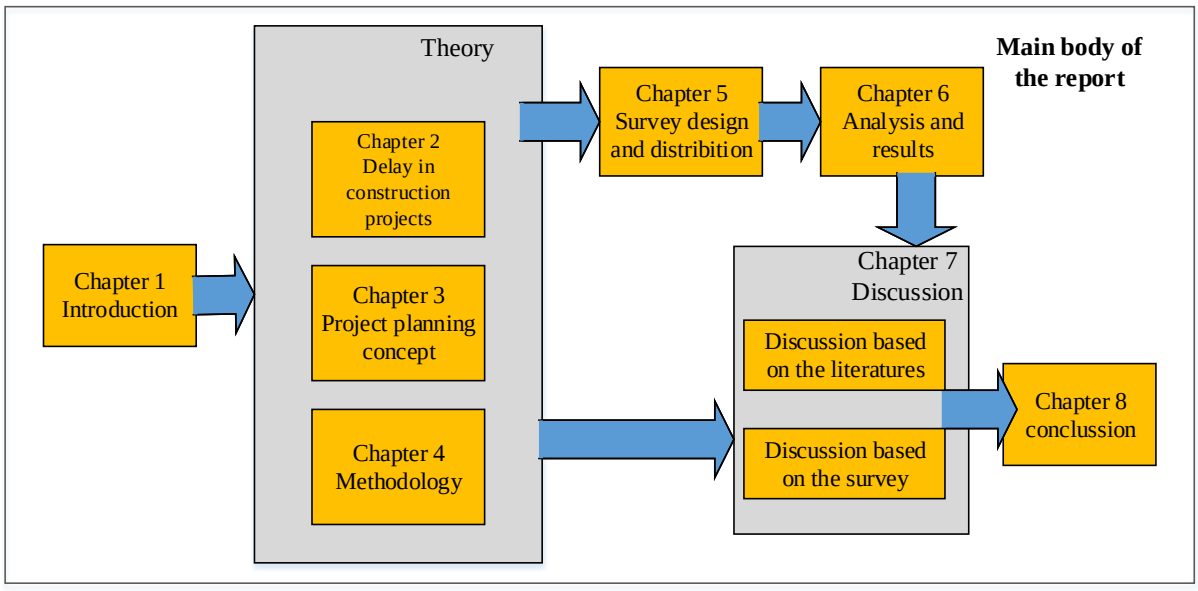

Figure 1 Report structure

Chapter

2 Delay in construction projects

As mentioned earlier, this study is following a study in project thesis (specialization project) on topic delay in construction projects. To answer the research question two (section 1.4) it is necessary to find out if there is any connection between delay and poor project time planning. In fact, a question about delay and poor time planning should be answered initially to find out if there is any connection between these two issues. In fact, this question is a foundation for answering the research question two. Therefore, it is necessary to provide the information about delay concept first.

The purpose of this chapter is to provide the required theories to understand about delay and the importance of avoiding delay in construction projects. This chapter answers questions:

- *What is delay and what is time overrun?*
- *What are the consequences of delay?*
- *What are the delay causes?*

Information provided in this chapter will give the reader an understanding of delay and delay causes. In addition, chapter acts as a foundation for chapter 3 and later is used in chapter 7.

In the following, a definition about delay and time overrun and effects of project delay will be provided. Afterwards, the delay causes, from several countries are mentioned.

2.1 Delay and time overrun

In a project, delay is the result of unexpected act or event that extents required time to complete the tasks under contract or beyond the date agreed by parties to deliver the project (Ramanathan et al., 2012, Sweis et al., 2008, Asnaashari et al., 2009). Delay can be either extra days of work for an activity or late start of an activity (Yang et al., 2013, Sweis et al., 2008). Projects comprise

of collections of activities and delays can be measured at the activity or project level. On the activity level, delays can affect completion of activities, which may or may not have an impact on succeeding activities. At the project level, analysis typically focuses on delays relative to project completion (González et al., 2014).

Different authors have used terms ‘delay’ and ‘time overrun’ alternatively. According to Oxford dictionary (2014) delay is “a period of time by which something is late or postponed” and overrun as “something exceeding an expected or allowed time…”. From these definitions, it can be concluded that delay and time overrun in a project activity are different issues. Delay for an activity is the situation where the start of that activity is postponed (due to some reasons). While time overrun is the situation where the duration of an activity is extended (due to some reasons). Both of these situations, in an activity level, may lead to project delay. Following figure presents delay and time overrun for an activity in three situations. In the first situation, start of the activity A is delayed. Activity B shows this situation. In the second situation, start of the activity A is not delayed but the duration of the activity is extended (time overrun). This situation is showed by activity C. In the third situation, start of the activity A is delayed and the durations is extended as well. Activity D illustrates this situation. All of these situations may delay the project completion. Since both of the situation above may lead to project delay, this report will only focus on the term ‘delay’.

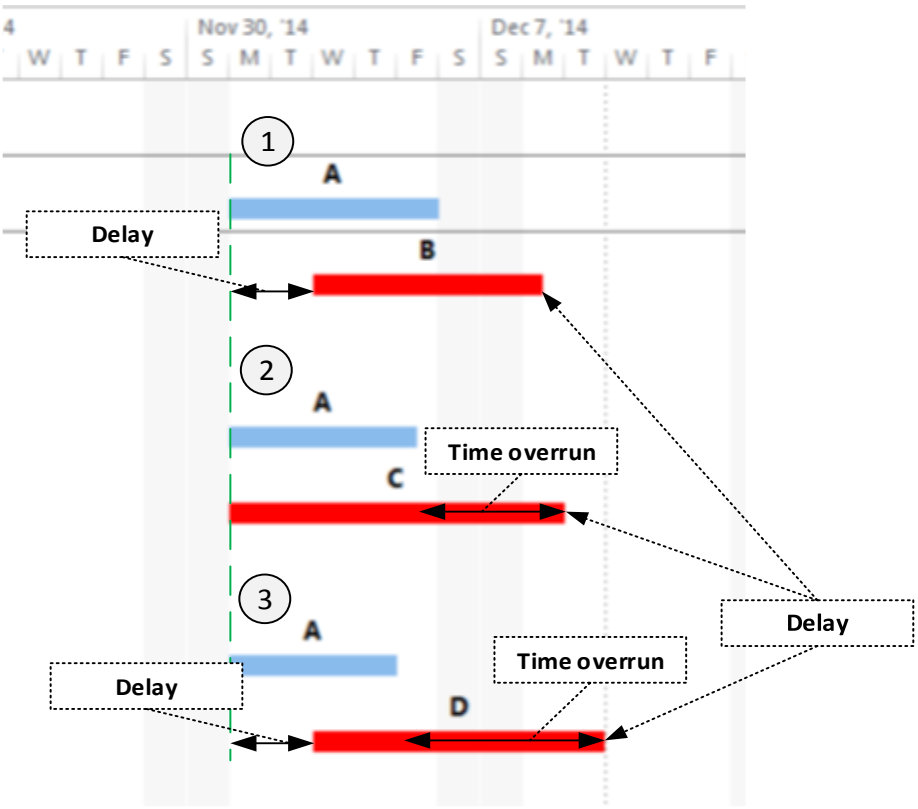

Figure 2 Delay and time overrun differences

Based on (Yang et al., 2013, Sweis et al., 2008, González et al., 2014)

2.2 Consequences of delay

Delays can lead to many negative effects such as cost overrun, disputes, arbitration, litigation and total abandonment (Pourrostam and Ismail, 2011, Sambasivan and Soon, 2007). Delay cause loss of motivation, procrastinate, and more delay (Halvorson, 2013). In addition, delays in projects result in troubles for both owner and contractors. The main troubles for the project owner include losing the benefits of first to market or late operation of the project, increase in expenses conflict with the contractor which may lead to claim by the contractor and end up as court case(Abbasnejad and Izadi Moud, 2013). The main troubles of delays for contractors are: overhead costs such as maintenance of facilities, protection of completed parts up to delivering time and paying such costs as salaries of permanent personnel, water, electricity, guards, renting fees, etc. Besides, expenses such as the deposit of machinery, maintenance of equipment, and decrease in the economic efficiency of machinery are other troubles to contractors. Personnel and workers engaged in delayed projects may become depressed and dispirited. The capability of contractor to win new contract might diminish and it has a negative effect on contractors

reputation (Abbasnejad and Izadi Moud, 2013). These emphasize on minimizing and avoiding delay in construction projects.

2.3 Delay causes

The first step to minimize delays is to identify causes that may lead to delay (Pourrostam and Ismail, 2011, Yang et al., 2013). Over the last 40 years, a significant attention is given to identify possible causes of construction delays (Yang et al., 2013). To identify delay causes, some authors (e.g. González et al., Faridi and El-Sayegh, Doloi et al., Chan and Kumaraswamy, Assaf and Al-Hejji, Kazaz et al. Sambasivan and Soon) have used quantitative methods like survey and questionnaires. While some others like Asnaashari et al. (2009) has used qualitative methods like interview to identify causes. Literature review shows that the causes of delays are different among countries. Different situations such as construction environment, working cultures, management style, project characteristic, methods of construction, local construction practices, geographical condition, stakeholders, the government policy, economic situation, availability of resources and political situations are some of the reasons of delay variation in literature (Asnaashari et al., 2009, Yang et al., 2013, Khoshgoftar et al., 2010, Toor and Ogunlana, 2008). Appendix II provides a list of 131 delay causes mentioned in the articles.

2.4 Poor project planning, a common delay factor

Different authors have identified a list of delay causes based on the country under their study (see Appendix I and Appendix II). One of the delay factors that is mentioned by many authors is ‘poor project planning’. The following table shows name of authors that have cited this factor.

Table 1 Poor project planning as a common delay factor in literature

Common delay factor	Author
Poor project planning	(Al-Kharashi and Skitmore, 2009), (Khoshgoftar et al., 2010), (Faridi and El-Sayegh, 2006), (Sweis et al., 2008), (Assaf and Al-Hejji, 2006), (Pourrostam and Ismail, 2011), (Marzouk and El-Rasas, 2014), (Akogbe et al., 2013), (Odeh and Battaineh, 2002), (Toor and Ogunlana, 2008), (Muya et al., 2013), (Sambasivan and Soon, 2007)

Considered articles mention poor planning as a reason of delay. Poor planning is a general term and contains many aspects like project time planning, resource planning, financial planning etc.

As mentioned before, this report focuses only on project time planning and other aspects of project planning will not be considered.

Chapter

3 Project planning concept

In the previous chapter, poor project planning as a reason for delay in projects were introduced. This chapter seeks to provide the readers an understanding about project planning concept. Earlier, it was mentioned that the focus of the report is on time aspect of project planning. Project time planning is joint component of project planning. Therefore, it is not possible to discuss project time planning without mentioning project planning as a general concept.

This chapter starts by discussing the importance of project planning in project management. Next, the project planning concept is explained and project planning processes based on different authors' perspective is provided. The chapter continues with reviewing project planning in each phase of a project. After this step, chapter will focus on project time planning. Finally, the chapter will finish by describing communication and uncertainty in project planning. The information in this chapter will be used in chapters 5 and 7.

3.1 Project management and project planning

Project is defined as sequence of activities and tasks that have certain objectives with a certain specification, defined start and finish dates, financial limitations, requires human and nonhuman resources and in cloud various functions (Kerzner, 2009). The primary challenge of project management is to achieve project objectives considering project constraints (Zidane, 2012). This requires applying knowledge, skills, tools and techniques to project activities to meet project requirements (PMI, 2013, Westland, 2006). According to (PMI, 2013), project management contains:

- Project requirements identification
- Addressing project stakeholders expectations

- Communication management between the stakeholders
- Balancing project constraints

To fulfill above-mentioned requirements, project management must combine (Westland, 2006):

- Skills: Special expertise, skills and experience to reduce the level of risk within a project and thereby improve likelihood of project success.
- Tools: Various tools such as planning software, financial software, modelling software, audit and review forms used by project managers to improve the chances of project success.
- Processes: Various processes and techniques like time management, cost management, quality management, change management, risk management and issue management that are applied to monitor and control time, cost, quality and scope of projects.

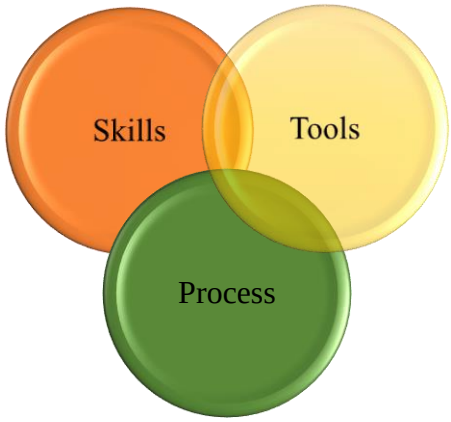

Figure 3Project management components (Westland, 2006)

Fulfilling the project management requirements and applying its components without planning the project is impossible (Zwikael et al., 2014). In fact, project plan is a proposal of how to do all the project management activities to achieve the project goals. The primary function of the project time plan is to serve the project manager as a map to show the route from project start date to project finish date (Mantel, 2001). Without having the map, project manager cannot accomplish the project management's tasks which result in project failure (Mantel, 2001). Following section provides comprehensive definitions for project planning and its processes.

3.2 Project planning

According to Oxford dictionary (2014) plan is a detailed proposal for doing or achieving something and planning is the process of making plans for something. Planning is a general term which is defined as "the process of deciding what to do and how to do it before performing a required action "(Lines et al., 2014, Radosavljevic and Horner, 2007). Project planning is a set of decisions concerning project execution in order to deliver a desired new product, service or result (Zwikael et al., 2014). PMI defines process of project planning as preparing and coordinating all subsidiary plans and integrating them into a comprehensive project management plan. Indeed, planning is all about thinking forward in time (Burke, 2003).

While there are many different processes for developing a project plan (Mantel, 2001, Westland, 2006, Burke, 2003) all of them use a systematic analysis to identify and list the things that must be undertaken (Mantel, 2001). These processes differ from industry to industry, and subject to subject. For example, architecture has a planning process so does the software development as does construction. PMI introduces project planning process as following steps:

1. Develop project management plan
2. Collect requirements
3. Define scope
4. Create WBS
5. Define activities
6. Sequence activities
7. Estimate activity resources
8. Estimate activity duration
9. Develop schedule
10. Estimate costs
11. Determine budget
12. Plan quality
13. Develop human resources plan
14. Plan communication
15. Plan risk management
16. Identify risks
17. Perform qualitative and quantitative risk analysis
18. Plan risk Reponses

19. Plan procurements

Table below shows two different project planning processes based on two different authors. Although these processes are stated differently, all of them cover the same criteria.

Table 2 Different project planning process

ID	(Mantel, 2001)	(Burke, 2003)
1	Project overview	Project charter
2	Project objectives	Feasibility study
3	General approach	Scope Management
4	Contractual agreements	Build method
5	Project schedules	Execution strategy
6	Project resource requirements	Work Breakdown Structure
7	Project personnel	Organization Breakdown Structure
8	Project evaluation methods	Risk Management Plan
9	Project potential problems	Baseline Plan

An aspect which is an important part of the project plan is milestone planning. A project plan may include several milestones. A milestone in a project plan is defined as a significant event in the project (Pinto, 2013).

Depending on the size and complexity of a project work package, it may contain a number of significant milestones that determine its progress toward completion (Pinto, 2013). Project managers who wish to avoid the damaging effects of project changes need to give a specific attention to milestone planning (Pinto, 2013).

Despite the kind of process to create the project plan, a plan should contain sufficient information. Therefore, the project manager, at any time, knows, what remains to be done, when

it should be done, what are the required resources, who should do it, and what specification should the output meet (Mantel, 2001).

Creating a project plan is hierarchical process which is a procedure of successively decomposing larger tasks into the component parts. This procedure continues until all of the activities in a project are included. This procedure is like creating a drawing, which first starts as a sketch, and then artist adds details gradually. Following picture shows process of completing a drawing, which is similar to planning a project (Mantel, 2001).

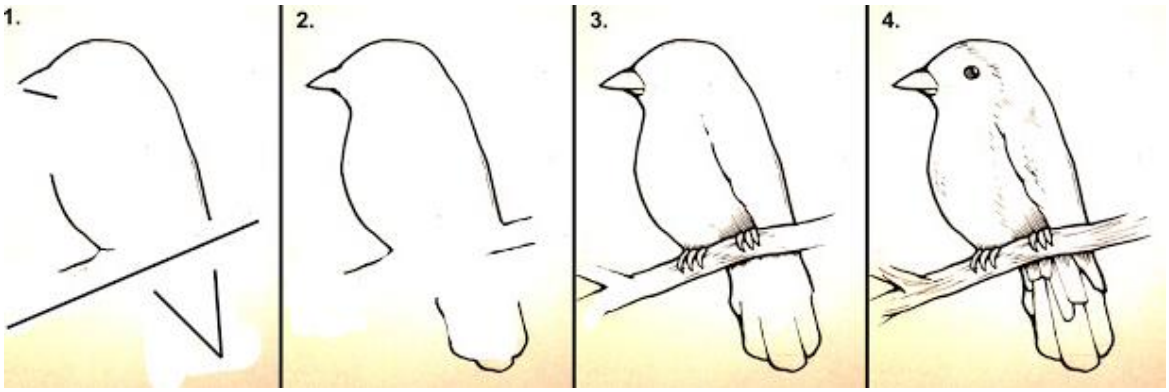

Figure 4 Comparing drawing of a bird to creating the project plan

based on (Mantel, 2001) picture source(Hobson, 2013)

3.3 Project life cycle and project planning

Project life cycle is sequences of phases that a project goes through from its initiation to its closure. Project life cycle "provides a basic framework to manage the project regardless of the specific work involved" (PMI, 2013). The phases of a project are sequential and sometimes overlapping and have time boundaries with a start, end or control point (Zidane, 2012, PMI, 2013). According to PMI (2013) and Westland (2006), four project phases are:

- Starting the project (initiation),
- Organizing and preparing (planning),
- Carrying out (execution), and
- Closing

These phases and their relations are shown in Figure 5.

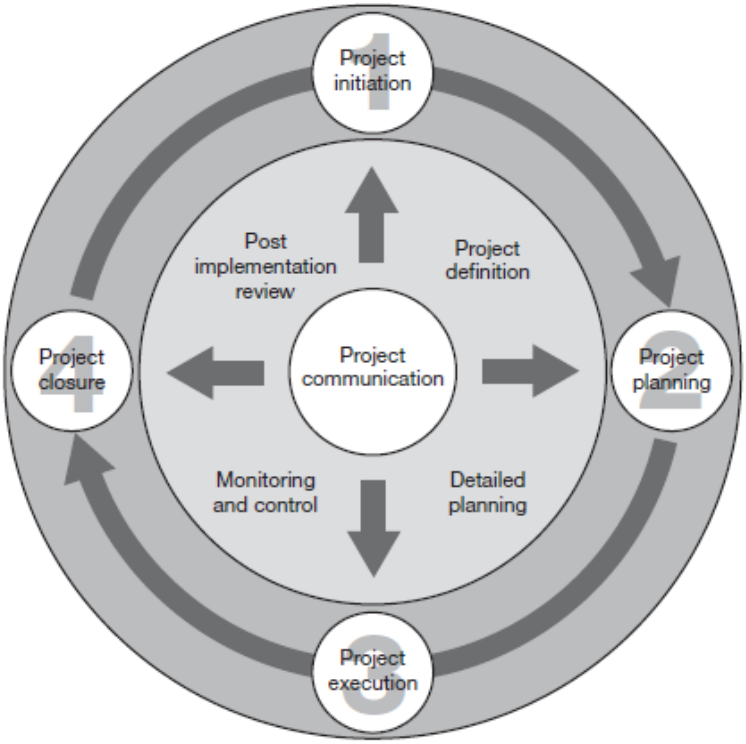

Figure 5 Different phases of project life cycle Source (Westland, 2006)

Planning phase of a project does not mean that it is the only phase for creating the project plan. Project planning process occurs at different stages of a project lifecycle and include varying stakeholders, degrees of certainty, and goals (PMI, 2013). Figure 6 illustrates how planning process group interacts during the time.

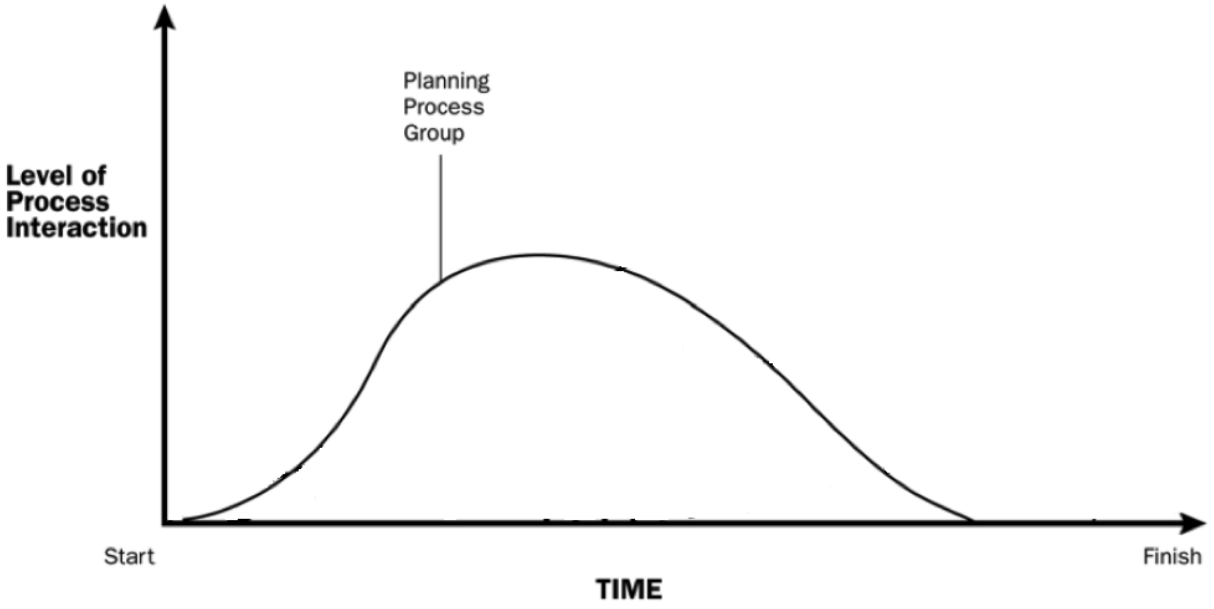

Figure 6 Level of process interaction of planning process groups interacts in a phase or project (PMI, 2013)

The earliest stage of project planning occurs once the owner determines there is a need for a new project. Contractor planning activities also occur during the bidding process and frequently into planning phase (Lines et al., 2015). Planning activities may also continue for the duration of the construction phase. Each of these planning periods are reviewed below briefly. It is worthy to mention that follwing planing activities are limited to the construction industry which is the focus of this thesis. In addition, this report focuses on three phases of initiation, planning, and execution, which suit best for the purpose of this research. Therefore, closing phase in the project life cycle is not included. Following picture shows project life cycle model. Only the green phases are considered in this report.

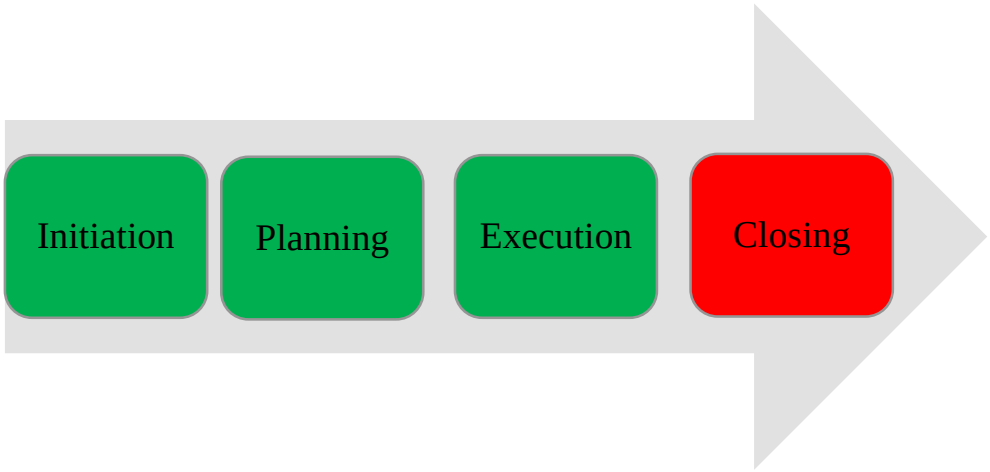

Figure 7 Phases included in this report are colored in green

3.3.1 Initiation planning

Innitation planning is one of the most improtant elements in developing a successful project and it decreases changes during project execution phase (Bates, 2008). Initiation planning is the planning process undertaken by the project owner, designer, and various consultants to assist with analysis of project feasibility and development of detailed project scope. Contractor input may also be required during this planning efforts (Lines et al., 2015). The Construction Industry Institute (CII) defines initaition planning as the process of defining strategic objectives so that owners are able to address high-level project risk and determine resource allocation to maximize project success (CII, 1997). The initiation planning process typically includes budget formulation and initial scope definition from the owner organization's perspective (Lines et al., 2015).

3.3.2 Pre-construction planning (plannig phase)

After the scope of the project is defined, the project enters the details planning phase (Westland, 2006). This phase typically begins when a single contractor is awarded the contract and may continue with early phases of the construction process. Pre-construction planning may involve the planning phase, the design phase, and the tendering and award phase. Once a contract has been signed, the planning stage is traditionally completed at no more than one month before mobilization and no more than two additional months beyond mobilization. Planning deliverables include a detailed schedule, baseline milestone schedule, risk management process, project operations plan, and a clear scope (Lines et al., 2015).

3.3.3 Construction execution planning

Planning may occur during the construction phase, which consists of all activities beyond mobilization and completion of preconstruction planning. This planning also covers risk management and can be focused on a single deliverable or the coordination and overlap of multiple tasks within the construction phase (Lines et al., 2015).

3.4 Project time management

According to (PMI, 2013), "project time management is the processes required to manage timely completion of the project". Indeed, time management is a process that records and controls time spent to finish each activity (PMI, 2013). Following figure illustrates the process of project time management.

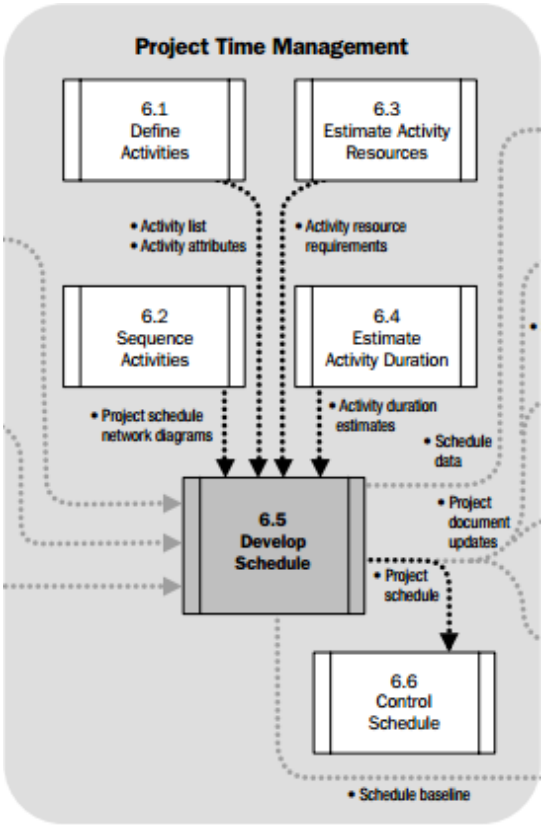

Figure 8 Project time management process (PMI, 2013)

By looking at the project planning process, one can see that project time planning is part of the project planning (Mantel, 2001, Pinto, 2013) (see Table 2). Undeniably, Project planning without knowing each tasks and period required to undertake each tasks is impossible.

The output of project time planning process is a project schedule (PMI, 2013, Lines et al., 2015). Project schedule allows the project manager to control the amount of time spent by each activity within the project (Westland, 2006). As mentioned before, project planning is a wide term and contains different aspects. Following figure shows project planning is narrowed to project time planning and project schedule is the outcome of project time planning.

Project planning concept

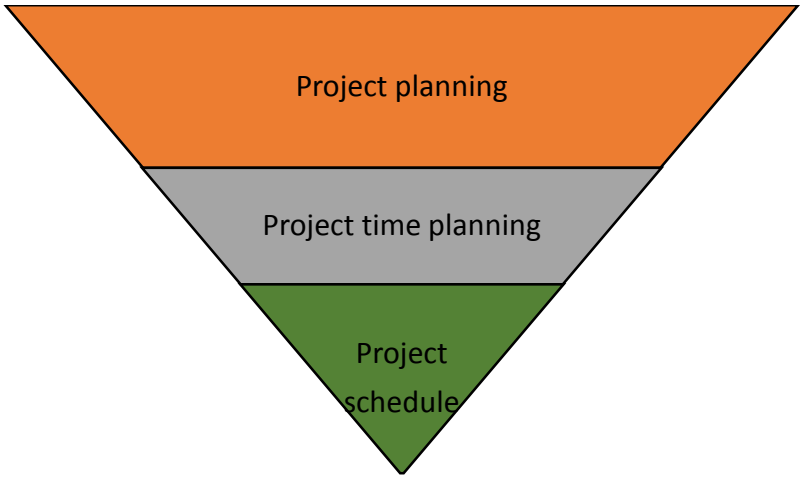

Figure 9 Project schedule, an outcome of time planning (PMI, 2013, Lines et al., 2015)

In the following, the project schedule is explained.

3.4.1 Project schedule

Project schedule represents the conversion of project goals into an achievable methodology for project completion. It creates a timetable that presents the network logic that relates project activities to each other in a coherent fashion (Pinto, 2013). PMI defines project scheduling as the process of analyzing activity sequences, durations, resource requirements, and schedule constraints to create the project schedule model. It provides the overall planning, monitoring and control mechanism by which the project team can ensure that the client's objectives are achieved (PMI, 2013). According to (Mantel, 2001), the project schedule is simply project plan in an altered format which is a convenient for monitoring and controlling project activities. At a minimum, the project schedule includes a planned start date and planned finish date for each activity. Project schedule makes a model with planned dates for completing project activities (PMI, 2013). Project schedule can be presented as activity lists, bar chart (Gantt chart), network diagram, etc. A project schedule can be presented as a form or graphically. However, it is more often presented graphically in formats such as milestone charts, bar charts, and project schedule network diagrams (PMI, 2013). The other outputs of project scheduling are schedule baseline, schedule data, and project document update (PMI, 2013). Of course, going through all of these outputs is beyond the scope and objectives of this research and mentioning them is for informing the readers. Figure 10 shows a scheduling process overview (PMI, 2013).

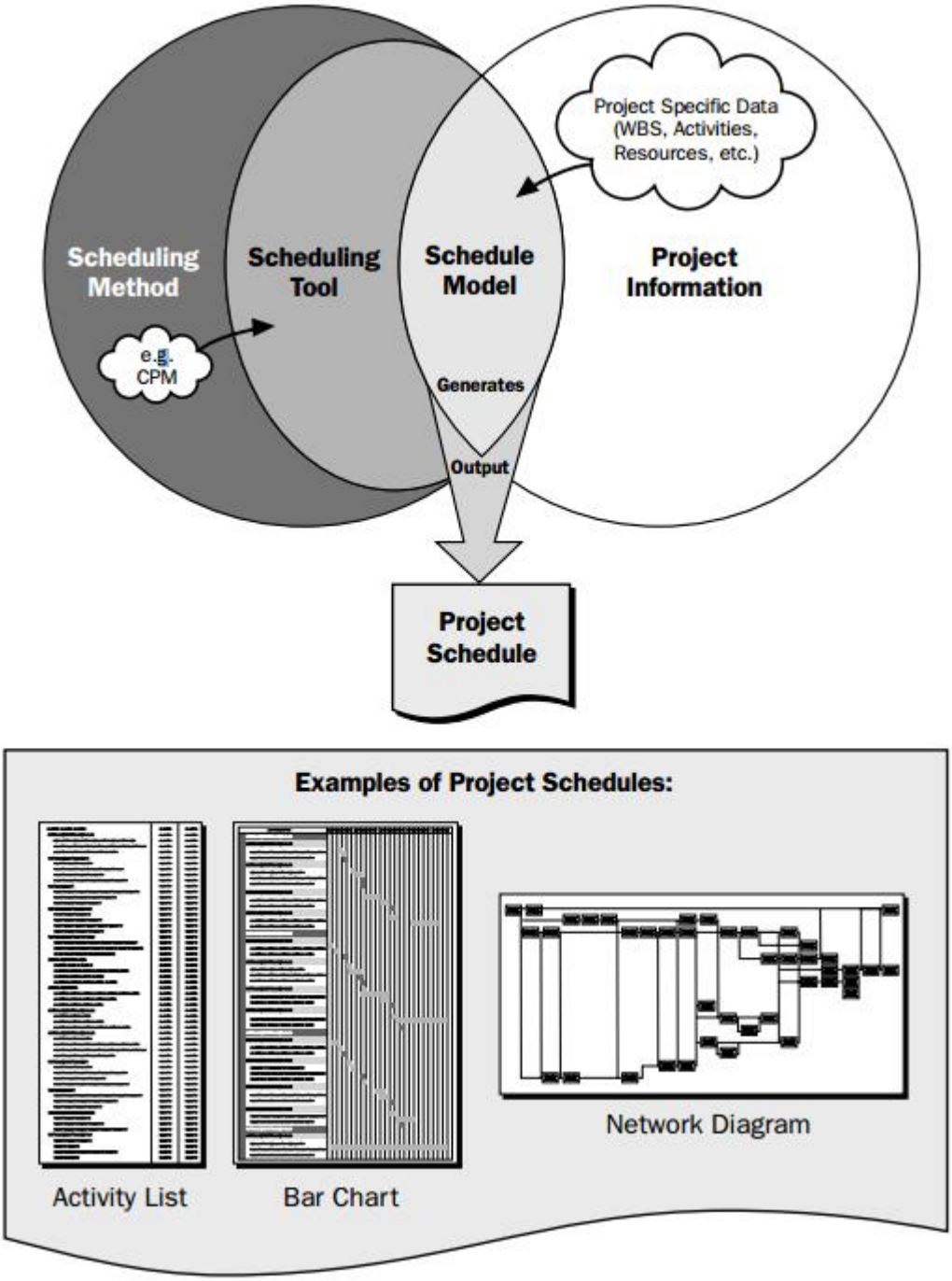

Figure 10 Scheduling overview (PMI, 2013)

3.4.2 Project scheduling tools and techniques

There is a considerable number of tools and techniques available for modeling a project schedule (Knotts et al., 1998, PMI, 2013, Mantel, 2001, Pinto, 2013). The earliest ancestors of these methods were developed in the late 1950s (Knotts et al., 1998). Two first tools for project planning are Critical Path Method (CPM) (created by du Pont and Remington Rand Univac) and Program Evaluation and Review Techniques (PERT) (was created as part of a joint effort

of Lockheed Aircraft and Booz, Allen, and Hamilton, and the United States Navy). Key scheduling terminologies are provided in Appendix III.

One important part in project scheduling is to estimate project activity durations. “Estimate activity durations is the process of approximating the number of work periods needed to complete individual activities” (PMI, 2013). This process is progressively elaborated when more precise data is available (PMI, 2013). To estimate of the activity durations, CPM uses deterministic or certain estimates. While, PERT uses probabilistic or uncertain estimates of activities durations (Mantel, 2001). There are different tools and techniques to estimate project activity durations. Techniques such as expert judgment, analogous estimating, and parametric estimating are used for deterministic duration estimation. Besides, technique of three-point estimates can be improved by considering estimation uncertainty (PMI, 2013).

Project schedule can be created after activities durations estimation, defining sequence of activities, and resource requirement. The finalized and approved schedule is a baseline which will be used for control schedule (“the process of monitoring the status of the project to update project progress and managing changes to the schedule baseline (PMI, 2013)).

3.4.3 Project management commercial software

As mentioned earlier in section 3.1, planning software are part of the tools of project management. Doubtless, project management software is an important part of today’s project planning. Without computerization of the planning and scheduling efficient project, planning and scheduling would be unfeasible. Many of the practical problems associated with scheduling processes have been overcome by continues development of handy computer software and improved graphical presentation (Conlin and Retik, 1997). Planning activities, such as finding critical paths in a project with thousand activities or controlling such a project, without planning software, requires numerous experts and extensive time. Although, it takes considerably more than a computer and some project management software to manage projects effectively, the introduction of project management software has revolutionized the practice of project management and has assisted project managers in accelerating their tasks (Conlin and Retik, 1997).

The use of project management (PM) software has grown and continues to grow at a rapid pace in all industries. This is especially apparent in the construction industry. Project management software is regularly used in the construction industry as a tool for better planning a project

(Vukomanović et al., 2012). Two widely use project management software packages are Microsoft Project and Primavera (Hazır, 2015).

3.5 Communication and project planning

Communication is mentioned as one of the requirements of project management (see 3.1). PMI (2013) emphasizes on the significance of communication when it connects communication with all the other process groups.

Communication is important in project planning of construction projects in two main aspects. First, the construction industry operates primarily as a system of sub-contracting business and professional alliances. There are a wide spread of stakeholders involved in a project through the project life cycle. Therefore, it becomes critical for all involved parties to communicate in order to understand the project plan (Aulich, 2013, Cheung et al., 2013). Second, lack of timely and effective communication leads to different issues like change in the project plan (Chan and Kumaraswamy, 1997, Zidane, 2012). Communication during the project life cycle helps understanding the issues of executing project plan and eliminating those obstacles (Zidane, 2012).

Facilitating communication in a project requires appropriate structure and communication systems linking all stakeholders throughout the whole project life cycle (Chan and Kumaraswamy, 1997). According to (Walker D.H.T, 2002) a construction management team with developed communication skills shows better project performance.

3.6 Flexibility and uncertainty

According to Olsson (2006a), "*flexible* is *characterized by a ready capability to adapt to new, different, or changing requirements*"". Project flexibility is the process of managing both internal and relative uncertainty and adjustments to uncertainty in general (Olsson, 2006). Project flexibility and uncertainty in the project are two sides of a coin (Agnar Johansen, 2012b). Major part of project planning is conducted during the early phases of the project (initiation and planning). Figure 11 illustrates uncertainty and flexibility through the project life cycle. In the initiation phase of the project, flexibility to influence the project is higher and the information about the project is short. On the one hand, the flexibility reduces as project goes through its life cycle and decisions are made. On the other hand, in the early phases of a project the project goals and objective can be changed without significantly affecting cost. Theoretically, the changes made in the later phases of the project have greater extra cost since

they may be involved with changes in plans, designs, and work in progress (Samset, 2010). As shown in Figure 11, due to high uncertainty and lack of in information in the early phase of the project, decisions are made based on assumptions and previous experiences (Zidane, 2012). It is impossible to forecast all unexpected potentially disruptive events while developing a project plan (Radosavljevic and Horner, 2007). As a result, it is quite normal to expect changes in project plan in later phases, where higher information are available. In Engineering and construction projects, a change refers to a modification to design, construction work, project plan or other aspects of a project caused by alterations to preexisting conditions, assumptions or requirements (Zidane, 2012).

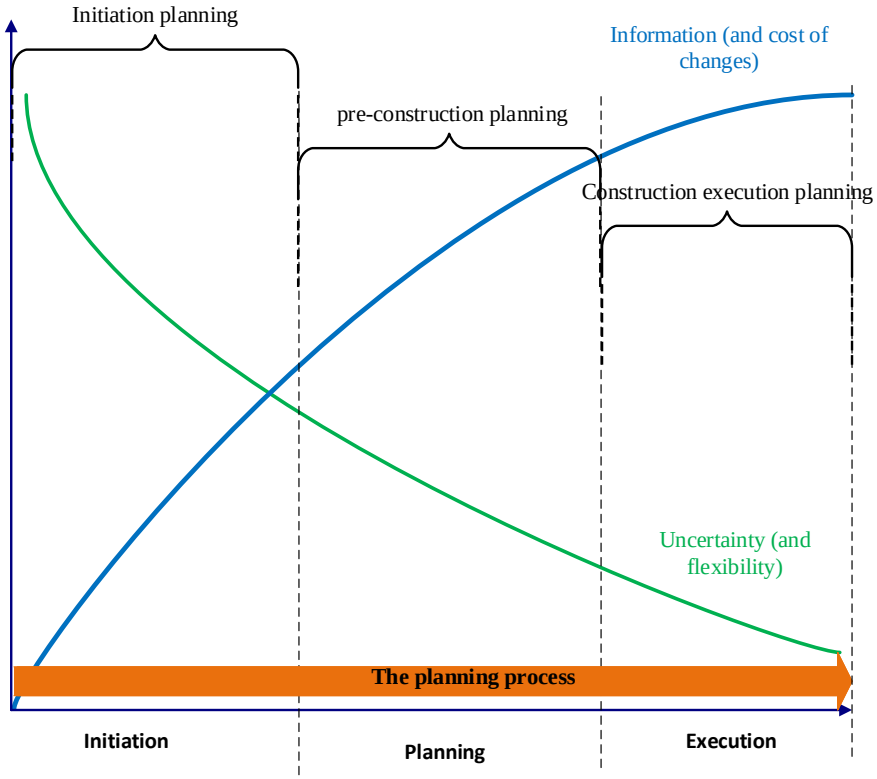

Figure 11 Level of uncertainty and information through project life cycle (Samset, 2010, Lines et al., 2015)

The truth is that uncertainty in projects is not only negative. When it comes to managing uncertainty in projects, there has been more focus on dealing with threats (negative aspect) than with opportunities (positive aspect) (Agnar Johansen, 2012a). It is relevant and important to look at opportunities – the positive outcome of uncertainty adequately, because it can generate benefits to projects and organisations. One of these opportunities can be in term of time. Opportunities in terms of time is when the project can deliver a product or service faster than planned, without increasing the cost and with the defined quality(Agnar Johansen, 2012a).

Chapter

4 Methodology

The purpose of this chapter is to explain common research methodologies and available research instruments in social science study. First, the general understanding about different methodologies will be presented. Second, the focus will be on a method suited for the purpose of this study. The chapter starts by introducing the history and purpose of social science study. Third, the research paradigms and research designs is described. Afterwards, the research approach chosen for conducting this research is provided. Consequently, the chapter discusses the quality of results. Next the research process in this report is expressed. Finally, the chapter finishes by expressing the experiences of author through the whole study.

4.1 Social science's purpose

According to (McQueen and Knussen, 2002), "research is carried out in order to describe, understand, explain, and predict a progressively sophisticated function". Simply, research on any subject aims to describe a phenomenon or a process that has previously been inaccessible or vaguely understood (McQueen and Knussen, 2002). Studying social sciences go back to long years ago when people become interested in society and those who live in it. Social scientists are constantly challenged to understand and measure human behavior (McQueen and Knussen, 2002, Gideon, 2012). The major aim of studying social sciences is to increase understanding of forces that exist in the world. Indeed, social sciences are expressing human curiosity about the world and their purpose is to apply understanding about the society to improve human conditions (McQueen and Knussen, 2002).

4.2 Research paradigms

There are several quotes for defining paradigms in the litearture. The most quoted definition for paradigms is "underlying assumptions and intellectual structure on which research and

development in a field of inquiry is based"(Haji-Kazemi, 2015, Kuhn, 2012). As a result of improvement in social science studies, there have been a development in different paradigms (Haji-Kazemi, 2015). However, according to Kumar (2011), there are mainly two paradigms that create a fundation for social science studies. The first paradigm, which has roots in physical studies, is the *positivism* approch. Positivism as a strict empricist declares the only statements, which reflect reduction to an observation, can claim a meaningful knowledge(Garner et al., 2009). The opposite paradigms to positivism is a naturalistic approach called *anti-positivism* or interpertivism (Kumar, 2011, Dash, 2005). The positivism paradigm is based on senses' experience and can be obtained by observation and experiment. While, interpertivism explains that social realities are interperted according to the individual's ideology and thoughts. Besides, positivists emphesize on objectivist approach for social studies and focus on quantitaive analysis methods. While interpertivists, emphesize on subjective approches which implement qualitative methods (Dash, 2005, Haji-Kazemi, 2015).

Despites what Kumar (2011) states, literatures still name a third paradigm which is called *citical realism* (Easton, 2010, Sayer, 1992). This approach, which supports case research as a research method, provides helpful implication for both teoritical development and research process (Easton, 2010, Haji-Kazemi, 2015). Critical realism has common features with positivisim and interpertivism and encourages a multidisplinary research that contains both quantitative and qualitative methods (Sayer, 1992, Haji-Kazemi, 2015).

Each of these paradigms provides a unique view on the way which knowledge is developed. It is important for a research process to clearly establish its research philosophy as it has a significant impact on the methodological framework applied (Saunders, 2006, Zidane, 2012). Differences between philosophical perspectives of each paradaigm and the aim of a study, to large extent, define the focus and structre of a study design (Kumar, 2011). In the following, different research design are explained.

4.3 Conceptualizing a research design

According to Kumar (2011), research design is "a plan, structure and investigating strategy to obtain answers to research question". There are two approaches for reseach design: quantitative and qualitative research. Quantitaive study designs are specifc, well structured, have been tested for their validity and reliability, and can be explicitly defined and recognised. On the contrary, study design in qualitative research either do not have these attributes or are less specific and precise (Kumar, 2011). The main focus in qualitative research is "to understand, explain, explor,

discover and clarify situations, feelings, perceptions, attitiudes, values, beliefs and experience of a group of people" (Kumar, 2011). While quantitaive research is "explantaion of phenomen by collecting numerical data which are analayzed through nathenatically based methods" (Aliaga and Gunderson, 2000, Haji-Kazemi, 2015). The are foundamental differences between quantitative and qualitative studies. While the quaniative view is positivism and objectivism, the qaulitative view is subjectivisom and interpertivism (Kumar, 2011, Haji-Kazemi, 2015). Following table illustrates some of the common characteristics of qualitative and quantitaive research and their contrasts.

Table 3 Quantitative and qualitative research characteristics (Kumar, 2011, Haji-Kazemi, 2015)

Qualitative	**Quantitative**
words	Numbers
Deductive logic	Inductive logic
More flexible	Less flexible
Less structured and sequntial	More structured and sequntial
Appropriate for exploring variation and diversity	Appropriate for exploring the **extent of** the variation and diversity
Less clarity and distinction between methods of data collection	More clarity and distinction between methods of data collection
Smaller study population	Biger study population
Not easily possible to replecate and reteste	Easily possible to replecate and reteste
Difficult to check researcher bias	Easy to chech research bias
Point of view of the participants	Point of view of the researcher
Researcher close	Researcher distant
Theory emergent	Theory testing
process	static
Contextual understanding	generalized

Qualitative	Quantitative
Rich, deep dat	Hard, reliable data
micro	macro
meaning	behavior
Natural setting	Artificial setting

4.4 Instrument for data collection

After selecting the research design, an appropriate method must be selected for data collection. Selecting a tool that fits best to the study depends on the type of research design (Kumar, 2011). In this section, different tools for collecting data based on the type of research design is explained. It is worthy to mention that explaining each of these tools is beyond the scope of this research and author will not discuss each tools in detail.

The most common associated tools with quantitative research are (Bryman, 2008, Haji-Kazemi, 2015):

- Questionnaire/ survey
- Observation schedules
- Coding frames

Some of the commonly used research methods in qualitative research are (Kumar, 2011):

- Case study
- Oral history
- Focus group/ group interviews
- Participants observation
- Holistic research
- Community discussion forums

4.5 Research design and research method

The research design selected for this study is quantitative approach and the research method is survey. Figure 12 shows the methodologuical approach applied in this research. The reasons for selecting survey as research tool are explained in the following.

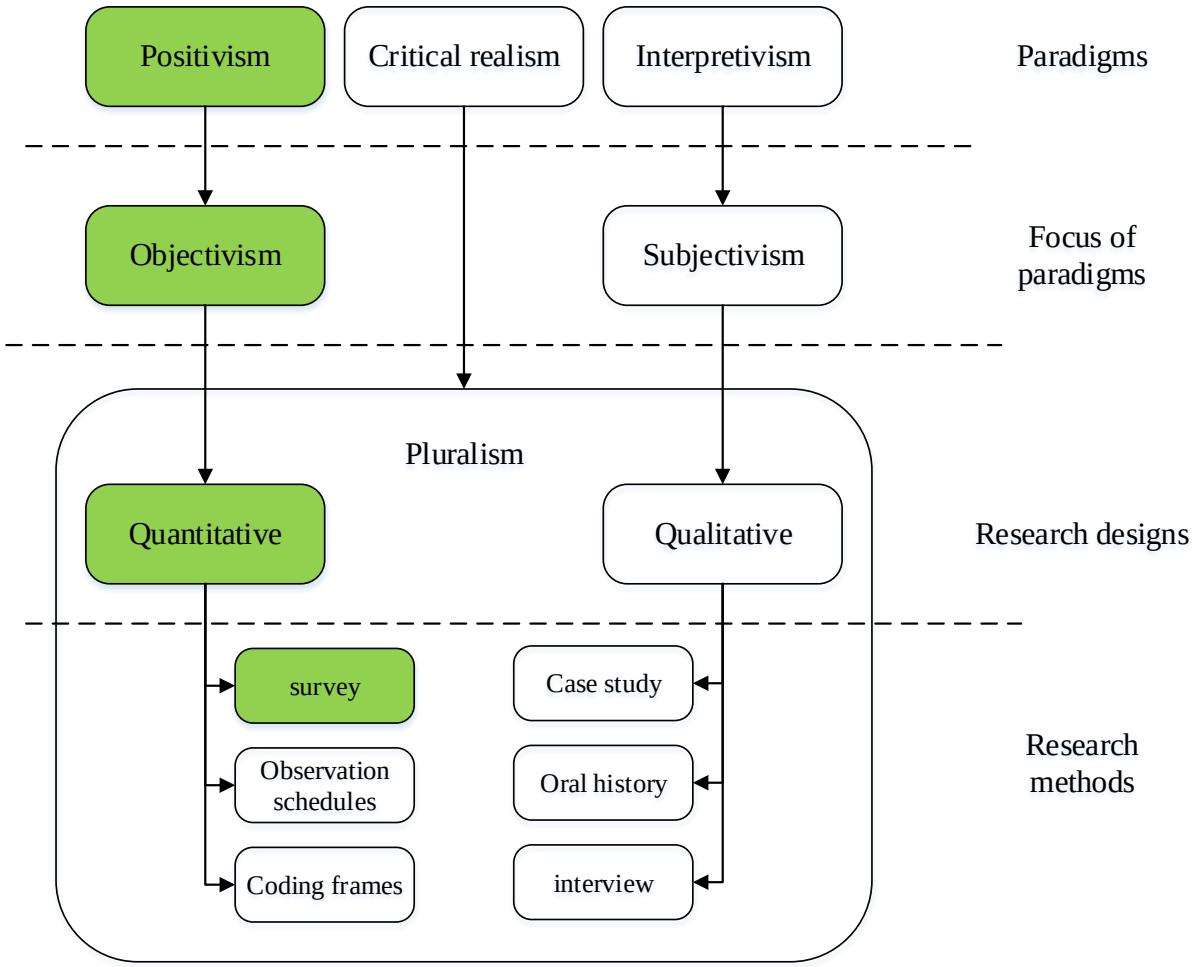

Figure 12 Methodological approach for this research based on (Haji-Kazemi, 2015, Kumar, 2011)

4.6 Survey

One of the most typical and cost effective methods of data collection in social sicences is the survey. It can contribute to advancement of scientific knowledge by involving a large number of people in the process in order to achieve better results (Galloway, 2006, McQueen and Knussen, 2002, Haji-Kazemi, 2015). Survey provides a huge quantities of descriptive information and its contribution to social research is in accuracy of its approach to data gathering (McQueen and Knussen, 2002). Scientific surveys are useful instruments to measure concepts and behaviors based on a sample of cases. Recent developments in the field of survey methodology have a great impact on the way different researches in the social sciences are conducted. Advances in survey methods are changing the way data collection strategies are conceived. Ultimately, they are changing the way we interpret survey data (Gideon, 2012). According to (Kumar, 2011) surveys help saving time, human and financial resources. Particularly, when a survey is administrated collectively to a study population, it will be

extremely inexpensive. Besides, it provides more anonymity, especially when sensitive questions are asked (Kumar, 2011).

One thing, that can affect the type and quality of information obtained from respondants in a survey, is form of the questions (Kumar, 2011). There are two main forms of questions, open-ended and closed questions. In the open-ended form, possible responses are not given. While in a closed question, possible answers are set out and respondents tick the best describe answers (Gideon, 2012, Kumar, 2011). Open-ended questions provide greater variety of information, but analysis of open-ended questions are more difficult and there is a greater possibility of being bias for the researcher. On the other hand, the biggest disadvantageous of a close question is lack of depth and variety in extracted information while the responses are easier to analyses (Kumar, 2011).

4.7 Validity and reliability of research method

One of the aspects which has a high significance for a researcher is to attempt to establish the quality of obtained results (Kumar, 2011). The concept of research quality is measured by two factors of validity and reliability which convince the readers that research has a value (Guba and Lincoln, 1994, Haji-Kazemi, 2015). Validity is defined as "the degree to which the researcher has measured what he has set out to measure". While, reliability refers to the extent that repeating a measurement by a test or scale under the same condition gives the same results (Kumar, 2011).

Following figure from (Cooper and Schindler, 2003) cited in (Haji-Kazemi, 2015) presents the concepts of validity and relaiability. When the shots are closely grouped in the middle of target, means that shots hit the same spot each time the gun is shooting. In this way the shots are both valid and relaible. The salvo is said to have high validity when the shots hit the same aim each time the gun is shooting. A quantity has high validity and relaibility when shots hit the aim (in this case the ceneter of the target) each time the gun is shooting.

Figure 13 Understanding validity and relaiability based on (Haji-Kazemi, 2015, Cooper and Schindler, 2003)

The question which comes up here is how to test and maximize the validity and relaibility of aresearch. Since the focus of this study is on quantitative method, types of validity and relaiability for only quanititative methods will be explained in this section briefly.

4.8 Different types of validity and reliability in quantitative methods.

There are three types of validity in quantitative research (Kumar, 2011):

1. Face and content validity: In this judgment, each question in the research methods, must have logical link with an objective. It is important that questions cover the whole issue being measured. This type of validity will be used in chapter 5 to discuss the validity of the survey.
2. Concurrent and predictive validity: This kind of validity is determined by comparing the assesement with another assesementand creats two kinds of predictive validity and concurent validity. Predictive validity judges the degree which an instrument can forecast an outcome. While concurent validity is how well an assesement is compared with a second assesment (Kumar, 2011).
3. Construct validity: This type of validity is based on the statistical procedure and is determined by "ascertaining the contribution of each contrust to the total varaince observed in a phenomenen".

The relaibility of a research methods depends on factors such as wording of questions and the respondents mood. Therefore, it is impossible to have research tool that is completely accurate. However the ways such as external consistency procedures and internal consistency procedures can be used to determine the relaiability of a method (Kumar, 2011).

4.9 Data analysis

The data analysis of the results included calculating the overall percentage of each question and calculating the correlation coefficient (r) among different variables. The Correlation coefficient is a measure of the strength and direction of the linear relationship between two variables that is defined as the (sample) covariance of the variables divided by the product of their (sample) standard deviations (Wikipedia, 2015). Literature review on correlation factors reveals different opinions on strength of correlation factors. For example, correlation coefficient (r) below ± 0.3 shows a small effect, the correlation coefficient between ± 0.3 and ± 0.5 shows medium effect, and a correction coefficient above ± 0.5 shows a strong effect. However, there is no rule for determining the strength of a correlation coefficient factor. For this study, correlation coefficient factor above 0.2 is considered strong and below this amount is considered weak. To measure the accuracy of the correlation coefficient factor, it is necessary to calculate p-value. In facts, p-value reveals that the results have been due to chance. In general, p-value lower than 0.05 reveals a significant differences from the null hypothesis while p-value above 0.05 shows no differences from the null hypothesis(Haji-Kazemi, 2015).

4.10 Research process

Kumar (2011) in his book compares research process to a journey and provide the required knowledge to select the most appropriate methods and procedures to conduct a research. Kumar offers eight steps model in three phases that provides the theoretical required knowledge to fulfill this journey. These phases and steps are presented in the following model.

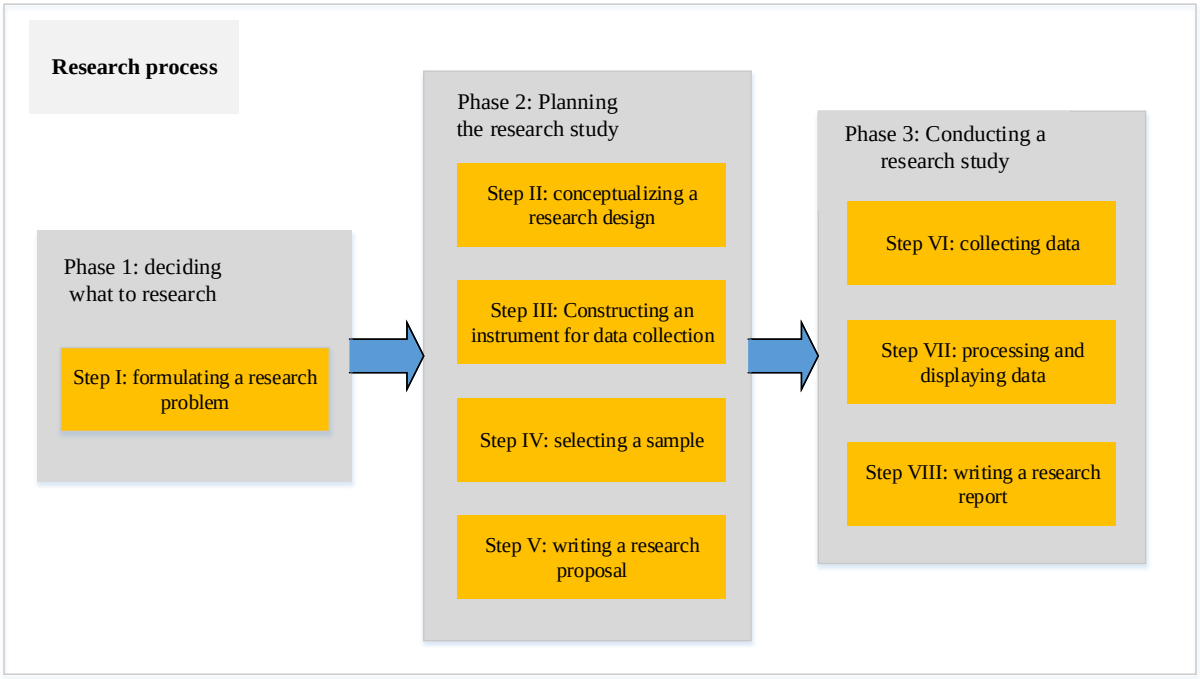

Figure 14 Research process(Kumar, 2011)

Description for each of the steps in the above model is provided in Table 4.

Table 4 Research process steps and descriptions (Kumar, 2011)

Steps	Description
Formulating a research problem	This step, which is the first and most important step in research process, explains what researcher's propose is and *what* the research wants to find out about
Conceptualizing a research design	This step explains *how* a researcher intends to find the answers to the research problems identified in the previous step. In fact, the researcher explains *tools and methods* he/ she will apply to find the answer to the research questions

Steps	Description
Constructing an instrument for data collection	To conduct the study, a researcher should construct a 'research tool' to collect data for the proposed study. This step is the first practical step in carrying out a study
Selecting a sample	Sampling, which largely affects the accuracy of a research, "is the process of selecting a few from a bigger group to become the basis for estimating or predicting prevalence of an unknown piece of information, situation or outcome regarding the bigger group"
Writing a research proposal	The overall plan of the previous steps that tells the reader about the research questions (*what)* and methods to investigate the research (*how)*
Collecting data	This step contains collecting data and using best-suited methods from which the researcher will draw discussion and conclusion for his/ her study
Processing and displaying data	In this step, the data gathered in the previous step are analyzed and displayed based on the type of information and decided approach to communicate the findings
Writing a research report	Writing a report informs the world about discoveries and the conclusion that the researcher has drawn from his/ her finding.

The above model is generic and can be applied to number of disicplines. However, not all of the steps might be required for all kinds of studies. Therefore, these steps are followed up to fulfill this research. Table below shows each step based on the Kumar model and how these steps are addressed in this report.

Table 5 Different steps of research process in this report

Step (based on the Kumar's model)	Section in the report
I	1.2
II	4.6
III, IV, VI	5
VII	6

From the above model, step V is performed by a research group in SINTEF and it is not be included in the report. In addition, step VIII is performed continuesly form the beginning of this study.

4.11 Author experience

This section is written almost as the last section in this report and aims to explain the author's experience of creating this report. The first experience of the author is how to search in the databases and find the relevant articles. There numerous articles in the topic of project planning and finding the most appropriate one is not easy. Besides writing an academic report and referencing correctly are other important experiences. To gain these experiences, like any other experiences, it requires training and practice. This research started by attending three short courses at Norwegian University of Science and Technology (NTNU) about how to search, how to write an academic paper and how to reference. These courses gave a better understanding regarding research and academic work and are applied throughout the whole report. Besides the author of this report conducted many talks with supervisors and doctoral students about the most appropriate databases to search. Author is not claiming that he is perfect in searching for the articles and writing a report, but author's ability to conduct an academic research has improved and this is one of the intentions of writing a thesis.

Familiarity with different research paradigms and research methods are another precious experiences in this study. Undoubtedly, conducting a survey and analyzing the results is the greatest academic research the author has done till now. The role of supervisors in creating the survey is inevitable and it could not be finished without their help. However, the supervisors' role is to guide the students and at last, it is the student who should do the job. During the creation of the survey the author had to have a clear understanding of the project goal. In addition, each question should be made in a way that answer an exact research question and as a result, address the final purpose of the project. That required many attention and thoughts. Each questions have to be clear enough so the respondents would answer what is really the purpose of the question.

The experience of analyzing the survey was another new experience for the author. It started by reading similar articles. Besides, the author received two Microsoft Excel files related to data analysis of surveys in another studies by the supervisor and one of the PhD student. These files were very helpful and gave the author the idea of how to analyze the data.

In total, the experience that the author gained is 'learning by doing' and the supervisors have always gave good comments. The author's skills in doing a research has improved a lot but still there are many things the author should learn regarding conducting a research.

Chapter

5 Survey design and distribution

This chapter discusses the purpose behind each question in the survey. First, the articles that have conducted similar research are introduced. Then different sections of the survey are presented and the connection between each part and the research questions are reviewed. Chapter continues by examining different key areas of the research and questions addressing each area. Afterwards, the purpose for each question is explained. The chapter finishes by describing the survey tool, survey test and distribution.

5.1 Survey Design

The survey designed to capture the real world experience of experts in project time planning of Norwegian construction industry. The starting point to create the survey was to find articles that have conducted similar research. Few articles could be found that have done a survey to capture the 'real experience' of experts doing project planning in construction industry. However, no article could be found that discuss the relationship between delay and project time planning using a survey questionnaire. Table 6 represents the most relevant sources that have done similar survey questionnaire in the field of project planning. As one can see, most of the sources are about CPM or planning software and none of the resources talks about the relationship between delay and poor project time planning. Most of the sources were conducted in US while the rest are from Middle-East and Europe. Only one is not conducted in the construction industry.

Those sources that do not contain the survey questions are contacted their authors and asked for their questions for their questionnaire surveys.

Table 6 Source with similar research topic

Author(s)	Kind of source	Topic	Country	Industry
(Liberatore et al., 2001)	Article	Project management in construction: Software use and research directions	The United States	Construction
(Galloway, 2006)	Article	Survey of the construction industry relative to the use of CPM scheduling for construction projects	The United States	Construction
(Galloway, 2005)	Article	CPM scheduling and how the industry views its use	The United States	Construction
(Vukomanović et al., 2012)	Article	The use of project management software in construction industry of Southeast Europe	Slovenia	Construction
(Ismail et al., 2009)	Article	The use of project management software in construction industry	Iraq	Construction
(Hegazy and El-Zamzamy, 1998)	Article	Project management software that meets the challenge	The United States	Construction
(White and Fortune, 2002)		Current practice in project management - An empirical study	The United Kingdom	Different industries

Author(s)	Kind of source	Topic	Country	Industry
(Kelleher, 2004)	Thesis	An investigation of the expanding role of the Critical Path Method by ENR 'S top 400 contractors	The United States	Construction

The sources in the Table 6 are used as an initiating point to gain ideas for making the survey. Some of the questions in the survey are used directly from above resources while many are created specifically for this study.

Since the survey aims to gain different information, it is decided to classify questions in different sections. Thus, the survey contains of four separate parts, which each part seeks to gather specific data. These parts and their purpose are described in the following.

- **Background questions**: to gain general information about experts who are involved in project time planning.
- **Project planning staff**: to understand the required qualification and tasks for doing project time planning.
- **Project planning tools**: to realize the tools used for project time planning
- **Project time planning and delay**: to understand any possible relationship between poor project time planning and delay.

Each of these parts address a specific research question. The connection between research questions and survey's different parts are explained in the next section.

5.2 The relation between survey's parts and research questions

As presented in the Figure 15, each part of the survey, address a part of a research question. Blue solid arrows show direct connection between section part and research question. While, dotted arrows show indirect connection between surveys' parts and research questions.

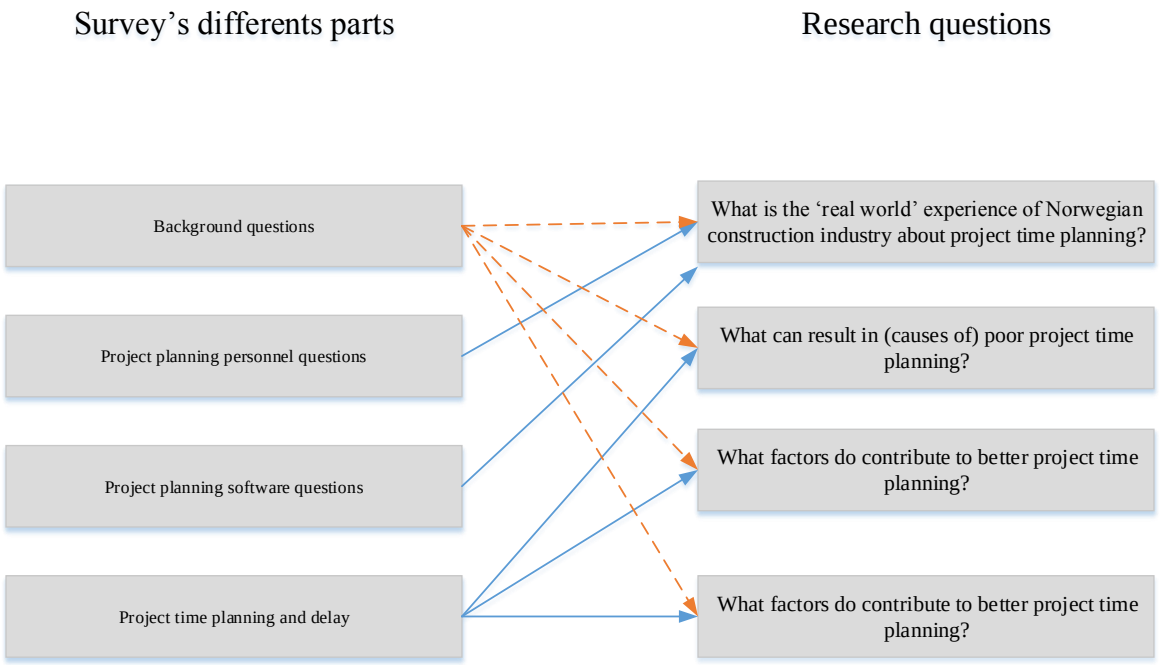

Figure 15 The relation between research questions and different survey's parts

As one can see, the first research question is answered by second and third parts of the survey. In addition, the second and third research questions are addressed by the last part of the survey. Next section discusses survey questions in details.

5.3 Survey questions and their options

Since all of the questions are close questions and options for each questions is provided, it is relevant to explain questions and their options. Therefore, this section seeks to address the logic behind creation of the survey. In the writer's opinion, it can help better understanding of survey's purpose. To address this section better, each questions is provided in the same section as the survey. Survey questions and their options are available in the Appendix IV and Appendix V.

The questionnaire comprised 19 questions with a mixture of yes/no, scale, multiple choice and matrix questions. Table 7 represents the key areas of the survey and the questions related to each area.

Table 7 Key areas of the survey and questions related to each area

Key areas	Questions to address issue
information about the respondents	1,2,3,4
How construction companies perform project time planning	5,6,7
How personnel gain required knowledge of project time planning	8
Tools for project time planning, number of use, the reasons and purposes of using the tools	9,10,11,12
If project time planning tools reduce delay	13
Reasons for poor project time planning and ways to improve project time planning	15,17
Extent of project delay due to Poor project time planning	14 (to some extent),16
Internal and external factors influence project time planning	18,19

According to Westland (2006), term ‘project planning’ refers to different kinds of planning like resource planning, financial planning, risk planning, quality planning etc. Since the main focus of the study is about time planning of the projects and to prevent confusion for the participant, phrase ‘time planning’ was replaced by ‘project planning’ in the questions. The purpose of each question is explained below.

5.3.1 Background

5.3.1.1 Question 1

The reason to add this question is to classify the data based on the name of each company and make a comparison among the companies. Due to confidentiality and anonymity of data, name

of the companies will be changed with numbers (i.e. company 1, company 2, etc.) in the analysis section of this report.

5.3.1.2 Question 2, 3 and 4

Results from (Faridi and El-Sayegh, 2006) reveals that individuals with different positions (e.g. contractor and consultant) and different years of experience, rank same option differently. This can be based on different views, roles and responsibilities, etc. Questions 2, 3, and 4 seek to find similar results. Question 2 gives the chance to classify the responds based on their positions.

Questions 3 and 4 gives the chance to compare responds by experts with different years of experience. Question 3 wants to find out whether experts in the same positions with different years of experience (in that position) rank options differently or not. While Question 4 aims to compare responses regardless of the position and just based on total years of experience. This question is provided in similar studies by (Faridi and El-Sayegh, 2006, Galloway, 2006, Kelleher, 2004).

5.3.2 Project time planning personnel

5.3.2.1 Question 5, 6, and 7

These questions, which are similar to questions used in the survey from (Galloway, 2006, Kelleher, 2004), seek to understand how Norwegian construction companies conduct project time planning. These questions give the information about which unit perform the planning (question 5), what the qualification for planning are (question 6), and what tasks are performed by those involved in project planning (question 7).

5.3.2.2 Question 8

This question target is to realize how ones involved in the project time planning gain knowledge in this topic. This question asks respondents to rank 1-5 (where 5 stands for the most favorable and 1 stands for the least favorable) the way they prefer to gain information about project time planning.

5.3.3 Project time planning tools

5.3.3.1 Question 9, 10, 11, and 12

These four questions aim to discover kind of tools, frequency of use, reasons for using the specific tool, and the purpose of using each tool. Similar to these questions is used by (Liberatore et al., 2001, Kelleher, 2004, Galloway, 2006, Ismail et al., 2009)

5.3.4 Project time planning and delay

Previous parts of the survey gain the information about the 'real world experience' of Norwegian construction companies. The last part of the survey, which asks about possible relation between 'project time planning' and 'delay', could not be found in other studies. In the authors' opinion, this part is the most important part of the survey since tries to find out the reason for poor project time planning, which is one of the common reasons of delay in construction projects based on the literature. Following explains the last part of the survey in details.

5.3.4.1 Question 13

This question seeks to find out whether time planning tools can help reducing the project delay. The options for this question are extracted from literature (see Appendix II).

5.3.4.2 Question 14

The purpose of this question is to understand if poor project time planning can lead to delay. However, based on the literature (see Appendix I) poor planning is one of the reasons of delay and time but literature review shows that delay causes are different in each country. According to literature, different situations such as construction environment, working cultures, management style, project characteristic, methods of construction, local construction practices, geographical condition, stakeholders, the government policy, economic situation, availability of resources, and political situation are some of the reasons of delay variation in literature (Asnaashari et al., 2009, Yang et al., 2013, Khoshgoftar et al., 2010, Toor and Ogunlana, 2008). Therefore, this question is provided to find out if respondents choose 'poor project time planning' as a reason for delay.

5.3.4.3 Question 15, 16, and 17

Question 15 looks for the reasons behind poor time planning. In addition, question 16 asks about the amount of delay due to poor project time planning. Question 17 seeks to find out the

ways to improve project time planning. The options for this question are extracted from literature (see Appendix II).

5.3.4.4 Question 18 and 19

These questions peruse to understand the internal factors (inside the organization) and external factors (outside the organization) that can influence the project time planning. The options for these questions are mostly selected based on the delay factors mentioned by the literature (see Appendix II).

5.4 Survey tool

To conduct the survey, the author has used SelectSurvey tool. This tool, which is provided by NTNU, gives the user this opportunity to create survey via the web, change and update questions, distribute the survey, and analyze the results. Using the tool is easy. However, there are user manual and videos available that help the user implement the tool better.

5.5 Survey test, distribution, and data collection

The first draft of the survey was made in English and later the Norwegian version was made with the help from a native speaker. Survey questions and their options where modified and discussed several times by the supervisors and experts in SINTEF. In addition, before distributing the final version of the survey, a pilot survey was sent to three persons from one of the companies to test the survey. This was necessary to test the potential suitability and comprehensibility of the questionnaire. Two out of the three experts answered the survey and confirmed clarity and relevance of the questions. Therefore, the reliability and validity of the survey was assured (see section 4.8). After this step, the final version of the survey was sent to contact persons in each of the companies and they were asked to be distributed the survey among experts who are involved in project time planning. The participants of the study are selected among seven Norwegian construction companies that are partners in SpeedUp[1] project. The survey was sent to contact person in each of these company and were asked to distribute it among experts. The survey was sent to the respondents by email, which contains of a link to

[1] To gain more information about SpeedUp project and its industry partners please check the following link. http://www.prosjektnorge.no/index.php?subsite=speedup

the online survey. Survey respondents were asked to answer the questions based on the last fulfilled project or the current project they are working in. A deadline of 3 weeks were placed and after the due date, the deadline was extended for one more week.

Chapter

6 Analysis and results

As noted above, the survey respondents well represented the construction industry and were both owners and contractors companies. Respondents have different roles in their projects and are actively involved in the planning of the project. Number of experts that the survey is sent to are142 and 62 complete responses was extracted. This gives the survey response rate of 44%. The data analysis of the results included calculating the overall percentage of each question of the responding companies and calculating the correlation coefficient factor among different variables. Data collection took place by the SelectSurvy tool and the data were later extracted to Microsoft Excel 2013 for analysis. Analyzed data for each question is presented according to each section of the survey beneath.

6.1 Background questions

6.1.1 Question 1. Respondents Company

As mentioned earlier, this question was placed in the survey so the results between the companies can be compared. Unfortunately, some of the respondents did not answer this question and they used other words to fill the question (e.g. confidential, 1, etc.). Therefore, not any specific result can be extracted from this question.

6.1.2 Question 2. Position of the respondents

Respondents in this study have positions such as construction manager, department manager, operation manager, adviser and engineering manager. As the Figure 16 represents 66% of the respondents are project/ construction manager. The reason for not translating the positions (in the figure) to English is that author believes translation will not convey the appropriate meaning of the positions.

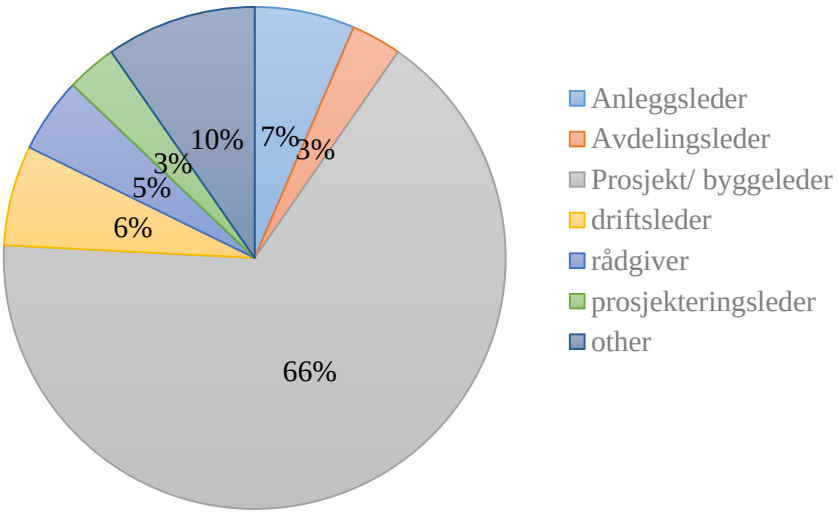

Figure 16 Position of respondents

6.1.3 Question 3. 4 Years of experience in the current position and total

47% of the respondents have between one to five years of experience and 40% have more than 10 years of experience in their current position (see Figure 17). While most of the respondents have more than 10 years of experience (85%) in total (see Figure 18).

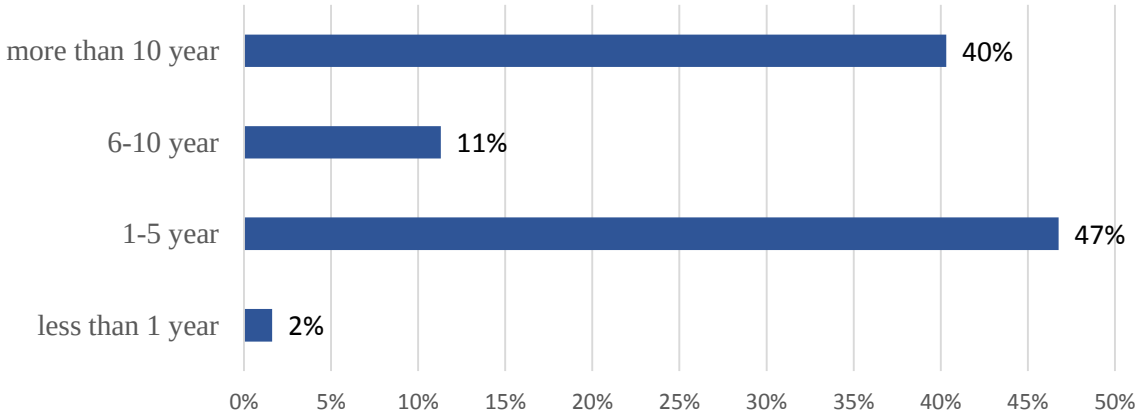

Figure 17 Respondents' years of experience in the current position

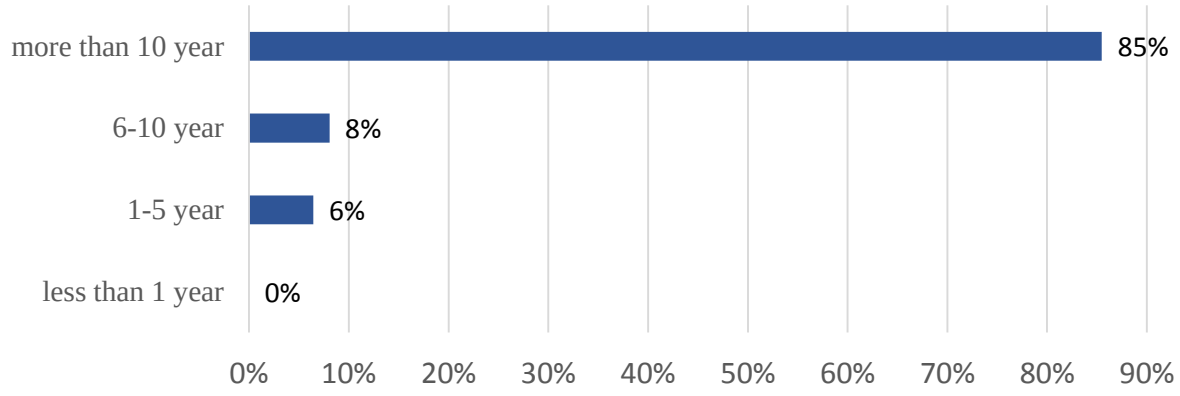

Figure 18 Respondents years of experience in total

Since most of the respondents have management positions and long years of experience, what discussed earlier in section 5.3.1 cannot be proven.

6.2 Project planning personnel questions

6.2.1 Question 5. The unit of doing project planning

50% of the respondents use in-house personnel for planning the project while only 10% use outside-consultant for project time planning and 40 % have mentioned that they use combination of both in-house and outside-consultant for planning their projects (see Figure 19).

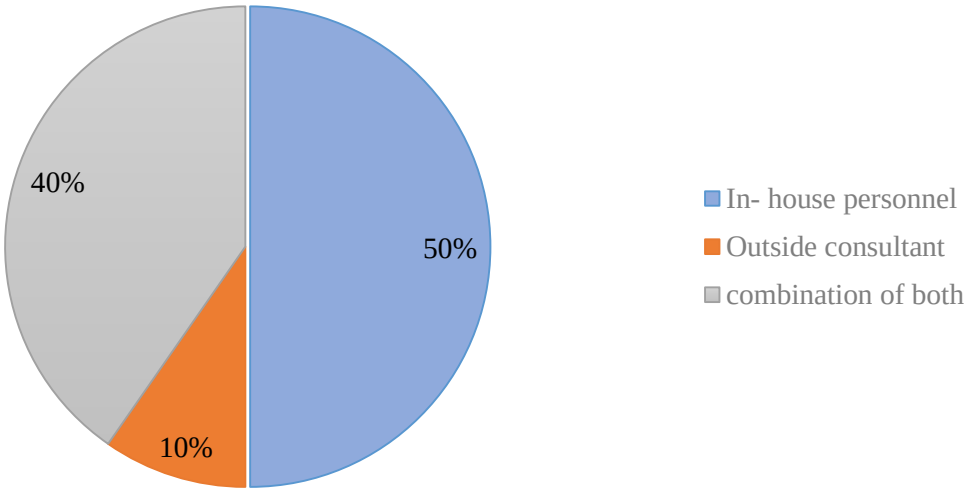

Figure 19 Unit for performing planning

6.2.2 Question 6. Qualification of performing project time planning?

For this question, ‘to have experience in project planning’ is ranked highest as qualification for project time planning (see Figure 20), while no one has mentioned ‘education in project planning’ as a qualification.

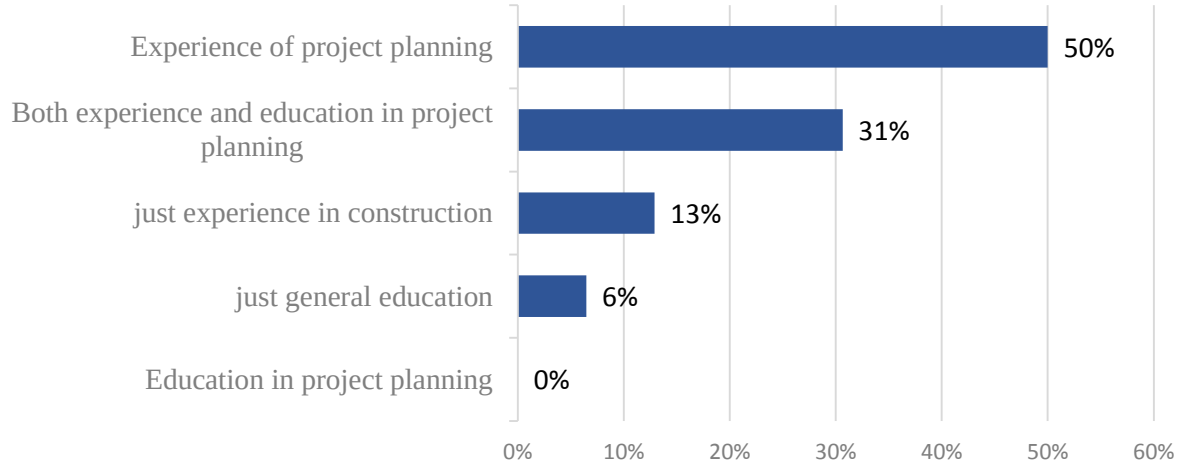

Figure 20 Qualification of project planning

6.2.3 Question 7. Project time planning personnel tasks

10% of respondents have mentioned that project planning personnel in their company do only project time planning the rest have mentioned that project time planning personnel do other jobs besides time planning (Figure 21).

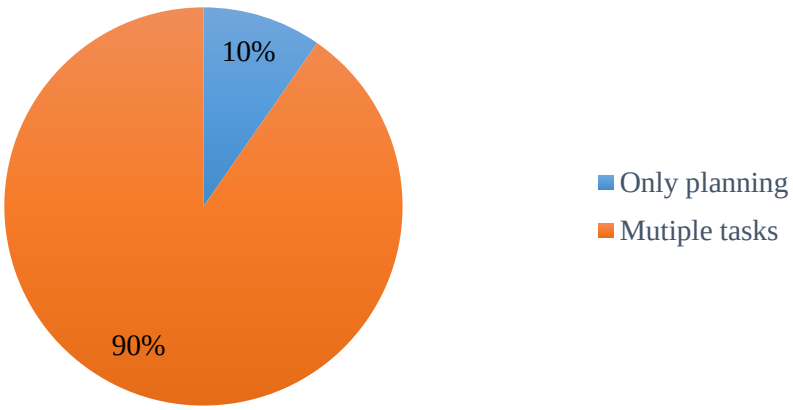

Figure 21 Project planning personnel task

6.2.4 Question 8. Gaining knowledge in project time planning

Respondents were asked to rank (from 1 to 5) the way they use to gain knowledge in project time planning (Figure 22). 82% of the respondents have mentioned that they prefer to talk with colleagues (see Figure 23).

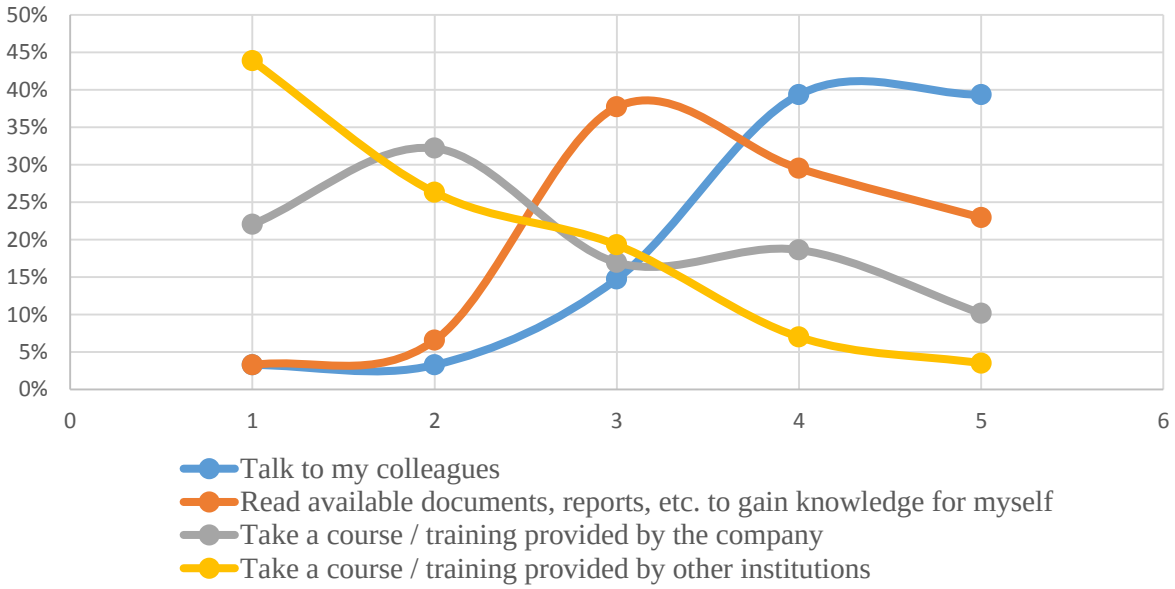

Figure 22 Ranking of criteria for gaining knowledge about project time planning

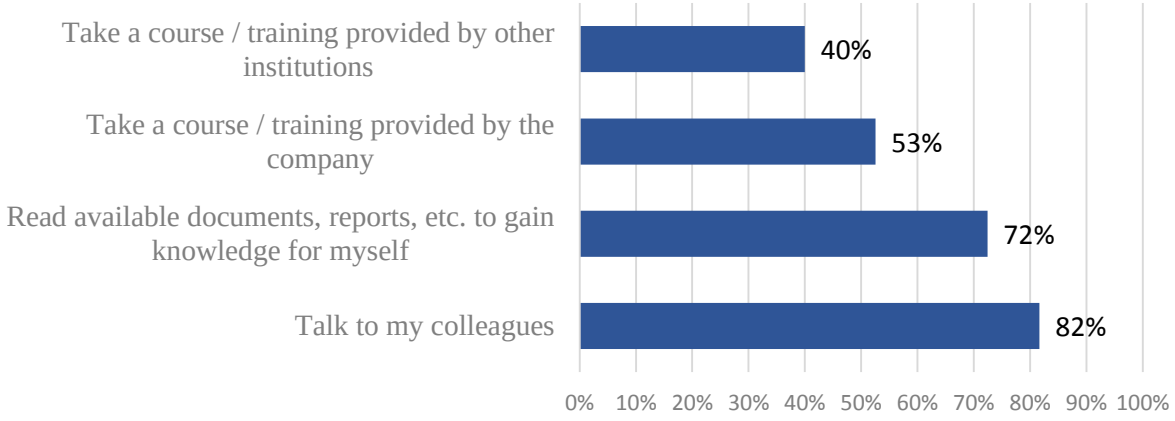

Figure 23 Preference of gaining knowledge in project time planning

6.3 Project time planning tools

6.3.1 Question 9. Tool for project time planning

Microsoft Project (82%) and Excel (44%) are the first and second tools used by respondents for project time planning (Figure 24).

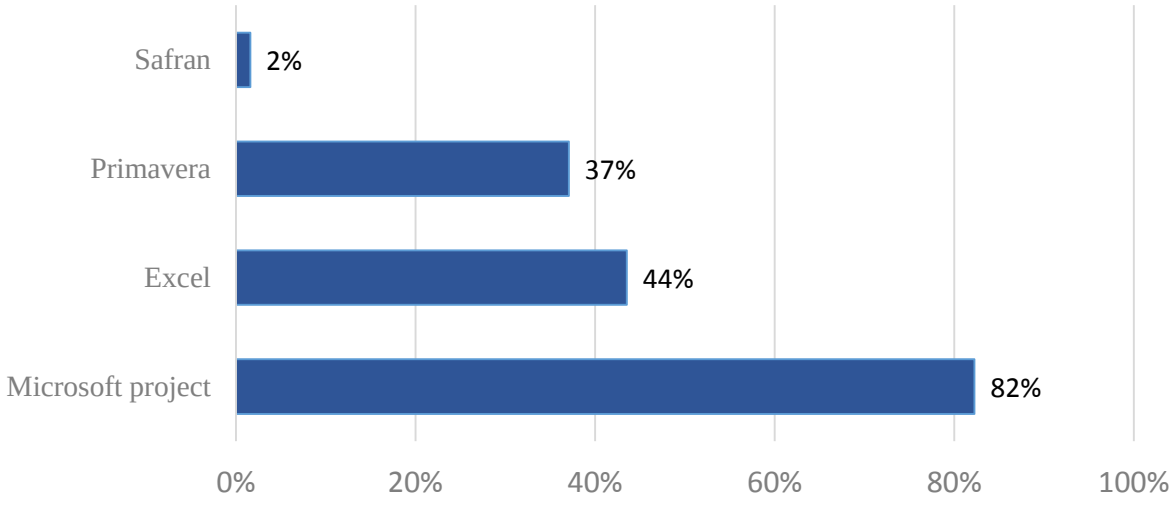

Figure 24 Planning tools

6.3.2 Question 10. How often do you use time planning tools?

32% of respondents use project planning tools at least once per month and only 8% use tools everyday(Figure 25).

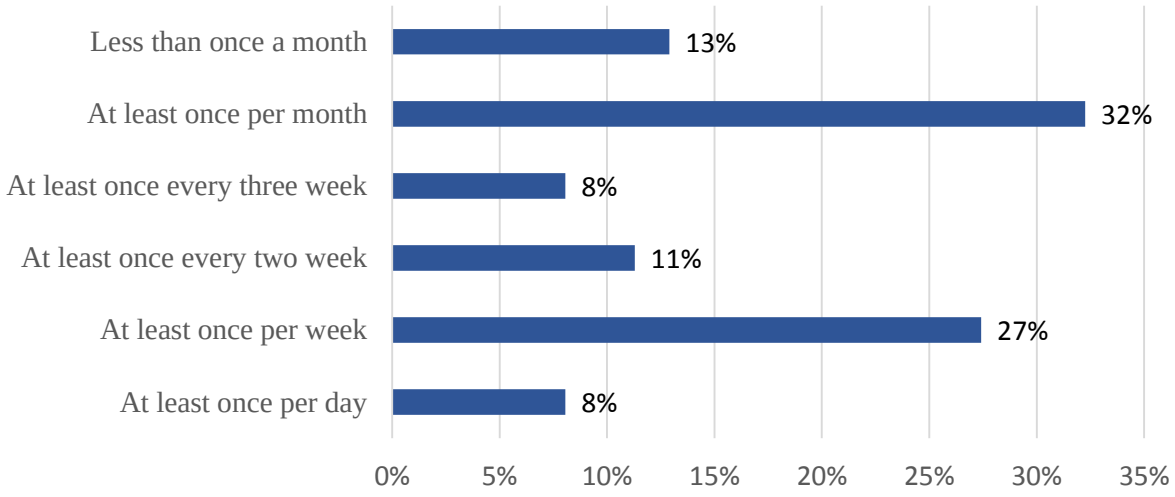

Figure 25 Frequency of using the tools

6.3.3 Question 11. Reason for using the specific project planning tool

According to the responses, user friendliness has the highest (55%) and tools price has the lowest rank as the reason for selecting project planning tools (Figure 26).

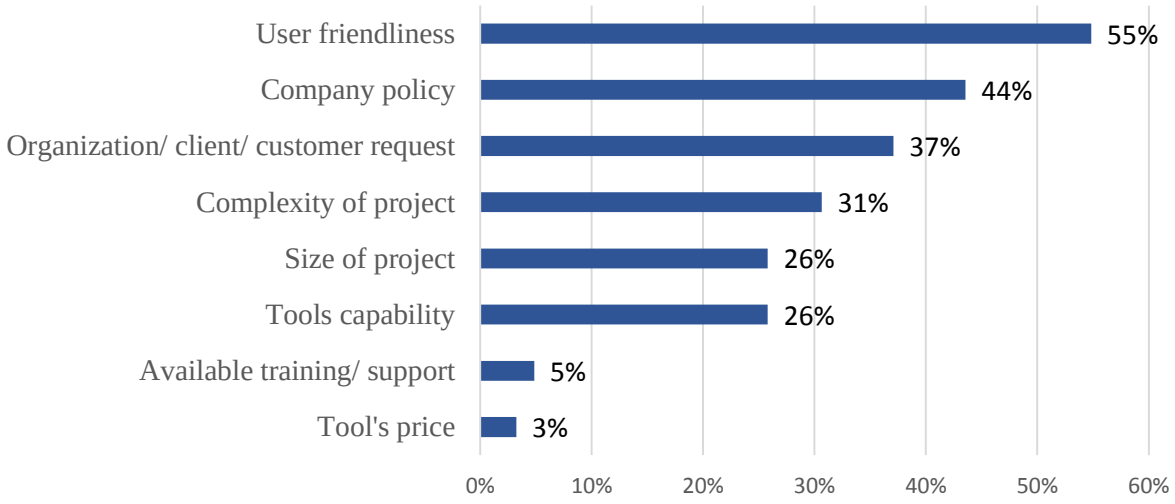

Figure 26 Reason for using the specific project planning tools

6.3.4 Question 12. Purpose of using time planning tool

For this question respondents have sited project control (74%) and updating the project plan (73%) as the purpose of using specific software (Figure 27).

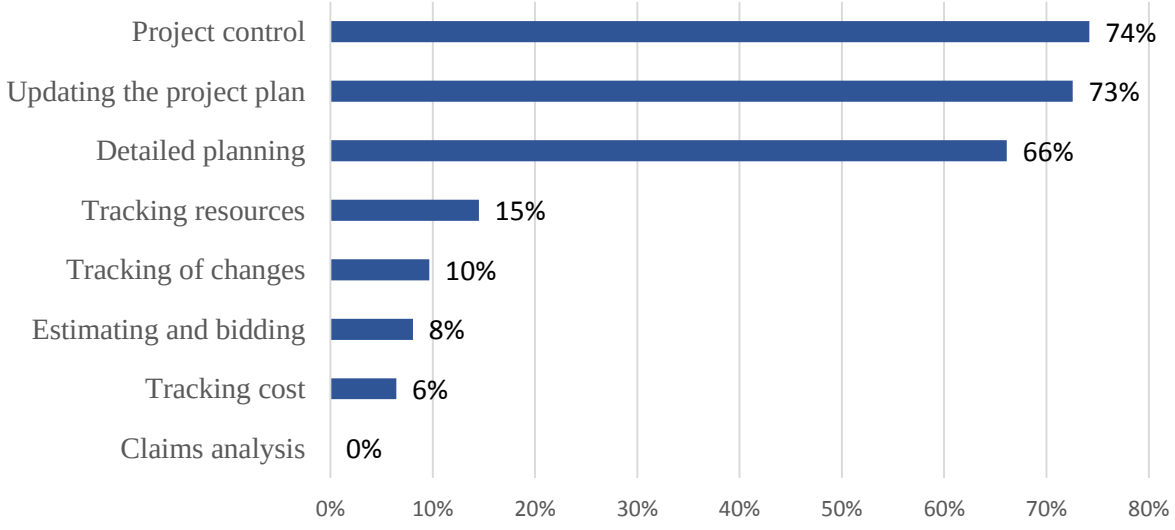

Figure 27 Purposes of using time planning tools

6.4 Project time planning and delay

6.4.1 Question 13. How time planning tools reduce delay in project

For the question asking how project time planning tools can reduce delay in projects, on the one hand 71% have stated that tools warn delay in project. On the other hand, 15% of respondents have declared that use of tools cannot reduce delay (see Figure 28).

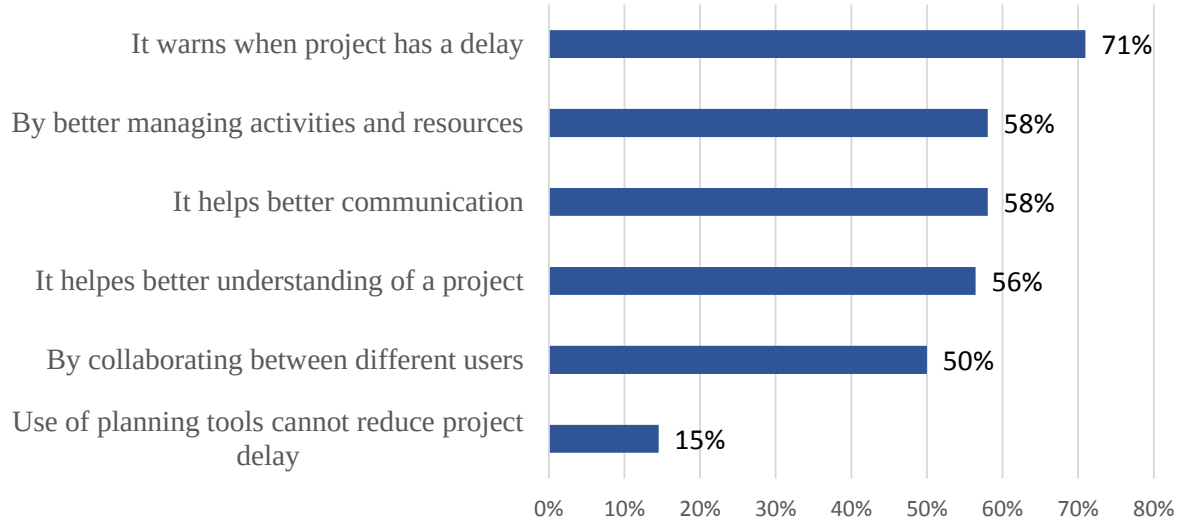

Figure 28 How planning tools reduce delay in projects

6.4.2 Question 14. Poor time planning of projects and the project delay

Figure 29 represents that majority of the respondents agree that poor planning will lead to delay in projects.

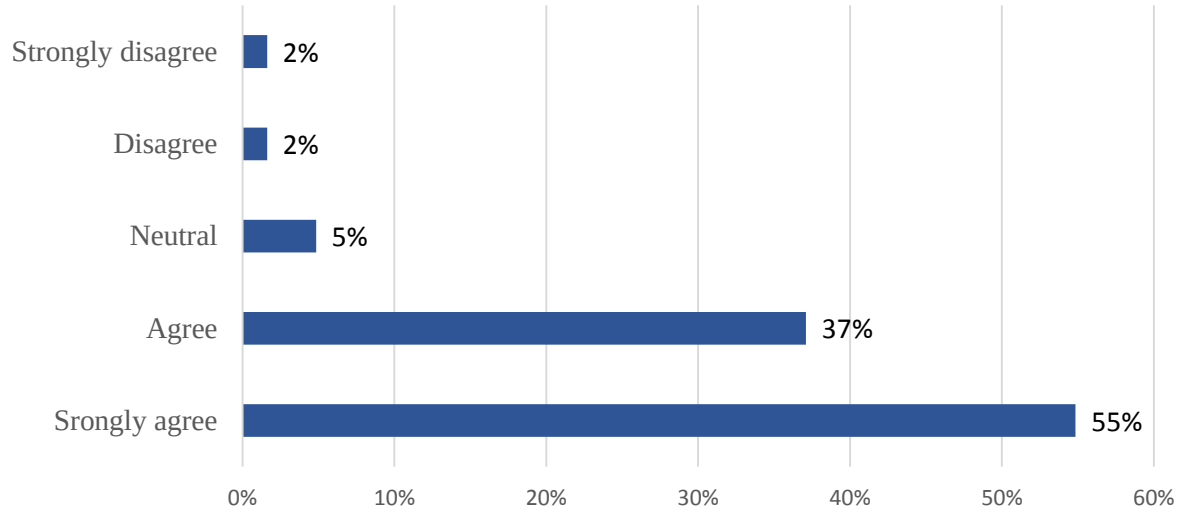

Figure 29 Whether poor planning leads to delay

6.4.3 Question 15. Amount of delay due to poor project time planning

Respondents were requested to indicate amount of delay due to poor planning. Figure 30 represents that 50% of respondents have mentioned between 1-6 months as amount of delay due to poor planning.

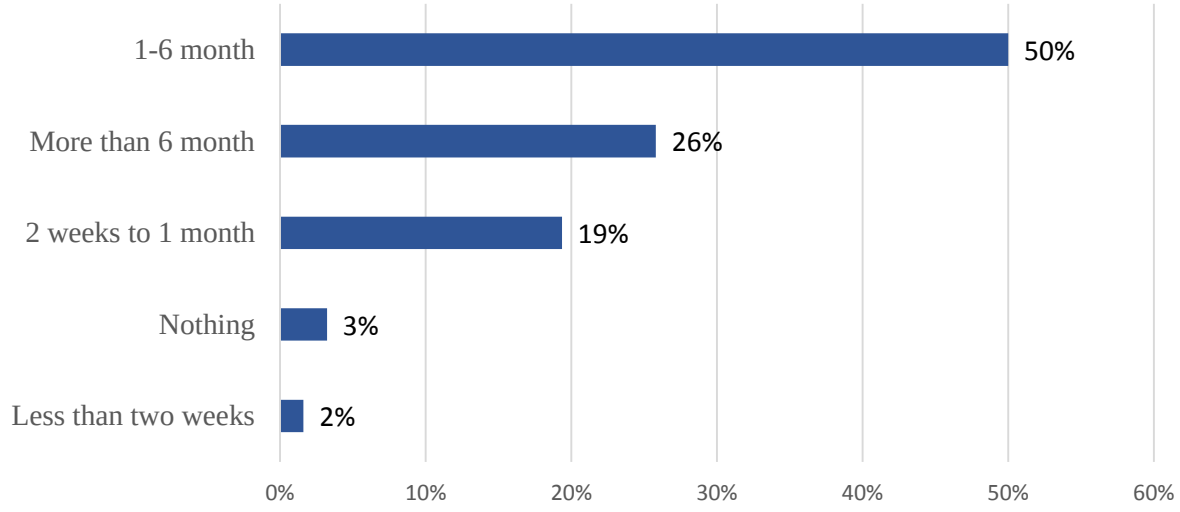

Figure 30 Amount of delay due to poor time planning

6.4.4 Question 16. Reasons of poor project time planning

Results 90% stated that ‘poor project management’ as the most important reason and ‘lack of communication between participating companies’ is the second important reason for poor planning (Figure 31).

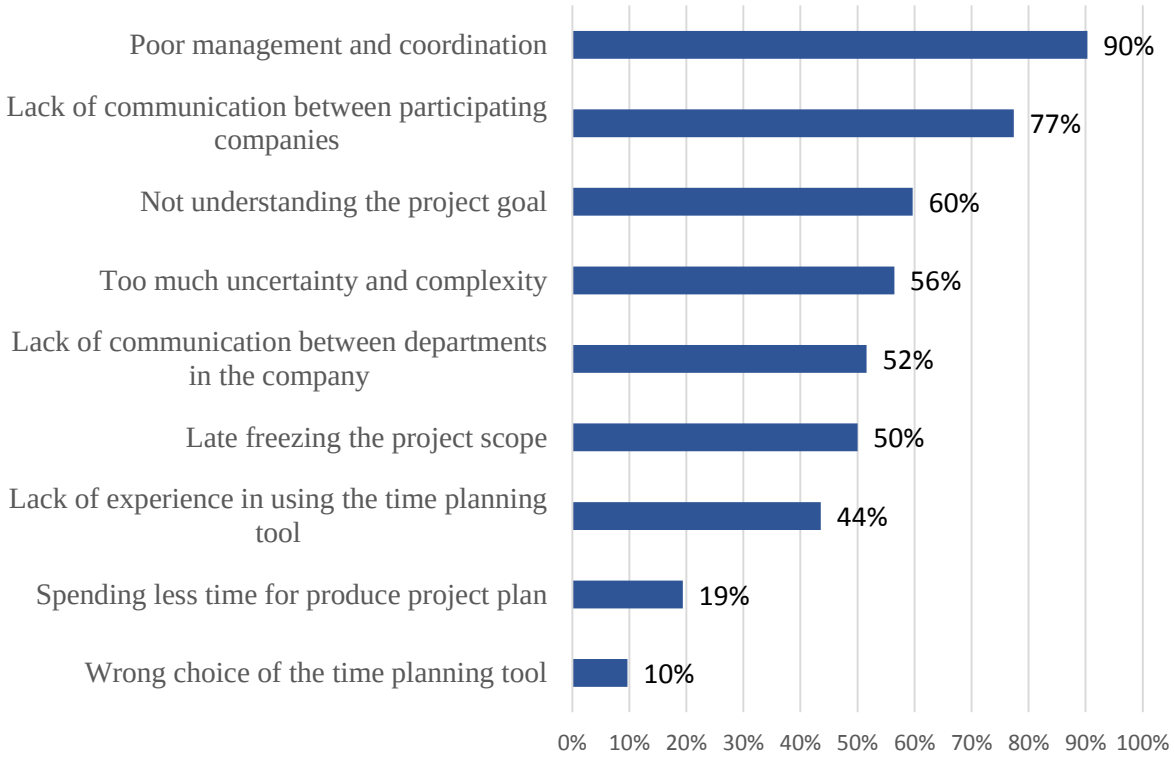

Figure 31 Reasons of poor planning

6.4.5 Question 17. Driver of better project time planning

Respondents have sited ‘more experienced people’ (79%) and ‘improving the clarity of the project’ (66%) highest as drivers of better project time planning (Figure 32).

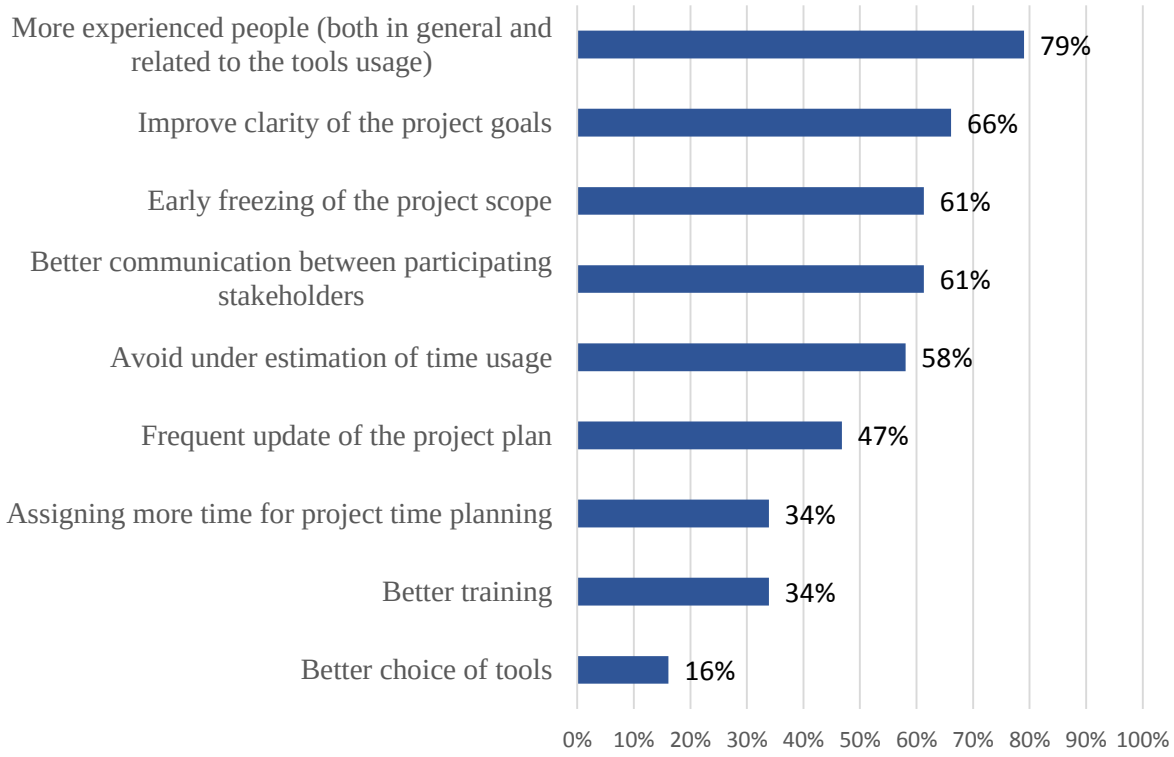

Figure 32 Drivers of better project time planning

6.4.6 Question 18. Internal factors influence project time planning

Respondents were asked to rank (from 1 to 5) internal factors that influence project time planning. Figure 33 represents how respondents have ranked the internal factors. Poor project management (87%) is ranked as the highest internal factor influencing project time planning (Figure 34).

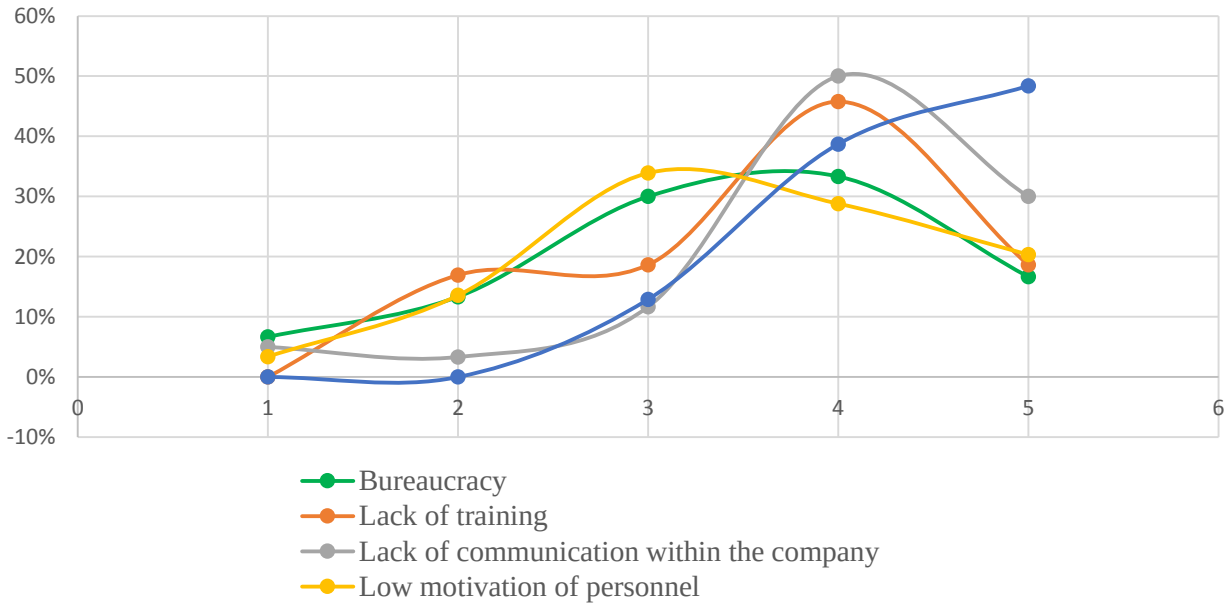

Figure 33 Ranking of internal factors influencing project time planning

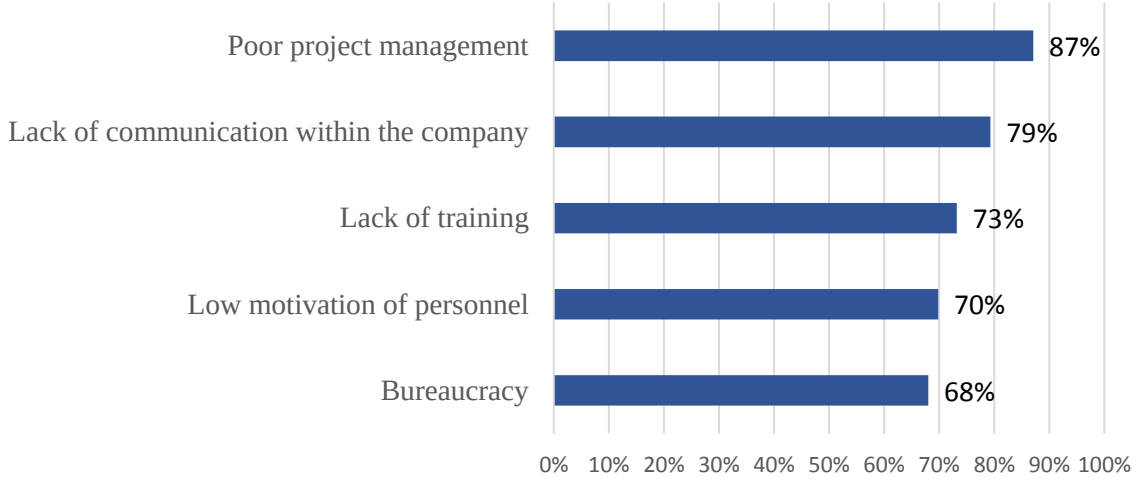

Figure 34 Internal factors influencing project planning

6.4.7 Question 19. External factors influence project time planning

Respondents were asked to rank (from 1 to 5) external factors that influence project time planning (similar to the question18). Different rankings for external factors by the respondents are presented in Figure 35. Results shows that external factors such as change (78%) , 'lack of

communication' (77%), 'slow decision making by other involved parties' (77%) are ranked highest as the external factors influencing project time planning (Figure 36).

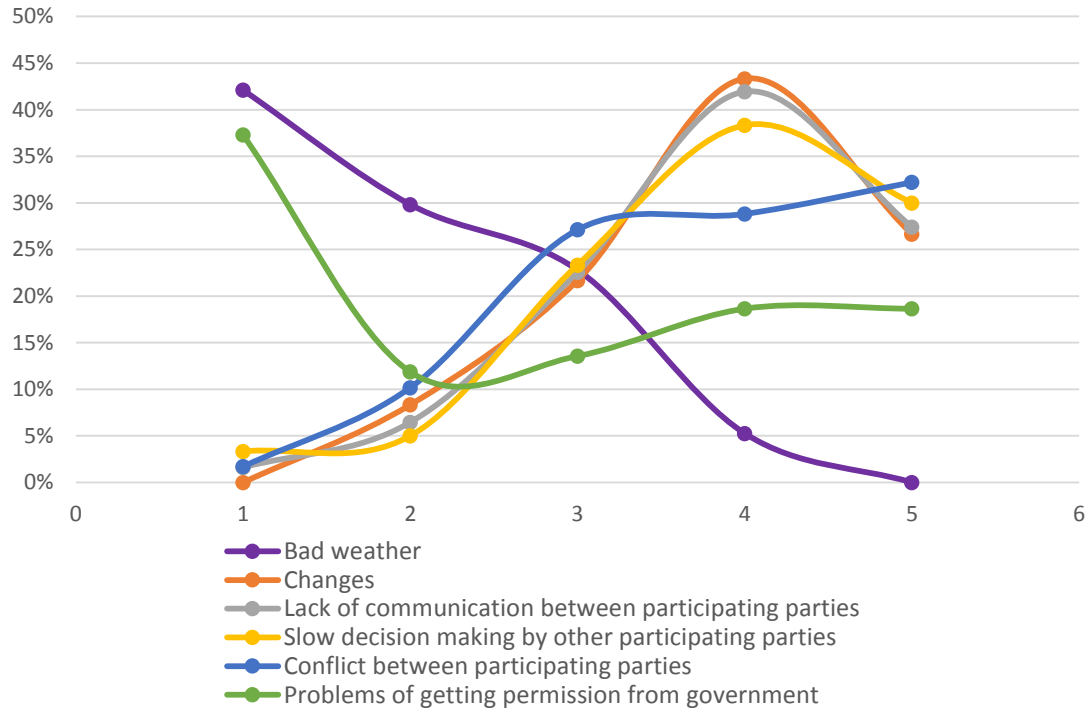

Figure 35 Rankings for external factors influencing project time planning

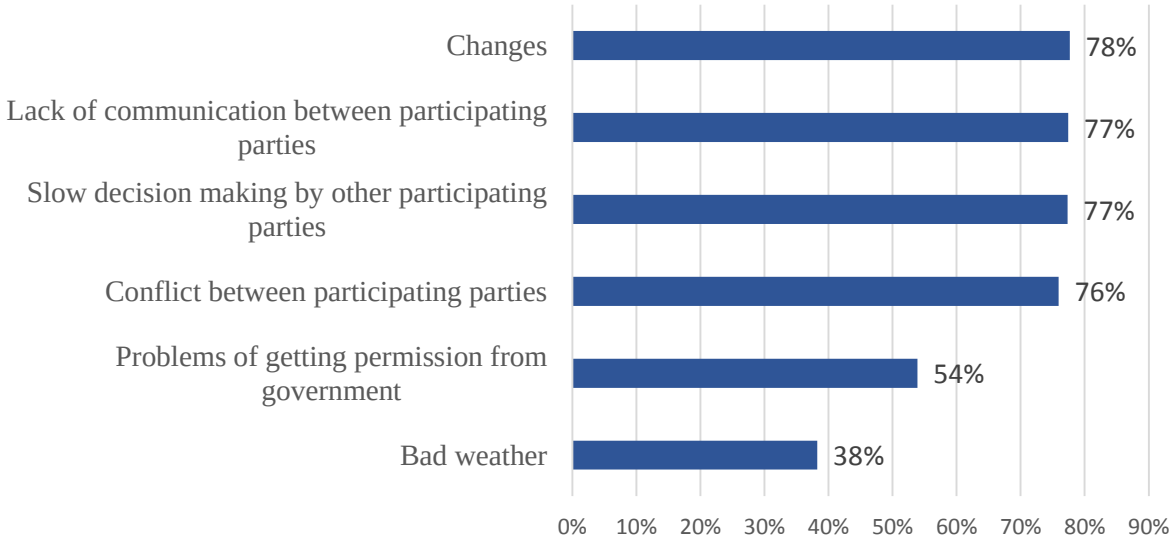

Figure 36 External factors influencing project planning

Chapter

7 Discussion

This chapter aims to discuss different areas about project time planning based on both literature and survey. The chapter is divided to two parts. First part is discussions based on the survey results and second part is the discussions based on the theory. Each part is divided into some sub-chapters to facilitate arguing different aspects. Chapter ends with discussing and presenting two models on the topics of delay and project time planning.

7.1 Discussion based on the survey results

7.1.1 Hypotheses

After compiling the survey responses and analyzing the data different hypotheses are proposed. To examine the accuracy of the hypotheses, it is necessary to calculate the correlation coefficient factor between the variables (see section 4.9). Since the correlation can only calculated for quantifiable variables, the factors that were not ranked by numbers were scaled to quantities. For example, the question asking about total years of experience include options: more than 10 years, 6-10 years, 1-5 years, less than 1 year which are quantified respectively as 4, 3, 2, and 1. Although, the approach does not necessarily allow for accurate results, it provides insight into the level of interdependency of the variables (Haji-Kazemi, 2015).

For this study seven hypotheses are stated and correlation coefficeint factor and p-value for each of the hypotheses are calculated. Following section describes these hypothesises. All of the calculation regarding the correlation coefficient factors and p-values are done by data analysis tool in Mircrosoft Excel.

The first group of hypotheses compares years of experience of the respondents with different factors. This hypothesis was predicted during the survey creation (see section 5.3.1.2). Results by (Faridi and El-Sayegh, 2006), in a similar study, show that years of experience influence the

results of the survey and respondents with different years of experience rank same option differently. Therefore, a correlation coefficient test is carried out to see if

1. Hypothesis 1: respondents with higher years of experience mention communication more.
2. Hypothesis 2: respondents with higher years of experience mention amount of delay due to poor time planning more.
3. Hypothesis 3: respondents with higher years of experience use planning tools less.

These hypotheses are explained and tested in the following.

7.1.1.1 Hypothesis 1

Respondents with higher years of experience emphasize more on ‘more communication between participating companies’ to improve project time planning (question 4- question 17). Importance of communication in project planning is explained earlier in section 3.5. Here, it is assuemed that respondensts with more years of experience are more aware of importance of communication in project time planning.

For this hypothesis, calculated correlation factor is 0.12 and p-value is 8.53812E-64 (less than 0.05). Result show that there is a correlation between ‘communication’ and ‘years of experience’ (see Figure 37). P-value is less than 0.05 for this hypothesis, which shows the credibility of the correlation. However, correlation coefficient factor, is lower than 0.2. This means that cannot strongly state that there are correlation between ‘years of experience’ and ‘communication’ in this study (see section 4.9).

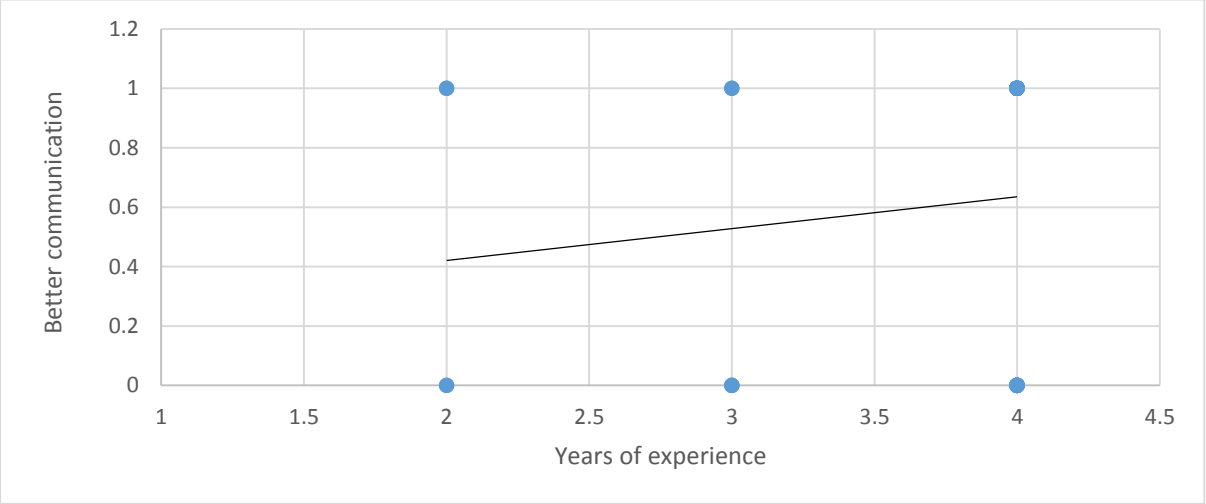

Figure 37 Correlation coefficient for hypothesis 1

7.1.1.2 Hypothesis 2

This hypothesis investigates if respondents with higher years of experience name amount of delay (due to poor project time planning) more than respondents with less years of experience (question 4- question 15). For this hypothesis, correlation factor is -0.13 (Figure 38) and p-value is 5.70411E-09 (less than 0.05). Since the correlation factor is negative, it states an opposite result from the hypothesis. It means that respondents with more years of experince rank amount of delay due to 'poor project time planning' less. P-value for this hypothesis is less than 0.05, which shows the credibility of the correlation. However, correlation coefficient factor, is lower than 0.2. This means that cannot strongly state experts with more years of experience have different opinion about amount of delay due to 'poor project time planning'.

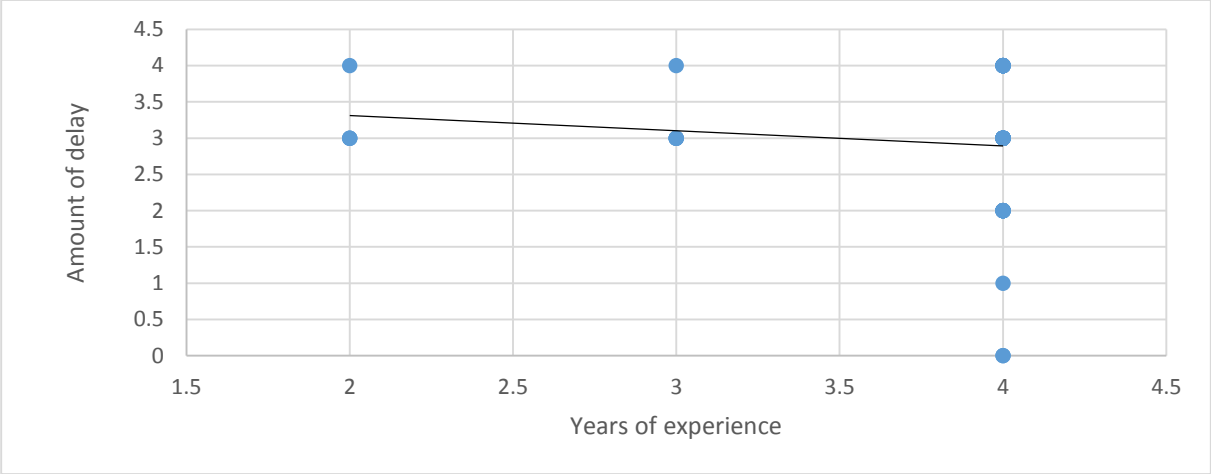

Figure 38 Correlation coefficient for hypothesis 2

7.1.1.3 Hypothesis 3

Respondents with higher years of experience use the project planning tools less (question 4-question 10). This hypothesis is based on the assumption that experts with more years of experience have management positions and they do not need to work with project planning tools frequently. Instead they ask other employees (e.g. project planners) to do the tasks such as updating the project plan they use the final outcome. For this hypothesis, correlation factor is 0.11 (Figure 39), and p-value is 3.09971E-06 (less than 0.05). However, the correlation results show opposite result from the hypothesis and experts with more years of experience use planning tools more. Perhaps the result from this assumption can be explained by the project planning tool the companies use. As shown in section 6.3.1, Microsoft Project is the tool mostly used by the companies. This tool is one of the oldest commercials used for project planning and many experts are familiar with it. Therefore, the managers familiarity with this planing tool makes it more convinient for them to use it more. This clarification might be one of the reasons

to explain the result of the test. However, for this hypothesis, correlation coefficient factor is lower than 0.2. This means that cannot strongly state respondents with more years of experience use project planning tools more frequently or less frequently.

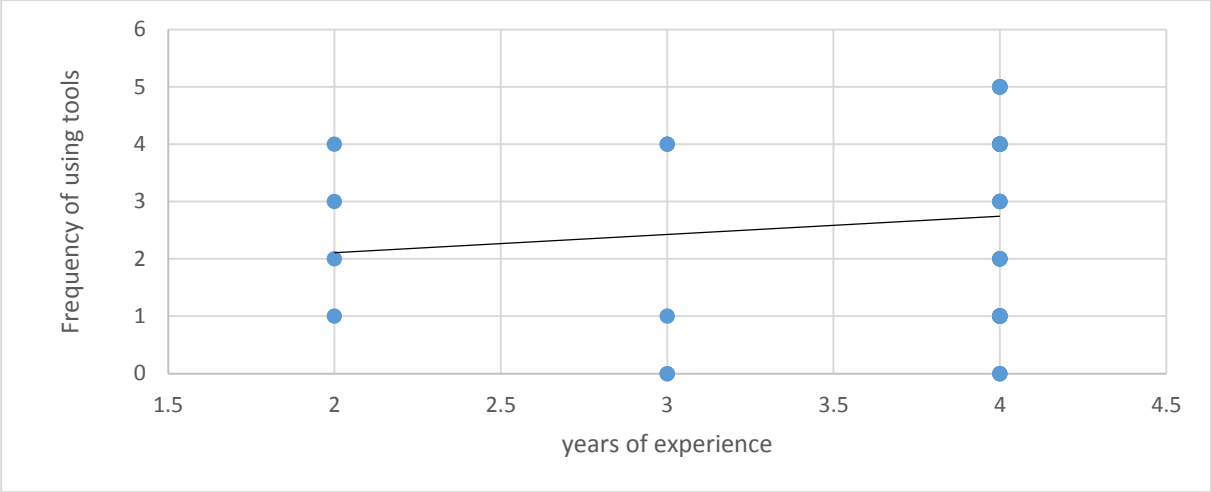

Figure 39 Correlation coefficient for hypothesis 3

P-value is less than 0.05 for all above hypotheses which, shows the credibility of result. However, correlation coefficient factors, as shown in this section, are lower than 0.2. This means that cannot strongly state that there are correlation between 'years of experience' and 'communication' (hypothesis 1), 'amount of delay' (hypothesis 2) and 'planning tools usage' (hypothesis 3) (see section 4.9). The low correlation coefficients might be due to distribution of the data. As shown in Figure 18, most of the respondents have more than 10 years of experiences and data are not distributed among other options. Therefore, there are less respondents with less than 10 years of experience. This might be a reason for low correlation coefficient factors.

Second group of hypotheses looks to see if the companies do the time planning internally and externally (combination) mention 'communication', 'change', 'late decision making', and 'conflict' as factors that influence planning more than the companies do the planning just internally. This time, it is assumed that companies do project time planning both externally and internally need more communication and coordination to make the project plan. Therefore, they experience above factors influencing project time planning more. These assumption is tested through hypotheses 4-7.

1. Hypothesis 4: Companies do time planning both internally and externally mention lack of communication among parties more.

2. Hypothesis 5: Companies perform time planning both internally and externally mention conflict among parties more.
3. Hypothesis 6: Companies do time planning both internally and externally mention late decision making by other parties more.
4. Hypothesis 7: Companies do time planning both internally and externally mention change more.

For these hypotheses, numbers on the horizontal axis indicates:

1= companies doing the planning internally

2= companies doing the planning externally

3=companies doing the planning combination of both externally and internally

These hypotheses are explained and tested in the following.

7.1.1.4 Hypothesis 4

Companies do project planning externally or both externally and internally, mention more 'lack of communication between parties' as a reason of poor planning (question 5- question 16). For this hypothesis, correlation factor is 0.11 (Figure 40) and p-value is 5.2399E-13 (less than 0.05). Result from the correlation coefficent factor shows there is a weak relationship between variables and p-value shows the crediblity of the test. Howerer, because the correlation coefficient factor is lower than 0.2, cannot strongly argue that lack of communication is a factor influencing companies do the time planning using an external agent (either externally or both externally and internally).

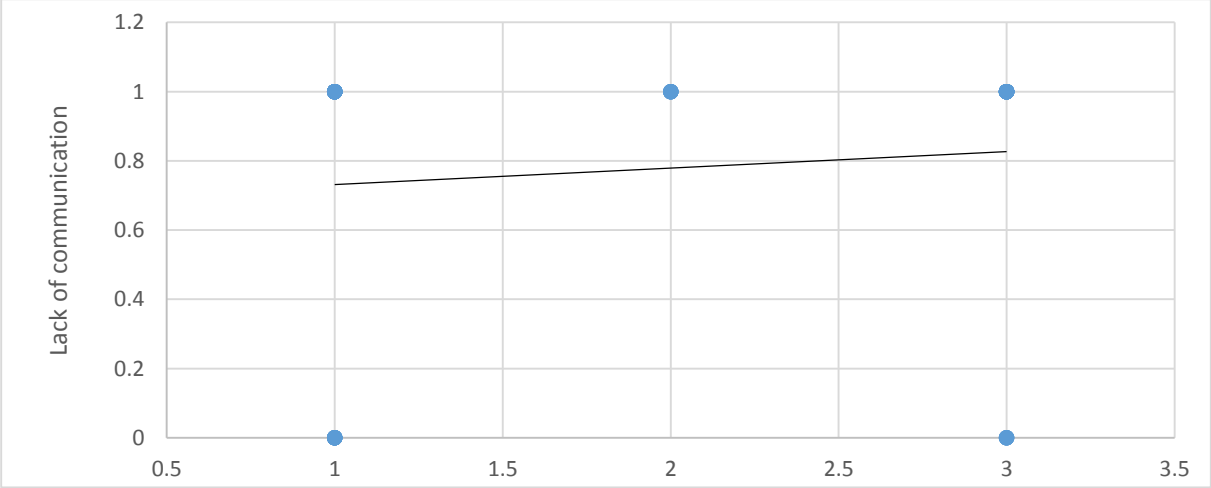

Figure 40 Correlation coefficient for hypothesis 4

7.1.1.5 Hypothesis 5

Companies, which do project planning ‘externally’ or ‘both externally and internally’ mention more ‘conflict between parties’ as an external factor influencing project planning (question 5- question 19). Correlation factor is 0.06 and p-value is 4.7E-18 (less than 0.05). Again, there is a weak relationship between the variables and p-value certify its credibility. Agian, since the correlation coefficient factor is lower than 0.2, one cannot strongly say that companies do time planning using an external agent (either externally or both externally and internally) experience more conflicts.

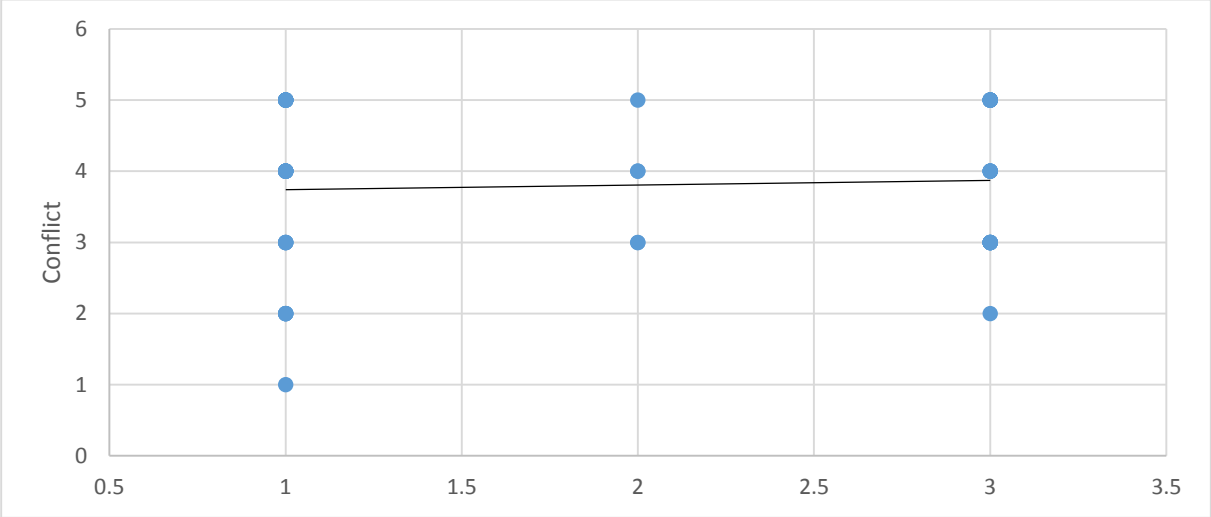

Figure 41 Correlation coefficient for hypothesis 5

7.1.1.6 Hypothesis 6

Companies, which do project planning ‘externally’ or ‘both externally and internally’ mention more ‘late decision making by other companies’ as an external factor influencing planning (question 5- question 19). Correlation factor is 0.12 and p-value is 7.65E-20 (less than 0.05). Another time, there is a weak correlation between factors and despite the small p-value cannot strongly state that late decision making influences companies do time planning using an external agent more.

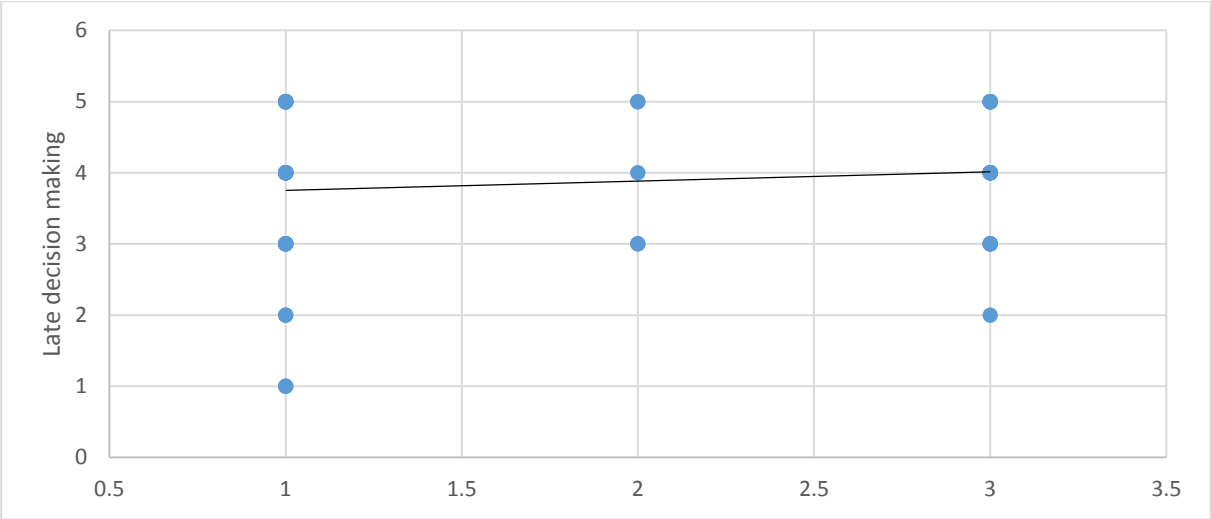

Figure 42 Correlation coefficient for hypothesis 6

7.1.1.7 Hypothesis 7

Companies, which do planning 'externally' or 'both externally and internally' mention more 'change' as an external factor influencing planning (question 5- question 19). Correlation factor is 0.06 and p-value is 9.44E-22 (less than 0.05). Again, the correlation between factors is small and despite credibility of the p-value, cannot strongly state that change influences more the companies do time planning using an external agent.

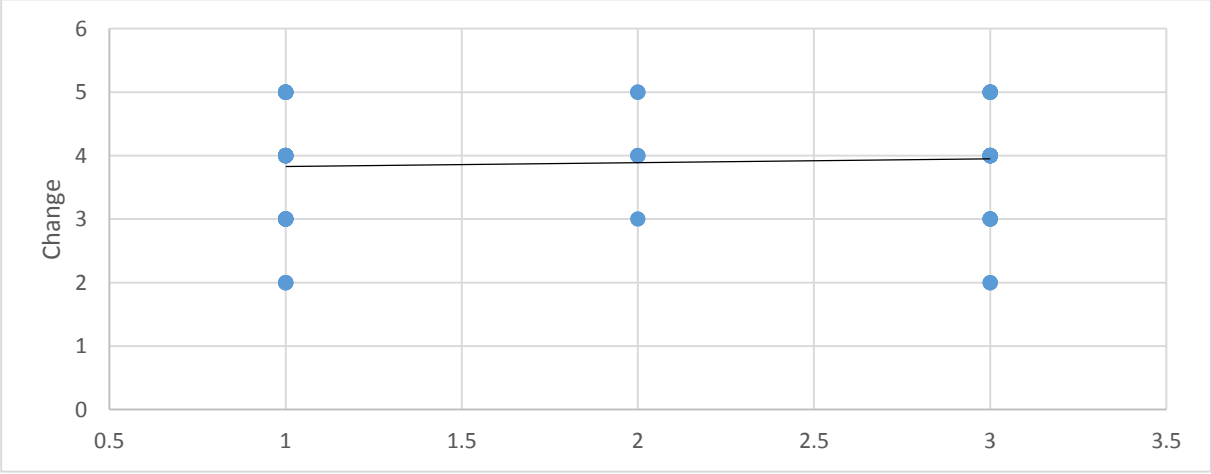

Figure 43Correlation coefficient for hypothesis 7

For the second group hypotheses the correlation coefficient factors, are lower than 0.2. It is not possible to explain why exactly correlation coefficient factors are low. However, one of the reasons might be the number of participants. Probably with more respondents, different results would be extracted. Another reason might be number of people who are involved in the project time planning. If just few people are involved in the planning process it is possible to expect less issues (e.g. lack of communication, late decision making, change, and conflict). Another

reason might be the position of the respondents. Most of the respondents have management positions (Figure 16). They might make the general planning and ask, for example, project planners to cooperate with external agent to make the detail plan. Therefore, since the managers are not directly involved in project planning process they cannot experience these issues. Perhaps if the same questions were asked form people with lower positions, different results would be extracted. These explanations are only some possible presumptions and it is not possible to answer definitely what the reasons of low correlations are.

7.1.2 Respondents point of view about 'education in project planning'

One option that has gotten low rank by the respondents is 'education in project planning' (question 6: what are the requirement for project time planning? See Figure 20 and question 17: what will improve project planning? See Figure 32). This low ranking may be explained by the respondents' years of experience. Since the respondents have long years of experience (Figure 18), they may have put more weight on the experience rather than education. This argue can be seen in the question 17 when most of the respondents mention 'having more experience people' as the most important enabler of better planning (Figure 32). Perhaps if the same question was asked from respondents in junior positions, different results would be extracted. As explained here and earlier in this chapter, years of experience may influence the ranking of options (Faridi and El-Sayegh, 2006).

7.1.3 Project planning tools

As mentioned in the section 3.4.3 of this report, Microsoft Project and Primavera are among the most common tools for project planning. Results from the survey (Figure 24) represents that experts in the Norwegian construction industry use mostly Microsoft Project. In addition, user-friendliness is the most ranked reason for using the specific tool for project planning (Figure 26). Generally, Microsoft Project is more user- friendly than Primavera. This can confirm why respondents choose Microsoft project more. In addition, studies form other countries reveals that Microsoft project is one of the tools used more by the experts in the construction industry (Herroelen, 2005, Hazır, 2015). Here, it can be stated that Microsoft Project is the most used tool for project planning in the Norwegian construction industry as well.

Another aspect to discuss is the purpose of using a specific tool (section 6.3.4). In the question 12 respondents answer that they use the planning tool mostly for the project control and updating the project plan. This answer is align with the respondents' position in the company.

As explained earlier, most of the respondents have management positions. It means they may not create the detail plan themselves but they ask other employees (e.g. project planner) to make the detail plan. Instead they control and update the project plan. This answer is align with question 13 as well. The answer to this question is (see 6.4.1) that tools warn when there is a delay in project. Evidently, when the respondents use mostly the tools for controlling the project, if the project is going untrack the tool will warn them.

7.1.4 Training and project planning

Respondents have ranked options related to training lowest in compare to other options (see Figure 31, Figure 32, and Figure 34). This does not specifically shows that respondents do not see the importance of training. One reason for low ranking might be importance of other options than training for the respondents. However, according to Herroelen (2005), managers who are willing to invest in training, can gain significant benefits from reducing the occurrence of uncontrolled situations (Herroelen, 2005).

7.1.5 More experience people, an enabler to improve project time planning

In question 17, respondents have mentioned ‘more experienced people’ as the highest factor to improve project planning. There can be many arguments about how ‘more experience people can improve project planning. One argument can be that ‘experienced people’ can identify early warning signs that a project is/ will not be planned appropriately. Early warning signs (EWS) are possible indicators of project failure in early stages of projects (Haji-Kazemi, 2015). One of the EWS source, which experience people can use, is “gut feeling”. “Gut feeling” is “an immediate or basic feeling or reaction without a logical rationale” (Wiktionary, 2014). Experts experiences can help identifying the possible issues regarding the project time planning. “Gut feeling” can be used during the whole project life cycle (Haji-Kazemi, 2015). Since the project planning take places in all project phases (Section 3.3), “gut feeling” by experts can be helpful during the whole project life cycle. In this way, experinced people can identify if the project planning has any deficincy and take action to avoid it. Factors that mentioned in question 18 and 19 can be warning signs of poor planning. These factors are more discussed in the next section.

7.2 Discussion based on the theory

7.2.1 Factors influencing project planning

In the question 18 and 19, respondents have ranked internal and external factors that can influence project time planning. There can be two points of view to these factors. First, these factors can be looked as threats and affect project planning in a negative way. As explained earlier (section 7.1.5), experts' experience may identify these factors as signs of poor time planning. Another point of view to these factors is the discussion by Agnar Johansen (2012a) in section 3.6. Based on his argument, uncertainty can be seen as opportunities (positive outcome) not just threats (negative outcome of uncertainty). The same point of view can be seen here. Therefore, internal and external mentioned factor should not be seen as factors influencing project planning only negatively. In fact, these factors can improve project time planning as well. For instance, change in project plan can improve project plan. This can be an opportunity in terms of time and helps to finish the project faster. Similarly, if lack of communication is identified, actions to improve it can be applied. Better communication helps the project scope be transferred appropriately and this improves project planning (section 3.5). In fact, the factors that can be looked as threat can provide opportunities in project planning as well. Regardless of looking to these factors as threat or opportunity, the role of experienced people to identify these factors is inevitable.

7.2.2 Poor project planning as a reason for delay

As it is mentioned in literature, (see Appendix I row 5) poor planning is one of the reason of the delay. In this study, most of the respondents have cited poor project time planning as a reason for delay as well (see Figure 29). If a project has deficiencies in time planning (a part of project planning process) it definitely suffers from poor project planning. As mentioned earlier (see section 2.3), delay causes are country specific. This will show that 'poor project planning' can be truly called a common delay factor around the world since it is mentioned in Norway and many other countries.

According to Mantel (2001), appropriate amount of time should be assigned for project planning and inadequate planning is one of the reasons for project failure. One reason for poor planning of a project might be project team impatience (Mantel, 2001). However, according to respondents' opinion, 'spending less time for producing the project planning' is not ranked high as a reason for poor project planning (see Figure 31 and Figure 32). One cannot state that the

only reason for poor project time planning is less spending time and there are many more factors involved. In addition, respondents have ranked ‘less spending time for project planning’ as reason for poor planning, although with very low importance. This means that at least part of the experts agree that ‘less spending time for project planning’ may result poor project time planning. Low ranking for this option might be due to importance of other options in the questions and it does not mean this option is neglected by the respondents. Therefore, it cannot be said that the answer by the respondents is against the theory.

7.2.3 Poor project management

According to the respondents, ‘poor project management’ is the most important reason for poor project time planning (Figure 31). Interestingly, the result from this question is similar to the results from a previous study (connected to SpeedUp project) about time-thieves and bottlenecks. According to that study, the major source of the time-thieves and bottlenecks is management and coordination (Youcef J-T. Zidane, 2015).

Literature approves that project management is crucial to avoid the negative impacts and increasing performance and productivity in the project (Putwain, 2014, Walker D.H.T, 2002, Borcherding, 1976, Ramanathan et al., 2012). Results from this study confirms that project management has significant role in improving time planning of project. In section 3.1, it was explained that project management without project planning would not be successful. Results from the survey shows that the reason for poor project time planning is poor project management. Since time planning is an aspect of project planning, anything that influences time planning will influence project planning in general. Based on this argument, it is possible to state that project management and project planning have a two-way relations and one influences the other one. Following figure shows this relation.

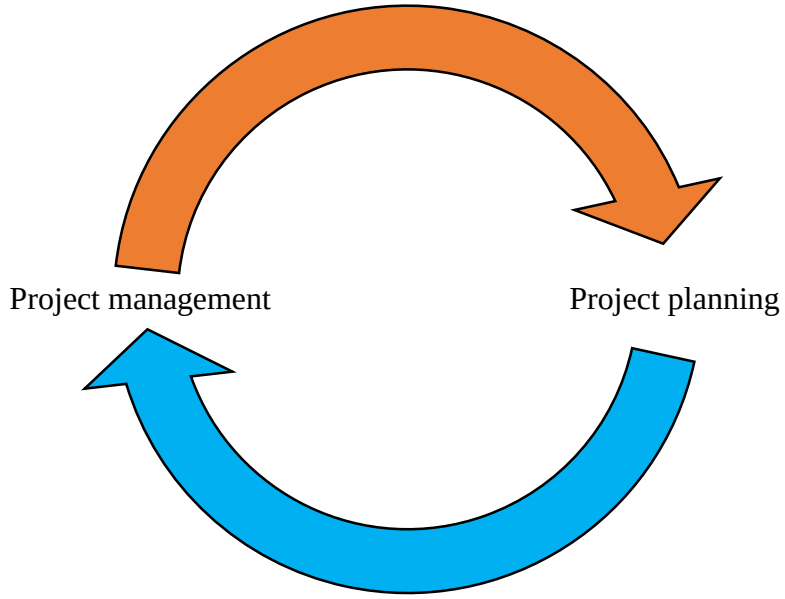

Figure 44 Relation between project management and project planning

The influence between project planning and project management can be both positive and negative. It means if one of them is implemented appropriately, it will have positive impact on the other one and vice versa.

An interesting result from the survey is that respondents have ranked 'poor project management' high while they have mostly management positions (Figure 16). Here it can be two assumptions. First, respondents emphasize project management role and its significance to improve project planning. This assumption is explained earlier in this section. The second assumption might be that respondents blame management (and maybe themselves) for poor planning. First assumption seems more reasonable.

Another issue to discuss is that what is really meant by poor project management? As discussed earlier (section 3.1) project management is using specific tools, skills and processes to fulfill determined requirements. It can be concluded that deficiency in accomplishing any of requirements or applying tools, skills and processes inappropriately will lead to poor project management.

Poor project management in terms of project time planning can be due to no application or inappropriate application of time planning tools, planning software, or planning skills. This results in failure of achieving the requirements (see section 3.1). One of the consequences of poor project time planning is delay (as mentioned by the literature and results by the survey). In addition, many authors have mentioned poor project management as a common reason for

project delay (see Appendix II). Poor project management is a wide term and it contains many aspects. Therefore, poor project management may lead to project delay in numerous way. One of these ways may be time planning. In fact, poor project management may lead to poor project planning (as explained earlier in this section). One aspect of poor project planning is poor time planning and poor time planning may result in project delay. Figure 45 represents one of many possible ways that poor project management can result in delay. The figure shows the connection between poor project management, poor project planning, poor project time planning, and delay.

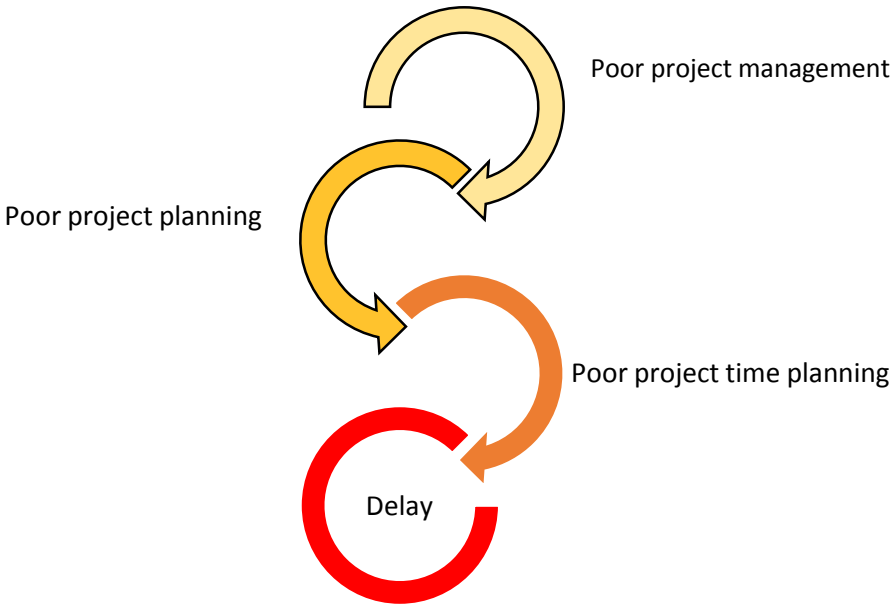

Figure 45 Connection between poor project management, poor project planning, and delay

7.2.4 Mapping project time planning on project life cycle

Sources considered in this thesis (e.g. Westland (2006), PMI (2013), Kerzner (2009), Mantel, (2001), Burke (2003)) do not mention when in the project life cycle the time management process starts and finishes. This section aims to conclude, based on the sources in this report, when time planning process in a project life cycle may start. Evidently, what will be mentioned here might not be general and is only based on limited resources. However, knowing where in the project life cycle the time management process starts and finishes is significant.

In the section 3.2, steps of project planning process are explained. According to PMBOK, time management process starts when the project scope is defined (Figure 8). According to Westland (2006), after the scope of the project is defined, the project enters the planning phase. Based on these two statements, it can be concluded that project time management starts in the planning

phase of the projects. Again, according to PMBOK the first step after defining the project scope is creating WBS (section 3.2) and then the time management process will start (section 3.2 and 3.4). Since time management comes after defining WBS, it can be concluded that short after start of the planning phase, time management process starts. As mentioned in section 3.4, project schedule is the outcome of the project time management process, which takes place in the planning phase. After this step, the project enters the execution phase. Due to the uncertainty in the planning phase (section 3.6), change in the project schedule in the execution phase is inevitable. Therefore, project time management continues until the end of the execution phase to update the baseline schedule.

While level of interaction of time management in the planning phase is high, the level of interaction of time management process decreases in the execution phase. That is because even though there will be changes to the schedule baseline, the level of interaction required to update the project schedule is less than when project schedule was created.

PMBOK describes project time management as part of the planning process. According to Figure 6, the level of interaction of planning process increases and again decreases. That is because less planning is required when the project is executed and goes through the final phases. A similar interaction, as the planning process, can be expected for the time management process since time management is part of the planning process. According to Figure 6, planning process can happen in the whole project life cycle (even though, PMOK emphasizes that process groups are not phases and all of the process groups would normally be repeated for each phase (PMI, 2013)). When the execution of the project finishes, it is expected that the planning process finishes as well.

Based on the arguments above, Figure 46 can be extracted. This figure shows that time management process starts early after the start of the planning phase and it ends by the execution phase. Besides, as it can be seen in Figure 46, the level of interaction of project time management process decreases in the execution phase and it has a similar shape as the planning process. This figure plots planning process from the initiation phase to the end of the execution phase. As mentioned before, closing phase is excluded in this study.

It is worthy to mention that the curves are not precise. The curves are estimates and represent difference between start of project planning process and start of project time management process. Besides, the curves show alterations in the level of interaction of these two processes through the phases.

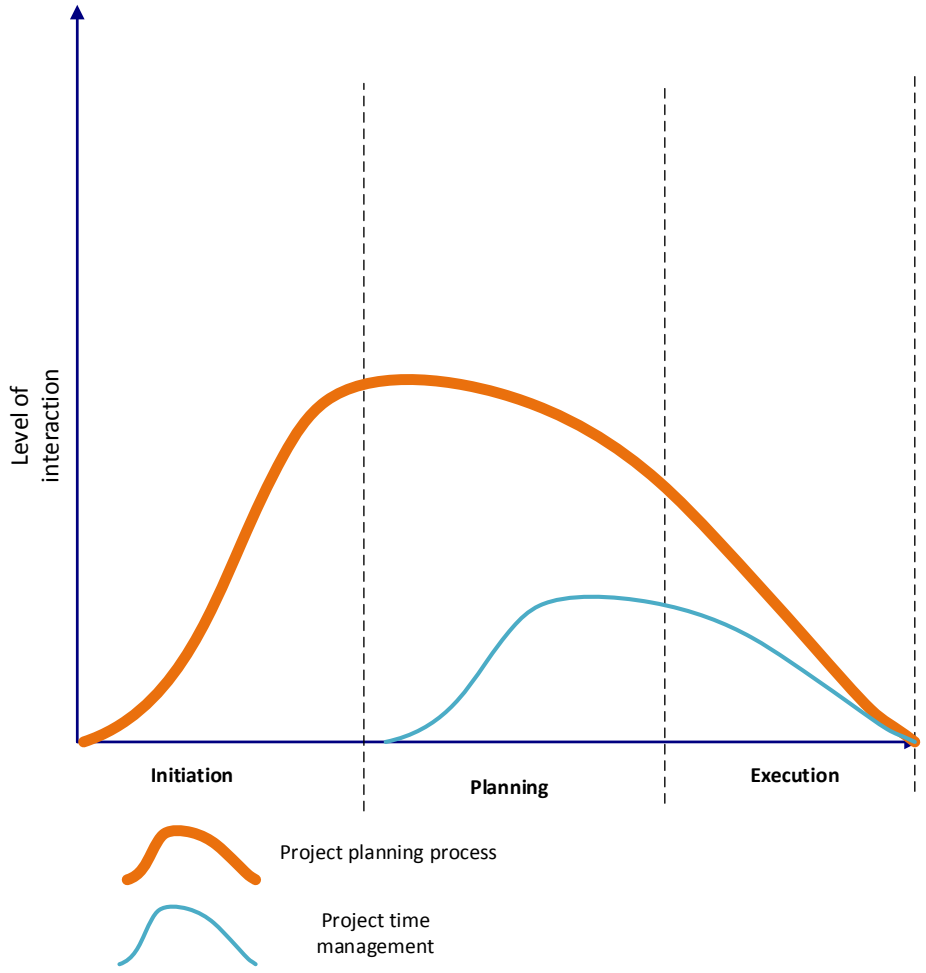

Figure 46 Level and phases of interaction of project planning process and project time management process.

7.2.5 Poor project time planning and project phases

One of the gaps among the articles discussing delay factors is that they do not study delay in different project phases. Unfortunately, these articles limit their work to identifying the delay factors and do not explain in which phases the delay probably occurs or may have greater effects. This issue is missing in the literature and requires more attention. For those practitioners that seek to prevent delays, it is crucial to find out in which phase they need to deal with delay factors. Unfortunately, no article have been found which discusses the delay in different phases and very few have briefly mentioned this issue. For example, Faridi and El-Sayegh, (2006) imply that "construction projects do not suffer from delays only during one time period or phase of the project, but during all phases". Or "the vast majority of project delays occur during the construction phase, where many unforeseen factors are always involved" (Ramanathan et al.,

2012). Or “The delays for the projects happened in the planning stage and during execution”. And the delay and cost overruns of construction projects are dependent entirely on the very early stages of the project (Akogbe et al., 2013). Unfortunately, the author of this report could not find more articles that discuss delay in different project phases in details. In the following, by referring to literature, it is tried to conclude in which project phase poor time planning, as a delay factor, contributes more. In addition, it will be explained where in the project life cycle more possibilities to improve project time planning is. As explained earlier, closing phase of the project is excluded and will not be discussed here.

As discussed earlier in this chapter, project time planning only occurs short after planning phase start. Poor time planning of a project results in project schedule changes in the end of planning phase or in the execution phase. In fact, by going from the planning phase to the execution phase consequences of project schedule changes are harsher (Figure 11). On the one hand, change in the project schedule in the later phases increases the possibility of project delay. On the other hand, if poor time planning is detected earlier, there are more possibilities to improve project schedule and consequently avoid delay. That is because the flexibility is higher in the early phases and this flexibility (to the changes) decreases through the project life cycle. Besides, early in the planning phase, level of the flexibility is higher in compare to end of the planning phase and the execution phase. Following figure represents this argument.

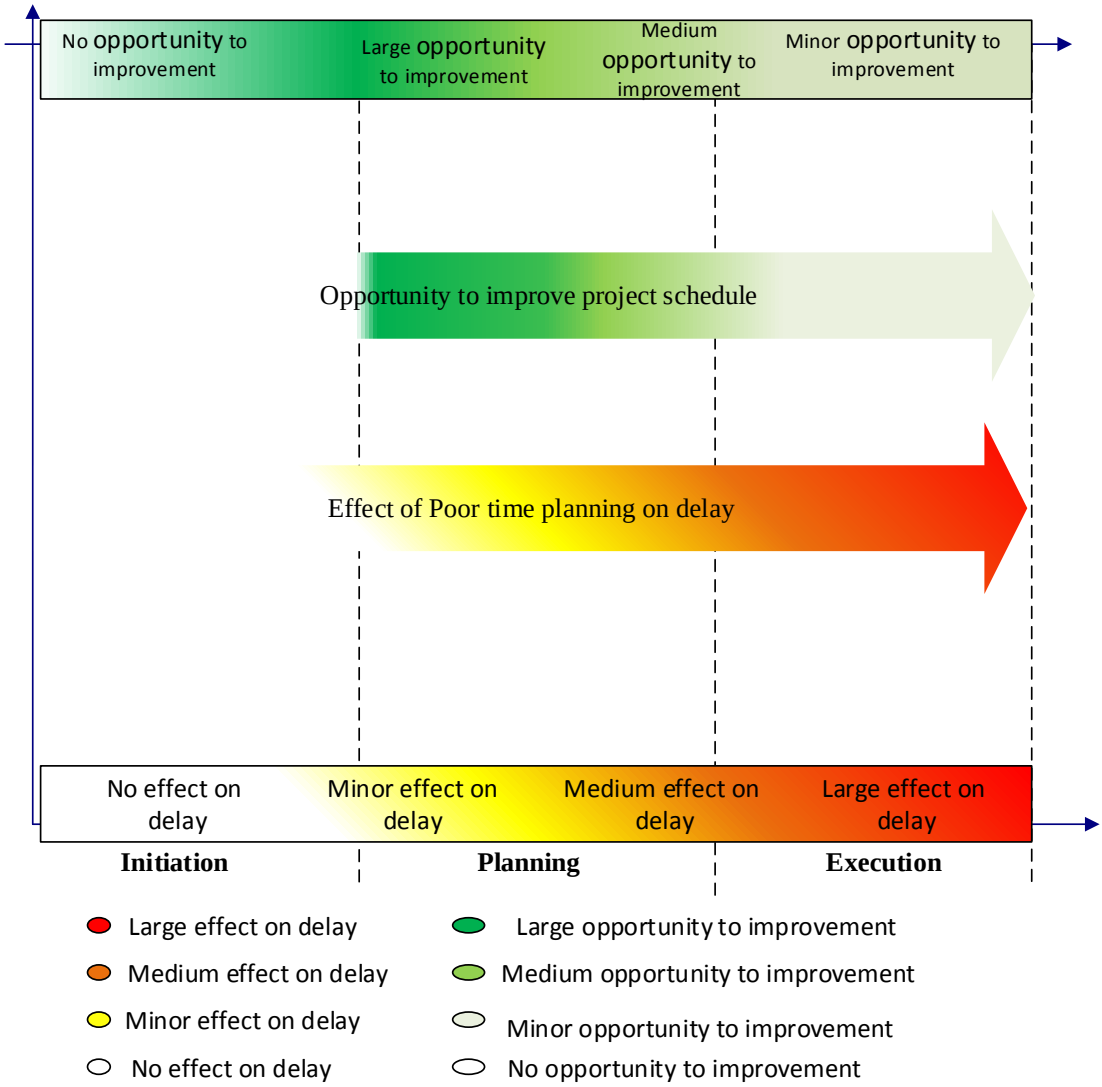

Figure 47 Effects of poor time planning on delay and possibility to improve project schedule in each phase

The above figure shows both possibility of improving project schedule and effect of poor time planning on delay. For the poor time planning, the white color reflects the areas that have no effect on delay, the yellow color shows the areas which have minor effects on delay, the orange color are areas with a medium effects on delay and the red color shows areas with large effects on delay. In addition, possibility to improve project schedule, white color reflects the areas that there is no possibility to improve schedule, dark green reflects the areas with large possibility of improvement, mild green reflects the areas with medium possibility of improvement and light green shows the areas with minor possibility to improve project schedule. As it can be seen, early in the planning phase the possibility to improve project schedule is greater while the effect of the poor time planning in the execution phase will be harsher. Since the effect of poor time planning on delay increases, the colors have changed from yellow to red gradually from planning phase to execution phase. On the other hand, the possibility of improving project

schedule reduces from the planning phase to the execution phase, colors have changed from dark green to light green. Even though, it is difficult to state in which area colors start to change, it is possible to estimate the areas. This figure helps the experts to see where the poor time planning have more effect on delay. In addition, experts can find out where in the project life cycle the possibility to improve the project schedule is higher.

7.2.6 Delay as a whole picture

Earlier it was discussed how poor project management may lead to poor time planning and consequently delay in projects. Considering common delay factors precisely (Appendix I), it can been realized that factors may trigger each other and contribute to delay. In fact, the relationship between delay factors and the way they influence each other may cause delay. For example, 'poor project management' is identified as the most important reason for 'poor time planning'. 'Poor time planning' may lead to delay and it may also lead to 'change' in the project. The project 'change' may not be transferred, properly and quickly, due to 'communication issues' and it may result in 'late decision making'. 'Late decision making' issues may result in the project delay but this may end up with 'financial' issues as well. 'Financial' issues may lead to 'material' issues (e.g. late providing of materials in the project site). 'Material' issues may lead to 'low productivity', which may delay the project. Therefore, delay is the result of relation between common delay factors and not necessarily one factor only cause delay all the time. What explained above is only one possible scenario of many probable scenarios. This condition is like a domino effect that starts by one factor and triggers other factors which may end up with delay. This domino effect is presented in the following picture.

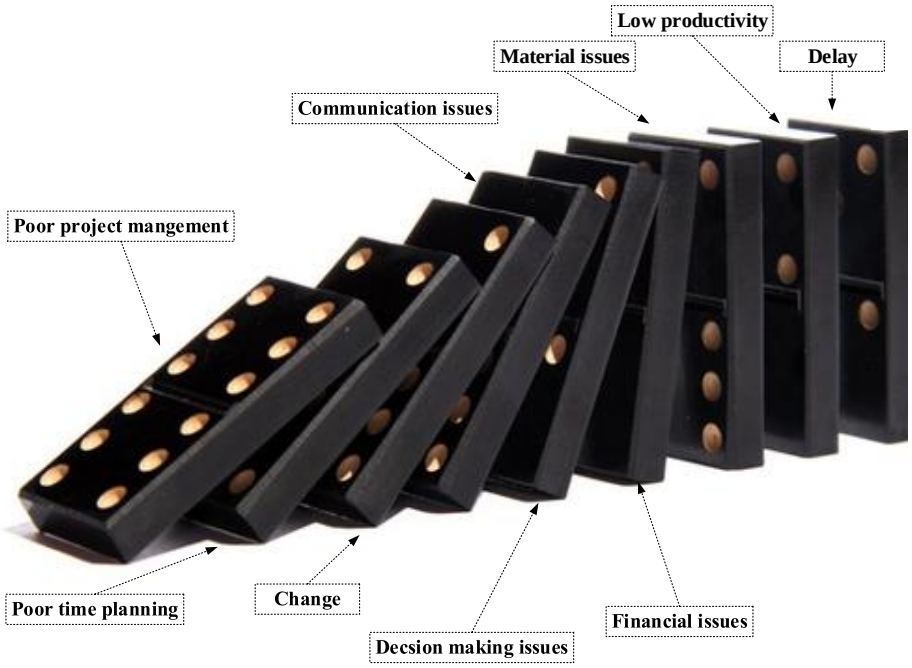

Figure 48 Domino effect

According to Figure 48, to avoid delay not only each factor should be considered but also the whole system should be controlled. In fact, if a project management team aims to avoid delay, only considering one of the delay factors is not enough. Because no matter how precise one factor is managed and controlled, if other factors in the project go out of the control, that one factor may go uncontrollable as well. This emphasizes on the significance of considering all of the factors as a system and not treating each of them solely.

Chapter

8 Conclusions

This section takes the final point of view about the topic and suggests areas for future researches. First, conclusion remarks is provided based on important topics discussed in this thesis. Afterwards, suggestions for further studies are given.

8.1 Conclusion remarks

This research is related to SpeedUp project which is one of the research projects in ProsjektNorge. SpeedUp focuses on reducing project execution time with minimum 30% in comparison with 2013 level and several academic institutes and companies are involved in it (ProjektNorge, 2014). This study is following a study in project thesis (specialization project) on topic 'delay in construction projects'. Many literatures have mentioned poor project planning as a delay factor in the construction projects. Project planning comprises different aspects and one of these aspects is time. Therefore this research desires to find out the relation between poor project time planning and delay in the construction projects. To narrow the scope of the work, this thesis focuses only on the project time planning in the construction industry in Norway. In addition, the report limits its scope to tactical level planning of projects and strategic planning of organizations or projects is not considered. This report aims to find out how experts in Norwegian construction industry perform project time planning. Besides, the study looks to realize what the reasons of poor time planning are, what factors contribute to improve project time planning, and what factors influence project time planning.

In the first step, to gain perception regarding report topic, numerous articles from several countries were studied. Articles were selected among high quality and reputation journals and only countries with stable situation were considered.

Report defines delay and discusses the importance of avoiding delay in projects (chapter 2). Time overrun and delays in activity level are two different terms but in the project level both may result project delay. Delay can be seen in the construction projects around the world. To avoid delay in the projects the first step is to identify the causes of delay. Literature shows that each country has specific delay factors. These differentiations among delay factors can be due to economical, geographical, political, etc. situations in each country. From the literatures, a list of 131 factors that may result delay in projects were extracted (Appendix II). Despite this fact, many authors around the world cite the same delay factors. One of these common factors is poor project planning (Appendix I).

After explaining delay concept and introducing poor project planning as one of the common delay factors, the report describes concept of project planning (chapter 3). There are different perspectives to project planning. However, despite the differences between project planning processes, all of the processes address the same criteria. Project planning contains different aspects (e.g. time, cost, quality) and it happens through the whole project life cycle. Project time planning is a part of project planning process and project schedule is the outcome of project time planning. There are different methods for scheduling a project (e.g. CPM and PERT) and commercial software like Microsoft Project can be used to improve project time planning. Since numerous stakeholders are involved in a construction project, appropriate communication is important to understand the project schedule. In this way, all involved parties understand goals and deliverables of the project. The project planning takes place in the early phases of the projects where the level of uncertainty is high and therefore, changes to project plan is relatively common in later phases. The uncertainty in a project plan is not just negative (threat) and it can be positive (opportunity) as well.

To conduct this study, positivism is selected as the research paradigm (chapter 4). In addition, the research design for this study is quantitative and the tool for data collection is survey. The reason of selecting survey for this study is its accuracy and the amount of information it provides. Face and content validity is the method to test the validity of the survey (chapter 5). In this report, analysis contains calculating overall percentage of each question and correlation coefficient between possible variables.

The chapters 2, 3 and 4 cover the theoretical part of the report and are used as a foundation for forming the survey questions (chapter 5). To make the survey questions, numerous similar articles are investigated. The articles gave the author a good start point for making the survey. However, no research have been found that tested the relation between poor project planning

and project delay. For this study, 19 questions in four different sections are created and each section addresses part of a specific research question. Supervisors and some researchers from NTNU and SINTEF were actively involved in the process of the survey creation and their comments were applied through the whole work. Besides, experts from one of the partner companies with SpeedUp project tested a pilot survey.

Chapter 6 provides the results from the survey. The results answer four research questions (section 1.4). Each of the research questions and their answers are described below.

8.1.1 Research question 1:

What is the 'real world' experience of Norwegian construction industry about project time planning?

This research question is answered by sections: background, project planning personnel, and project planning software. Most of the respondents have management position with more than 10 years of experience. The data from the survey reveals that 50% of the companies perform project time planning inside the companies. While 40% of the companies use an external agent in addition to internal personnel to perform project time planning. In addition, 50% of respondents mentioned 'experience in project planning' as the requirement in project time planning. Besides, none of the respondents cited 'education in project planning' as a requirement for project time planning. According to the respondents, most (90%) of those involved in project time planning perform other tasks beside time planning of projects. In case of gaining knowledge in project time planning, 82 % of respondents prefer to talk with their colleagues. Microsoft Project (82%) is the most used tool for project time planning and 32% of the respondents use the planning tool at least once per month. User friendliness (55%) and company policy (44%) are the reasons for selecting the specific tool. Furthermore, project control (74%) and updating the project plan (73%) are the aims of using the specific tool (for the detail results see chapter 6).

8.1.2 Research question 2:

What can result in (causes of) poor project time planning?

To answer this question, a few questions must be provided about delay and whether poor time planning results in delay in projects. Therefore, questions 13, 14, and 15 trim the respondents' mind to answer the second research question. 71% of respondents believed that tools can warn if the project has delay. More than 90% of the respondents agree that poor project time planning

results in delay and this delay can be between 1-6 months for the whole project. Finally, this research question is answered in question 16. According to the respondents, the most important reason for poor time planning is poor project management (90%). The result from this question is similar to the results from a previous study (connected to SpeedUp project) about time-thieves and bottlenecks. According to that study, the major source of the time-thieves and bottlenecks is management and coordination.

Deficiency in accomplishing any of requirements or applying tools, skills and processes inappropriately leads to poor project management. Poor project management in terms of project time planning can be due to not applying or inappropriate implementation of time planning tools, planning software, or planning skills (see section 7.2.3). On the one hand, poor project management is one of the most common delay factors by the literature and one of the aspects of poor project management can be poor project planning. On the other hand, based on the literature, planning is a critical process in project management and can influence it. In addition, poor management can influence project time planning and as a result can influence project planning in general. Therefore, there is a two-way relation between project planning and project management and one can influence the other (section7.2.3). Based on this argument, poor project management may lead to poor project planning. Poor project planning may lead to poor project time planning and poor time planning results in project delay.

8.1.3 Research question 3:

What factors do contribute to better project time planning?

This research question is addressed in question 17 where 79% of the respondents mentioned that ‘having more experienced people’ will result in better project time planning. How more experienced people can improve project time planning in a project can be discussed in different ways and one of the possible ways may be by detecting the EWS of the project. More experienced people can use ‘gut feeling’ to detect deficiency in project time planning (see section 7.1.5). Detecting the early warning signs can be, for example, by detecting the signs in the question 16 (see section 6.4.4) or the factors in questions 18 and 19 (see sections 6.4.6 and 6.4.7)

8.1.4 Research question 4:

What factors can influence project time planning? (Both in terms of threat or opportunity).

This research question is addressed by questions 18 and 19 in the survey and respondents are asked to rank internal and external factors (see sections 6.4.6 and 6.4.7). The important aspect is that internal and external mentioned factor should not be seen as factors influencing project planning only negatively. In fact, these factors can improve project time planning as well. These factors can act as opportunities to improve project time planning (see section7.2.1). Role of experienced people in detecting these factors using 'gut feeling' is relatively important.

8.2 Hypotheses

Seven hypotheses are tested in this research to find out any possible relation between different variables. The hypotheses are divided to two main groups. The first group test any connection between respondents' years of experience and communication, amount of delay due to poor time planning, and frequency of using planning tools. The second group hypotheses tests whether using an external agent for project planning has any effect on communication, conflict, late decision making, and change. For all of these hypotheses p-values are less than 0.05 and this certify the credibility of the results. However, due to low correlation factors it is not possible to strongly state any results. This situation might be due to number of the respondents and/ or their years of experience. Most of the respondents have long years of experience and it causes low correlation coefficient factors for the first group hypotheses. In the second group of hypotheses total number of the respondents and number of the companies using an external agent might be the reason of low correlation factors.

8.3 Provided models in this report

There are three models introduced in thesis which are covered in sections 7.2.4, 7.2.5, and 7.2.6.

The first model (section 7.2.4) discusses that the project time planning starts early in the beginning of the planning phase, while project planning process (as a general term) starts from the initiation phase. The model presents that level of interaction of project time management process increases in the planning phase and decreases in the execution phase.

Second model (section 7.2.5) discusses the effects of poor time planning on delay and possibility to improve project schedule in each project phase. For those practitioners who seek to avoid delay, it is necessary to know in which phase poor time planning has greater effect in terms of delay. Besides, they should know where in the project life cycle there is higher possibility to improve project time planning. Based on this model, poor project time planning

has harsher effect on delay in execution phase and the best phases to improve time planning is in the planning phase.

Final model discusses that delay is the consequence of relation between different delay factors which starts of one factor can trigger other factors as well. A domino model can show this relationship (see section 7.2.6). In the domino model, presented in Figure 48, occurrence of one of the factors may start other factors and one of the final consequence may be delay. Therefore, to reduce delay it is important to look at all of the delay factors as a system and only avoid one of the delay factors is not sufficient.

8.4 Limitation of the study

This study has used survey as the tool for data collection. One of the limitation of the study was number of the respondents. It is suggested to test the study with more respondents and compare the results. Authors believe that the position of the respondents in this study has affected the answers in some of the questions. It is suggested to do the study with respondents with different positions.

8.5 Suggestions for further research

This study has used survey to collect data. One suggestion is using other methods for data collection. Although, survey is an accepted method, it has its own limitation. Using other data collection tools such as interviews and/ or case studies in the similar research and comparing the results with this study is an interesting topic.

As explained earlier, project planning has many different aspects. As a result, poor project planning as a delay factor can have different aspects as well. In this thesis, only time aspect of project planning is considered. It is clear that other concepts like cost, resource, and risk, if not planned properly, can result in delay as well. A suggestion for further study is to do a similar research on other concepts of project planning.

In this report, closing phase of the project was not considered. It is recommended that further studies reflect this phase as well. It would be interesting to study the effects of delay factors in the closing phase and to show how delay affects this phase.

More experienced people are one of the enablers of better time planning in projects. The connection between more experienced people and EWS are explained in section 7.1.5. A

research topic is to answer what the EWS of poor project (time) planning are. And how these signs can be identified.

The results from this study found reasons of poor time planning, the factors contributing to better planning and factors influencing time planning. Now by knowing the problem and contributing solutions it is important to implement the findings in a real life project as a case study and observe possible improvements. Implementing these solution in a real life project is another suggested topic.

Poor project management is one of the most important reasons for both poor project time planning and delay in projects. One research topic can be identifying Key Performance Indicators (KPIs) of improving project management in projects. These KPIs can be used to create a performance measurement system that measure the level of improvement in different aspects of project management. This performance measurement system can be used to see how improvement in project management will improve (time) planning of projects and reducing delay. Furthermore, the common delay causes mentioned in this report can be used as performance indicators to measure the performance of a project. It is interesting to build a performance measurement model based on the common delay causes and check if the project has a deviation from its goals or not.

Earlier it is discussed that the factors in question 18 and 19 of the surveys can be seen as opportunities in the projects. Generally, there is a negative point of to these factors and they are seen as threat to the projects. One suggestion is to find out how those factors can act as opportunities and improve project time planning.

Education in project planning has ranked lowest according to respondents' point of view. One suggested study is to compare results of project planning performed by experienced people and project planning performed by educated people. Again, a performance measurement system can be used for benchmarking the results.

Investigating delay factors in other industries like manufacturing, oil and gas, and IT and comparing those factors with the construction industry is another suggestion for further research. It is suggested to study solutions to prevent delay from other industries and investigating possibility of applying these solutions in the construction industry.

Another topic would be using flexibility in the project to deal with delay. It would be interesting to find out how flexibility can be applied as a tool to avoid delay in the projects.

Using early warning signs to cope with delay in projects is another attractive topic. Since delay causes have a root in early phases of the project, early warning signs can be applied to identify the causes in projects.

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Appendix

Appendix I

Most common factors of delays in literature for construction projects source

ID	Most common delays in the literature	Author
1	Financial difficulties by owner/ client	(Yang et al., 2013), (Sweis et al., 2008), (Pourrostam and Ismail, 2011), Khoshgoftar et al., 2010), (Hwang et al., 2013), Hamzah et al., 2011), (Akogbe et al., 2013), (Sambasivan and Soon, 2007), (Alaghbari et al., 2007), (Abd El-Razek et al., 2008), (Marzouk and El-Rasas, 2014), (Abbasnejad and Izadi Moud, 2013), (Kazaz et al., 2012), (Ren et al., 2008), (Assaf and Al-Hejji, 2006), (Al-Kharashi and Skitmore, 2009), (Odeh and Battaineh, 2002), (Wong and Vimonsatit, 2012), (Toor and Ogunlana, 2008), (Muya et al., 2013), (Faridi and El-Sayegh, 2006)
2	Change (scope and change order)	(Yang et al., 2013), (Sweis et al., 2008), (Pourrostam and Ismail, 2011), (Khoshgoftar et al., 2010), (Hwang et al., 2013), (Hamzah et al., 2011), (Akogbe et al., 2013), (Abd El-Razek et al., 2008), Marzouk and El-Rasas, 2014), (Kazaz et al., 2012), (Ren et al., 2008), (Assaf and Al-Hejji, 2006), (Odeh and Battaineh, 2002), (Ahmed et al. ,2003), (Doloi et al., 2012), (Toor and Ogunlana, 2008), (Muya et al., 2013)
3	Poor site management	(Pourrostam and Ismail, 2011), (Hwang et al., 2013), (Chan and Kumaraswamy, 1997), (Sambasivan and Soon, 2007), (Abbasnejad and Izadi Moud, 2013),

Appendix

ID	Most common delays in the literature	Author
		(Akogbe et al., 2013), (Doloi et al., 2012), (Assaf and Al-Hejji, 2006), (Khoshgoftar et al., 2010), (Faridi and El-Sayegh, 2006), (Alaghbari et al., 2007), (Odeh and Battaineh, 2002), (Yang et al., 2013)
4	Late/ slow decision making (by all the participants in the project)	(Alaghbari et al., 2007), (Al-Kharashi and Skitmore, 2009), (Odeh and Battaineh, 2002), (Chan and Kumaraswamy, 1997), (Pourrostam and Ismail, 2011), (Ahmed et al. ,2003), (Abd El-Razek et al., 2008), (Sweis et al., 2008), (Wong and Vimonsatit, 2012), (Hwang et al., 2013), (Khoshgoftar et al., 2010), (Toor and Ogunlana, 2008), (Akogbe et al., 2013), (Assaf and Al-Hejji, 2006)
5	Poor project planning	(Al-Kharashi and Skitmore, 2009), (Khoshgoftar et al., 2010), (Faridi and El-Sayegh, 2006), (Sweis et al., 2008), (Assaf and Al-Hejji, 2006), (Pourrostam and Ismail, 2011), (Marzouk and El-Rasas, 2014), (Akogbe et al., 2013), (Odeh and Battaineh, 2002), (Toor and Ogunlana, 2008), (Muya et al., 2013), (Sambasivan and Soon, 2007)
6	Poor communication among parties	(Hwang et al., 2013), (Khoshgoftar et al., 2010), (Wong and Vimonsatit, 2012), (Sambasivan and Soon, 2007), (Al-Kharashi and Skitmore, 2009), (Ren et al., 2008), (Al-Kharashi and Skitmore, 2009), (Toor and Ogunlana, 2008), (Odeh and Battaineh, 2002)
7	Labour Productivity/ availability	(Marzouk and El-Rasas, 2014), (Assaf and Al-Hejji, 2006), (Kazaz et al., 2012), (Faridi and El-Sayegh, 2006), (Doloi et al., 2012), (Odeh and Battaineh, 2002), (Muya et al., 2013), (Toor and Ogunlana, 2008)

Appendix

ID	Most common delays in the literature	Author
8	Poor material management (late delivery, poor material problem, low quality, etc.)	(Hwang et al., 2013), (Akogbe et al., 2013), (Yang et al., 2013), (Sambasivan and Soon, 2007), (Alaghbari et al., 2007), (Doloi et al., 2012), (Khoshgoftar et al., 2010), (Khoshgoftar et al., 2010), (Faridi and El-Sayegh, 2006), (Muya et al., 2013), (Odeh and Battaineh, 2002), (Assaf and Al-Hejji, 2006)

Appendix II

List of all delay factors mentioned in the articles

Source: (Abbasnejad and Izadi Moud, 2013, Abd El-Razek et al., 2008, Ahmed et al., 2003, Akogbe et al., 2013, Alaghbari et al., 2007, Al-Kharashi and Skitmore, 2009, Asnaashari et al., 2009, Assaf and Al-Hejji, 2006, Chan and Kumaraswamy, 1997, Doloi et al., 2012, Enshassi et al., 2010, Faridi and El-Sayegh, 2006, Frimpong et al., 2003, González et al., 2014, Hamzah et al., 2011, Hwang et al., 2013, Kaming et al., 1997, Kazaz et al., 2012, Khoshgoftar et al., 2010, Mahamid et al., 2012, Mansfield et al., 1994, Marzouk and El-Rasas, 2014, Memon et al., 2014, Muya et al., 2013, Nkado, 1995, Odeh and Battaineh, 2002, Pourrostam and Ismail, 2011, Ramanathan et al., 2012, Ren et al., 2008, Sambasivan and Soon, 2007, Shehu et al., 2014, Sweis et al., 2008, Toor and Ogunlana, 2008, V, 2012, Wong and Vimonsatit, 2012, Yang et al., 2013)

Table 8 Delay causes in the literature

Delay reasons	
1	Slow preparation and approval of shop drawings
2	Delays in payments to contractors by the owner (progress payement, complete work payment, etc.)
3	Changes in design/design error and considerable extra work.
4	Lack of manpower (skilled, semi-skilled, unskilled labor, technical perfessional,etc.) in contractor, consultant, sub-contractor or owner
5	Owner more concerns with regard to financial issues
6	No application and implementation of projetc management, construction management or contractual methods
7	Cash flow problems/financial difficulties by owner or contractor
8	Difficulties in obtaining permits from (owner, consultant, gowernment agancies, etc.)
9	‘‘Lowest bid wins’’ system (type of project bidding and award)
10	Poor design (ambiguities and mistakes in specifications and drawings, mistakes and discrepancies in design documents, etc)
11	Changes in orders/design
12	Severe weather condition
13	Unforeseen site conditions
14	Late deliveries (materials, equipment,etc.)

Appendix

	Delay reasons
15	Transportation delay (problem due to shortages or inadequacies in industry infrastructure)
16	Owners' lack of experience in the construction business
17	Slow preparation and approval of drawings
18	Inadequate early planning of the project
19	Slow decision making by the owner and consultant
20	Poor site management and supervision
21	Low productivity of manpower (unskilled)
22	Poor planning and scheduling by contractor
23	Assigning incompetence staff to the project
24	Improper technical study by the contractor during the bidding stage
25	Lack/ ineffective quality control by the contractor or consultant
26	Insufficient coordination and communication among the parties in planning and execution phase
27	Delays in contractor's payments to subcontractors
28	Not pursueing safety ruels and regulation by contractor
29	Delay in the approval of contractor submissions by the consultant/ client staff and government agancies
30	Interface by the owner in the construction operations
31	Shortage/ assignment problem of equipments and resources
32	Lack of contractor's administrative personnel
33	Delay in contractor's claims settlements
34	Shortage of materials in the market
35	Late procurement of materials
36	Equipment breakdown and maintenance problem
37	Price (material, equipment, land, etc.) fluctuations and inflation
38	Use of improper construction techniques by the contractor/ sub-contractor
39	Delay in mobilization of site by contractor or sub-contractor
40	Problem with neighbours and site condition
41	Modifications in materials specifications
42	Delays in site preparation/ site handover by the owner
43	Work suspension by the owner
44	Changes in Government regulations and laws
45	Poor estimation practices
46	Mistakes during construction (Human error)

Appendix

Delay reasons	
47	Delays in producing design documents/ lack of design information
48	Poor contract management by different parteis (contractor, consultant, etc.)
49	Bad decisions in regulating company's policy
50	Poor national economy situation
51	Changes in site conditions
52	Poor risk management and supervision
53	Organizational deficiencies
54	Design complexity.
55	Lack of personnel training and management support
56	Effects of subsurface conditions (type of soil, utility lines, water table)
57	Design team's management style
58	Procurement and supply method
59	Lack of team communication effectiveness and teamwork in different parties (contractor, consultant, owner, etc.)
60	Commitment of project participants;
61	Works in conflict with existing utilities
62	Conflicts among project participants (contractor, sub-contractor,etc)
63	Labor disputes and strikes
64	Spend some time to find sub-contractors company, frequent sub-contractor change due to low performance
65	Lack of negotiation, contract, etc. skill by different parties
66	Poor distribution of labour
67	Lack of protection of complete work
68	Lack of testing or quality control/ assurance
69	Few supervisors
70	Delay preparation and approval of tests and inspections
71	Contract modifications (replacement and addition of - new work to the project and change in specifications)
72	No priority/ urgency by owner to complete the project
73	Poor provision of information to project participants and unclear specifications
74	Inadequate managerial skills for all parties
75	Time wasting inspection and testing procedure
76	Rework of bad quality performance
77	Poor site documentation and no detailed written procedures
78	Low quality material, equipment, tools, etc.

	Delay reasons
79	Too much overtime for labour and labour unrest
80	Highly bureaucratic organization
81	Project construction complexity
82	Lack of a strong organizational culture
83	Inaccurate prediction of equipment production rate
84	Major disputes and negotiations
85	Inappropriate type of contract
86	Government relations and building Regulations
87	Bureaucracy in Government agencies, owner, consultant or contractor
88	Project site location
89	External work due to public agencies
90	Adjustment of prime cost and provisional sums
91	Incomplete design at the time of tender
92	Lack of cost planning/monitoring during pre and post contract stages
93	Lack of cost reports during construction stage
94	Delays in costing variations and additional works
95	Tendering maneuvers by contractors, such as front- loading of rates
96	Lack of experience of project location
97	Lack of experience of project type
98	Lack of experience of local regulation
99	Wrong / inappropriate choice of site
100	monopoly of technology
101	Change in the scope of the project
102	Different nationality and culture of laborers (Social and cultural factors)
103	Accident in project site (fire, injury,etc.
104	Conflict in schedule (between contractor and subcontractor or between sub-contractor)
105	The joint ownership of the projects
106	Incomplet project information
107	Project objectives are not very clear by owner
108	Damage to materials (due to wrong storage)
109	Lack of high-technology equipment
110	Lack of database in estimating activity duration and resources
111	Application of quality control based on foreign specification
112	Traffic control regulation practiced in the site of the project

Delay reasons	
113	Delay to furnish and deliver the site to the contractor
114	Force Majeure as war, revolution, riot, strike, and earthquake, etc.
115	Unavailability of utilities in site or Delay in providing services from utilities such as (water, etc.)
116	lack of feasibility studies;
117	Old construction methods;
118	Poor material management;
119	Nomination of Sub-contractors and suppliers by owner
120	Many provisional sums and prime cost by owner
121	Irregular attending of weekly meetings by owner
122	Inadequate duration for inspection by consultant
123	Experience of staff in management and technical inspection by consultant
124	Congested construction site
125	Ineffective delay penalties
126	Type of construction contract (Turnkey, construction only,.)
127	Unavailability of incentives for contractor for finishing ahead of schedule
128	Weak motivation among all parties
129	Inflexibility (rigidity) of consultant
130	Insufficient data collection and survey before design
131	Delay in manufacturing special building materials Political situation

Appendix III

Table 9 Key scheduling terminologies (Pinto, 2013)

Key Scheduling terminology
Scope—The work content and products of a project or component of a project. Scope is fully described by naming all activities performed, the resources consumed, and the end products that result, including quality standards.
Work Breakdown Structure (WBS)—A task-oriented "family tree" of activities that organizes, defines, and graphically displays the total work to be accomplished in order to achieve the final objectives of a project. Each descending level represents an increasingly detailed definition of the project objective.
Work package—A deliverable at the lowest level of the Work Breakdown Structure; it is an element of work performed during the course of a project. A work package normally has an expected duration plus an expected cost. Other generic terms for project work include task or activity.
Project network diagram (PND)—Any schematic display of the logical relationships of project activities.
Path—A sequence of activities defined by the project network logic.
Event—A point when an activity is either started or completed. Often used in conjunction with AOA networks ,events consume no resources and have no time to completion associated with them.
Node—One of the defining points of a network; a junction point joined to some or all of the others by dependency lines (paths).
Predecessors—Those activities that must be completed prior to initiation of a later activity in the network.
Successors—Activities that cannot be started until previous activities have been completed. These activities follow predecessor tasks.

Appendix

Key Scheduling terminology
Early start (ES) date—The earliest possible date on which the uncompleted portions of an activity (or the project) can start, based on the network logic and any schedule constraints. Early start dates can change as the project progresses and changes are made to the project plan.
Late start (LS) date—The latest possible date that an activity may begin without delaying a specified milestone (usually the project finish date).
Forward pass—Network calculations that determine the earliest start/earliest finish time (date) for each activity. The earliest start and finish dates are determined by working forward through each activity in the network.
Backward pass—Calculation of late finish times (dates) for all uncompleted network activities. The latest finish dates are determined by working backward through each activity.
Merge activity—An activity with two or more immediate predecessors (tasks flowing into it). Merge activities can be located by doing a forward pass through the network.
Burst activity—An activity with two or more immediate successor activities (tasks flowing out from it).Burst activities can be located by doing a backward pass through the network.
Float—The amount of time an activity may be delayed from its early start without delaying the finish of the project. Float is a mathematical calculation and can change as the project progresses and changes are made in the project plan. Also called slack, total float, and path float. In general, float is the difference between the late start date and the early start date (LS – ES) or between the late finish date and early finish date (LF – EF).
Critical path—The path through the project network with the longest duration. The critical path may change from time to time as activities are completed ahead of or behind schedule. Critical path activities are identified as having zero float in the project.
Critical Path Method (CPM)—A network analysis technique used to determine the amount of scheduling flexibility (the amount of float) on various logical network paths in the project schedule network, and to determine the minimum total project duration. It involves the calculation of early (forward scheduling) and late (backward scheduling) start and finish

Key Scheduling terminology
dates for each activity. Implicit in this technique is the assumption that whatever resources are required in any given time period will be available.
Resource-limited schedule—A project schedule whose start and finish dates reflect expected resource availability. The final project schedule should always be resource-limited.
Program Evaluation and Review Technique (PERT)—An event- and probability-based network analysis system generally used in projects where activities and their durations are difficult to define. PERT is often used in large programs where the projects involve numerous organizations at widely different locations.

Appendix III

Table 10 List of articles related to project planning

List of articles found related to project planning of construction projects
Castillo, G., Alarcón, L.F., González, V.A. **Implementing lean production in copper mining development projects: Case study** (2015) *Journal of Construction Engineering and Management*, .
Caldas, C.H., Kim, J.-Y., Haas, C.T., Goodrum, P.M., Zhang, D. **Method to assess the level of implementation of productivity practices on industrial projects** (2015) *Journal of Construction Engineering and Management*, .
Deng, X., Low, S.P., Li, Q., Zhao, X. **Developing competitive advantages in political risk management for international construction enterprises** (2014) *Journal of Construction Engineering and Management*, .
Zhao, X., Hwang, B.-G., Low, S.P. **Investigating enterprise risk management maturity in construction firms** (2014) *Journal of Construction Engineering and Management*, .
Xia, B., Skitmore, M., Wu, P., Chen, Q. **How public owners communicate the sustainability requirements of green design-build projects** (2014) *Journal of Construction Engineering and Management*, .
Kim, T.W., Fischer, M. **Ontology for representing building users' activities in space-use analysis** (2014) *Journal of Construction Engineering and Management*, .
Azambuja, M.M., Ponticelli, S., O'Brien, W.J. **Strategic procurement practices for the industrial supply chain** (2014) *Journal of Construction Engineering and Management*, .
Ko, C.-H., Chung, N.-F. **Lean design process** (2014) *Journal of Construction Engineering and Management*, .

List of articles found related to project planning of construction projects

O'Connor, J.T., O'Brien, W.J., Choi, J.O.
Critical success factors and enablers for optimum and maximum industrial modularization
(2014) *Journal of Construction Engineering and Management*, .

Gudiene, N., Banaitis, A., Podvezko, V., Banaitiene, N.
Identification and evaluation of the critical success factors for construction projects in Lithuania: AHP approach
(2014) *Journal of Civil Engineering and Management*, .

Lucko, G., Alves, T.D.C.L., Angelim, V.L.
Challenges and opportunities for productivity improvement studies in linear, repetitive, and location-based scheduling
(2014) *Construction Management and Economics*, .

Shahtaheri, M., Nasir, H., Haas, C.T.
Setting baseline rates for on-site work categories in the construction industry
(2014) *Journal of Construction Engineering and Management*, .

González, P., González, V., Molenaar, K., Orozco, F.
Analysis of causes of delay and time performance in construction projects
(2014) *Journal of Construction Engineering and Management*, .

Zhao, X., Hwang, B.-G., Pheng Low, S., Wu, P.
Reducing hindrances to enterprise risk management implementation in construction firms
(2014) *Journal of Construction Engineering and Management*, .

Nguyen, T.P., Chileshe, N.
Revisiting the critical factors causing failure of construction projects in Vietnam
(2014) *Proceedings 29th Annual Association of Researchers in Construction Management Conference, ARCOM 2013*, .

Hanna, A., Boodai, F., El Asmar, M.
State of practice of building information modeling in mechanical and electrical construction industries
(2013) *Journal of Construction Engineering and Management*, .

Hinze, J., Hallowell, M., Baud, K.
Construction-safety best practices and relationships to safety performance
(2013) *Journal of Construction Engineering and Management*, .

Zhao, X., Hwang, B.-G., Low, S.P.
Developing fuzzy enterprise risk management maturity model for construction firms
(2013) *Journal of Construction Engineering and Management*, .

List of articles found related to project planning of construction projects

Liu, J.Y., Zou, P.X.W., Gong, W.
Managing project risk at the enterprise level: Exploratory case studies in China
(2013) *Journal of Construction Engineering and Management*, .

Sylvie, J.R., Thomas, S.R., Lee, S.-H., Chapman, R.E., Smith, R.T.
Development and interpretation of the security rating index
(2013) *Journal of Construction Engineering and Management*, .

Idoro, G.I.
Comparing the planning and performance of direct labour and design-bid-build construction projects in Nigeria
(2012) *Journal of Civil Engineering and Management*, .

Hwang, B.-G., Ho, J.W.
Front-end planning implementation in Singapore: Status, importance, and impact
(2012) *Journal of Construction Engineering and Management*, .

Hare, B., Cameron, I.
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(2012) *Engineering, Construction and Architectural Management*, .

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(2012) *Environmental Impact Assessment Review*, .

Xia, B., Chan, A.P.C.
Measuring complexity for building projects: A Delphi study
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Zaini, A.A., Takim, R., Endut, I.R.
Contractors' strategic approaches to risk assessment techniques at project planning stage
(2011) *ISBEIA 2011 - 2011 IEEE Symposium on Business, Engineering and Industrial Applications*, .

Alencar, L.H., Almeida, A.T., Mota, C.M.M.
Prioritizing activities on a building site project
(2011) *IEEE International Conference on Industrial Engineering and Engineering Management*, .

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Lucko, G.
Optimizing cash flows for linear schedules modeled with singularity functions by simulated annealing
(2011) *Journal of Construction Engineering and Management*, .

Sebastian, R.
Changing roles of the clients, architects and contractors through BIM
(2011) *Engineering, Construction and Architectural Management*, .

Shan, Y., Goodrum, P.M., Zhai, D., Haas, C., Caldas, C.H.
The impact of management practices on mechanical construction productivity
(2011) *Construction Management and Economics*, .

Shahin, A., Abourizk, S.M., Mohamed, Y.
Modeling weather-sensitive construction activity using simulation
(2011) *Journal of Construction Engineering and Management*, .

Son, J., Rojas, E.M.
Impact of optimism bias regarding organizational dynamics on project planning and control
(2011) *Journal of Construction Engineering and Management*, .

Mawdesley, M., Long, G., Al-Jibouri, S., Scott, D.
The enhancement of simulation based learning exercises through formalised reflection, focus groups and group presentation
(2011) *Computers and Education*, .

Li, H.-B., Si, G.-B., Li, H.-M.**Application of value management to real estate project planning**
(2010) *Proceedings of the International Conference on E-Business and E-Government, ICEE 2010*, .

Augenbroe, G., Verheij, H.**Process-mediated planning in A/E/C through structured dialogues**
(2010) *eWork and eBusiness in Architecture, Engineering and Construction - Proceedings of the European Conference on Product and Process Modelling 2010*, .

Adeyeye, K., Bouchlaghem, D., Pasquire, C.**A conceptual framework for hybrid building projects**
(2010) *Facilities*, .

Christodoulou, S.E., Ellinas, G.N., Aslani, P.**Disorder considerations in resource-constrained scheduling**
(2009) *Construction Management and Economics*, .

List of articles found related to project planning of construction projects

Afshar, A., Ziaraty, A.K., Kaveh, A., Sharifi, F. **Nondominated archiving multicolony ant algorithm in time - Cost trade-off optimization** (2009) *Journal of Construction Engineering and Management*, .

Menassa, C.C., Mora, F.P., Pearson, N.
Option pricing model to analyze cost-benefit trade-offs of ADR investments in AEC projects
(2009) *Journal of Construction Engineering and Management*, .

Doloi, H.
Application of AHP in improving construction productivity from a management perspective
(2008) *Construction Management and Economics*, .

Gonzalez, V., Alarcon, L.F., Mundaca, F.
Investigating the relationship between planning reliability and project performance
(2008) *Production Planning and Control*, .

Johansen, E., Wilson, B.
Investigating first planning in construction
(2006) *Construction Management and Economics*, .

Yu, W.-D.
PIREM: A new model for conceptual cost estimation
(2006) *Construction Management and Economics*, .

Yu, W.-D., Lo, S.-S.
Time-dependent construction social costs model
(2005) *Construction Management and Economics*, .

Antonson, D., Hoffman, B., Yurovsky, T.
Port Chicago Pipeline Project - A partnering success story
(2004) *Joint Conference on Water Resource Engineering and Water Resources Planning and Management 2000: Building Partnerships*, .

Ford, D.N., Lander, D.M., Voyer, J.J.
A real options approach to valuing strategic flexibility in uncertain construction projects
(2002) *Construction Management and Economics*,.

Appendix IV

English version of the survey

Background

This survey is conducted as part of a master thesis at NTNU which is connected to SpeedUp project. The main objective of the SpeedUp project is to reduce project execution time within Norwegian construction industry.
This survey is designed to understand:
- 'Real world' experience of Norwegian construction companies about project time planning
- Reasons for poor project time planning
-Ways to improve project time planning in Norwegian construction industry
As a result all of the questions are related to time planning of a project. By project time planning it is meant "all the processes required to manage timely completion of the project".
Please answer the questions based on the most recently conducted project or the current project you are involved in.
All data contained in the questionnaire will be kept strictly confidential and will be used solely for the purposes of scientific research. If you have any questions concerning the survey, please contact Erfan Hoseini at erfanh@stud.ntnu.no
We deeply appreciate your time and cooperation.

1. What is the name of your company?*

2. What is your current position within the company?*

3. How many years of experience do you have in your current position?*
   - Less than 1
   - 1- 5 years
   - 6- 10 years
   - More than 10 years

4. How many years of experience do you have in total?*

- Less than 1
- 1- 5 years
- 6- 10 years
- More than 10 years

Project time planning personnel

5. Which unit performs the project time planning in your company?*
   - In- house personnel
   - Outside consultant
   - Combination of both
   - If other, please specify

6. What does your company require of someone performing project time planning?*
   - Experience of project planning
   - Education in project planning
   - Both education and experince in project planning
   - Only general education in construction
   - Only general experience in construction

7. What are the tasks performed by project time planning personnel in your company?*
   - Only planning and scheduling related tasks
   - Multiple tasks in addition to planning and scheduling

8. In general, when you have a need to gain new knowledge on project time planning, what will you do?*
   Where 5 stands for the most favorable and 1 stands for the least favorable

	1	2	3	4	5
Talk to my colleagues					
Read available documents, reports, etc. to gain knowledge for myself					
Take a course / training provided by the company					
Take a course / training provided by other institutions					

Project time planning tools

9. What is the specific tool you use for project time planning?*
Multiple answers possible

- [ ] Microsoft Project
- [ ] Primavera
- [ ] Safran
- [ ] Excel
- [ ] If other, please specify

10. How often do you use time planning tools?*

- ( ) At least once a day
- ( ) At least once a week
- ( ) At least once in every two week
- ( ) At least once in every three weeks
- ( ) At least once in a month
- ( ) Less than once in a month

11. Why do you use the specific tool in your project?*
Multiple answers possible

- [ ] User friendliness
- [ ] Tool's capability
- [ ] Tool's price
- [ ] Organization/ Client/ Customer request
- [ ] Size of the project (e.g. number of tasks)
- [ ] Company policy
- [ ] Available training/ support
- [ ] Complexity of project
- [ ] If other, please specify

12. For what purpose do you use the specific tool?*
Multiple answers possible

- [ ] Detailed planning

- [ ] Project control
- [ ] Updating the project plan
- [ ] Claims analysis
- [ ] Estimating and bidding
- [ ] Tracking cost
- [ ] Tracking resources
- [ ] Tracking of changes
- [ ] If other, please specify

Project time planning and delay

13. In your opinion, how does use of time planning tools reduce the project delay?*
Multiple answers possible

- [ ] It helps better communication
- [ ] By better managing activities and resources
- [ ] It warns when project has a delay
- [ ] By collaborating between different users
- [ ] It helpes better understanding of a project
- [ ] Use of planning software cannot reduce project delay
- [ ] If other, please specify

14. In your opinion, can poor time planning of projects result in delay?*

- ○ Strongly Agree
- ○ Agree
- ○ Neutral
- ○ Disagree
- ○ Strongly Disagree

15. Based on your opinion, what will lead to poor time planning?*
Multiple answers possible

- [ ] Poor management and coordination
- [ ] Lack of communication between participating companies
- [ ] Lack of experience in using the time planning tool
- [ ] Wrong choice of the time planning tool
- [ ] Not understanding the project goal
- [ ] Too much uncertainty and complexity
- [ ] Late freezing the project scope
- [ ] Lack of communication between departments in the company
- [ ] Spending less time for produce project plan
- [ ] If other, please specify

16. In your opinion, how much will poor project planning delay total project delivery?*

Nothing | Less than 2 weeks | 2 weeks to 1 month | 1-6 months | More than a year

17. In your opinion, what will help better project time planning?*

- [ ] Better choice of tools
- [ ] More experienced people (both in general and related to the tools usage)
- [ ] Better training
- [ ] Improve clarity of the project goals
- [ ] Better communication between participating stakeholders
- [ ] Avoid under estimation of time usage
- [ ] Early freezing of the project scope
- [ ] Frequent update of the project plan
- [ ] Assigning more time for project time planning
- [ ] If other, please specify

18. In your opinion, How will following **internal factors** influence project time planning?*
Where 5 stands for more influence and 1 stands for less influence

	1	2	3	4	5
Bureaucracy					
Lack of training					
Lack of communication within the company					
Low motivation of personnel					
Poor project management					

19. In your opinion, How will following **external factors** influence project time planning?*
Where 5 stands for more influence and 1 stands for less influence

	1	2	3	4	5
Bad weather					
Changes					
Lack of communication between participating parties					
Slow decision making by other participating parties					
Conflict between participating parties					
Problems of getting permission from government					

Appendix V

Norwegian version of the survey

Bakgrunn

Denne undersøkelsen er en del av en masteroppgave ved NTNU og er direkte knyttet opp til SpeedUp-prosjektet. Forskningsprosjektet SpeedUp har som hovedmål å redusere den totale gjennomføringstiden i komplekse bygg- og anleggsprosjekter med minimum 30% sammenlignet med 2013-nivå. Dette skal la seg demonstrere i 3-5 prosjekter innen 2017.
Hensikt med denne undersøkelsen er å forstå:
-Hvordan byggebedrifter i Norge håndterer tidsplanlegging i sine prosjekter- Hva er praksis?
-Hva som fører til dårlig tidsplanlegging i prosjekter?
-Hvordan kan byggebransjen i Norge forbedre tidsplanlegging i sine prosjekter?
Med tidsplanlegging i prosjekter menes alle prosesser som er viktige for å styre og lede prosjektet slik at det avsluttes innen tidsfristen.
Med bakgrunn i et nylig avsluttet prosjekt du har vært involvert i eller er involvert i nå, vennligst svar på spørsmålene i undersøkelsen.
Data som er innsamlet gjennom undersøkelsen vil bli holdt konfidensielt, og vil kun bli brukt for forskningsformål.
Hvis du har noen spørsmål angående denne undersøkelsen, ta kontakt med Erfan Hoseini på mail: erfanh@stud.ntnu.no.
Vi setter pris på din tid og samarbeid

1. Hva er navnet på bedriften du jobber i? *

2. Hva er din nåværende posisjon / stilling i bedriften?*

3. Hvor mye arbeidserfaring har du i din nåværende stilling?*
   - ○ mindre enn 1 år
   - ○ 1- 5 år
   - ○ 6- 10 år
   - ○ Mer enn 10 år

4. Hvor mye arbeidserfaring har du totalt?*
   - ○ Mindre enn 1 år
   - ○ 1- 5 år
   - ○ 6- 10 år
   - ○ Mer enn 10 år

Project planlegging personell

5. Hvem gjennomfører tidsplanlegging i prosjektet?*
   - ○ Internt i bedriften
   - ○ Eksternt – konsulent
   - ○ Både internt og eksternt
   - ○ Hvis det er noe annet, vennligst skriv det her

6. Hva kreves av bedriften for den som gjennomfører tidsplanlegging?*
   - ○ Erfaring fra prosjektplanlegging
   - ○ Utdannelse i prosjektplanlegging
   - ○ Både erfaring og utdannelse i prosjektplanlegging
   - ○ Bare generell utdannelse i byggfag
   - ○ Bare generell erfaring i byggfag

7. Hva gjør de som jobber med tidsplanlegging i din bedrift?*
   - ○ Jobber bare med tidsplanlegging
   - ○ Jobber med andre oppgaver i tillegg til tidsplanlegging

8. Vannligvis, hva skal du gjøre når du har behov for å skaffe ny kunskap om prosjekts tidsplanlegging?*
   Hvor 5 betyr mest aktuelt og 1 betyr minst aktuelt

	1	2	3	4	5
Snakker med mine kollegaer	○	○	○	○	○
Leser tilgjengelige dokumenter, rapporter, osv.for å skaffe kunskap selv	○	○	○	○	○
Tar et kurs eller opplæring gitt av	○	○	○	○	○

bedriften

Tar et kurs eller opplæring gitt av andre bedrifter	○	○	○	○	○

Tidsplanleggingsverktøy i prosjekter

9. Hvilke verktøy bruker du for tidsplanlegging i prosjekter?*
Det er mulig å velge mer enn et alternativt svar

- [ ] Microsoft Project
- [ ] Primavera
- [ ] Safran
- [ ] Excel

10. Hvor ofte bruker du tidsplanleggingsverktøy i prosjektet?*

- ○ Minst en gang per dag
- ○ Minst en gang per uke
- ○ Minst en gang i hver andre uke
- ○ Minst en gang hver tredje uke
- ○ Minst en gang per måned
- ○ Mindre enn en gang per måned

11. Hvorfor bruker du de(t) valgte tidsplanleggingsverktøy i prosjektet?*
Det er mulig å velge mer enn et alternativt svar

- [ ] brukervennlighet
- [ ] Verktøy kapasitet / kapabilitet
- [ ] Pris på verktøy
- [ ] Anmodning fra bedriften / oppdragsgiver / kunde
- [ ] Prosjektets størrelse (antall oppgaver)
- [ ] Bedriftens policy
- [ ] Tilgjengelig opplæring
- [ ] Prosjektets kompleksitet
- [ ] Hvis det er noe annet, vennligst skriv det her

12. Hvordan bruker du tidsplanleggingsverktøy i prosjektet?*
Det er mulig å velge mer enn et alternativt svar

- [ ] Detaljplanlegging
- [ ] Prosjektkontroll
- [ ] Oppdatere prosjekts tidsplan
- [ ] Analysere reklamasjon
- [ ] Estimering og anbud
- [ ] Sporing / sporfølging av kostnad
- [ ] Sporing / sporfølging av ressurser
- [ ] Sporing / sporfølging endringer
- [ ] Hvis det er noe annet, vennligst skriv det her

Tidsplanlegging og forsinkelser i prosjekter

13. Etter din mening, hvordan reduserer bruk av verktøy forsinkelser i prosjektet?

*
Det er mulig å velge mer enn et alternativt svar

- [ ] Det hjelper bedre kommunikasjon
- [ ] Lede av aktiviteter og resursser bedre
- [ ] Varsle når prosjektet har forsinkelser
- [ ] Samarbeide med forskjellige brukere bedre
- [ ] Forstå prosjektet bedre
- [ ] Tidsplannlegingsverktøy kan ikke redusere forsinkelse i prosjektet
- [ ] Hvis det er noe annet, vennligst skriv det her

14. Etter din mening, fører dårlig tidsplanlegging til forsinkelser?*

- ( ) Sterkt enig
- ( ) Enig
- ( ) Nøytral
- ( ) Uenig
- ( ) Sterkt uenig

15. Etter din mening, hvor stor total forsinkelse vil oppstå i prosjektet på grunn av dårlig prosjektplanlegging?*

○ Ingen ○ Mindre enn 2 uker ○ 2 uker til 1 måned ○ 1-6 måneder ○ Mer enn 6 måneder

16. Etter din mening, hva vil føre til dårlig tidsplanlegging?*
Det er mulig å velge mer enn et alternativt svar

- ☐ Dårlig ledelse og koordinering
- ☐ Manglende kommunikasjon mellom deltakende bedrifter
- ☐ Manglende erfaring på bruk av verktøy for tidsplanlegging
- ☐ Valg av feil verktøy for tidsplanlegging
- ☐ Feil forståelse av prosjektmål
- ☐ For mye usikkerhet og kompleksitet
- ☐ Forsinket bestemmelse om prosjektets omfang
- ☐ Manglende kommunikasjon mellom avdelinger / enheter internt i bedriften
- ☐ Bruker mindre tid for å lage prosjektplan
- ☐ Hvis det er noe annet, vennligst skriv det her

17. Etter din mening, hva vil bidra til bedre tidsplanlegging i prosjektet?*
Det er mulig å velge mer enn et alternativt svar

- ☐ Bedre valg av verktøy
- ☐ Å ha personer med mer erfaring (både generelt og knyttet til bruk av programvaren)
- ☐ Bedre opplæring
- ☐ Klar definisjon / beskrivelse av prosjektmål
- ☐ Bedre kommunikasjon mellom deltakende bedrifter
- ☐ Unngå å underestimere tidsbruk
- ☐ Tidlig bestemmelse om prosjektets omfang
- ☐ Hyppig oppdatering av prosjektet
- ☐ Tildele mer tid for prosjektets tidsplanlegging
- ☐ Hvis det er noe annet, vennligst skriv det her

18. Etter din mening, hvordan vil følgende interne faktorer påvirke tidsplanlegging i prosjektet?*
Hvor 5 betyr mer påvirket og 1 betyr mindre påvirket

	1	2	3	4	5

Byråkrati					
Manglende opplæring					
Manglende kommunikasjon innen bedriften					
Lav motivasjon mellom personell					
Dårlig prosjektledelse					

19. Etter din mening, hvordan vil følgende eksterne faktorer påvirke prosjekts tidsplanlegging?*
Hvor 5 betyr mer påvirket og 1 betyr mindre påvirket

	1	2	3	4	5
Dårlig vær					
Endringer					
Manglende kommunikasjon mellom deltakende bedrifter					
Langsom beslutningsprosesser av andre deltakende bedrifter					
Konflikt mellom deltakende bedrifter					
Problemer med å få tillatelse fra regjeringen					