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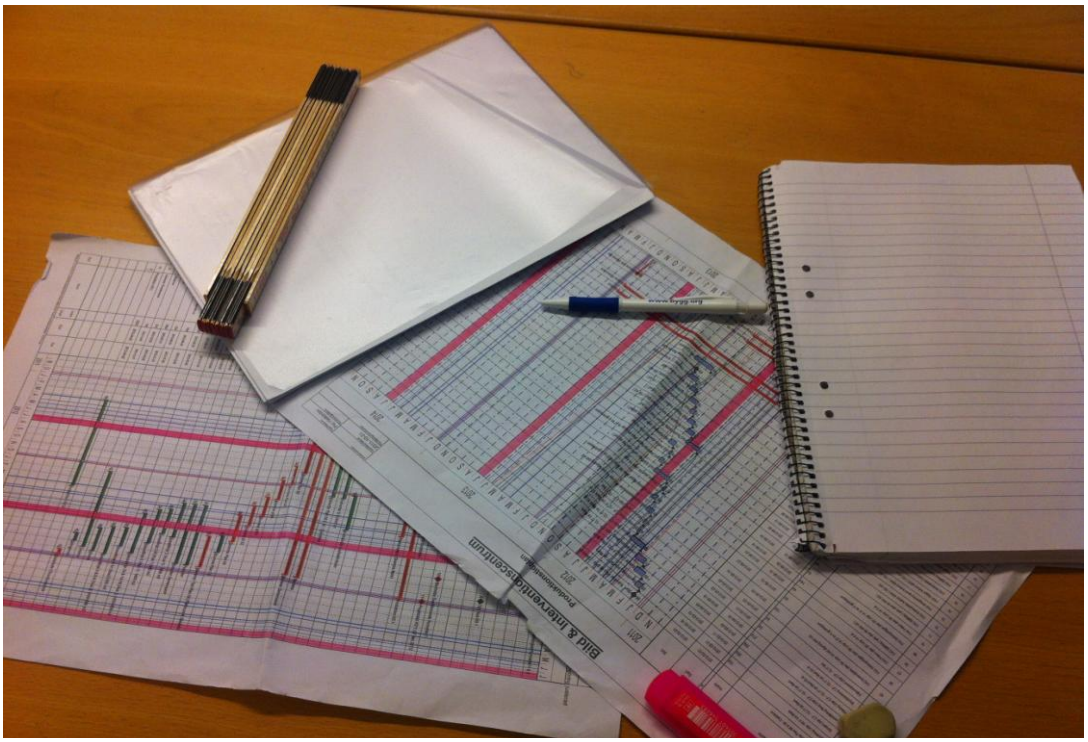

The preconstruction planning process from a site manager perspective

Master of Science Thesis in the Master's Programme Design and Construction Project Management

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Department of Civil and Environmental Engineering
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ABSTRACT

Today the site manager's role has become even more important than before as the complexity of construction projects has increased and as the business environment has become more dynamic. To deal with the challenges in construction projects the site managers' planning is essential and the preconstruction planning has been claimed to be a major determinant for project success. It is during the preconstruction planning that the production is planned so that the right production flow can be reached. Previous studies on construction planning have often been limited upon the methods and techniques of project planning or the planning process as a whole and not just the preconstruction planning. The purpose of this study has been to describe the preconstruction planning from the contractor's perspective and identify aspects that govern how site managers plan for an appropriate production flow. The study is based on a literature review and five semi-structured qualitative interviews with site managers at large construction companies. To analyse the results from the interviews a structure model with five important factors for construction planning was used. The results showed that the respondents managed to fulfil these factors to an adequate level. Moreover, three main aspects that govern how site managers plan in the preconstruction planning were identified. These are project characteristics, site managers' abilities and assigned resources. Our recommendations for further studies are to analyse these aspects more thorough to find out more precise how they influence the preconstruction planning. Additionally further studies should focus on the issue of how to transfer the knowledge that experienced site managers have over to new and inexperienced planners.

Key words: preconstruction planning, site managers, planning process, construction projects

Produktionsplanering före byggstart: platschefens perspektiv
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SAMMANFATTNING

Platschefernas roll har idag blivit ännu viktigare än tidigare eftersom komplexiteten i byggprojekten har ökat samt att företagsklimatet har blivit mer dynamiskt. Platschefernas planering är väsentlig för att hantera de utmaningar som återfinns i byggprojekten. Detta gäller kanske framförallt den tidiga planeringen som görs innan produktionen startar då denna har visat sig vara av avgörande betydelse för projektets framgång. Det är under denna tidiga planering som produktionen planeras så att rätt produktionstakt kan nås. Tidigare studier inom byggplanering har ofta varit begränsade till metoder och tekniker eller analyserat planeringsprocessen som en helhet och inte bara fokuserat på den tidiga planeringen. Syftet med denna studie har varit att beskriva den tidiga planeringen ur byggentreprenörens perspektiv samt identifiera aspekter som styr hur platschefer planerar för en lämplig produktionstakt. Studien bygger på en litteraturgenomgång och fem semistrukturerade kvalitativa intervjuer med platschefer på stora byggföretag. För att analysera resultaten från intervjuerna har en strukturmodell med fem viktiga faktorer för byggplanering använts. Resultaten visade att de tillfrågade lyckats uppfylla dessa faktorer till en tillräcklig nivå. Dessutom har tre huvudsakliga aspekter som styr hur platscheferna planerar identifierats. Dessa är projektets egenskaper, platschefernas förmåga och tilldelade resurser. För framtida studier rekommenderar vi att analysera dessa aspekter mer ingående för att mer precist ta reda på hur de påverkar den tidiga planeringen. Utöver detta bör det utredas hur man kan överföra den kunskap som erfarna platschefer har till nya och oerfarna planerare.

Nyckelord: den tidiga byggplaneringen, platschefer, planeringsprocessen, byggprojekt

Contents

Preface

In this study, five interviews have been conducted with site managers and project managers at large construction companies. We would like to thank the respondents for participating in this study and answering our questions. Without them the study could not have been completed. We would also like to thank Sebastian Reismer for helping us to find an interview on short notice.

Furthermore, we would like to thank our supervisor at Chalmers, Per-Erik Josephson. The guidance and continuous support along the way has helped us to complete the study. Finally, we also appreciate the interesting discussions that we have had about the subject and the knowledge that you have provided us with.

Göteborg April 2012

Claes Andersson & Linus Rosenberg

1 Introduction

Studies have shown that site managers have an important role when planning is done both in the initial phase of the project and during the production phase (Chan et al. 2001; Divakar and Subramanian 2009). Additionally there are studies that have tried to identify critical success factors in construction projects and pointed out the site manager's skills and attributes as significant for the project outcome (Anderson 1991; Fryer 1985). Among the requirements that a site manager need to fulfil are: satisfying the stakeholders', completing the project in time and not spending over budget. Since every project is somehow unique the site manager will also have to deal with the uncertainties that come with every project. Today the site manager's job has become even more important as the complexity of construction projects has increased and as the business environment has become more dynamic (Laufer et al. 1999).

Common problems that site managers face in the construction industry today are cost overruns, delayed projects and lack of meeting the pre-set targets (Zwikael 2008). In the literature on project planning and construction project planning many researchers claim that these kinds of problems can be avoided by planning the project properly (Friblick and Olsson 2009; Gidado 2004; Hendrickson 1998; Maylor 2005). Occasionally this literature also tries to identify how planning can be done better, both in the initial phase of the project and during production. However, Laufer et al. (1993) points out that many studies on construction planning are limited upon the methods and techniques of project planning and not the planning process itself. Many studies also look at the planning process as a whole and not just the preconstruction planning that takes place just before the production starts. The preconstruction planning is claimed to be a major determinant of project success (Laufer et al. 1993). It is during the preconstruction planning that the production is planned so that the right production flow can be reached. Therefore this study will focus on describing the contractor's preconstruction planning and the role of the site manager in this process. Moreover, the study aims to identify the underlying aspects that govern the way site managers plan to reach an appropriate production flow. The study will evaluate methods and techniques in the preconstruction planning but also focus on the process itself and clarify how it is done in real life practice. By highlighting the aspects that govern how site managers plan this study may contribute to a better understanding of site managers preconstruction planning and what influence it has on the production flow.

The study is based on a literature review and five semi-structured qualitative interviews with site managers and project managers at large construction companies. The literature review consists of books and scientific articles collected from databases available via Chalmers library. The literature review was done to get a better overview of the subject and to be able to compare our findings from the interviews with theory from the field.

1.1 Purpose

The purpose of this study is to describe the preconstruction planning from the contractor's perspective and to identify aspects that govern how site managers plan for an appropriate production flow.

The following research questions are the basis for our purpose:

- What is the site manager's role in the planning process and how significant is his/her performance on the outcome of the project?
- What are the aspects that govern how site managers plan the production and how do these aspects influence the production flow?
- What are the differences in the way site managers plan compared to what the literature of preconstruction planning suggests?
- What tools and techniques do site manager's use in the planning process and how does it distinguish from literature on preconstruction planning?

2 Literature review

This section describes the primary theory for preconstruction planning and the most important aspects regarding our study.

2.1 Planning in construction projects

In the construction industry planning is a complex and challenging task and there is an increasing need for a more comprehensive view in the projects. When describing planning in construction the definition varies depending on who is asked. A couple of examples of what planning can be is; flow of material plans, weekly planning meetings, resource planning, work preparation etc. (Friblick and Olsson 2009) To simplify how planning is conducted in a construction project, it can be described as a process where the planner tries to identify the required activities for reaching a pre-determined result (Hendrickson 1998). E.g. contractors often start with a description of what the building will look like and then try to reason backwards to be able to generate the required activities to reach the desired result (Friblick and Olsson 2009). The planning process also involves estimation of required resources, estimation of the duration of tasks and identification of possible interactions between different tasks. However there are no guarantees that a plan will not be interrupted no matter how much effort and time that are put into it (Maylor 2005).

Another aspect that needs to be considered is the uncertainties there might be in the project work and in the project planning. Laufer et al. (1999) found that uncertainty is one of the major factors that influence project performance and determine its ultimate success. Uncertainty can be defined as a situation in which there are no historic data or previous history relating to the situation being considered by the decision maker (Flanagan and Norman 1993). Each plan is based on presuppositions with a certain amount of uncertainty (Maylor 2005). The uncertainties can take different shapes in the project. It can be the environment that it is built in, the resources that need to be allocated or in the scheduling that changes from day to day. The construction projects are built with a complex dynamic and in uncertain environments and this highlight the need for effective planning and scheduling tools (Bruni et al. 2011). The uncertainty is a result from the increasing demands for project speed, greater environmental awareness and greater community impact on the decisions that affect the quality of life (Laufer et al. 1999). When the uncertainties have been identified a suitable strategy to handle the risk needs to be established (Bruni et al. 2011).

Risk management is often referred to when talking about uncertainties in construction. It can be divided into three main areas; identification, quantification and response control or mitigation (Maylor 2005). In the identification phase the objective is to identify the key risk symptoms as they are likely to be indicators that something is going wrong in the project. Moreover asking external sources, checking key assumptions and doing a TCQ (Time, Cost, Quality) analysis for expert input are ways of getting input on the risk symptoms. The quantification of risk management is assessing how likely the event is to occur, determining the extent of the effect on the

activity and the last factor is identifying how easy it is to hide a part of the project that is going bad. Finally response control/mitigation factor is trying to reduce the effects of the risks or the likelihood of the risks occurring.

2.1.1 Definition of plan, planning and planning process

To be able to identify the aspects that affect the preconstruction planning process, it is necessary to understand what planning and planning process means. The main form of plan can be defined as a detailed proposal for doing or achieving something e.g. project drawing, specifications, schedules etc. It can also be described as an intention or decision about what one is going to do or a detailed map or diagram (Laufer et al. 1993). This explains the essence of what plan means and it is the result of the planning. Moreover, a project plan is the documentation of the project planning efforts. A Project Implementation Plan (PIP) is a definitive document regarding the project scope, schedule and cost (Douglas 2004).

So how can planning be explained? Mintzberg (1981) said that planning is making a strategy for future activities, or more specifically planning can be defined as a process of deciding what to do and how to do it before action is required. According to Maylor (2005) a prerequisite for calling the project planning a "process" is that there is a well-defined route of activities for the project planner to follow but it is not always clear what this route should constitute of. Anyhow, the planning process shall involve the consumption of resources and the related costs. The costs associated with the planning process are identified as: planned labour and associated expenses, costs related to the planner's tools (such as IT-systems), costs for preparing the written plan (such as typing and binding) and opportunity costs. The opportunity costs are the costs for having participants in the planning process instead of letting them work elsewhere. Finally, Kerzner (2009) argues that the project planning process is a task of balancing costs and benefits.

2.1.2 The purpose of planning

Planning seeks to calculate what risks that may occur in the project and how to deal with them during the project lifetime. The planning is also where the budget and the schedule is developed (Hendrickson 1998). Maylor (2005) suggests that if the planning process is to be value adding, not just cost adding, benefits of the activity have to be shown. The benefits described are first of all the avoidance of costs generated by chaos due to unplanned activities. Secondly, it provides a basis for evaluation of different alternatives for filtering out those that is unprofitable. Finally, the planning process gives the planner a chance to identify problems in advance and resolve them on paper early in the project. Moreover, planning in construction is necessary to account for all the variables and situations that may arise during a construction project. It allows the contractor to be proactive rather than reactive to problems in the construction project (Awad et al. 2010).

One aspect that is often overlooked is the monitoring of the project during the on-going work. This may led to delays not being identified in time, which can be

problematic and costly. Besides this the earlier a variance is identified the better it is, so that actions can be taken as soon as possible. E.g. Eklund (2002) describes four different actions that can be taken if management have control and are able to identify variances. These are to lower the level of ambition, add more resources, reorganize or allocate resources differently, or extend the time for the project.

The monitoring component of the planning can be very helpful to site managers to be able to change the on-going work pace and also to ensure a successful completion of the project (Divakar and Subramanian 2009). If the work can be monitored in a good way is dependent on the production plan, which is why it is related to the preconstruction planning.

According to Marttala and Karlsson (1999) there are four variables that should be taken into consideration when managing a project: time, cost, quality and scope. Even if a project is on schedule the costs can be higher than expected. Maylor (2005) also described that on-going check-ups of possible variances is important, so that the costs not exceed the budget. Moreover, management should control that the scope of the work and the quality is according to the plan. Controlling the quality of works can be difficult because quality is such an abstract term. However one way of dealing with this is to have checklists with expressed quality objectives (Marttala and Karlsson 1999). Furthermore, Knausender (2005) and Wikforss (2003) describe the importance of doing regular project evaluations and have systems to maximize the use of them. This is advantageous as it may enable site managers to identify what the focus should be on. Moreover it is important that the follow-up on the projects are done when the project is still fresh and on the mind, otherwise there is a risk that the knowledge is forgotten when project members are split up on new projects (Blomé 2004). Many times these aspects are not prioritized and gets overlooked and studies have shown that follow-up's on projects are limited and are done so rarely that knowledge from the project is forgotten or just stays with the knowledge carrier (Knauseder 2005).

2.1.3 The preconstruction planning process

The planning that is done before the project starts has been identified as the most important to deliver the project successfully (Laufer and Tucker 1987; Douglas 2004). Furthermore construction industry experts believe that the earlier planning is done the larger impact it can have on the outcome of the project (Gibson et al. 1995).The procedure before a contractor goes into a project looks a little bit different depending on what type of contract form that the client has chosen for the project. This also means that site managers have slightly different conditions to adapt to in the preconstruction planning. This section will give a brief description of how this procedure typically looks like.

The contract forms that have been applied in the cases in this study are two of the most commonly used in the Swedish construction industry, design-bid-build (DBB) and design and build (DB). The main difference between the contract forms is basically how the responsibility is allocated between the parties' in the project (Söderberg 2011).

In DBB contracts the client is responsible for the design of the building and the contractor receives documents such as drawings, descriptions and specifications from the client (Nordstrand 2008). At this point the client sends documents to several contractors that compete for executing the work. These documents provide the basis for the contractor to make estimations and reply with a tender. The estimations that the contractor does before the tender is not very detailed, which is why it needs to be further developed if the contractor gets the job. The information in the documents from the client is regulated to make it easier for more realistic estimations. However, exactly what type of information these documents should include and how they should look like is dependent on the type of contract.

It might be worth mentioning that for some projects there may not even be a client because the contractor executes the project at own incentive. Finally, in DB contracts the process is similar to DBB except that it is the contractor that is responsible for the design and has to make the drawings (Söderberg 2011).

When the contract is signed the contractor can start to plan for the production. According to Aldoson et al. (1996) the activities in the preconstruction planning process may vary depending on the time available. However, there are some tasks that usually are performed which are presented in the list below.

1. Documents that include information about the project such as drawings and descriptions are reviewed.
2. A work breakdown structure (WBS) is conducted. The WBS includes grouping of the different activities in the project.
3. Calculation of quantities is carried out based on the activities in the WBS.
4. Requests for tenders are sent out to subcontractors and direct costs for material are retrieved. What type of production method to chose is decided if there are room for alternative methods.
5. The time required for direct labour is calculated and the time required for subcontractors' works is obtained.
6. A time plan for the production is established. Based on the activities in the time plan the planner allocates resources. The aim is to plan for an even employment of labour throughout the project without peaks and downs.
7. The costs for direct labour, direct material and subcontractors are summarized. In addition indirect costs for the construction site are added, such as equipment costs, management cost, rent of sheds etc.
8. Finally, the costs of overheads, risk and profit are added. These costs can either be merged or calculated separately. The risk and profit is dependent on the circumstances on the market.

One of the most important tasks in construction planning is to prepare the time plan (Hendrickson 1998). The time plan is an essential part of the planning to make sure that the project will be finished in time. Söderberg (1999) described that construction

planning can be divided in three different levels depending on the time perspective. The first level is strategic planning which is the most comprehensive planning in an organisation. This planning often focus on the organisations long-term objectives and vision. In a construction project it is the main time plan that represents the strategic planning. The second level is the tactical planning where the aim is to form a structure for the organisations operations. The tactical planning is represented through the production time plan in a construction company. Finally, it is the operational planning which aims to reach the short-term objectives in the project. The operational planning in a construction project is represented by weekly or working plans. These time plans involve resources and activities on a more detailed level.

In a study by Friblick and Olsson (2009) several types of time plans was identified at construction sites. However, they discovered that site managers defined the time plans that were used in their projects differently. E.g. many of the respondents in their study did not make any difference between a production time plan and a main time plan, but instead viewed them as the same. Moreover, the majority of the respondents did not make any difference between weekly time plans and working time plans.

It is the site manager that is responsible for the making of the production time plan while the foremen often handle the weekly and working time plans (Nordstrand 2008). However, older site managers often let the younger foremen do planning because they have better knowledge of the planning program (Friblick and Olsson 2009).

To update the production time plan is often viewed as unnecessary because the reality is constantly changing and managers think that it would be too much work to go back and make adjustments in the time plan (Laufer and Tucker 1987). The same reasoning applies in the study by Friblick and Olsson (2009) when site managers explain why they do not communicate updated time plans, even if the weekly time plans are better communicated. Communication of updated time plans is important so that workers get an understanding of the progress in the project (Söderberg 1999). A common method is to have regular meetings with the craftsmen where the activities for the upcoming week are discussed.

A paradox for the planner is whether the time plan shall be treated as a working tool or a form of organisational straitjacket. Maylor (2005) argues that the project plan should change as the circumstances change and that a well-balanced plan should guide the project participants without defining in detail what people should do every minute of every day. There is a risk that people have so much focus on the plan that they forget about the actual project objectives, and the planning itself become more important than the project.

2.1.4 Takt time

When analysing how site managers plan an interesting viewpoint is to integrate the idea of “takt time”. This because it is part of a strategy in lean that strives to achieve an appropriate production flow, or as Liker (2004) described it a one-piece production

flow. According to Liker (2004) a one-piece flow is desirable due to a number of reasons such as less inventory costs, higher productivity and higher customer satisfaction. The word takt is derived from German and means rhythm or meter. So takt is ultimately the rate of customer demand, or the rate at which the customer is buying a product (Womack and Jones 1996). Takt time is about controlling the production rhythm so that the number of produced units meets the customer demand. As Liker (2004) described, Toyota established a takt time so that they were not producing too fast, which would have lead to wasteful inventories, and so that employees could focus on getting all the work done in the available time. It is stated to be the heartbeat in the production flow, which eases the organisation to work as a whole instead of having sub-optimization throughout the production line. Therefore, the idea is to produce according to the demand, not more neither less, as in a pull scheduling system. If they are producing faster that might lead to overproduction, and if they are producing slower that might create bottleneck departments. Takt time is also described as a useful tool to make workers aware if they are behind or ahead of schedule (Womack and Jones 1996). Determining the takt time can be done with the formula: Net time available for production divided by the customer demand.

To some extent one can argue that the concept already is in place, or at least should be according to the literature on construction planning. For example, some of the planning techniques presented in this study are related to resource levelling for establishing a more even production flow. It is not named takt time, but many researchers state that it is desirable to have a constant flow and even use of resources at the site. E.g. Kerzner (2009) argues that site managers should even out peaks and downs in the resource utilization. Moreover, researchers such as Maylor (2005) and Andersson (1999) relate to this issue when they discuss the resource allocation and how to minimize the total duration of a project. However, a problematical factor found by Friblick and Olsson (2009) is that site managers often prioritize other activities than the planning. This is a fact, even if they said that they knew how important the planning is to reach a good production flow. A reason was said to be that they do not like to spend time in front of a computer.

2.1.5 Structural model

To analyse the results from the cases a structure model was needed. The model is used to examine how site managers and project managers planned the projects. It also provides a basis for analysing the potential differences on what they put their emphasis on in the planning. In their study Laufer and Tucker (1987) came up with five factors that were the most important when planning in construction. The factors were; execution, coordination, control, forecasting and optimisation. These factors represent the purpose issue of why it is important for site managers to plan their projects.

Execution – can be described as how well the plan can be translated into what actually needs to be done. The plan should answer the questions of how the project should be done, who should do what, and when it should be done.

Coordination – can be defined as coordinate and communicate so that all the parties can work together as a team in the project. This makes construction projects complex and it is vital to coordinate the production to reach the project objectives.

Control – can be described as to make sure that the project objectives are reached. It is important that the site manager can monitor the progress and evaluate the performance in the project. Control strives to minimize the impact of three risks that can occur in the project.

- Conceptual risk: derives from the planner's inability to formulate the problem correctly such as chose incorrect decision criteria or make wrong assumptions.
- Administrative risk: can occur if management fail to implement solutions.
- Environmental risk: changes in the environment can cause problems even if there is an elaborated and well implemented plan.

Forecasting – can be defined as the process of using past experience and knowledge to recognize what will happen in the project. It serves as a decision-making tool for now or soon and is important to minimize the effects of future problems.

Optimisation – can be described as a process to find the best solution based on the existing conditions. There are three different approaches of optimisation:

- Constructability planning: strives to find the most favourable integration of knowledge and experience by employing experts at an early stage. This enhances the chances of the design to be more precise which will hold down costs and time.
- Efficiency planning: can be described as to maximise the performance of the available resources, or to minimise the required resources to perform at a specific level.
- Contingency planning: can be described as planning in advance for the most likely future environments. Several plans are prepared so that response time is quicker if an alternative plan is needed.

2.2 Planning Techniques

As previously stated the purpose of planning in construction projects is to coordinate, allocate resources, prevent problems etc. The planning conducted in the early stages of the project is supposed to work as a framework for controlling and managing later on. To conduct a construction project plan there are several useful tools and techniques that are more or less frequently used, often integrated in computer software.

The most commonly used planning tools at construction sites in Sweden are PlanCon, Microsoft Project, Excel or pen and paper (Friblick and Olsson 2009). However, it seems to be a lack of awareness of what techniques there are and site managers do not use all the available functions although they know of them.

To get a better understanding this section will briefly go through the basic techniques that often are integrated in today's construction planning software.

2.2.1 Gantt charts

The production time plan in construction projects is commonly visualized in the form of a Gannt chart that illustrates the start and finish times for activities (Maylor 2005). An advantage with the method is that it shows durations and order of activities in a simple way. Usually the Gantt charts also show dependency relationships between the different activities, which have become easier with today's computer-aided planning software (Andersson 1999). The charts often include two components; a table with information and a chart with activities visualized as bars on a time axis.

Because of its simplicity and due to the fact that the method is so widely adopted, most people will understand and know how to interpret the information in a Gantt chart. However criticism to the method is that Gantt charts easily gets unwieldy for larger and complex projects, and that they have little information per area of display (Andersson 1999). Moreover, the method is said to be best suited for schedule management rather than presenting resource utilization.

2.2.2 Critical Path Method (CPM)

With the CPM an analysis of the activities in a project is conducted so that critical activities can be identified (Maylor 2005). This means that estimates are made of the time needed to complete each one of the activities (Andersson 1999). The earliest starting time for each activity is given by the preceding activities' total duration. Thereafter a calculation is made backwards, from finish to start, to identify when activities must start and finish to meet the deadline. The timely difference between the earliest starting time and the earliest finishing time is named buffer or slack. The critical activities do not have any slack or buffer and therefore they must start and finish according to the schedule, otherwise the whole project will be delayed.

By adding the costs it is also possible to estimate the most optimal relation between time and costs (Antill and Woodhead 1990). Usually the costs are divided into direct or indirect costs. When trying to optimize the costs for a project both these categories are considered. Decreasing the duration of an activity usually mean higher costs because more resources must be used, but it does not necessarily mean that the total project duration will be shortened. The total project duration will however be shortened if activities on the critical path can be performed in less time. By conducting a critical path, the site manager gets a chance to better allocate resources to finish the project on time. The method was originally developed for computer-aided planning, and an advantage is that changes in duration or costs are obtainable in real time. Criticism to the technique points out that there is too much emphasis on detail (Maylor 2005). Another obstacle is that the technique is said to provide deterministic plans that is difficult to follow. Moreover, there is criticism about the method being too much orientated on control rather than future. What might also be an issue is that CPM does not consider spatial dependencies between activities.

2.2.3 Resource planning

A site manager will only have a limited number of resources to use for a project, which is why resource planning becomes important (Andersson 1999). Resource planning is mainly about making the most out of what is disposable. Resources may refer to human labour, but also to machinery, tools, materials, equipment etc. As mentioned earlier, the allocated resources can affect an activity's duration. If the rate of production is proportional to the use of resources, the costs for an activity will be the same, no matter if an activity is finished in less time with more resources or in longer time with fewer resources. A suitable way to allocate resources is to start with the critical activities so that the total project duration can be minimized (Kerzner 2009). The most efficient and generally common way of planning resources in construction projects is to even out peaks and downs in the resource utilization. In this case, the contractor can have approximately the same number of employees at site during the project.

2.3 The role of the site manager

This section will give an overview over the site manager's role, including challenges and tasks. Moreover, the significance of the site manager for the outcome of the project will be evaluated, as well as other factors that can have an impact on the project performance.

As Laufer and Tucker (1987) explain, there is a difference between project management from a contractor's perspective compared to what it is from a client's perspective. This study is focusing on the contractor's perspective, and site manager refers to a person working for the contractor. These individuals are sometimes also referred to in the literature as construction managers.

It was found by Friblick and Olsson (2009) that a well planned project is going to be profitable and that it is the site manager's task to ensure that the project reaches the objectives. An important ingredient to be able to reach the objectives is the site manager's abilities (Anderson 1991). As clarified before, site manager's tasks consist of managing, coordinating, and supervising the construction process, starting already in the initial phases throughout the whole project. Therefore it is logical that the competence of the site manager is a contributing factor to whether the project will be successful or not. Johansen and Wilson (2006) discovered that the most valued feature of a site manger is personal experience and planning in previous projects. Moreover, a site manager should have a number of personal attributes such as social skills, decision-making skills, problem handling skills, opportunities recognizing skills and also be good at managing changes (Fryer 1985). In line with this Anderson (1991) states that the role of the site manager is a frequently mentioned determinant for project success, and that a site manager should have both managerial skills and technical skills to be able to manage the project successfully.

However, when looking into the factors that may affect the success of a project and performance of site managers there are several viewpoints. One view calls attention to

experience and understanding of the project (Gidado 2004; Johansen and Wilson 2006). But even projects with experienced and knowledgeable site managers can fail, advocating that site managers alone cannot make a project successful. As mentioned one of the problems that occur is that construction projects lacks in meeting the pre-set targets due to poor quality of management practices (Zwikael 2008). This makes the site manager's role more important in the project, knowing when to step in and make the right adjustments can be decisive to make sure that the project can maintain on schedule. Another view was discovered by Friblick and Olsson (2009). They found that there is no clear picture over how planning really is done and the explanation to this might be that there is no framework of how to plan. In their study planning is understood to be only about making time plans. But planning consists of other moments e.g. resource planning, work disposition plan etc. Moreover, Rubin and Seeling (1976) concluded that a site manager's previous experience has a minimal effect on the project success, but is instead determined by the size of previously managed projects. Another viewpoint is to emphasise on how environmental factors influence the project performance. Pheng and Chuan (2006) investigated such an influence when they analysed the impact of the working environment on site managers. The findings showed that most of the working environment variables proved to be significant for the outcome of the project. These variables included project characteristics such as complexity of the project, duration of the project, materials and supplies and so forth. Furthermore, it included organisational variables and job related variables. Finally, Friblick and Olsson (2009) found a few factors that site managers thought had an influence on their planning. First of all, site managers require well-prepared documents and drawings to be able to plan the project properly. These documents should be ready and received by site management before the production starts. However, a common problem is that the documents are not a hundred percent finished which makes site managers frustrated because they are not able to do a correct production time plan. Moreover changes from the client cause site managers too feel that the planning they have done earlier has been a waste of time. The changes that are made in the plan are relatively big and many. This makes the planning process more difficult and it is viewed as something negative by site managers.

To be able to perform the required tasks site managers use different planning tools and techniques. The planning of a construction project also takes time and this is something that site managers sometimes lack in the pre phase of the projects. A study by Laufer and Tucker (1998) identified that specialist planners have the time and better strategic decision-making skills than construction site managers. The specialist planners do however lack the contact with the construction site and therefore they do not know the latest technologies and they are also not able to have the same contact with the subcontractors. Site managers do not always have the needed time to plan but they do have practical knowledge and a better contact with subcontractors. Regarding this, if the subcontractors are involved in the planning process it creates a better understanding of the project's structure (Friblick and Olsson 2009). Johansen and

Wilson (2006) found that subcontractors have their own agenda during the planning phase and fail to see the full picture which makes it even more important to establish a good contact and understanding with them. This was supported by Friblick and Olsson (2009) who discovered that the site manager asks for the subcontractors own time plan but they keep it to themselves. The reason for this is believed to be that they want to have control over their own work. Furthermore Johansen & Porter (2003) recognised the need for improved planning competence from subcontractors. Finally, if all of the parties concerned in the project are involved in the planning process it is easier to straighten out and solve the problems together early in the project. It also enables a better overall picture of the project (Friblick and Olsson 2009).

2.3.1 Project goals

When the contractor conduct the production plan it is important to have a clear view over the objectives that need to be fulfilled in the project. The site manager must know what to relate to when conducting the time plan. Moreover, this section presents some of the factors that have been shown to be important for the project success.

To measure if a project is a success it is usually defined in meeting goals e.g. a specific time, cost and quality or satisfying the project stakeholders (Baccarini 1999). Anyhow to deem a project a success may be viewed differently depending on who is asked. A project that is viewed as successful by the contractor's organisation does not necessarily have to be viewed as successful by the client's organisation and so forth. Moreover there are several other key factors that have to be reached to deem a project successful. These factors can be critical to the outcome of the project and may therefore be called critical success factors. The critical success factors can be divided into two different groups. The first group is the strategic group and involves factors such as project mission, top management support and project scheduling. The second group is the tactical group and consists of factors like client consultation, personal training and training (Schultz et al. 1987). How well these two criteria groups are met and fulfilled may influence the outcome of the project. Furthermore another study by Chan et al. (2001) showed that the project team's commitment, the contractor's competencies, the end users constraints imposed and the needs are also critical success factors that need to be taken into consideration. However the most important aspect for the successful completion of the project is the management aspect (Brown et al. 2001). The management of the project is dependent on the site manager. The role of the site manager is to be a linking connection between the clients, consultants and other participants. It is also very important that the critical success factors mentioned above are closely monitored by the site manager and that they are given special attention because they may influence the project outcome (Divakar and Subramanian 2009).

After this brief literature review a few conclusions can be made. First of all, there have been many attempts to find out which factors that have an impact on project performance. It seems to be a range of contributing variables that determines project success. Secondly, there has been research about how to plan projects properly and

what effects that might have on the end result. Construction planning has been the subject of several studies and the site manager's role seems to have a significant impact on project performance. However, it appears to be less knowledge about the site managers' attitudes when it comes to the preconstruction planning and what aspects that may have an influence on that. As mentioned, this study has a focus on this subject and seeks to identify these aspects to provide a better and more comprehensive view over the contractor's preconstruction planning.

3 Method

The aim has been to produce a study that showcases and highlights the aspects that govern how site managers plan the production. We decided that this aim would be interesting and also a learning process since planning is something we will work with in our future careers. Furthermore, we discovered that preconstruction planning is an area where there was room for further investigation.

First of all research questions were formulated to come up with a purpose of the study. Based on the type of research questions the decision was made that interviews should be the best way to gather data. The aim was to investigate how site managers planned the production and the most suitable alternative was to ask them about it. Usually in scientific methodology people distinguish between qualitative method and quantitative method (Holme and Solvang 1997). A quantitative method is often better suitable to quantify data and to statistically find relations or measurable results (Hartman 2004). A qualitative method was better for us because we did not want to answer questions such as "how many" or "how much". Instead this study was focused to get a deeper understanding of how site managers plan. Hartman (2004) described that the qualitative methodology can be divided into three main phases: planning, gathering and analysing. These phases were followed as will be further described down below, starting with the planning of the interviews based on the research questions and the purpose. The questions were of a more open type and not very specified, mainly because we wanted the mangers to give explanations rather than short answers.

The selection criteria for the interviews were that the respondents should be involved in the preconstruction planning, working for a contractor and be in contact with the construction site. Therefore a site manager or a project manager became the obvious choice. Several companies were contacted and eventually one company thought that it would be interesting to collaborate and provide respondents for the interviews. From the beginning there were five interviews from that company but due to complications another company was contacted for a replacement. This could have influenced the results but since the work that the site mangers do is so similar between the two companies this risk is probably trivial.

The interviews were semi-structured and the effects of this were that the respondents could talk more freely and the whole idea was to let them talk as much as possible about their preconstruction planning without interrupting too much. Moreover, a focus on five longer interviews was preferred to get a deeper understanding rather than conducting many interviews. A negative aspect of this choice is that the study might not be as representative as it would have been with a larger sample. The fact that we did all the interviews at large construction companies may also have influenced the result in this study. This choice was made because the probability to find large projects with a more extensive preconstruction planning would be higher. Another factor that limited the number of interviews was the time available.

3.1 Data collection

As previously stated the five interviews in the study were conducted in a semi-structured manner to enable a more open discussion that stretches beyond the original framework of the questions. The five interviews took place at large construction companies. Four of the interviews were assigned from one of the companies and other practitioners recommended one. Moreover, the location of the interviews was at the construction sites or at the local head offices. The respondents worked at different projects in the Göteborg region. Four of the projects were in the final stages or finished while one was in the initial production phase. Moreover the interviews took approximately 40-60 minutes from start to finish and focused on the respondents' on-going projects. The questions that were asked in the interviews derived from the research questions and the purpose. During the interviews a template was used with approximately 20 questions. The questions focused on general project information, how they planned, what they did during the planning, why they planned in this particular way etc. All the questions can be found in appendix A. We both asked questions during the interviews and both of us tried to ask supplementary questions when the chance was given. To be able to analyse the results from the interviews recorders on cell phones were used. The recording of the interviews were a way to make sure that nothing was missed out. Between each interview discussions took place about how to improve and what to focus on.

During the interviews the goal was to get the respondents to talk about how they did their preconstruction planning. Because it would be difficult for the respondents to know what the study was about the objectives of the study were explained before the interviews started. Sometimes the respondents talked about the planning that was done during the production and then the focus on the preconstruction planning was clarified. Sometimes the respondents gave short answers and then questions were asked so the answers could be further developed. On other occasions the respondents misunderstood the questions that were asked. After going through the interviews it was recognised that opportunities sometimes were missed to ask follow-up questions that would have been interesting.

3.2 Data analysis

The analysis started already when the processing of the interviews began and developed from this to the discussion in the analysis. After the interviews were done the results were transcribed verbatim. This was done the same day or the day after the interview took place. Then, by using the transcripts the results were analysed and written as short summaries for each interview. From the summaries the cases were composed and a table was used to clarify the general information about the project. The cases were divided in three sections; general information, preconstruction planning and reflections on the preconstruction planning to get a structure that made it easier to analyse the results.

The next thing was to write the analysis but first the purpose and research questions had to be reviewed. The five factors by Laufer and Tucker (1987) from the literature review was used as a basis for the analysis. By using this model it was easier to identify what results that were interesting and see what the managers put most emphasis on. This model was used because it included five factors that are connected to the purpose of planning in construction. Each case was viewed at separately and the findings for each category from the structure model were written down. After this was done with all the cases a discussion was written about each category in the analysis section. Similarities or differences between the cases were identified and reconnected with the literature review.

4 Planning in five construction projects

This section deals with our results from the interviews we conducted. The results are presented in five cases and each case is divided in three major parts; general information, preconstruction planning and reflections on the preconstruction planning. General information outlines the basic facts about the project and the respondent's role in the project. The preconstruction planning describes what the respondent did during the preconstruction planning phase. It also deals with how it was done and what tools and resources that were used during the planning. Finally, reflections on the preconstruction planning present the thoughts of the respondent on the planning that has been done.

4.1 Case 1 – Venus, Gårda

Interviewed person	Started working in 2007 and is now a site manager. He has an educational background as a civil engineer
Location	Inner city Göteborg, Gårda
Project type	Residential housing
Contract form	Design Bid Build
Size	400 million SEK, 316 apartments
Client	Bostads AB Poseidon. The company administrates and owns more than 24 000 apartments in the municipality of Göteborg
Project duration	The project started in August 2009 and is expected to be finished in the Summer of 2012

Figure 1 Venus

The project is divided in three stages and the first stage was a garage built by another contractor. The site manager started working in the project when planning of the third stage begun. The client saw this as a top of the line project and has put in a lot of effort which increased the requirements on quality and materials. Another characteristic for the project was its location in the central area of the city which caused logistic issues. Therefore they chose to hire a logistic manager and a worker that handled the deliveries.

Preconstruction planning

The site manager could not give a direct answer on how much time he spent on planning the project. This was partly because he was not involved until the third stage of the project started and because many things in the preconstruction planning overlapped from the second stage. In this particular case he could look at the previous stage of the project and thereby get information from the experience. He thought that this was a big advantage because he knew the durations when he started his planning.

A major part of his preconstruction planning has been related to the time plan. Most of the time plan was locked up from the start but he said it is important to have flexibility in resources if the project does not proceed as planned. He felt that it was important to involve the subcontractors when he did the time plan. This made it easier to put pressure on them to remain on schedule and get higher commitment.

They needed to hire an installations co-ordinator to get a grip on the complexity of the installations work. He felt that it is out-dated to not use this service and this was a necessity to make the time plan as they did in this project. He believed that site managers around his age have a different attitude to these kinds of services compared to 55 to 60 year old site managers.

Reflections on the preconstruction planning

He could clearly see the results from the planning because they were able to identify lags early in the time plan and thereby take action. For example they could identify a problem with the gypsum walls and put in 35-40 % more manpower during two months. He continued to stress the importance of the time plan as a foundation for the project and that it gives the opportunity to finish the project comfortable.

He explained that to reach a good production flow the time plan should be realistic and thoroughly elaborated and workers should not be occupied at the same station. Moreover the time plan should be at the right level of detail to make it possible to continuously monitor the progress.

There have been some critical activities in the project that he knew was crucial for the overall project completion. One of the critical activities was made by a foreign subcontractor and this caused some problems since they were used to a different way of working and had language difficulties. Moreover he said:

> *"For a project of this dimension there are some critical activities that are very important. The framework of the building is of course important,*

because without it you obviously cannot complete the house. That the house is dense, which means that you get roofs and facades is very important. Moreover it is gypsum and painting... Those are the four most important activities..."

Finally he would have done the time plan in the same way if he could do it again but perhaps he would have pushed the workers even more although it is a difficult balance. Moreover he argued that you should never make adjustments in the time plan because if you do you will not be able to meet the deadline.

4.2 Case 2 – Brf Linjalen, Hisingen

Interviewed person	Site manager with more than 20 years of experience in the production
Location	City of Göteborg, Hisingen
Project type	Million programme residential housing project. Refurbishment of pipe systems, and brush-up of the wet areas
Contract form	Design and Build
Size	60 million SEK, 425 apartments
Client	Brf Linajalen. Affiliated with Sweden's largest housing cooperation HSB
Project duration	The planning of the project started three months before the production began in January 2010. The project was finished in January 2012

The project is divided in four stages and the major part of the project consists of changing the pipe systems and brushing-up the wet areas. The project is unusual because there were 40 different bathroom types in the 425 apartments. The reason for this was that there had been four different contractors that had worked there before.

Preconstruction planning

The site manager simulated how he wanted to manage the project before he started planning. He looked at how he wanted the project to develop, and what kind of characteristics that is included in the project. As this was a project with different stages they needed to check-up after each stage what adjustments that have been done in the planning and then re-plan for the next stage and make some small adjustments. He gave the craftsmen an easy start to be able to push up the tempo after the first time plan was completed. Normally there is a learning effect in the projects but because of the many different bathroom types this effect was lost.

Figure 2 Brf Linjalen

They used something called a Mölö meeting where all the concerned parties from site manger to project leader were involved. At the meeting they simulated building the project and came up with a critical line of the whole project. This critical line governed how they did the time plan.

Moreover he tried to identify what kinds of problems there might be with the changing of the pipe systems. He explained that in a refurbishment project the planning is locked and that activities cannot lag as it will start a chain process on the coming activities. Furthermore he broke down each stage by itself and then looked at each activity and planned as detailed as possible, almost down to when the shelf screws are mounted.

He estimated that the time he spent planning the project corresponded to three months full-time work. The company has a routine but there were no control over how the planning had to be done. The subcontractors were involved so they might have their say on their part in the planning and then he reasoned with them to reach an agreeable timeframe.

When asked what he did more precisely during the planning process he said that he did the time plan by himself. He divided the time plan in four parts one for each stage. Then he had to consider what the administrative regulations said about weekends and longer breaks and adapt the time plan. Moreover he always had a reserve in the time plan because the pace would slow down but this was something that he kept to himself. The site manager argued that the time plan can never change and it is one of the most important documents in the project. Moreover he said:

> *"You get a bad product and a bad result if the planning is poor... It is everything... If you don't have a plan, you can almost guarantee it will be a chaotic project and crappy results... The better the planning, the easier you can control..."*

Reflections on the preconstruction planning

During the tendering process the site manager estimated that they could do the job in three years or two and a half years if they turned up the pace. However later in the process the client claimed that they had another contractor that could do it in two years. Therefore they planned so that they could finish the project in two years. This went against the site manager's principles of how fast the production should proceed and in the end he noticed that the workers were run-down. Furthermore he said that the economy and the quality could have been even better if he would have had another six months in the project.

The result of the planning was that they finished on time but there were some complications on the way. One of the subcontractors went bankrupt during the construction so they had to negotiate for a new deal with other companies during the work time and hire workers one by one. He also said that they discovered problems in the apartments. E.g. some of the shelves were attached with the electrical pipes that were supposed to be replaced. Moreover there were no blueprints of how the TV- and internet-cables were located and this caused some unexpected problems.

He also mentioned that when you are doing a refurbishment project it is important to have an understanding from the tenants. This will make them more co-operative so that work can be done more efficiently.

Finally he said that the money limits him in the planning process. As an example he tried to identify the consequence of using a better and more expensive machine over a slower and less expensive. In this decision he weighed in the satisfaction of the workers and the direct costs in the project.

4.3 Case 3 – Offices for Hufvudstaden, Spannmålsgatan

Interviewed person	A project manager who has been working in the construction sector for several years in different companies. He has a four year technical educational background of high school level
Location	Inner city Göteborg, Spannmålsgatan
Project type	New offices and installations
Contract form	Design Bid Build
Size	200 million SEK, 7700 m^2
Client	Hufvudstaden is a real estate group that specialises in offices and retail premises
Project duration	The project started in August 2010 and was finished in September 2011

Figure 2: New offices on top of the shopping mall Nordstan

The project manager's role was to handle the administrative work and to have the overall responsibility. There was also a site manager that was more responsible for the production. The main challenge was that they had to provide heating, cooling and ventilation to all the stores and offices meanwhile construction took place. Moreover the logistics was difficult since there was only a limited space to remove all the demolition materials and bring in deliveries. Therefore one person was assigned to handle all the logistics at the site.

Preconstruction planning

Planning for the new floor with offices was like planning for ordinary new production. The difficult part was to plan in advance for the replacement of installations and therefore they had many morning meetings during the most intense period of the project. Because of this the offices had been planned in detail but with the installations they had to be more flexible. Even so they still had interim targets that they wanted to achieve. Moreover a large amount of time in the planning was spent together with the installations co-ordinator. The project manager could not estimate how much time they had spent on the planning but they started already during his previous project. Furthermore it was the other project manager that was more responsible for doing the production time plan.

To get a smooth production flow, the first thing was to go through the documents and try to get a hold of what they were supposed to do. Next thing was to establish a work breakdown structure where they defined the different activities, main activities and in what order to do them. This was especially difficult in this project because of the logistics, e.g. where to place the cranes. When he estimated the duration of activities there were unit durations as an aid and it was also based on experience from previous projects. Additionally, he brought in the subcontractors to let them be part in this process so that everyone could feel that they took part.

Early in the project they gathered all the people for a meeting to brainstorm and discuss about the planning. A problem was that all the documents were not yet complete, which meant that the procurement of subcontractors dragged on. The project manager had to call subcontractors and consultants to ask about their work in the project.

During the planning the project manager had help from a logistic manager and a specialist planner. Moreover they also had help from a person from the installations division at the company.

Reflections on the preconstruction planning

The project manager could clearly see the importance of the preconstruction planning and said that it is very important to have a proper time plan, to see what will happen in the project. Moreover he stated that the earlier you can have a correct time plan the better it is because it works like governing framework for subcontractors. He was very satisfied that they finished in time and managed not to disturb the tenants. He said he would have wanted more time for doing the preconstruction planning. Finally, he would have brought in the foremen at an earlier stage of the project so they could be better prepared.

A major factor that influenced the planning was an idea about how they removed the demolition materials more efficiently:

> *"…initially in the planning we had intended to remove all demolition materials. And that was a lot. It was lightweight concrete walls, the old roof and that becomes a lot. We had planned to take it out on the scaffolds and then have a container that the crane could lift down. But instead we had roof cartridges that the crane lifted from every day. And that saved us a tremendous amount of time ... it was an event that we came up with. I mean when you sit and plan you're not always thinking right from the beginning..."*

4.4 Case 4 – Häktet, Göteborg

Interviewed person	The project manager has solid background in construction and started his career as a carpenter
Location	Inner city Göteborg, Ullevigatan
Project type	New arrest building in Göteborg
Contract form	Design and build
Size	450 million SEK, 20 800 m^2
Client	Vasakronan is a real estate concern that specialises in offices and retail premises
Project duration	The project manager said that they began planning six months before the production started. It started in April 2008 and was finished in June 2010

Figure 4 Häktet

Already in the tendering process they recognised that they could not meet the deadline without changing the client's initial plan. E.g. they had to broaden the building and use prefabricated elements. They set aside a period of time that would be sufficient for the planning of the project and therefore they early recognised how demanding the time plan was. One of the challenges in the project was organising the logistics as it was located in the central area of Göteborg. Moreover the project was difficult because of the organisation they worked with. There was only one person that they could communicate with and that person was supposed to take all the decisions. What

made it even more difficult was that there were contradictions in their documents and the nature of the project with all the safety measures.

Preconstruction planning of the project

There were four people, along with the project manager that worked full time for two and a half months to plan the project. They had professional time planners that worked to create functional time plans. Moreover he thought that they hired one of the best planners in Sweden whose task was to make the time plan pedagogical. They tried to look at objects of comparison but there were nothing that they could use as a reference project, especially concerning the security class of the project.

Furthermore, he explained that they made a Project Implementation Plan, a PIP-plan. The PIP-plan identified what needed to be done and then connected it with the purchasing of the materials and tried to see where it matched in the production so that everything moved along smoothly. Moreover they planned with the subcontractors and tried to communicate with them to reach a suitable timeframe for all the parties. He also explained that it is important in the role as contractor to keep the project together for all the parties.

Reflections on the preconstruction planning

The project manager planned in this way because it gave him a sense of security. They locked the time plan quite early after identifying the critical line which was mainly decided by the deliveries. They monitored the progress as detailed as room by room but what he said was more important was the availability for the following worker to do his job.

He could see the benefits of the planning and the result of the planning was that he felt relieved and could answer the client's questions. Moreover the time plan gave support for delays on deliveries and they could easier explain why and what was going wrong and what activities that it depended on. The time plan and the connection of all the activities to it enabled an overall picture of the project which he felt were essential for it to work.

They used a way of communicating the progress in the project that was new to the project manager. A projector and a whiteboard showed the contractor where they were in the time plan and it was updated daily. He felt that this was fantastic and it worked very well.

He said that the most important thing to do in order to reach a good production flow is to plan carefully and to prepare all the activities in the project with work preparation.

> *"Q: But is it really ... If you could explain... What is the biggest key to the production flow running in a good way?*
>
> *A: Planning. Good planning and work preparation. All steps should be work prepared.*
>
> *Q: What do you mean by that?*

A: That you sit down with the people involved and then go through exactly how it is going to be built. You go through the project on the paper exactly how it's done. You try to imagine how you're going to receive the material, how it is hauled into the building, who will be involved, what tools do we have [...] You need to have accurate work preparation with everybody involved. So that everyone knows exactly what to do before the project starts."

4.5 Case 5 – Photo and interventioncenter, Sahgrenska

Interviewed person	Site manager with several years of experience from the production
Location	Göteborg, Hospital area Sahlgrenska
Project type	Hospital building
Contract form	Design and Build
Size	250 million SEK, 24 000m^2
Client	Västfastigheter who handles the properties for Västra Götalandsregionen
Project duration	Production started in December 2011 and is expected to finish in December 2013

Figure 5: The photo and intervention center at Sahlgrenska

The project is divided in three stages and the site manager and his team are responsible for the first stage, which includes the foundation and the concrete framework. He said that because of the depth of the shafts and that the ground consists of mud it is a quite complicated project.

Preconstruction planning

The company spent around 1000 hours of planning before they started working at the site, and the time the site manager spent was around 500 hours. His tasks included preparation of the time plan, the flow of the materials plan, and the disposition plan. The estimation of activity durations was based on the experience of the site manager but there were also discussions with a specialist planner. Moreover he said that it was important to provide information to that person.

He pointed out the importance to identify the critical line in the time plan and see how the activities along it are affected. Additionally an external flow of materials plan is important to have in the project. They also did a purchase plan so they know when to order materials.

The site manager did the plan lucid so that everybody could understand it and know what to do. Moreover he examined what requirements there were when working so close to a hospital. Two challenges he pointed out were to get hold of how deliveries could be handled and what environmental requirements there were on the site. Furthermore he kept the subcontractors well informed and had a dialogue with them to ensure that they got sufficient time to do their work.

He said that it is important to have all activities in the plan from the beginning. Even so, some activities were a bit flexible in the sense that they had alternative methods to do them. An example was that they can choose to shape the concrete foundation traditionally or use moulds. Moreover they received five changes from the client early in the project that influenced how he planned.

He did not go into too much detail in the plan. As an example, if they are supposed to put up gypsum walls he calculates how many square metres it is and makes an assumption of the duration. After that a foreman estimates the progress and communicates that to him. He claimed that the workers should be able to see what they are supposed to do two or three weeks ahead. The most important thing is that the time plan can be used when monitoring the progress. He explained:

> *"Q: So that everyone knows what to do?*
>
> *A: Everyone should know approximately, they should know when all this should be done. And then the supervisor makes a three-week period schedule on it. Even if it lasts for two months, he must break it down in three-week periods. In that way he can monitor…*
>
> *Q: So you could say that this is also a way to get a good production flow then?*
>
> *A: Yes"*

The time plan is divided in parts and connections between activities are clearly visualized. Some of these connections might be obvious although others are difficult to identify without the plan.

Reflections on the preconstruction planning

The site manager thought that there was enough time to do the planning before the production started and the result of the planning was that everyone could understand their part and knew what to do. He said that there are no limitations in the planning and that it is his own responsibility to get hold of information to work around obstacles.

Finally, he argued that a time plan is never more precise than the start and the finish. Even so it is needed to monitor the progress and to see where to take action. He described the meaning of the plan as a way of seeing where the knot is and to find a way to loosen up the knot and that building without a time plan is irresponsible. Since the time plan showed the connected activities this enabled the site manager to get an overall picture of the whole chain of consequences.

5 Analysis

In this section we analyse our results from the cases using a structure model that describes the five most important factors when planning in construction according to Laufer and Tucker (1987).

Execution

The interviews show that the respondents were aware of the importance of the time plan as a guideline and foundation in the project. In case two and five the respondents went further to explain why the time plan was particularly important for understanding how the project should be executed. Both these respondents made it clear that the workers must know what to do according to the time plan. The respondent in case four explained how the PIP-plan connected the whole process which eased the execution of the project. However, respondent three emphasised more on the time plan as a governing tool for the subcontractors' execution.

Even though every respondent talked about the importance of planning and the execution this category was the least mentioned. The questions we asked were more aimed about what they did and not about how the plan worked. Our main focus was not questions about how the plan worked as a tool for executing of the project. This may be one of the explanations of why this category did not receive as much attention as the others.

Even so it is strange that the execution part is so little talked about. Execution of the plan should be very important for the project so that everyone in the project knows what to do. When Laufer and Tucker (1987) conducted their study they also pointed out that this category receives low priority even if it should be the main reason why you plan.

Coordination

Johansen and Wilson (2006) argued that it is important to establish a good contact with the subcontractors. This was also something that we identified in the cases. All the respondents clearly articulated a will and need to have a close collaboration with the subcontractors in the planning process. Several of the respondents said that it is important to reach an agreement on the time that the work should take. Moreover, it was a way to get everyone "on-board" and this increased the commitment from the subcontractors in the project.

However, coordination in construction projects is more than just involvement of subcontractors. An interesting finding in case four was how they communicated the project progress to the whole project team which eased the coordination of the project. They used a whiteboard with a projector that was continuously updated by the specialist planner. This showed the on-going process so that the project participants knew where they were in project and the progress that had been done.

In case three there seemed to be a high focus on coordination because of the project type and because all the documents were not yet completed. The same focus on

coordination was found in case two where the site manager had to coordinate the work with the tenants. Regarding this, our belief is also that coordination is important in order to reach a good production flow and execute the work more efficiently.

The coordination of the project starts already before the planning of the production and it seemed that in most of the cases there was some kind of start-up meeting. However this was particularly evident in case two where all the concerned parties went away on a planning meeting over a weekend.

Moreover, Friblick and Olsson (2009) found that the involvement of subcontractors in the planning process enables a better overall picture. Therefore the subcontractors' role in the project planning cannot be neglected. This was found in the interviews where all the respondents talked about how important it is to involve the subcontractors in the planning process. Finally the subcontractors can provide experience and knowledge which can be useful for the site manager when coordinating work.

Control

All the respondents claim that it is important to have a time plan that can be used for monitoring and evaluating the progress. Marttala and Karlsson (1999) explained that the time plan is an important tool for controlling that the project proceeds as expected. Moreover, they stated that the earlier a variance is detected the easier it is to correct it. We have seen that the level of control was relatively high in almost all cases. The only case where we believe control was less was in case three because they needed to be more flexible with certain tasks.

In the fourth case the respondent mentioned how important control is to be able to explain to the client why you face setbacks. This was interesting because all the other respondents talked about monitoring the progress just from their own point of view.

Another finding related to control is to have a time plan with connected activities. This was also pointed out by the respondents in case four and five as something fundamental for controlling the project. This is essential for having control in the project because it enables to see the consequences for the whole time plan when single activities are interrupted.

Control has been important in all the cases to identify problems that occur during the project lifetime. It has become evident to us that without control it is more difficult to recognise when activities go wrong. Moreover, it seems that the respondents has had sufficient amount of control because all the completed projects had achieved the objectives.

Moreover control is affected by the level of detail in the time plan. In the cases we have seen differences in how detailed the respondents were in their planning. The respondent in case two explained that the time plan was at a very high level of detail. While in case one the respondent said that it has to be at the right level of detail so that it could be controlled. Case three was different because some of the tasks were only controlled by interim targets and an on-going dialogue. From the interviews we

have found that control is not only important to be able to take corrective action but also to create an awareness of what happens in the project.

Furthermore it is important that the respondents have all the information and requirements needed for the project. It is the responsibility of the site managers to obtain information but on the other hand it is also the client's task to provide information. If the manager does not get all the information that is needed you cannot expect that it is possible to fully control the project. This was apparent in case four and was also mentioned in the report by Friblick and Olsson (2009) where they found that site managers could not plan properly without complete documents.

Finally, the higher level of detail the more accurate the progress can be monitored. Anyhow, the level of detail in the time plan should reflect what the site manager is capable of monitoring. This was also mentioned by respondent five when he claimed that the most important thing is that you can monitor the progress. The level of detail in the planning was also something that Maylor (2005) brought up. He said that if the time plan is too detailed people tend to focus too much on it and forget about the actual objectives. Then planning itself becomes more important than the project.

Forecasting

In all of the cases attempts have been made to identify potential future problems. Moreover all the respondents have used past experience and knowledge to come up with a critical line for the project. By doing this they can prevent or minimize the effects of the problems. A clear example of this was in case four where they recognised early that they had to use another method than what was proposed in the initial plan. Another example was in case one where the respondent was able to identify four critical activities that had to be completed at a certain time.

What also came up during the interviews was that the respondents tried to look at earlier projects or stages in the project to use as a reference. Here we could see differences between the cases in terms of how much help the respondents had from previous project data. The respondent in case one could use earlier stages when planning which he thought was a big advantage. In contradiction the second respondent did not have the same help when planning because each stage looked different. Moreover in case three and four they tried to use previous projects to make an accurate forecast. However the problem in case four was that there was no similar project to use as a reference.

Our conclusion is that the planning meeting used in case two is favourable when planning for any type of project. To gather all the people and simulate the project from start to finish increases the chance of identifying future problems. We understand that the time to have this kind of meeting is often not there but the benefits of having it is more important. Furthermore, as Awad et al. (2010) explained, it is necessary to account for different future scenarios in advance. In this way the contractor is allowed to be proactive rather reactive to problems in the project.

Optimisation

In four of the five cases they have used some kind of expertise when doing the planning of the projects. Some of the respondents hired external consultants for knowledge and experience as in case one where the respondent realised his limitation when planning for installations. In case three they had help from internal resources with the installations. Furthermore in cases four and five they used specialist planners to help them plan the project. We have found that it is beneficial to bring in expertise help because the respondents who did this expressed a high satisfaction and it seemed to work very well. However in case two, the respondent explained that he does not think these services are useful because they can deal with them themselves. Of course the cost has to be taken into account when these services are used. The respondent in case one claimed that it is out-dated to not take advantage of these services, especially if the services are available internally.

Another challenge in several of the projects was to handle the logistics. To deal with this the respondents used logistic managers on the construction site. This is also a good example of how to utilise expertise help to create a better production flow. To optimise the production the logistic issues are vital because it makes the construction site work more efficiently.

It is not always obvious which method that will be the most effective one to perform the work. The respondent in case two highlighted this issue and said that it is several factors that must be considered such as cost and the satisfaction of the workers. This was an interesting opinion and we can understand the difficulties when making decisions that influence the workers situation. Moreover to choose the less expensive equipment over the more expensive might not be the most optimal option if the workers become unsatisfied. This is difficult to measure in costs, which is why it can be hard for a site manager to justify the choice of the more expensive equipment.

For some activities in the project there are several different options of how to do the work. In these situations the manager must make a decision on what solution that is the most optimal. As revealed in case five it may be better to keep some activities more flexible in the time plan, to wait and see which method that will be the most cost effective.

Table 1 Summary of the five case projects

	Case 1	Case 2	Case 3	Case 4	Case 5
Execu-tion	The plan was used as a guideline	The level of detail in the plan made execution easier	The time plan worked as a governing framework for the subcontractors	Used a PIP-plan so that the project moved along correctly	Made the time plan lucid so that everyone knew what to do
Coordi-nation	Involved the subcontractors in the planning and tried to avoid having workers at the same place	Used a Mölö meeting and involved the subcontractors	Gathered all the people to brainstorm about the planning	Used a special method to communicate the project progress	Kept the subcontractors informed and had a dialogue with them
Control	Monitored the progress and could identify variances	Detailed plan with high level of control	More flexible and less control of certain tasks	Detailed monitoring of the progress with focus on availability for the next worker	Aware of the importance of the time plan for controlling the project
Fore-casting	Could make accurate estimations due to information regarding previous stages	Had to re-plan for each stage and make adjustments	The logistics made it difficult to predict the project work	Set aside sufficient time for planning and could identify problems in advance	Thought that a purchase plan was important to know when to order materials
Optimi-sation	Hired an installations coordinator due to the complexity of the project	Tried to find the most optimal balance between cost and the satisfaction of workers	Came up with an idea on how to remove the demolition materials more efficiently	Had professional time planners that worked to create functional time plans	Some activities were more flexible in order to asses which was the best

It is evident that the site managers have considered the factors and managed to fulfil these factors to a satisfactory level. Several examples that are related to each factor have been identified. Moreover all of the respondents in this study have had a major contribution and an important role in the preconstruction planning. Ultimately it is the site manager that is responsible for the planning of the production and therefore the site manager will have a significant impact on the project outcome.

The results reveal that many of the decisions that the respondents make are the dependent on the project characteristics. One example is the findings that are related to optimisation where the complexity of the work seems to influence if the site manager will bring in expertise help or not. Moreover, other project characteristics such as the client's requirements influence how the site manager's control, coordinate, forecast and execute the project. E.g. the decision to have some activities more flexible with less control in case three originated from the client's requirement to not disturb the tenants. Another example, related to control, is that the client must provide

the site manager with sufficient and adequate information. Otherwise the site manager will not be able to keep control in the project.

Another significant finding is that the preconstruction planning seems to be so much dependent on the site managers' experience and knowledge. The results show that there are no clear frames or guidelines from the company of how to conduct the preconstruction planning. Instead it is up to the site manager to make sure that what needs to be done is done. Therefore the site manager's own abilities are an important aspect that governs how the production will be planned. However, no matter how experienced and knowledgeable a site manager is there may still be issues in the early planning. Some of the issues derive from the project characteristics, but the results also indicate that it has to do with the assigned resources for executing the project. E.g. a majority of the respondents mentioned complications with the logistics and therefore assigned people to work solely with this. So, in several of the projects the availability of these resources have been crucial for the respondents preconstruction planning. Furthermore, the assigned resources include the possibility to bring in expertise such as specialist planners, installations coordinators etc. Without these assigned resources the projects would probably not have met the objectives.

6 Conclusion and recommendations

The purpose of this study is to describe the preconstruction planning from the contractor's perspective and to identify aspects that govern how site managers plan for an appropriate production flow. The study is based on five qualitative semi-structured interviews with site managers and project managers working for large construction companies. The results from the interviews were presented in five cases and the analysis was based on a structure model with five factors that are important for construction planning.

The four research questions in our study are answered below.

What is the site manager's role in the planning process and how significant is his/her performance on the outcome of the project?

The site manager is ultimately responsible for the making of the time plans in the project. They also have an overall responsibility for the production as a whole. Their role is to be the anchor in the project and to coordinate, communicate and control that the project will reach its objectives. This study suggests that the preconstruction planning is essential for the outcome of the project. Without the preconstruction planning the project will be difficult to manage and there will be nothing to rely on when communicating with project participants. Because of the site manager's role in the project they have a significant impact on the project outcome.

What are the aspects that govern how site managers plan the production and how do these aspects influence the production flow?

The project characteristics are one aspect that governs the planning. This can include the logistics and the uncertainties in the project, the complexity of e.g. installations and the clients' conditions and requirements. Another aspect is the site manager's abilities such as experience and knowledge from previous projects. Moreover, the assigned resources by the company are also an aspect that determines how the site manager can plan the production. These aspects are connected with the planning of the project and therefore influence the production flow.

What are the differences in the way site managers plan compared to what the literature on preconstruction planning suggests?

The planning that has been done in the cases is comparable to what the literature suggests and there are no major differences found. The site mangers showed awareness of the most important aspects in the preconstruction planning and in all the cases the planning was sufficient to reach the project targets. In brief, the site managers simulated the project and came up with a critical line. After this they developed a time plan that they knew was crucial for the project completion. However, the study showed that there is even more focus on the time plan than what the literature suggested.

What tools and techniques do site manager's use in the planning process and how does it distinguish from literature on preconstruction planning?

This study showed that the use of planning tools and techniques are very limited and most of the planning is done by routine based on experience. They have computer software as an aid but ultimately the planning is dependent on the individuals. The stages in the preconstruction planning process are followed when the site managers plan and there are no distinguishing differences from the literature.

Finally, there is no clear framework of how the preconstruction planning should be conducted but it is more connected to the experience of the site manager. With their experience they know roughly what to do regardless of the project type. Before the planning starts they know what parts that needs to be included in their preconstruction planning. Despite this the site managers have difficulties to express exactly what they are doing in the preconstruction planning. This is a problem because if they are unable to describe what it is they do, how can others more inexperienced managers learn how to plan the production in a good way?

In this study we have identified three main aspects that govern how site managers plan in the preconstruction planning. These are project characteristics, site managers' abilities and assigned resources. We can conclude that the site managers in this study know how they should plan for the production. Our recommendations for further studies are to analyse these aspects more thorough to find out more precise how they influence the planning. Another recommendation is to find out how the site managers can pass on this knowledge to the more inexperienced planners. One way of doing this can be to look at how construction companies can develop a better framework to educate new inexperienced planners.

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Appendix 1

Interview

Date:

Name:

General information

Your role in the project?

Type of project?

The size of the project (budget)?

Location of the project?

Who is the client?

What type of contract?

Duration of the project?

Preconstruction planning

What has been significant for this project? (E.g. customer, product etc.)

How much time has the company spent on planning, from the time you got the job until the production started?

How much time have you spent on the preconstruction planning?

What did you do during the preconstruction planning phase?

How did you do it? (E.g. what aids, tools, procedures were used)

Why did you plan in this way?

What were the results of the planning?

What data was available for the preconstruction planning?

What additional information did you acquire?

Did anything limit you in the planning? (E.g. customer, company guidelines, etc.)

Would you have done the preconstruction planning differently if you could?

Have you been able to settle the planning or has the planning been more open and flexible?

Has there been a crucial event in the planning that affected how the production was planned? (E.g. customer impact, other external circumstances, weather, etc.)

Has the planning been meaningful and fulfilled its purpose? Or something that just has to be done?

Do you see the benefits of planning in the way you have done?