



Norwegian University of
Science and Technology

Bottlenecks and Time-Thieves: Comparison Between the Construction Industry in Norway and a Case Company in Spain

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Abstract

This thesis compares the bottlenecks and time-thieves in the construction industry, between a case company in Spain and the Norwegian construction industry, the thesis also examines the current bottlenecks and time-thieves and the measures that are being used nowadays in order to limit their impact and reduce their appearance.

The construction industry is a source of value for all the countries in the world, and the correct implementation of the methods and procedures helps to achieve the success of the project maximizing the benefits, the Norwegian government has invested resources in SpeedUp projects for reduce the final time of the construction projects, the project identify the bottleneck and time-thieves as one of the main sources delay. The literature reveals the nature of the different issues studied, revealing the closeness between all of them, and the measures that can be taken in order to reduce them.

The utilization of the qualitative research in the thesis aims to identify the bottlenecks and time-thieves of a case company of Spain, and also identify the measures that are taken in the company. Once the different bottlenecks and time-thieves are identified, a comparison between the case company and the previous research is done in order to identify the similarities and differences between both countries and identify why these differences appear. The thesis compares both cases and also the measures that are being used in the theory for proposing them to the case company and see the results.

The originality of the work comes with the comparison of the two countries with a previous theoretical explanation of all the bottlenecks and time-thieves that have more influence in the performance of the projects. However, there are some limitations that have to be identified, the study of the case company and the issues that they have should not be the same in all the companies of Spain, even inside the company the utilization of just five project managers for the research could not be enough. The implementation of the measures will have long-term results, so their effects is not going to be study in the thesis. Further research includes the study of other cases of Spain, and the interview to some project managers in Norway to identify the reasons behind the bottlenecks and time-thieves.

Keywords: Bottlenecks, Time-Thieves, Time Optimization, Comparison.

To my parents, Jose Carlos and Mari Angeles for their effort

To my family and friends, for their help and attention

To Javi, without his help this thesis would have been impossible

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1.Introduction

1.1 Background

All the countries have several kind of projects, and several ways to make their economy grow, but if we look over all the activities that all these countries do, we will see that the construction industry is present in each one of them, with different characteristics and problems, but there is no country in the world that doesn't have a construction industry as a source of value. The importance of the construction industry lies in the fact that even if you can import equipment, materials and human resources to a project from other countries, you cannot import the building, road, tunnel, dam or bridge. With this we can see the importance of the development of the construction industry in all the countries.

Projects are the basis of the different companies' strategies, and are the main source of income in order to achieve their goals. Hence, the success of the project will be decisive for the prosperous development of the project. However, is difficult to define the success of the project and it has been a source of conflict during the years, Project success is not a fixed target. (Jugdev and Müller (2005)).

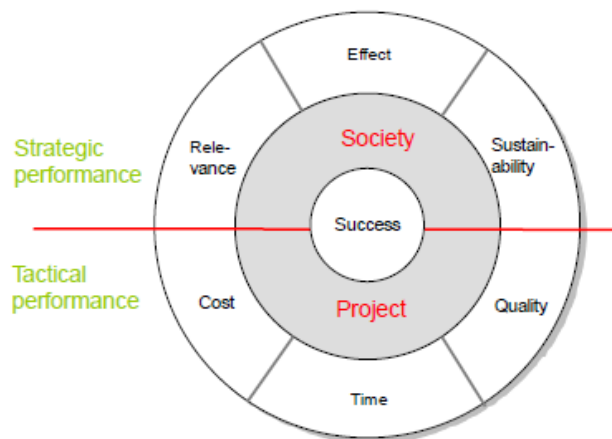


Illustration 1: Successful projects: some strategic and tactical issues (Knut Samset (2015))

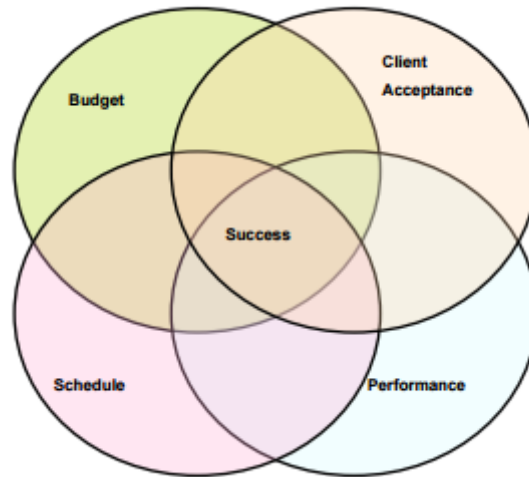


Illustration 2: Dimension of success (PINTO)

As we can see there are several conceptions of how to be successful in a project, Cooke-Davies (2002) set the difference between project management success and project success, in the fact that the project management success is based on the achievement of time, cost quality or other goals set for the management of the project, however, project success is based on the achievement of planned business results with the use of the project's outcome.

As we can see the success of the project has a wide variety of range of several concepts that could be taken into account, but we can observe that all of them have the time as one of the biggest source of impact in the determination of the final success.

Time management has an important weight in the final success of the project. In this context is where the SpeedUp platform is born, SpeedUp is a program drive by the Norwegian government, whose main objective is to develop and study the major causes of delay in a project for reducing the overall time of complex projects, the objective is to reduce at least a 30% compared with 2013.



Illustration 3: SpeedUp logo

1.2 Formulating the research problem

The objective of this thesis is the development of a study about the bottlenecks (factors that slow down the project) and time-thieves (factors that steal time). These two terms are going to be studied in a Spanish construction company. The purpose of this thesis is to find the correlations between the bottlenecks and the time-thieves in Norway and in Spain and see the how they deal with them, paying more attention to the most important ones, trying to see the main causes and effects of them. Also the way the case company manage their problems will be an objective in the research, see what kind of procedures they use in order to limit the consequences of the bottlenecks and time-thieves. The current chapter points out the importance of the bottlenecks and time thieves in a project.

1.2.1 Problem formulation

The role that the construction projects play is significant inside any country's economy and has impact on a lot of industries (Muya et al., 2013). There are a lot of industries which have direct relation with the construction due to the need of infrastructure to develop the activities related with the sector. Delays occur in every construction project and the magnitude of these delays varies considerably from project to project. Some projects are only a few days behind schedule; some are delayed by over a year (Wa'el

Alaghbari et al., 2007) So it is essential to define the actual causes of delay in order to minimize and avoid delays in any construction project (Ahmed et al., 2003). Even though the advance of the technology and understanding of the managerial techniques has improved considerably, the problem of the project delay has not been solved (Sweis et al., 2008, Yang et al., 2013). All the projects can be improved, because when the project is scheduled we can also find other alternatives (Simms, 1984) The relation between cost and time is very thin and a deviation from the original forecast to the final cost could be considerable for the owner.

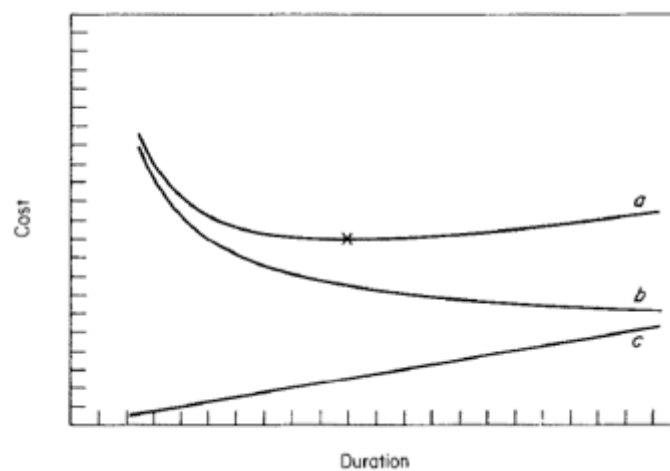


Illustration 4: Optimum Project duration X; (a) total project costs, (b) resource costs, (c) time-dependent costs. (Alfred Simms, 1984)

Besides the increase of the final prize of the projects, as a consequence be out of the budget, a time overrun in the project could guide to a loss of the competitive advantage over your competitors and could be also a source of inconveniences between the stakeholders (Yang et al., 2013, Odeh and Battaineh, 2002, Mohammed et al.,2014). Time performance is one of the most important aspects to be benchmarked in project management (Le-Hoai et al. 2012). The owner wants to have the shortest time in the period in other to turn the corner of the loses, while the contractor wants an efficient use of the resources (Simms, 1984). The relation between them is one of the most important bottlenecks.

Given that utilizing time effectively and efficiently is one of the important factors determining the success of a project, understanding where time is lost, and the

character of the bottlenecks and time-thieves will be useful to increase the performance of the project (Petter Eik-Andersen et al., 2015).

Two concepts have to be defined. "Bottleneck" is a constraint resource that creates limitation in the production process and therefore slows down the project (Goldratt et al. 1992). "Time thief" is all conditions that reduce production capacity of a working process. Time-thieves are related to the concept of waste or non-value adding activities (Petter Eik-Andersen et al., 2015). The concept of bottlenecks and time thieves carries semantic overlap, intentionally.

Several bottlenecks and time-thieves have been identified in the Norwegian construction industry, and they have been gathered into groups and sorted by relevance by Petter Eik-Andersen et al., 2015. The list of the different bottlenecks and time-thieves can be found in the chapter 2.1.

1.3 Research objectives and research questions

The problems in the construction projects have been mainly the same in every country that has been studied before, the final objective of this thesis is to compare Spain and Norway, find the similarities between them, understand better the nature of the different bottlenecks and time-thieves and finally see what kind of measures are being used in the studied company to manage the different issues. In order to get a better understanding of the research, we can have a look to the research questions each one of them tries to deal with the topics presented before. The first question is about understanding the company, his singularities and problems. The second tries to find the correlations between the two countries, similarities and differences. The third and last question tries to deal with the management of the different time-thieves and bottlenecks, how does the company face them. Following are the research questions, although more attention will be given to them in the next chapters.

1. What are the main time thieves and bottlenecks in the case company? Are the same in every project?
2. Are this bottlenecks and time-thieves different from the ones that we found in Norway?
3. Which measures are they applying in order to deal with them?

Compare two countries is a very tough and almost impossible job, lot of time and information is required, get all the amount of information needed it has been impossible. However, what we can do is to analyze and study five different projects from the same company by having the information right from the project manager. In order to do that, a qualitative is carried out to understand from first-hand the projects and its problems. On the other hand, an extensive literature review has been done in order to understand properly the main different bottlenecks and time-thieves and get more information about their nature and make the proper questions during the interviews.

1.4 Research scope

One of the main issues when proceeding with the thesis was setting the boundaries of the research, or what is the same, stablish the research scope. Have a reasonable project scope will help for the focus of the efforts and try to deal with not too much information. The basic boundaries of this thesis are the study of the main bottlenecks and time-thieves found in the Norwegian construction industry and compare them to a construction company in Spain. In order to do so, five construction projects will be analyzed by interviewing the project managers and study the basic characteristics and framework of them, in order to have an idea of the propose of the project. In the next figure we can see the research scope.

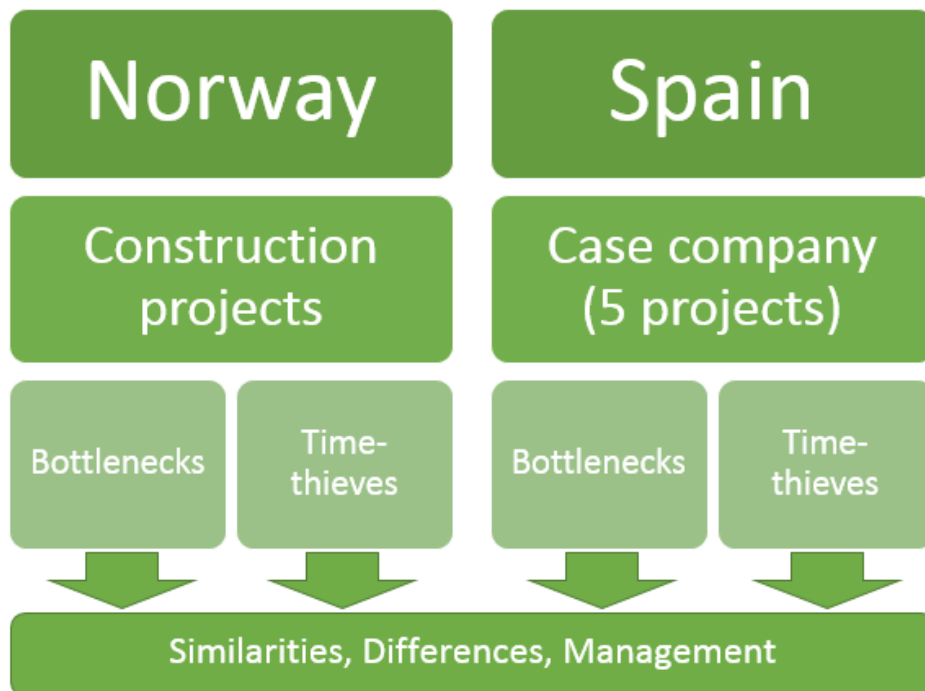


Illustration 5: Research scope

Study the main bottlenecks and time-thieves could be a really wide task, for dealing with the issue the most important ones founded by Petter Eik-Andersen et al., (2015) have been selected. Three bottlenecks and three time-thieves have been chosen to understand the nature and their main characteristics. They are studied in order to have a theoretical background, understand what is going on when a manager identify management and coordination as a bottlenecks as an issue for example, and also for getting more information when interviewing. In order to truly understand the problems of the case company, a theory base is needed in order to ask the proper questions.

Finally, when the interviews are done, the main bottlenecks of the company are identified, and a knowledge of how they deal with them and why, a further study will be done in order to compare to the ones existing in Norway and see if the measure that are being taken could be improved by comparing them with the actual procedures and tendencies.

1.5 Why do we compare countries?

The comparisons between projects could be a very useful way to improve your productivity and effectiveness, has been pointed out by several authors that the experience and the knowledge improve the different stages in a project, based on an experiment, Mullins et al. (1999) concluded that experienced decision makers' previous training and knowledge have an influence on product development decision making, The management ability of the project's owner is the second important factor causing delay in construction projects (Wa'el Alaghbari et al., 2007).

In order to gain that experience and knowledge needed, a comparison between different projects could be done in order to see the procedures of others and reduce our project uncertainty.

Time problems in construction projects are not a particular issue in Norway, Sambasivan and Soon (2007) and Iyer and Jha (2005) highlighted the complexity on this issue across many countries. Malaysia (Wa'el Alaghbari et al., 2007) (Shehu et al. 2014), India (Doloi H. et al. 2011), Chan and Kumaraswamy (1997) studied the case of the Hong Kong construction projects, in Australia only one-eighth of the construction contracts were found on time, and the average overrun was 40% (Bromilow 1974). Vietnam was also a subject of study for Le-Hoai, Lee and Nguyen (2012). As seen, time management has been a source of surveys in several countries, with different procedures and traditions but all of them with the time overrun as a big problem in their respective construction industry.

1.6 Structure of the thesis

This thesis contains eight chapters divided in three main parts:

The first part is the introduction and the evaluation and framework of the future research, what is going to be done and why, describes the importance of the study and the research questions. Chapter 1 is included in this part. It also includes the Chapter 4, in this chapter the methodology used along the projects is described. These two chapters can be considered as a framework for understanding what has been done in the project and why has been done in this way.

Following this part, we found the second part of the report, this part is the theoretical one, is divided in two parts, one of them includes chapter 2 and 3. Chapter 2 talk and describe the nature of the different bottlenecks and time-thieves that are being studied, the main problems found in each of the topics and their framework. Chapter 3 talks about the measures proposed by the theory and the authors in order to limit and avoid the consequences of the bottlenecks and time-thieves.

The last part of the report is the research part, this part starts with Chapter 5, in this chapter a brief explanation of the studied projects is going to be done, the description includes the budget and the time of the project. Chapter 6 contains the main findings of the interviews, the study of the transcripts has been done, and the different conclusions found referring to the different bottlenecks and time-thieves of the case company. Chapter 7 aims to find the differences and similarities between the theoretical study of the bottlenecks and time-thieves, with the issues found in the case company. Finally, Chapter 8 includes the conclusions of the thesis, the research questions are answered and a proposition for further research is done, also the limitations of the thesis are explained.

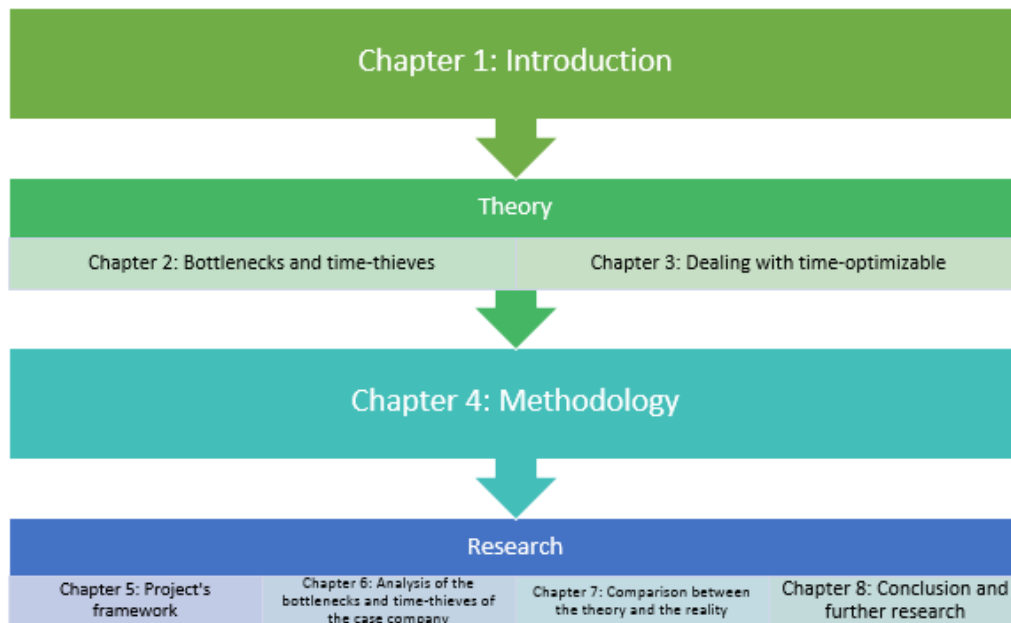


Illustration 6: Structure of the thesis

2. Bottlenecks and time-thieves

This chapter aims to explain the nature of the principal bottlenecks and time-thieves found in the Norwegian construction industry. After a brief definition of the concepts of bottleneck and time-thieves, an explanation of why the following bottleneck and time-thieves are the chosen will be carried out. Then, five main bottlenecks and time-thieves are going to be studied, described and broke down in the main issues that affects them. Since every concept is very wide with a lot of conditioning factors, is important to break them down and study them in order to get the proper knowledge for the following interviews.

2.1 Definition and Selection process

Bottleneck is a constraint resource that creates limitation in the production process (Goldratt 1985). An example could be lack of people, lack of equipment.... On the other hand, we have the time-thieves, defined as conditions that increase the final duration of the project, by using time in useless activities, reducing then the productivity of the project: An example of that could be: unnecessary meeting, sickness of the workers... The label for the concept is adapted from Michael Ende's novel *The Grey Gentlemen (1973)*. As seen before, the time delays in constructions are a real and a big issue affecting the projects. To reduce the project duration, we must understand why projects have slow pace nowadays (Zidane Y.J-T. et al. 2015). In order, to identify the bottlenecks and time thieves in the Norwegian construction industry Zidane, Johansen, Andersen and Hoseini (2015) carried out a survey in where they found the following issues.

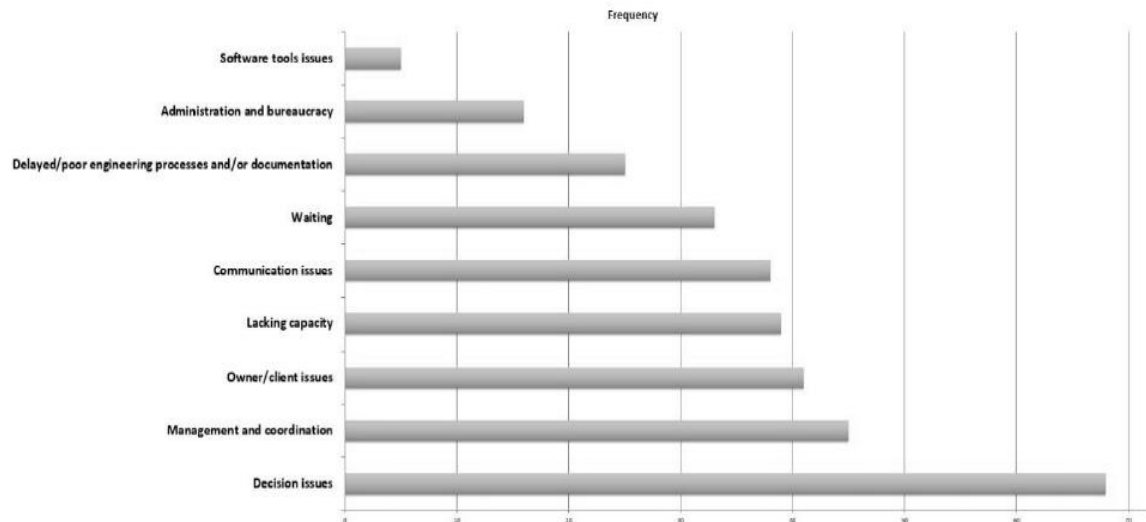


Illustration 7: Bottlenecks in the Norwegian construction industry

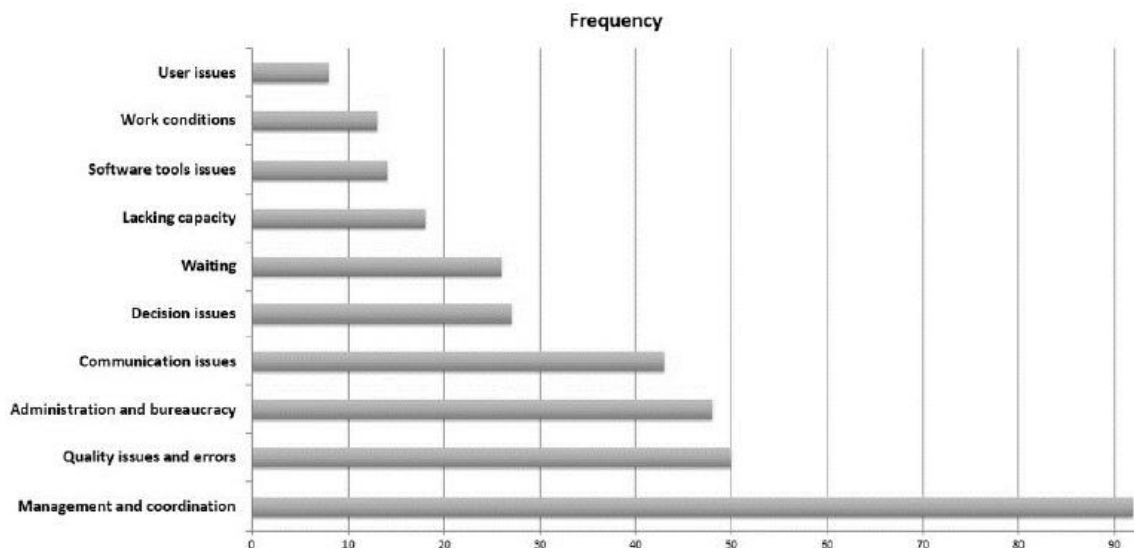


Illustration 8: time-thieves

The fact that decision issues is the highest source of bottlenecks and is also considered as a time-thief was explained by the authors, the fact could be explained by knowing that the most of the subjects of study were contractors, they find that the client/owner are delaying them with their decision, but they are fast taking theirs.

Once we have identified the main bottlenecks and time-thieves, a further research in the main ones will be carried out, the chosen ones have been: decision issues, management and coordination and owner-client issues as bottlenecks and management and coordination, administration and bureaucracy and quality issues and errors. The

first one is already justify in the previous paragraph, the relation between the decision issues and the owner/client has been already pointed out, and seeing the direct relation between them and the specific weight of the owner/client in the study this have been chosen as one of the more interesting ones to make the further research. At last but not at least we can find the management and coordination, according to all participants “management and coordination” and “decision issues” were the most important delay factors (time-thieves and bottlenecks) in the Norwegian construction industry (Zidane Y.J-T. et al. 2015, Petter Eik-Andersen et al., 2015). It is important to highlight the importance of the “management and coordination” because we can find it as the most important time-thieve and the second bottleneck. The relation between bottlenecks and time-thieves is very close and sometime they overlap, as we have seen in the previous chapter.

When talking about the time-thieves, the quality issues and errors are going to be studied, because it has been found a lack of interest in this important factor by the contractor and the owner and is a really interesting topic because a lot of measures have been proposed. Following we have the bureaucracy and administration a topic in which there is not existing a large survey but has been found a real issue when stealing your time. Finally, we have the mentioned management and coordination.

2.2 Time-optimizable

When a first research if the literature has been done, the problem with the overlapping of the concepts of bottlenecks and time-thieve has been found real, several concepts are not defined as one particular bottleneck or time-thieve, and when going through the different concepts inside a bottleneck or a time-thieve, what at the begging was thought a bottleneck turns out to be a time-thieve, because of this and the close relationship that they have, a new concept is going to be described in order to deal with this problem and stablish a concept.

Time-optimizable is going to describe both, bottlenecks and time-thieves, this concept is trying to solve the overlapping problem, and define in a wider aspect the concepts, in

order to avoid the problem of the distinguish between both, this concept will save time and will make the things easier for the reader.

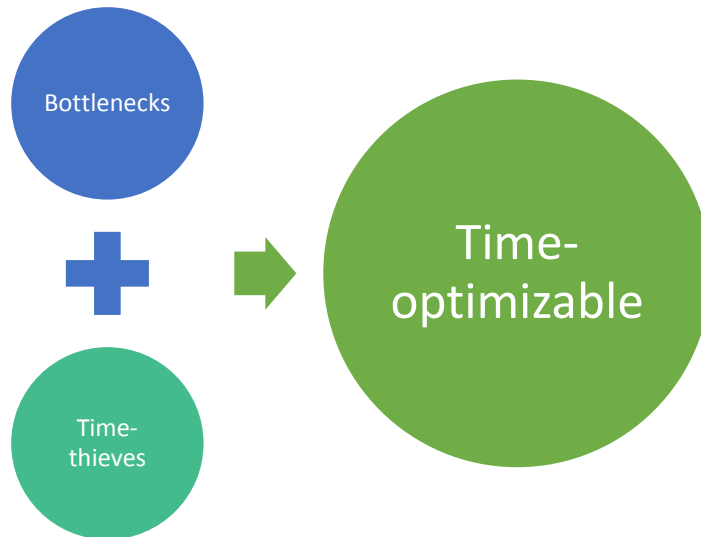


Illustration 9: time-optimizable

Bottlenecks and time-thieves are concepts that can be optimized, they affect the performance of the project and increase the final time of it, because of that time-optimizable has been chosen as a concept to explain issues that can be improved and affect the final duration of the project.

2.3 Decision issues

The decisions are expected to be taken by rational choice model (March, 1999), that means that the decision makers are aware of the alternatives, the consequences and order of all the alternatives and they make the decision based on that, the challenging of applying this method is based on the restrictions of knowledge time and money (Simon,1976). Simon (1976), concluded that humans have develop some procedures to overcome the lack of knowledge and the limited memory. All these procedures are based on the bounded rationality (limited number of variables and consequences). It is

also pointed out that the judge of the decision makers plays an important role, the perception capabilities and the emotions (Bentzen E. et al 2011).

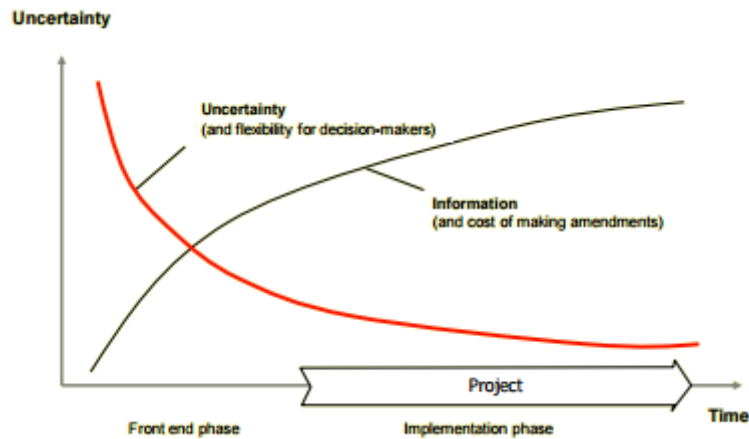


Illustration 10: Evolution of the uncertainty (Knut Samset (2015))

As we can see the uncertainty reduces during time, while the information is increasing, or as much information, less uncertainty, the factors that increase the level of information and affect the decision-making process are described in the following parts of the chapter.

The decision making process is affected by several factors and complexities, such as different stakeholder goals and coalitions (Cyert and March, 1963) and the relevance of understanding the process of attention direction as allocation of time (March, 1978), others point out that the unconscious process play a bigger role than the conscious ones (Allwood and Selart, 2001).

Construction projects have targets, Cooper (2001) is very concerned and says that “deadlines must be regarded as sacred”. He urges to check the projects constantly and “check to make sure that you’re on schedule and on budget”.

Based on an experiment, Mullins et al. (1999) concluded that experienced decision makers’ previous training and knowledge have an influence on product development decision making. Structured approaches and management systems are expected to facilitate a better and smoother management process (Cooper, 2001), which should

make it possible to spend less time on ongoing projects as compared to new projects. In tight projects it's been pointed out that if the projects manager is the construction side, a reduction in time will be done, because the actions will be taken on time. (Simms, 1984).

As seen, decision issues are attributed to two main factors, the managerial abilities and the stakeholders influence, following we will see nature and the reasons founded for this problems.

2.3.1 Stakeholder influence

Owner, company politics, consultants, governments... have been found one of the main factors affecting the time in the decision-making process. Their different perception of the project is the source of some conflicts that reduce the productivity of the project.

The importance of this is such that when Wa'el Alaghbari et al., (2007) grouped the categories of delay has one just for the owner, these are called "compensable delays", are caused by the owner or its agents, these issues are related with the owner's failure to respond in time, the changes in design the owner's disruption and/or change in the sequence of the work.

Wa'el Alaghbari et al., (2007) also described another kind of factor related with the stakeholders, the "Non-excusable delays" are caused by the suppliers and the subcontractors.

The importance of the project owner decision making process is pointed out in this article (Wa'el Alaghbari et al., 2007). It is found that the management ability of the project's owner is the second biggest factor that cause delay in the projects on the construction industry. The whole of the participants agreed that "slowness in making decision" by the owner is a determinant factor.

The consultants as part of the stakeholders of the project, have also their part of responsibility in the delays of the project, consultants are very important in the

construction projects nowadays and have been found several causes of that, Wa'el Alaghbari et al., (2007) found that the supervision too late and slowness in making decisions and so give the correspondent instructions lead to a decision problem from the part of the project manager.

2.3.2 Managerial abilities

Several causes related to the managerial abilities and knowledge have been found, this leads to slow down the project because the managers take more time than needed when taking decisions.

Decisions sometimes take more time than needed because the project, and the project manager are not well prepared, Williams and Samset (2010) identify that we don't have the tradition of identifying alternatives before the designing of the project, because of that all the decisions are restricted to the project level. A lack of a good plan and a good evaluation of the projects leads to make incorrect decisions that could guide to errors and then a redo of the concept, which is equal to more time and resources.

Project managers have a "bounded rationality", which means that they cannot make a fully rational decision. They are not only limited when solving complex problems, but also the have a lack of complete information about the present and the future (Williams and Samset 2010).

Several facts affect to the estimation of the project, Flyvbjerg (2009) describes the biases involved, dividing them into technical (due to inadequate forecasting techniques or honest mistakes), psychological ("optimism bias"), and political-economic explanations (reasons to deliberately claim an optimistic view of the future).

The main problems when we refer as managerial abilities, in the decision making process, is that the managers are not well prepared, they do not do a proper evaluation of the project in order to foresee the future development of the project and have a plan in case that the things are not going as thought. This lack of preparation is what leads to the increase of the time when taking a decision, if a good evaluation is done, the uncertainties could be reduced and so, a plan for every type of fact could be

implemented. The environment in which projects take place is turbulent and complex, and conventional project management is not well suited to such conditions (Williams and Samset 2010).

2.4 Owner Client issues

The nature of working relationships between owner and contractor in engineering and construction projects is considered to have a major effect on project performance (Suprpto M. et al., 2014). Different points of view between both, contractor and owner could lead to disagreements and affect the relationship. The owner, aims to get the shortest construction time, during the construction cash flow is always negative, and it is after the delivery of the final project when the owner can start receiving money and recover the initial investment, (Simms, 1984). Turner and Müller (2004) list the interest of the owner:

- The end deliverable will meet their functional requirements.
- The process follows the right manner to deliver the outcome in the optimum way.
- Quality, time and budget will be achieved.
- The required control methods are done in order to get the above.
- Project Manager will behave in a professional and trustworthy manner.

On the other hand, the contractor's policy is to optimize his performance in all the ongoing projects, by an efficient use of the resources. It is clear than when the arrangement between the owner and the contractor is done, the money will set the final time, although the increase of this is not proportional to a final reduction of the building time (Simms, 1984).

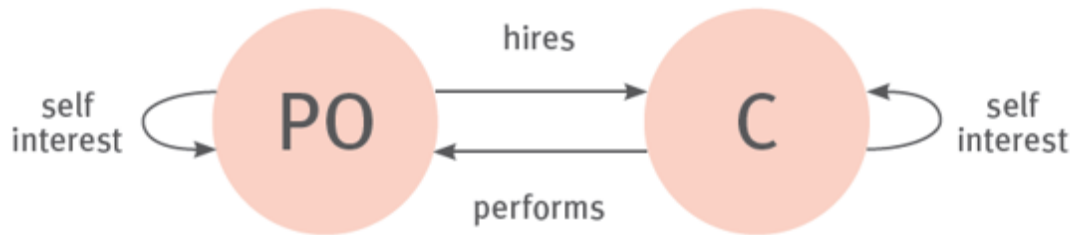


Illustration 11: Project Owner (PO) - Contractor (C) relationship

Because of this difference of points of views, communication is an important component affecting the final time of the project. The communication in construction project is a complex phenomenon that covers different fields, organizational levels, as well as the mentioned perspectives and interpretations. The collaboration between participants is needed as well as the share and the integration of information (Ceric A. 2012).

Delegation and trust are the basis for a prosper relationship. Assuming that, agents could try to get the maximum for their own benefit, even when a damage to the other part could be done (Ceric A. 2012). Ceric A. (2012) points out that this problem is characterized by three main factors: adverse selection, moral hazard, and hold-up. To be brief in the explanation: when the principal lacks of the exact qualifications before signing the project, adverse selection appears. Referring to moral hazard, the principal cannot ensure that the contractor will act on the principal's behalf after the contract is signed. Last we have the called hold-up; hold-up takes place when an investment on resources is done but the contractor acts for his own interest after the sign of the contract.

The phenomenon of the asymmetric information (Schieg, 2008), appears when one of the two parts is better informed than the other, because of self-interest a deterioration in the relationships occurs and the obtaining of the project's outcome gets difficult to fulfill in terms of time, money and quality (Ceric A., 2012).

Under the effect of adversarial relationships small issues turns out to become bigger and bring with them costly delays and ending in formal litigation. Owners might challenge request of approval, delay the payments and try to control the contractors' work. On the other hand, may negotiate in an aggressively way and make changes retaining vital

information. Adversarial relationships lead to short-term deals, based on the opportunity and confrontations. (Suprpto M. et al., 2014).

All these perceptions aim to point out the need of a collaborative relationship, with an alignment of the goals and interests, open and honest communication, commitment and trust for trying to create a long-term relationship (Suprpto M. et al., 2014).

Collaborative relationships are not easy to happen, and they may take a range of approaches, the main propose of the owner-client relationships is the willing of a common goal, a relationship based on commitment and trust is needed, the use of the resources in the most effective way and the sharing of values and norms is needed.

2.5 Quality errors and issues

The literature about the topic shows to main branches for facing it, the first one is the issues related with uncertainty and the errors that it brings. On the other hand, we have the finding of the material management in a project as a source of a lot quality errors.

2.5.1 Uncertainty

Poor project planning is cited by many authors as a big delay factor in the construction industry, as seen in the point 2.2 uncertainty plays an important role in the development and final outcome of the project, as was shown the decision-making process is influenced by the correct plan and study of the project. Uncertainty's impact can be detrimental resulting from a late discovery of a problem (Lee S., 2006).

Errors and changes can develop further consequences and affect other activities due to the proximity or the procedures. Errors and changes can have harmful effects on project performance, not only in the activity that the take place, but also in other activities because of the complexity of the project (Lee S., 2006).

When changes and errors appear in a project, an action is need to be taken by the project manager in order to overcome the issue, like for example: addition of resources,

changing the construction method, or implementing time overrun. But not all these measures fulfill perfectly our desire, and negative side effects, that were not predicted, could appear, with the consequent consequences (Lee S., 2006). These consequences can appear in several forms, from an increase of the resources needed in an activity, to the appearance of a new activity that was not expected.

The performance of an activity to face the uncertainty is defined by two main characteristics, the reliability and stability. Reliability is defined by the degree of completion of the activity correctly and on time, and stability shows the degree of similarity between the plan and the final execution in terms of changes. Therefore, reliability reflects an activity's robustness against error, and stability reflects the robustness against change (Lee S., 2006).

2.5.2 Material Management

The consideration of the material management by the senior managements has not always been recognized, material management is the main contributor to the cost effectiveness of projects. Not enough attention has been paid to control the largest cost element of a project (The Business Roundtable, 1982).

Material management's definition is not just about the inventory management, it also includes other aspects, like the maintenance of equipment and materials, follow-up (including inspection and expediting), delivery (logistics) of the materials to the projects site, inventory control at the construction, and disposal of surplus material at the end of a project. (Silver E. A. 1988).

All the projects are unique, because of that several challenges have been found:

- Finite horizon and the associated contractors chosen by the firm to execute the project
- The nature of the equipment/materials associate to the project
- Impact of material delivery process (e.g., delay of the project's final time)
- Typical thinking to reduce the time at almost any cost.

Material delivery in a project has been found the main issue when managing materials, some issues help us to context this fact and create a framework for understanding the problem. Ala-Risku T. et al. (2006) define this issues:

- During construction, raw materials must be delivered fast and, at the same time, unsuitable materials must be returned.
- Uncertainty is present in the travel times, even though transport time can be determined.
- Customer must be patient and allow vehicle arrival with a soft time contingency.

The researches find that ensuring that the prerequisites need for a construction task, are in place before needed. However, different problems are brought with that perception, excessive site inventories create problems with the maintenance and increase the cost, because material could be stolen, broken, or get lost. The timing of the deliveries must be adaptable to respond to the unexpected and last time changes in the schedule (Ala-Risku T. et al.,2006). Therefore, the suppliers have to be informed about the project's progress, so they can react to the needs in a proper way, the flow of information between contractor and suppliers has to be active and efficient.

2.6 Bureaucracy and Administration

People is just waiting for the things to happen, the government is inefficient, filling the formal documents is a huge time consumer, so it is vital to be efficient. These are some of the different findings in the bureaucracy literature, as we can see bureaucracy is a very criticized aspect of the projects, is common in every projects and the problem is found to be outside.

While some documents are essential, others are found useless and only takes the project staff time for other things. One main aspect is to distinguish between what have to be done by the project manager and what kind of papers he can delegate in less important staff, to stay focus in the optimization of time. Simplification is the key of success (Robinson G., 2012).

Some legal aspects as the solicitation for starting the construction take more time than expected to be ready, while the project is ready to start, the legality says that there is waiting time. Changes in projects due to unexpected facts are also a cause of bureaucracy waiting for example when digging the ground some findings can appear, or when doing a project, some lands could be in conflict with organizations like NGO or the owner of the land.

The main cause of this has been found the inefficiency of the government when dealing with the paper work and when filling mandatory documents that have been found useless. Chang and Shen (2014) estimate that a 7.2% of engineers' time can be saved by removing the irrelevant and redundant paper work. This shows a large potential of reducing action.

Inside the company some issues can appear, the mandatory procedures because of the company's policy are found to be the time-thieves, the work-load of the higher parts of the organizations is also an issue when a green light is needed for starting with one part of the project, or when a change needs to be done.

2.7 Management and coordination

Management and coordination has been found one of the biggest issues, considering both time-optimizable: bottlenecks and time-thieves. A differentiation has been done when dealing with this topic, we can find problems because of poor site management, poor coordination among parties and communication, and finally one called managerial skills, that will try to point out the correlation between the manager and the final project outcome.

2.7.1 Poor site coordination

Due to workload variation, in projects exist a high level of subcontracting. The main contractor, using the multi-layer subcontractor structure deals with the long-term environmental uncertainties and stays focus on the short-term contingencies (Andy N.G., Price A., 2010).

A study of Andy and Price (2010) groups the common site coordination problems and the causes of them.

| | |
|------------------|---|
| Group: | Construction Information |
| Problems: | a. information not detail enough b. unclear or contradictory information |
| Group: | Working programme |
| Problems: | a. working programme not detail enough b. working sequence not practical c. short notice for commencing site work d. late change of working programme |
| Group: | Preparation for work place |
| Problems: | a. work place environment not yet prepared such as general site cleaning, fresh air supply, lighting b. inadequate or insufficient site reference points c. inadequate or insufficient temporary work support such as scaffolding, water & power supply |
| Group: | Interfacing work to be completed by other subcontractors |
| Problems: | a. work not yet completed b. work not accurately completed |
| Group: | Access to work place |
| Problems: | a. access road not yet ready b. access routing not convenient |
| Group: | Plant support |
| Problems: | a. late to provide plant support b. type of plant provided not appropriate |
| Group: | Material support |
| Problems: | a. insufficient amount b. type of material provided not appropriate |
| Group: | Response to site problem |
| Problems: | a. late response to site problems b. solution recommended not practical |

Illustration 12: Common Site Coordination Problems

As can be seen in the Illustration 12, we can group the problems, in the ones due to the inefficient plan and the one the ones due to external causes. Further in the named survey, a finding of the causes and the aggregated importance of them, this information will be showed in the illustration 13.

| Category | | C | F | C x F |
|-----------------|--|------|------|-------|
| Category | Technical | | | |
| Causes | a. Insufficient technical support from head office | 5.03 | 6.61 | 33.25 |
| | b. poor temporary work design | 4.93 | 6.06 | 29.88 |
| | c. Insufficient site office space | 4.44 | 4.53 | 20.11 |
| | d. poor site layout | 3.91 | 3.17 | 12.39 |
| | e. poor project programme or phasing of work | 3.17 | 5.14 | 16.29 |
| Category | Management system | | | |
| Causes | a. unclear job duties | 7.08 | 7.11 | 50.41 |
| | b. unclear communication path | 7.03 | 6.44 | 45.27 |
| | c. Insufficient authority for frontline staff | 6.97 | 5.19 | 36.17 |
| | d. unclear accountability system | 6.86 | 6.67 | 45.76 |
| | e. too much paper work | 4.83 | 6.56 | 31.68 |
| Category | Staffing | | | |
| Causes | a. staff too inexperienced to coordinate the technical administration work | 6.94 | 6.86 | 47.61 |
| | b. frequent change of personnel | 6.68 | 3.72 | 24.85 |
| | c. staff too inexperienced to coordinate the site work | 6.19 | 5.76 | 35.65 |
| | d. Insufficient directly employed worker to carry out the temporary work | 5.81 | 6.53 | 37.94 |
| | e. Insufficient staff to coordinate the site work | 5.50 | 5.26 | 28.93 |
| | f. insufficient staff to coordinate the technical administration work | 5.23 | 5.17 | 27.04 |

Key C: Degree of Contribution; F: Frequency of Occurrence C x F: Aggregated Importance Score

Illustration 13: Causes of Site Coordination Problems

Unclear job duties have been found the most important factor, people don't know what to do and spend more time trying to figure it out than actually doing it, followed by the inexperience of the staff that lead to incoordination, the unclear accountability system and the problems with the communication have been also found relevant, finally is important to say that as we can see in the illustration 13, the causes related with the technical aspects are the less important.

Some conclusions can be founded on these illustrations, a well-defined system of duties and responsibilities for each member of the project is important to ensure that activities can proceed without problems. Along the life of the project, a dynamic temporarily multi-organization is sometimes crated, the organization is always confronting two levels of objectives: the temporal objective of the construction project; and long-term objectives from the participating stakeholders and operational phase of the project (Mohsini and Davidson, 1992).

Even though, there is no guarantee of success when a project main contractors can make a well-organized management system unique for the project. The assignation of the adequate staff by the contractor is determinant, as seen before, the staff have to

have the technical knowledge and experience in order to proceed properly with the management system (Andy N.G., Price A., 2010).

2.7.2 Poor Coordination Among Parties and Communication

Construction projects have a high complexity, is about putting all the materials in order to achieve the specifications and quality standards, in order to so coordination plays an important role, Coordination can be explained as the process of linking activities, set paths, establish dependencies between the activities and join all the actors to set the collective task tasks (Malone and Crowston 1994). It is important to know that coordination also includes the management of people and resources (Hossain L., 2008).

The coordination is needed all along the construction project, different professionals and persons participate actively in the different stage, from the design office to the construction site, since the identification of the need till the final delivery of the project (Hossain L., 2008). In the design and build approach, the owner produces a list of requirements for the project, showing the project's goals. The different contractors available for the project, will present their ideas, after an evaluation of all of them, the owner will select the one that he finds more interesting according to several criteria: time, money, trust in the contractor.... Once the contractor is selected, the project manager will be the responsible of the final delivery of the project in time and in budget. Several actors with their consequent contracts will take place, subcontractors, designers and managers could be needed for the correct development of the project. Therefore, the project manager has to deal with several actors in the several stages of the project, with the already difficulties that the project has.

In order to coordinate the work, the different actors use methods such as meetings, plan, and contracts, as mentioned before. But, these methods are used more for convenience or preference rather than effectiveness (Carlson and Davis, 1998).

Even though these methods are thought to help in the decision-making process, they do not always bring with them the improvement of the quality and the effectiveness (Maltz, 2000). The increasing of the coordination quantity does not always bring increased

effectiveness (Chang A.S. and Sheng F-Y., 2014). Several studies have studied the relationship between the time spent on coordination and performance. Kuprenas (2003) found that holding one or more design team meetings per month reduced the design phase cost by 35% and issuing one or more status reports per month reduced it by 14%, Pocock et al. (1996) says that the performance of the project is not improving significantly after a certain degree of interaction.

Complexity and coordination brings with them communication, no one in the industry of construction would deny nowadays that effective communication is a crucial factor for the final project success in terms of the team and the outcome (Emmitt and Gorse, 2003; Dainty et al., 2006). Communication is a complex and dynamic practice that constructs and is constructed by humans, using technical and semiotic tools (Fairclough, 1992, 2003; Scollon, 1998).

Construction projects have a fragmented nature and many stakeholders, because of this there is a high demand of mediators of the information and on the mediating tools used (Emmitt and Gorse, 2003). Communication in construction is diverse and inherently complex, it involves different dimensions on individual, group and organizational level: not only does it involve the transfer of information, but also it bridges distances, is the basis of interaction between people, and conveys feelings, values and beliefs (Dainty et al., 2006). Dainty et al. (2006) highlight that effective communication only works in the interpersonal level, through discursive practices, working together for understand the problem, the actions taken and the procedures. However, the most of the attention has been paid to improve the performance of the construction project by improving processes and products rather than study the constraints of organizational culture and human relationships on the communication (Emmitt and Gorse, 2003).

Project's staff must agree, Gorse and Emmitt (2003) have discussed that the mismatch between the manager's intention and the non-enactment of the employees may be the inability of both parties to link the task-orientation in the construction site and the socioemotional interaction elicited by the firm. Furthermore, environmental facts are often a subject to tensions between the long-term intentions of managers and the short-term needs for the project's tasks (Labuschagne and Brent, 2005).

Talks and actions are related, and both construct and keep the organizational structure, social practices and contractual arrangements. When these interactions appear is when information may be appropriated, the information must be internalized by the staff and consequently act according to that. In order to facilitate the appropriate information, the requirement of competent mediators and effective tools. The tools, the situations and the different perspective are already constructed and these resources are available (Lave and Wenger, 1991; Wertsch, 1998, Gluch and Räsänen, 2009).

The implications of this is that the unit of study cannot just the actors, social contexts or mediating tools. Communication needs to be viewed as a social fact that involves the interaction of participants, contexts, semiotic systems, tools and technologies (Gluch and Räsänen, 2009). The new technology does not always bring with him the new knowledge, the information shared must be aligned with the company politics and problems.

Interaction and so coordination, takes place through socially recognized types of communicative action, genres, arrangements, meetings, errors, which are habitually enacted by members of an organization. Patrashkova- Volzdoska et al. (2003) found that too much communication did not necessarily bring a better performance, but actually it could impede it.

Six critical communication variables are identified by Thomas et al. (1998), these affect project's performances. Two of them were related to the quality of coordination methods: information accuracy and procedure effectiveness. Also Maltz (2000) talks about four dimension of information quality. Three of them were related with the quality of coordination methods: credibility, comprehensibility, and relevance. Finally, Low and Mohr (2001) similarly divided information quality into four categories: relevance, accuracy, reliability, and timeliness.

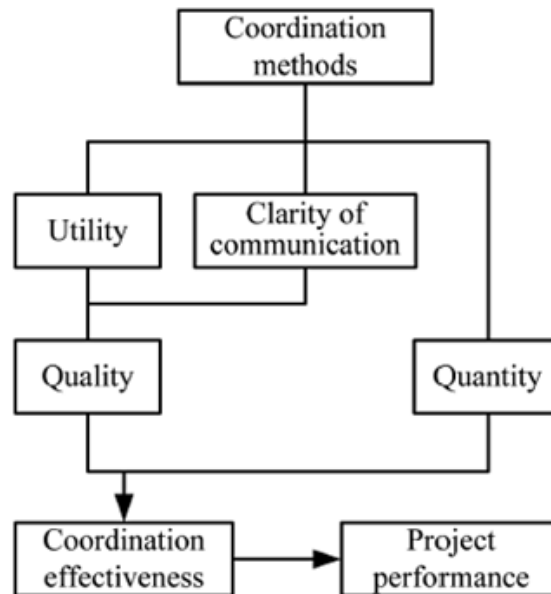


Illustration 14: Coordination-Communication (Change and Shen, 2014)

Describing the terms of Illustration: Coordination effectiveness talks about how effectively a coordination method is used for finishing work. It includes the quantity and the quality of a coordination method. Coordination quality refers to the utility of a measure and the utility of communication between the actors using the method, it also refers to the amount of communication used in the method and can be used to use the rate of use. Further information will be given in the next chapter.

Construction projects as seen before are complex, and the fast transition of information is fundamental for the proper development of the plan, bring closer the different parts and actors of the project will speed up the different processes. Centrality measures the degree of closeness, in a social sense, centrality refers to the potential importance influence and prominence of an actor in a particular network, in this case, the construction project (Freeman, 1979; Borgatti et al.,2002). So, the coordination in a project, can be identify by the importance, prominence and influence of an actor (Hossain L., 2008).

Centrality can be measure according to Freeman (1979) by three main factors that will reveal how centrality affects group processes, these three factors are degree, betweenness and closeness. Betweenness is how the two concepts relates to each other

in the shortest path. Closeness shows the distance between one point and the others. Finally, degree shows the potential importance of an activity in the network.

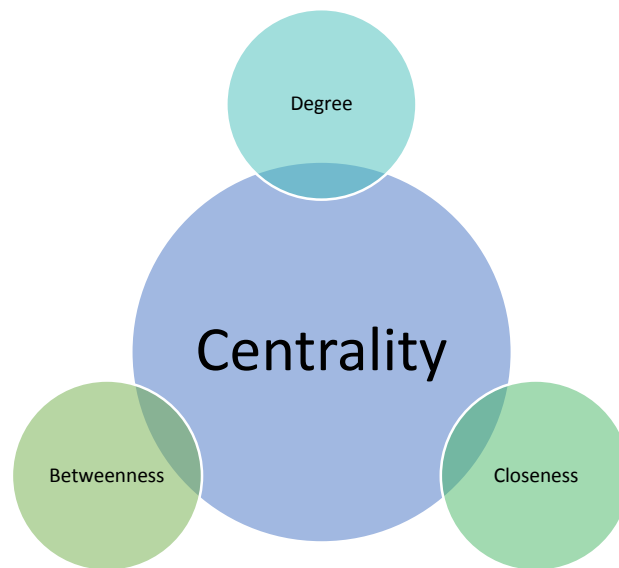


Ilustración 15: Centrality

2.7.3 Managerial skills

Managers play an important role in the project's final success, and several factors affect their performance, in a sector like the construction, a small difference could set the difference for getting a competitive advantage. It's been point out that a good manager could improve the project's performance in a 5% (Simms A., 1984). The performance of a manager is more likely to endure if the manager's personal characteristics match with the requirements of the position (Mumford et al., 2000).

The profile of the project managers has been found a useful way to identify the success, profiling aims to identify the combination of behavioral, emotional temperamental and mental attributes. Profiling is useful to identify candidates or explain failure or success in a project (Müller R. and Turner R., 2009). Following a study of Dulewicz and Higgs (2003) identify and relates managerial skills and managerial styles.

| Group | Competency | Goal oriented | Involving | Engaging |
|-------------------|---------------------------------|---------------|-----------|----------|
| Intellectual (IQ) | 1. Critical analysis & judgment | High | Medium | Medium |
| | 2. Vision and imagination | High | High | Medium |
| | 3. Strategic perspective | High | Medium | Medium |
| Managerial (MQ) | 4. Engaging communication | Medium | Medium | High |
| | 5. Managing resources | High | Medium | Low |
| | 6. Empowering | Low | Medium | High |
| | 7. Developing | Medium | Medium | High |
| Emotional (EQ) | 8. Achieving | High | Medium | Medium |
| | 9. Self-awareness | Medium | High | High |
| | 10. Emotional resilience | High | High | High |
| | 11. Motivation | High | High | High |
| | 12. Sensitivity | Medium | Medium | High |
| | 13. Influence | Medium | High | High |
| | 14. Intuitiveness | Medium | Medium | High |
| | 15. Conscientiousness | High | High | High |

Illustration 16: Fifteen leadership competencies and three managerial styles (Dulewicz and Higgs (2003))

The skills are divided in three groups, the Intellectual capabilities of the manager, the Managerial ones and finally the emotional ones, and we can see the different importance of them according to the managerial style. The involving style is a style for organizations that suffering a significant transformation. Engaging style is based on involvement and empowerment in changing environments, these leaders produce changes with the engagement and commitment. Finally, the goal oriented style is focused on deliveries in a stable context (Müller R. and Turner R., 2009).

Every kind of projects has a project manager that fits better with it, and will affect the final result of the project. Project success is not a fixed target, the understanding of what is project success changes. Several approaches have been done in order to suggest the best way to face the managerial style, Wateridge (1995) explained that project manager must identify the success criteria first, and then identify the factors that will help them, with their respective tools and techniques. Cooke-Davies (2002) don't identify projects

manager’s competence as success criteria, but they focus on risk management, program and portfolio management.

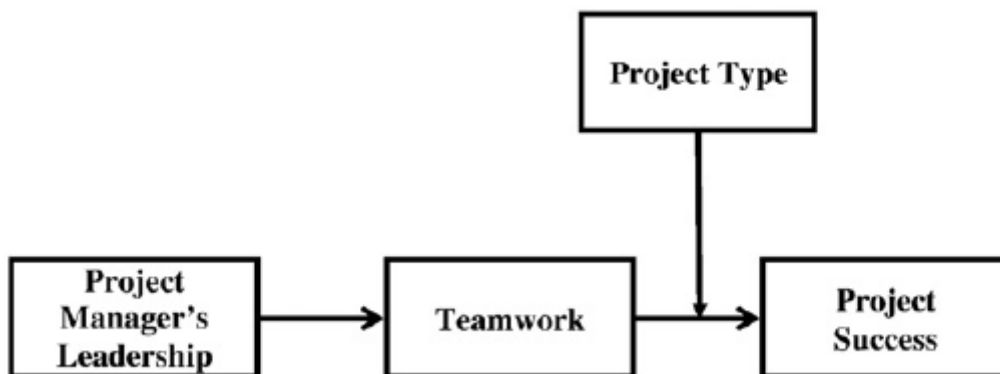


Illustration 17: Leadership (Yang et al. (2010))

Leadership is becoming a critical factor, even though there are no empirical data, the benefits of project manager’s leadership style are tangible and real. Leadership style affect teamwork, in terms of collaboration, communication and commitment. A proper environment in the team will help on getting the project success, and work in a more efficient way. Finally, the project type is related with the procedures that have to be taken in the team for getting the success, a survey made by Yang, Huang and Wu (2010) reveals the association between the team collaboration and other aspects of the project.

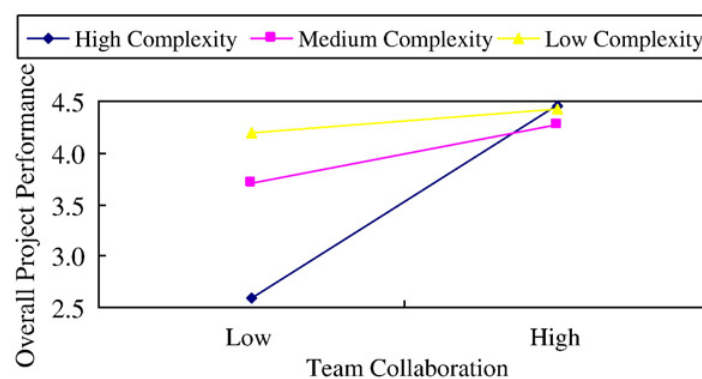


Illustration 18: Complexity-Collaboration

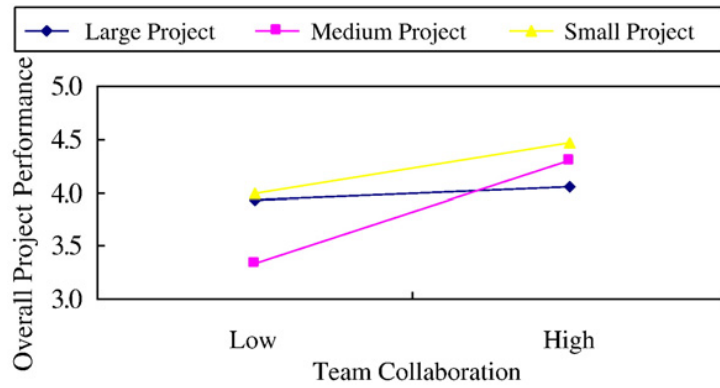


Illustration 19: Project Size-Collaboration

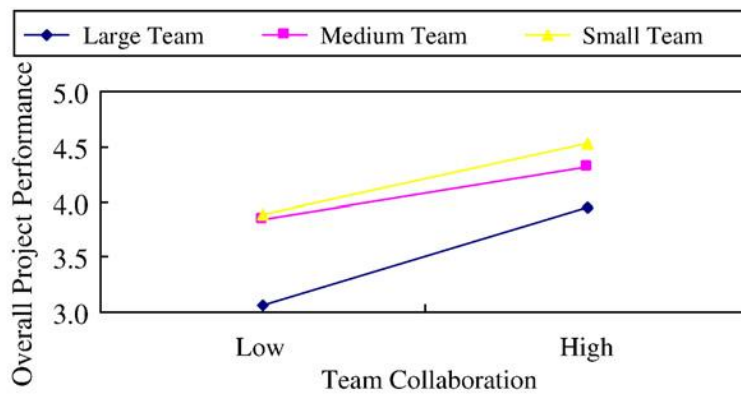


Illustration 20: Team Size-Collaboration

As can be seen the most critical factor of the study was the project complexity, as higher complexity higher collaboration is needed, this collaboration is most likely to appear in a good work environment, the final responsibility for this environment is the project manager.

2.8 Summary of the Chapter

Bottlenecks and time-thieves are considered one of the main issues that affect the final time of the project. Bottlenecks are those elements that constraint the processes inside the projects, and time-thieves are those elements that add time to the project and are considered useless for the performance of the projects.

Different bottlenecks and time-thieves have been identified in Norway, decision issues are those problems related with the decision making process, these decisions are influenced by other actors of the project, and other issues that affect is the managerial abilities, what are the procedures that the manager follows in order to take a decision. The relationship that the manager has with the owner of the project is also a source of delays, not sharing all the information because of own interest and maximize the benefits of the project for each part is a factor that affects the final outcome of the project. There are also errors due to the lack of information, the projects are not properly defined and some errors incur to an increase of the resources and so of the final time of the project. Manage the materials properly also increase the performance of the project, have the materials on time can set a relevant difference in the final time of the project.

Finally, there are to other bottlenecks and time-thieves that are considered of big relevance in the case company, bureaucracy and administration is consider to be one of the biggest time-thieves, paperwork and waiting because of legal procedures slows the project and stops the project. The manager's abilities and the way they coordinate the projects play an important role in the final outcome of the project, the managers have to coordinate the projects in the construction site, subcontractors and staff must be aware the whole time of their duties, good communication is crucial for that, establish effective procedures make the projects faster, because the duties are defined better. The training of the manager is important in order to improve the performance.

3. Dealing with bottlenecks and time-thieves

Different measures are being taken in order to manage the different bottlenecks and time-thieves, in order to deal with the research question number 3 a survey is going to be done in order to identify what are people doing and then compare these measures with the ones applied by the company and try to optimize them.

As has been seen in the previous chapter, several causes lead to bottlenecks and time-thieves, between them we have three main causes that affect more than one time-optimizable, they are: Uncertainty, Communication and Managerial activities. Furthermore, we have the ones that affect just one of them, these one are: Material Management and Poor site coordination.

3.1 Reducing Uncertainty

Uncertainty plays an important role in two of the studied bottlenecks. On one side, we have the problem with the uncertainty in the decision process, when a decision is taken, all the possibilities should be studied in order to see if there is a better one or not, this decision taken with lack of information may also lead to a waste of time if the decision is wrong, as have seen in the chapter 2.5.1 bad decisions could lead to errors, that not only will slow down one activity but also could lead to the appearance of another, that will need more resources and so, time and money.

Several measure can be taken in order to reduce the uncertainty and so, have a plan that fits better with the reality:

Hiring experts of the topic that we are working on: it has been point out that good managers can reduce a 5% the project performance, but if we do not have the right experience, a way to reduce uncertainty is asking someone that is an expert on the topic,

so he can provide the project with his ideas and experiences. project schedule performance can be improved by joint working (Suprpto et al., 2014).

Comparing our project with other similar project, of course every project is different and unique, but some things could be in common between one and others, for example the stakeholders, how another project has deal with them could be interesting to avoid future projects. The market leader could also be a source of information, by comparing his procedures with ours.

Uncertainty as seen above could lead to non-predicted resources, in order to deal with it Lee et al. (2006) pointed out the need of contingency, a project plan made with some extra time and money could prevent some disagreements with the owner or the different stakeholders, for example: a late time delivery could be managed it, also a conflict between the owner and a client could be avoided when more money is needed.

As mentioned above, project schedule could be improved by different methods, even though all the information is not available, if a good project schedule is made, sometime will be saved because all the project will be thought and some problems could be predicted.

In order to schedule the project, CPM techniques are the main tools used, an example of these tools are: PERT, Gantt and CPM.

Construction managers have been found to be reluctant to follow the CPN schedules that their head office send them because they found them as merely 'theoretical' (Greenwood and Gledson (2012). Mawdesley et al. (1997) suggested that these discrepancies are due to the fact that when formulating the assumption that all the resources will be on time, is made. Conventionally when using the CPN some assumptions are made, the resources are considered available and the resources need of each activity is underestimated.

To overcome these problems and so make this CPN methods useful, further actions are taken in order to adjust the schedules. The update of the CPN on the construction site, will help to guide the further steps, although is an extra effort, have a useful CPN has been point out as a sources of time reduction, and will help to prevent further mistakes and take next steps.

Several studies and surveys have been done in this problem, when using this method, the time constraint is the most important factor, but also Gibson (2009) identify that integrated project teams, the good selection of contractors and finally ensuring that enough efforts are taken on the planning phase, will help to reduce the problem and make a reliable CPN.

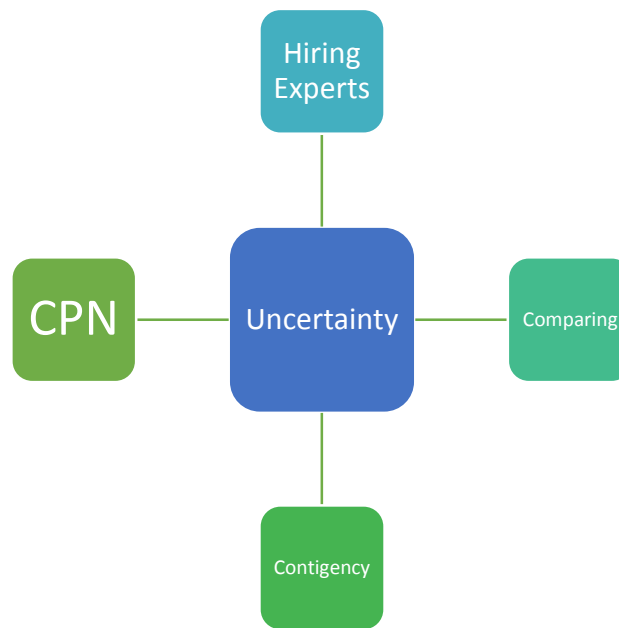


Illustration 21: Dealing with Uncertainty

3.2 Improving Communication-Coordination

Inefficient communication has been point out as an issue in several parts of the project, the nature of this problems change, sometimes is because own interest when it comes to the relationship of the owner and the client, sometimes is because the project's staff is not well informed about what they have to do, and others is because of the contractor is not aware of the time necessities.

But not also time improves can be done by improving the communication, Suprpto et al. (2014) pointed out that an open and effective communication can improve the cost performance. The fluency of the project is affect by these inconveniences and several measures can be taken in order to avoid them.

As seen in the previous chapter, communication and coordination have a very tight, because of that following we will face the problem of both together and assuming that, a good communication system will improve the coordination among the parties.

Projects, as said before are unique and complex, and so several activities are being done at the same time, because of that Hossain (2009) established and divided the coordination process in four main branches with some solutions to face them:

1. Managing shared resources
 - Personal instruction to a person for a particular task, or suggest someone capable for an especial task.
2. Managing producer–consumer relationships
 - Dissemination and creation of useful and tangible information.
3. Managing simultaneity constraints
 - Synchronize actors in order to work in several activities at the same time
 - Taking possible times for an event.
 - Set a particular day for an event.
 - Split the information about the time of an event.
4. Managing task/subtask dependencies
 - Planning tasks and strategy to achieve a higher-level overall goal.

Once we have seen the different areas where actions can be taken in order to improve the project's coordination, ASCE (2000) proposed 13 particular methods in order to achieve the coordination of a project.

- | | |
|---|---|
| (1) clear definition of the owner's project objectives, | (8) distribution and review of field reports and lab tests, |
| (2) coordination procedures, | (9) joint visits to work sites, |
| (3) schedules, | (10) formal compliance reporting, |
| (4) budgets, | (11) procedures for reporting discrepancies, |
| (5) written contract clarifications, | (12) change order procedures, |
| (6) progress reports, | (13) coordination meetings. |
| (7) joint reviews of documents, | |

Several conclusions and data have been found when measuring the coordination methods, Kuprenas (2003) found that the design phase could be reduced 35% if one or more team meetings are made monthly, and issuing status reports improves the performance in a 14%.

Once we have seen the methods of improving the coordination of the project, is time to face the communication, as we can observe some of the coordination methods involve meetings, reports or visits, the need of fluent communication is patent. Because of that Chang and Shen (2014) purpose and evaluate eight communication issues:

1. Meetings: Face-to-face meetings, including coordination meetings (13), are useful for exchanging ideas, purpose measures, update the staff and make the things easier.
2. Informal discussions: Informal conversations, conducted either face to face or by telephone, are used to deal with emergencies, last-time issues and exchange opinions in a private conversation.
3. Site visits: Visits to the site, including joint visits (9), are useful to stay close to the project, see the progress and act fast if a problem appears, also inspections are needed in terms of quality and safety.
4. Written correspondence: Letters and memos, including written contract clarifications (5), and field reports (8), are used to stablish the formal procedures and exchange information between the parties.
5. Plans and procedures: Plans and procedures are written or used by engineers to plan and guide implementation. They include those required by the owner or proposed by the contractor. They also include project objectives (1), coordination procedures (2), budgets (4), procedures for reporting discrepancies (11), and change order procedures (12).

6. Schedules: Schedules (3) are prepared and updated by engineers' day to day in order to control the progress and check the information.
7. Reports: Reports are written by engineers to review and document the quality of the work in a specified task of the project, are useful for sharing information, these include progress reports (6) and compliance reports (10).
8. Contract documents: Contract documents include contract articles, drawings, and specifications given by owners to engineers used to specify the rights and obligations. Their stipulations must be followed and requirements must be met.

All these communicational aspects are critical, and the performance of each one of them should be controlled, reviewed and changed if needed. A bad performance of meetings could lead to waste of time of resources as in each one of them. Following the survey made by Chang and Shen (2014) could be observed.

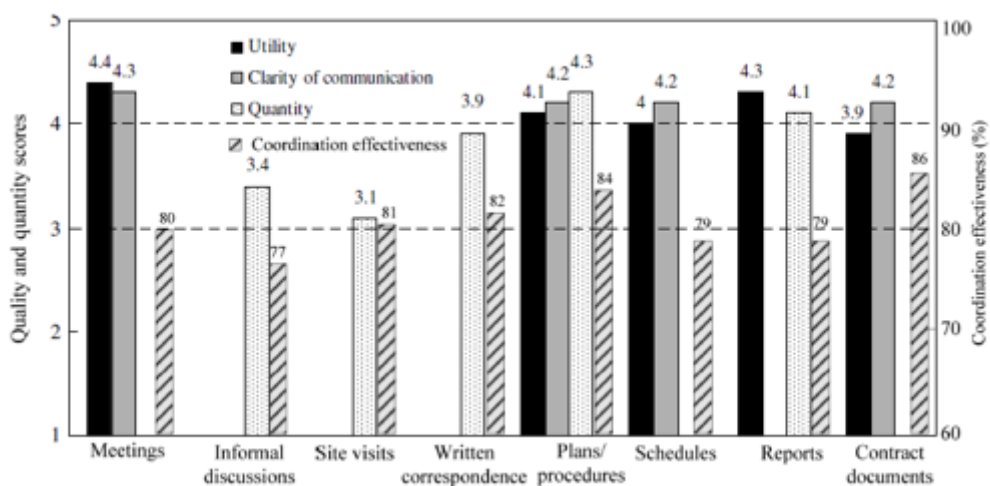


Illustration 22: Quality, Quantity and effectiveness of communication methods

As observed, informal discussions, written correspondence and site visits cannot have a measure of how useful they are, but site visits have been found important for the

coordination effectiveness. On the other hand, we can see how meetings are really useful and the clarity of the information is high. All the measurable elements have been found useful for the proper development of the project, is important to point out that the plans and procedures are the factor that influences the most the effectiveness of the coordination.

3.3 Material Delivery Problems

Have the resources on time and with the proper conditions and quality is a critical factor for the final time of the project, as seen the CPN methods use a basis that all the resources will be available when needed, but in the real construction this does not happen so often. A survey made by Ala-Risku and Kärkkäinen (2005) shows that late materials and lack of quality of them account for 8-25% of the non-completed tasks.

Last Planner method is a method made to deal with that problem, that allows materials to be on time where needed based on previous explanations.

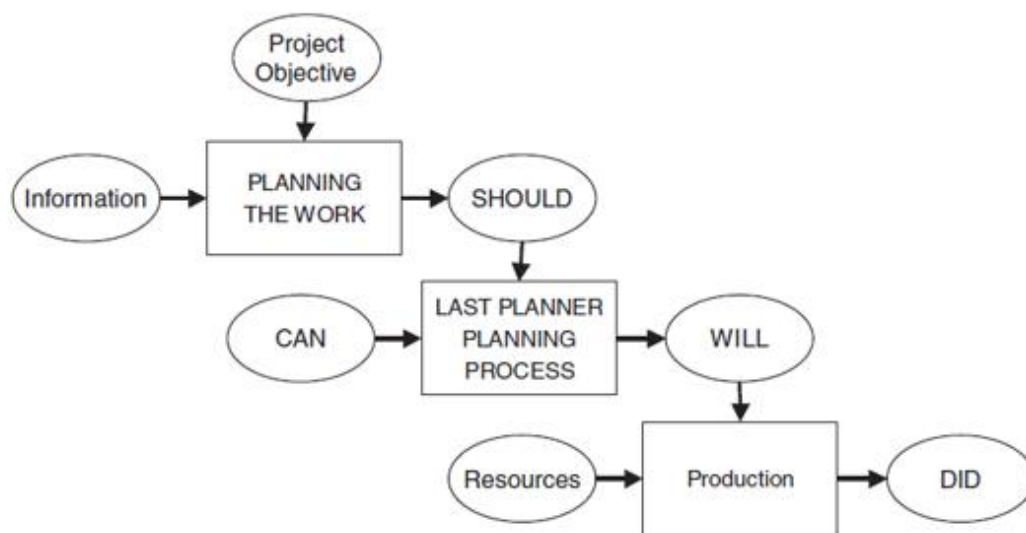


Illustration 23: Last Planner System (Ballard 2000)

In order to make the proper framework for the Last Planner System, is important to know that the project's task can be divided in four main categories, as seen in the Illustration 23.

- SHOULD: tasks that according to the project plan, have to be performed in the near future.
- CAN: tasks that are ready to start, have all their resources and prerequisites ready.
- WILL: tasks that are commenced before the next one.
- DID: tasks that are already completed.

Once the Last Planner Planning is identified as the intersection between the should and the can, and will lead to the will, is important to distinguish between two different material flow management. First, the method needs to have full information about the materials needed and available for project task; and second, the materials should be available with trust and without a big inventory in the construction site.

The main challenge when managing the last planner is the availability of the materials, due to the inventory control method, have a big inventory in the construction site could lead to loses in terms of money, because of deterioration of the material, security and facilities for the storage. Project materials are often ordered well in advance.

The last planner needs to be aware of all the future necessities of materials in order to avoid possible constraints in future tasks.

The uniqueness of the project makes this method more challenging, the supply chains are independent for one project to the other and once the project is finished they are disbanded (Dainty et al., 2001). The method has result useful in the long-term commitment, which is needed for the most information technology development projects (Voordijk, 1999).

Tracking the deliveries and because of that have a good on-time inventory has been found a solution for dealing with the problem.

3.4 Stakeholders

When dealing with this topic a wide range of things is going to take into account, on one hand the managerial abilities and how the managers affect the project, and on the other the relation between the owner, the client and the suppliers.

3.4.1 Stakeholder relationship

The relationship between the different stakeholders has been found a source of problems all along the project's life, self-interest among others is one of the main reasons of that problem, as seen in the previous part, an improvement on the communication will improve the relationship and will finish with the problem known of the asymmetric information, but when dealing with the relationship between them the main problems has been found in the trust and the commitment between one and the others.

Short-term deals imply with them lack of commitment and then trust, when building a prosper relationship in order to improve the performance in the projects, long-terms deals are needed, not just the improvement of the project performance by the delivery of the materials on time and with the quality needed, the final delivery of the project on time and in budget, but also because trust and commitment will help to create a better work atmosphere, with the consequent freedom to all of the participant to participate freely and so have another points of view and alternatives.

The creation of long-term deals has been found one of the biggest factors that improve the projects performance, parties that work under this terms are happier and work in a more efficient way.

3.4.2 Managerial abilities

It has been pointed out that the leadership style affects to the performance of the project, project manager's abilities should fit with the requirements of the project in order to increase the probability of success, the duty of the leader is to create a good environmental and encourage all the team members to develop the work as good as they can, Yang and others (2010) found that project manager's leadership capabilities are correlated with the teamwork and at the same time is related with the project success as seen in the illustration 17.

Müller and Turner (2010) found out that for construction projects, goal oriented leadership style as well as Involving and Engaging have the same relevance. The Intellect of the leader is not the most important factor, of course is important but leadership competencies should be taken into account, they conclude that project's manager training and development should focus in the development of leadership competencies, not only in the technical skills.

Müller and Turner (2010) suggest a five process in order to improve the project performance

1. Recognize and evaluate the projects, and then match the projects with the better leadership style
2. Asses the managers about the leadership styles. Tools such as Leadership Development Questionnaire (LDQ), developed at Henley Management College, UK, by Dulewicz and Higgs (2005).
3. By training and experience are useful weapons to achieve the development of the leadership areas in accordance with successful managers
4. Where the organization undertakes several types of project, then the profiles of individual project managers needs to be maintained centrally and appropriate
5. Evaluate the project's outcome

3.5 Summary of the Chapter

Four different type of measures have been identified in order to deal with the bottlenecks and time-thieves, these group of measures point out the close relation between the different bottlenecks and time-thieves.

Measures to reduce the uncertainty, uncertainty has been found as problem in different bottlenecks and time-thieves such as, the decision making process, the relation with the owner, errors that incur to an increase of resources. In order to reduce uncertainty several measures can be taken, hire experts is important specially in the design phases, compare your procedures with others could be useful for avoid errors, the use of contingency plans is also important for limit the consequences of the uncertainties, at last but not at least CPN methods are important to have a tracking of the project and foreseen future problems.

Measures to avoid the problems of communication and coordination, coordination can be improved by different methods, is a complex issue and there several ways to improve them, the manager should be aware of all of them and stablish an efficient report methodology. Coordination and communication have a very close relation; communication is crucial in order to improve the communication of the project, for improving the communication some procedures have been identified, like meetings, writings and reports, but what is considered more relevant is to make them useful, some of these procedures are considered a waste of time, and the proper plan in hands of the manager is relevant for improving the communication.

Material delivery problems can be limited in terms of frequency if a good plan is developed, in order to do that the Last Planner Procedures are born, these method is based on the foreseen of all the materials that are going to be needed for a task in the project, tracking the deliveries and have an accurate time of delivery are important to the success of this method.

Finally, another source of measures to be done is in order to deal with the stakeholders, the different stakeholders of the project play an important role in the final outcome of the project, in terms of quality, time and money. Keep a good relation with the owner will make the things easier and faster, and trust in the subcontractors will lead to

improvements also, because of that managers should try to have a professional and cordial relationship with the stakeholders.

But managers not only have to be aware of others, but also to themselves. The company and the managers have to know that their performance is very important in the final outcome of the project. The abilities of the manager will foresee future errors, and predict some problems that will have during the projects, experience cannot be given but a good training can help.

4. Methodology

This chapter aims to describe the process done during the development of the thesis, from the decision of the topic to the final analysis of the results and the finding of the conclusions, indicating the research theories supporting the process. The chapter will be divided in the steps taken, outlining the references needed. The selection of the method and the reasons why, will be explained and so, the consequences of this.

4.1 Purpose of the project

First of all, and before going through the development of the thesis, is important to know the academic reason behind this thesis, and so the set of the boundaries for the project. This Thesis represents the final project for completing the Master of Industrial Engineering of the Univesitat Politecnica de Valencia (UPV), the development of the project has been done in the Norwegian University of Science and Technology (NTNU) with the help of the program of exchange of study ERASMUS. The thesis is done in the department of Production and Quality (IPK), and is simultaneously carried out with the SpeedUp project at SINTEF. This program aims to reduce the overall time in construction projects by 30-50% by sorting out the causes of delay and developing strategical and tactical measures in order to deal with them. This thesis means 30 ECTS and so, a time limit of 20 weeks for its completion.

4.2 Choosing and developing the topic

Once the reasons for the development of the thesis are known, the selection of a topic was done after contacting with different professors and reading about the several topic and fields of study available, one of my areas of interest was how to improve the

efficiency of the project, so after all the first contacts, my supervisor explained my about SpeedUp, that reflects perfectly my areas of interest of improving efficiency of projects, in this case construction project. As a consequence, and because of the size of SpeedUp a further selection had to be done.

After some time studying and gathering information about the 13 topics that SpeedUp involves, some meetings with supervisors of the department and SINTEF were done, in order to gather some ideas that turned to be really interesting and useful for the development of the final thesis. After getting a main ideas of the topics, the possibilities of them, and my own interest, bottlenecks and time-thieves were selected as a main topic of research for the thesis, because of several reasons. The lack of further research in the topic was interesting and opens a wide range of possibilities, the several bottlenecks and time-thieves are really different between them and have different nature which implies variety when studying them, and finally and no for this less important the bottlenecks and time-thieve fits perfectly with my areas of interest because are about managing your resources in the best way possible as so, improving the relationships between the stakeholders, are a good way for joining the engineering and the human relationships.

Once the bottleneck and time-thieves were selected my field of research, a final decision needed to be done in order to reduce the scope of the project, because study all of them will be unmanageable. The final decision came after meeting with different researches of SINTEF that help me to choose a particular case of study, after I came up to my supervisor with the topic, and because of the possibility of doing interviews with different project managers and employees of the construction industry in Spain, the final topic of comparing the two countries came up. The purpose of the topic was going to be, identify the biggest bottlenecks and time-thieves in the case company, compare them with the ones that are identified in Norway, and purpose measures in order to deal with them.

But after studying the different surveys made by the NTNU, I realized that there were too many bottlenecks and time-thieves identified, and a study of all of them for trying to get more information for the interviews was going to be impossible, because of the time scope of the thesis. Then after a first contact with the case company, I choose

between all the time-optimizable identified the ones that have more importance in Norway, a selection of 5 time-optimizable was done.

As interviews were going to be done, and in order to be ready for them and have a background in the topic for studying and purposing measures to deal with them, a theoretical study of all the chosen topics was done. The study aimed to give a background, in order to ask the right questions in the interviews, and try to sort out the nature of the topics, identifying the main reason behind them. Database, books and articles were used in order to gather the information, and after a summary was done and presented in previous chapters of the thesis.

According to the purpose of the thesis, the theoretical study was done following to main branches, the first one was, as said study the time-optimizable, and the second one was, once identified the main reasons that cause delay in the final time of the project, they were grouped in four main causes, and because the thesis aims to give measures to the company, this delay reasons were study in order to know how they were dealing with them nowadays, see the current tools and theories in order to face them.

4.3 Research Classification

Based on the objectives of the topic and the limitations that are described above. I described and purpose three research questions, in order to face the problem and dived the information and the efforts.

1. What are the main time thieves and bottlenecks in the case company? Are the same in every project?
2. Are this bottlenecks and time-thieves different from the ones that we found in Norway?

3. Which measures are they applying in order to deal with them?

The first question is the main axis for the future development of the thesis because, once the study company is studied, and so question 1 is answered the questions 2 and three can be faced. Questions 1 and 2 try to deal with the comparison between Norway and Spain, sort out the similarities and differences and try to discover why.

On the other hand, questions 1 and 3 try to deal with the time-optimizable by studying the measures in order to deal with them, identify what are doing in the case company and what is being done in other places.

The research tries to describe the phenomenon of the bottlenecks and time-thieves, and also point out in an objective way the correlations between Spain and Norway, and finally describe the measures used in the company and the ones used in the theory. In order to face this problems and deal with the problem, the qualitative research has been chosen as a method of study.

When choosing the way of getting the data for the further development, two main research designs can be chosen. On one side we have the quantitative research, based on the paradigm of the positivism, the data can just be evaluated in one objective way, are more structured and a big quantity of data is needed in order to have a reliable base. The reason why I didn't follow this branch is because the access to a big amount quantity of data was not possible. This method implies that the researcher cannot have influence in the survey and his/her opinion will not be reflected.

The other side of the research methods is the qualitative research, the one that I've chosen for the thesis, this methodology is based on the paradigm of the interpretation and so, the subjectivism, the opinion and the point of view is present the whole time because he/she is the one that does the interviews and structure them, so it is more easy to find the information that the researcher is looking for. In order to deal with the qualitative method, the interview is used as a tool, because a freedom is allowed for trying to get the information needed, or interpret the word of the interviewed.

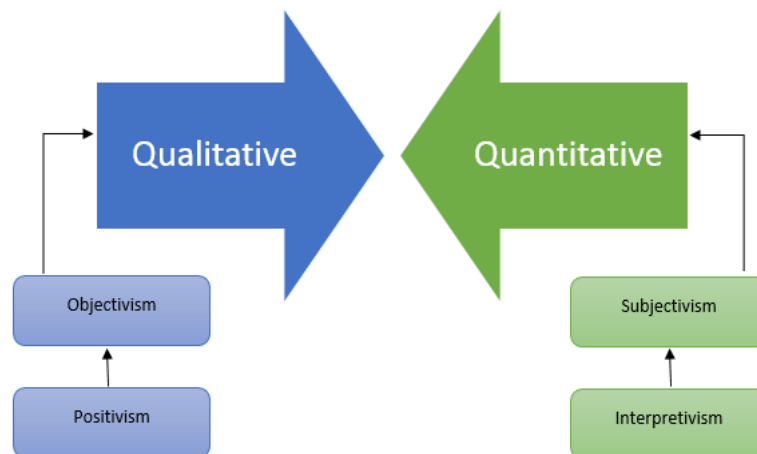


Illustration 24: Qualitative vs Quantitative based on (Haji-Kasemi, 2015, Kumar, 2011)

4.4 Qualitative methodology and procedures

The objective of the thesis is found out new correlations between the procedures in Spain and Norway, in order to do so, interview is one of the most important methods in the qualitative data collection, not only because the data obtained in the interview, but also because the interviewer has to have a theoretical background in order to face properly the interview (Qu S.Q., Dumay J. 2011).

This thesis implies to main steps in the methodology, the first part is, gather all the information needed in order to get the theoretical background. The second one is the interview part, in order to get the useful data to answer the research questions.

When getting the theoretical background several methodologies have been proposed, the one that I choose is the one proposed by Crawford and other in 2006, this method consist on getting the articles from the database, in order to do so, a first search must be done with the keywords of the topic that has to be studied, in my case, I use as keywords the different names of the time-optimizable studied, once the first search is done, a lot of articles appear and in order to reduce the number of them, a first read is done to the abstract of the article, once we have reduced the number of articles a further read should be done, this case with the conclusion or the introduction, after this

second read the number of articles for each topic was reduced to five-six main articles that were the base for the development of the survey.

Once the theoretical background is achieved, I go to the interviews with enough knowledge to get the proper information, several theories and tips are done in order to make an interview and get the maximum information. In this thesis and because the type of study, I chose the non-structured interview, this interview is characterized by the non-fixed sequence of questions, the questions were prefixed but their sequence was deference according to the development of the interview, this kind of interviews are flexible and improve the adaptation to the interview (Ruiz Garzon F.). The questions were written first and not improvised for not skipping any important topic.

The difficulties for getting enough project managers for doing face-to-face interviews, reduce the final number of interviewed to five, this five project managers, where the managers of five constructions projects done in Spain, in different years, with different budget and unique conditions, this five projects studied give significant information in order to get conclusion and identify the different bottlenecks and time-thieves that they found in the projects. The name of the company and of the project managers will remain anonymous, and each some of them participate in others and also gave their opinion, not only as project manager but also as part of the project's staff.

In order to prepare the interviews, the objectives need to fit inside the interview plan, and also they have to be coherent with the global objectives of the survey (Flick,2004) The questions to ask where written when going throw the literature, and after everything was written, a read of all the theory of the thesis was done in order to make the final list of questions. When doing the interview, several facts were considered:

The first set of questions are easy and the interviewed has to feel comfortable, in this way the conversation can start in a more informal way, creating a trusty environment and making the dialogues flow, the best way to star is introduce our selves and make a brief explanation of the ongoing research (Flick, 2004; Arnal et al., 1995).

During the interview, make a summary of the meaning of the questions, in this way the interviewed can add some details and some mistakes can be corrected (Arnal et al., 1995).

When doing the interview guide, the fact that the interviewed has to talk widely about the topics has to be considered, the questions must be asked in the right order, Yes/No questions have to be avoided (Acervo E.G., 2007). As a summary Acervo (2007) make a table for the realization of the interviewed.

| | |
|-----------------------------|---|
| Avoid close questions | Those which answer is Yes/No |
| Don't induce the answer | Don't show your position or opinion during the question, or the interview |
| Don't assume academic terms | Use easy language |
| Switch questions | Take into account the level of the question and alternate them |

Illustration 25: Question guide tips

When everything is planned and the interview takes place there are several facts that affect his development: the correct plan and the correct development of the questions, the nature of the study, the interviewer experience, the personal characteristics of the interviewed and external factors (Acervo E.G., 2007).

Acervo (2007) is his guide for doing an interview also proposes some tips in order to make easier and more profitable the interview:

| | |
|-----------------------------------|--|
| Don't stay with the questionnaire | Must be used as a guide, in an informal way. |
| Create a friendly environment | A friendly context helps not only to the interviewed, but also to the interviewer. |
| Don't forget the roles | Make sure that the interviewer is the one that ask, and the interviewed the one that replies. |
| Don't interrupt | Give the interviewed the right time to think and give the answer. |
| Re-asking capacity | Pay attention to the interviewed words, and make sure that everything is understood, or ask some further questions that are not included in the questionnaire. |

| | |
|--------------------------|--|
| Use transition sentences | Before changing the topic, is useful to make transition sentences to make sure that the interviewed is on the topic. |
| Observations | The non-verbal communication also plays an important role in the development of the interview |

Illustration 26: Interview tips

After the realization of the interviews, the results of the interview must be analyzed and see if the results fit with the initial plan, have a look at the interview is useful for:

- Check the initial hypothesis, see if they are right or wrong
- Check if the searched information has been found
- See if there are new topic to face and new dimensions in the interview
- Use it as experience for the future interviews, learn from the mistakes

The transcript of the data is a step almost as important as the realization of the interview itself, there are some tips written by Taylor and Bogdan (1996) of the one that they proposed I have adopted some of them for my interviews and transcripts, the realization of diagrams for explaining some aspects, take notes during the interview to make sure that the information is reliable, and finally when the interview is finished I went through the transcripts for seeing if I understand everything and add something if needed, while the information is fresh in your head is useful to rewrite some aspect that could remain unclear (López Estrada R.E. and Deslauriers J-P. 2011)

Once every interview was done according the previous tips and advices, the results of all of them were analyzed as a whole, and the result of this analysis is presented in the next chapters.

4.5 Data validity and analysis

It is important to know that I have the occasion of going to two of the studied projects, one of them was already finished, but the manager explained me some issues and the other was about to finish so I was able to see some procedures and developments in the construction site.

Once all the information was available, was time for checking the value of the data and analyze the interviews, the first thing I do was to group all the topics of the different managers, in this way I could have all the information related to each topic closer, I read all of the interviews and the conclusions were coming, the things that all the managers had in common were taken as conclusion and the differences were also considered and studied as important. It is important to know that not all the managers identify the same bottlenecks and time-thieves but when asking them about others, the issues came out, so a further study in the interviews was need in order to identify these hide aspects.

In order to make sure that the research was useful and that the conclusions taken were actually real, a comparison between the interviews and the reality was done, as can be read in chapter 7, in this way I wanted to make sure that the things that I found were actually real and that the theory and the practice are similar, but there are some aspects that are difficult to overcome.

The results of the thesis could be interesting and applicable to other companies and projects of the same company. In terms of projects inside the company the results found in the research could be useful to have a perception about the problems that other managers are having and what are they doing in order to reduce the impact of the bottlenecks and time-thieves, compare the procedures of other managers to your own could be a good way to increase the performance of the project.

Referring to the use of the findings by other companies, even though the procedures of each company could be different and the managers cannot change them because they come from the company, the managers can have a look at what is going on in other companies, it is interesting to know and compare the different bottlenecks and time-thieves to see if they are different and observe their what you are doing wrong and if

there are any measure that the company is not applying and could be important in terms of increase the efficiency of the project.

4.6 Ethical considerations

Doing the interviews to project managers involves some ethical considerations, some confidentiality was kept during the interviews when giving examples or explaining some concepts, that information has a private character, is personal and will remain in private. The interview was to unknown project managers with just a few free time, so I really have to appreciate all the efforts done in order to help me with my research and for sharing with me all the information needed with any kind of issues, the trust that we create was really important for the development of the thesis and the proper data collection. Permission was required when doing the interviews to take note the whole time and ask more private questions, for avoiding errors and make a trustful analysis of the data not only based on the memory. All the confidential data was not written in the transcripts, neither in the thesis.

5. Case Projects

The objective of this chapter is to create the proper framework for the understanding of the projects. The type of contracts will be explained, also the kind of paper that the project manager has, his responsibilities and duties.

Once we have the background for the contracts and the managers a brief description of every project will take place, in this description the budget, time execution, the year and the client will be explained.

5.1 Type of contracts

All the projects studied for the survey as well as all of the projects from the case company have the same characteristics.

The owner, in the case company, the government launch a project, the project only includes the final outcome, the procedures and materials are not specified, the participation on this project is open for all the construction companies, that will send their proposals, including the procedures, the budget and the time that is going to take.

Once all the proposals are evaluated by the owner, they chose the best ones based on the procedures, the time and the money. The winner has now the project, and they are the final responsible of the outcome and up to now they will be the one that have to discuss with the owner all the inconvenient that can come.

5.2 The figure of the project manager

Is important to know for giving the proper relevance to the study that the figure of the project manager is really important, the project manager is the final responsible of the final outcome of the project, and his him the one that has to respond in case something goes wrong.

Because of that is important to point out that his commitment with the project is complete, and he/she will do everything that needed for the proper development of the manager. In all the projects studied, the project manager is the one that comes out with the idea for getting the project, his alternative has been the best among the competitors, he has use all the resources available in order to win the project.

The project manager as the final responsible of the project is the one that choses the suppliers and subcontractors, based on experience and trust, has been pointed out that the most of the suppliers have long-term relationships with the managers, has was showed in previous chapters, the long-term relationships is a good way to improve the performance and reduce the time by creating a commitment relationship between the stakeholders.

Furthermore, all the paperwork is evaluated by the project manager, even though he delegates for some things, he reads carefully all the papers, and he is the one in charge of keeping the relations with the owner, in all the project's studied were government institutions.

Finally, it is important to know that even though the interviews are done for particular projects, the interviewed have a lot of experience in the construction industry in Spain, one of them with more than 30 years, so a lot of the information is given in general terms taking into account all his experience as project manager, all the managers combined have experience in more than 40 projects.

Bottlenecks and time-thieves

5.3 Projects' description

5.3.1 Azud de la Marquesa

Name of the construction: Rebuilding project of the Azud de la Marquesa

Location: Cullera (Valencia)

Client: Confederación Hidrográfica del Júcar

Budget: 8.725.611,91€

Ending year: 2012

Execution time: 22 months

Project's description: The project aims to rebuild the 'Azud de la Marquesa'. The project involves a demolition of the previous azud and the construction of a new one, because of that one of the main challenges was to keep the water flowing during the construction.

Two contention walls were built, in order to prevent the overtopping because of the strong rains. The project also involves the construction of an auxiliary water stream, for further maintenance.

Finally, in order to respect the environment an ecologic channel was built for the fishes and the proper measures were taken in the nearby to restore the initial conditions and respect the natural trees and animals that live there.



Illustration 27: Panoramic view of the azud



Illustration 28: Building the azud



Illustration 29: Azud de la Marquesa

Bottlenecks and time-thieves

5.3.2 Foia del Pou

Name of the construction: Modification of the irrigation systems in the Foia del Pou community

Location: Montaverner (Valencia)

Client: SEIASA

Budget: 3.636.532,72€

Ending year: 2014

Execution time: 21 months

Project's description: The construction consists on the realization of 43.00 meter of pipe for irrigation.

The building of a pond of 169.000 m³.

A pumping station with the electric facilities and the system of control.

Finally, the reconstruction of the environment was done at the end of the project.



Illustration 30: Pond



Illustration 31: Pumping station

Bottlenecks and time-thieves

5.3.3 Dam of Almansa

Name of the construction: Refurbishment of the dam of Almansa

Location: Almansa (Albacete)

Client: Confederación Hidrográfica del Júcar

Budget: 5.797.805,00€

Ending year: 2007

Execution time: 16 months

Project's description: Execution of two check dams for the contention of mud that come from the reservoir. The check dams have 25 and 16 meters.

Execution of a stream of water for draining.

Change the drain pipe at the bottom of the dam for adequate it to the current legislation.



Illustration 32: Dam of Almansa

5.3.4 High Velocity Train Torrejoncillo

Name of the construction: Building of an access platform for the high velocity train.

Location: Abia de la Obispalia (Cuenca)

Client: Adif

Budget: 45.000.000,00€

Ending year: 2009

Execution time: 19 months

Project's description: The construction consists on a 7 km section for the high velocity train.

Construction of a viaduct of 1050 m, with space between pillars of 33 m.

Construction of a viaduct of 650 m, with space between pillars of 33 m.

Construction of a viaduct of 120 m, with space between pillars of 33 m.

Construction of a viaduct of 90 m, with space between pillars of 33 m.

Two tunnels of 350 m and 150, also for the railroad tracks.

There were about 10.000.000 kg of steel in the whole construction.



Illustration 33: Viaduct for the railroad track

Bottlenecks and time-thieves

5.3.5 Aznalcóllar

Name of the construction: Improvement of the oriental branch and supply of Aznalcóllar y Gelves

Location: Aznalcóllar y Gelves (Sevilla)

Client: Confederación Hidrográfica del Guadalquivir

Budget: 1.602.000€

Ending year: 2014

Execution time: 8 months

Project's description: The construction was divided in three main parts inside a unique project.

First part, improvement of the water conduction pipes inside Aznalcóllar, a total length of 1.908,59 m. Pipes of 300mm of inner diameter.

Second part, improvement and expand the supply of the towns of Aljarafe and Gelves, main conduction of 1.675,64m with an inner diameter of 300mm and a reinforced section of 336,65m with an inner diameter of 200mm.

The last part is the performance in the oriental branch and the room of taps, substitution of valves in the oriental branch with 800 mm of diameter and the repair of some sections. Substitution of the valves and improvement of the electromechanical facilities.



Illustration 34: Supply



Illustration 35: Valve of the oriental branch

5.4 Summary of the Chapter

As can be seen, the projects of study have several nature and are form different parts of Spain, the explanation of these five projects and the knowledge of the managers during their career, give a whole view and are useful to understand the validity and of the thesis and its scope.

The projects have all of them particular characteristics, but there are some conclusions that can be observed, as said before the most of the projects have cost overrun, almost the 80%, in terms of time, the results are more satisfactory, 80% on time. But the prize that has to be paid to finish on time is the increase of the budget.

Following a table with information of the projects can be found as a summary.

| Project | Location | Budget | Ending year | Execution time |
|---------------------|----------|----------------|-------------|----------------|
| Azud de la Marquesa | Valencia | 8.725.611,91€ | 2012 | 22 |
| Foia del Pou | Valencia | 3.636.532,72€ | 2014 | 21 |
| Almansa | Albacete | 5.797.805,00€ | 2007 | 16 |
| Torrejoncillo | Cuenca | 45.000.000,00€ | 2009 | 19 |
| Aznalcollar | Sevilla | 1.602.000€ | 2014 | 8 |

Illustration 36: Summary of the projects

Can be observed that the projects have different nature and also different size, we have projects of 1.6 million and others of 45 million, there are also differences in the execution time and the ending year of the execution of the project, it is important to know that the ending year refers to the ending of the construction not to the start of the operation, the special cases are mentioned in the thesis. With all these can be observed that the problems existing in the projects are common to the size and have the source in the construction industry.

6. Analysis of the bottlenecks and time-thieves of the case company

In this chapter the data obtained from the realization of the interviews will be presented and analyzed. Through this analysis, the time-thieves and bottlenecks explained in the chapter 2 will be analyzed from the point of view of the different interviewed. I will divide this chapter in parts, according to the different topics asked during the interview.

First, a brief description of the bottlenecks and time-thieves found in the case company. The approximation aims to give a framework for the following parts of the chapter.

Following this part, an analysis of all the data collected during the interviews will be done from the point of view of the participants.

It is important to know that all the analysis is done a whole, there will be some examples for some projects but the conclusions will be done in general terms, that is because all the experience that the interviewed have in different projects all along the Spanish geography.

6.1 Data treatment

The data for the survey was obtained through interviews to project managers in a construction company of Spain. Before the interviews with the managers, the interview guide was evaluated and corrected with the help of a project manager of the company in order to try to make the interview more efficient.

The project managers interviewed combined have experience in more than 40 projects. The range of age of the stakeholders was very wide, including managers with less than 10 years of experience and other with more than 30 years. With all this different managers, different information is obtained and some methods are different according

to the experience, this give a more extensive information involving different generations of managers.

The difference between the project managers helped me for getting conclusions, if all the interviewed feel the same problems independently of his experience is because the problems are real, and will help for a better answer to the research questions.

The representation of the data obtained follows a sequence based on the topics that they are referring, in the following scheme we can see the sequence of the topics of interest, the first part of each step of the sequence shows the name of the bottlenecks or time-thieve and following is the name in which is faced in the chapter.

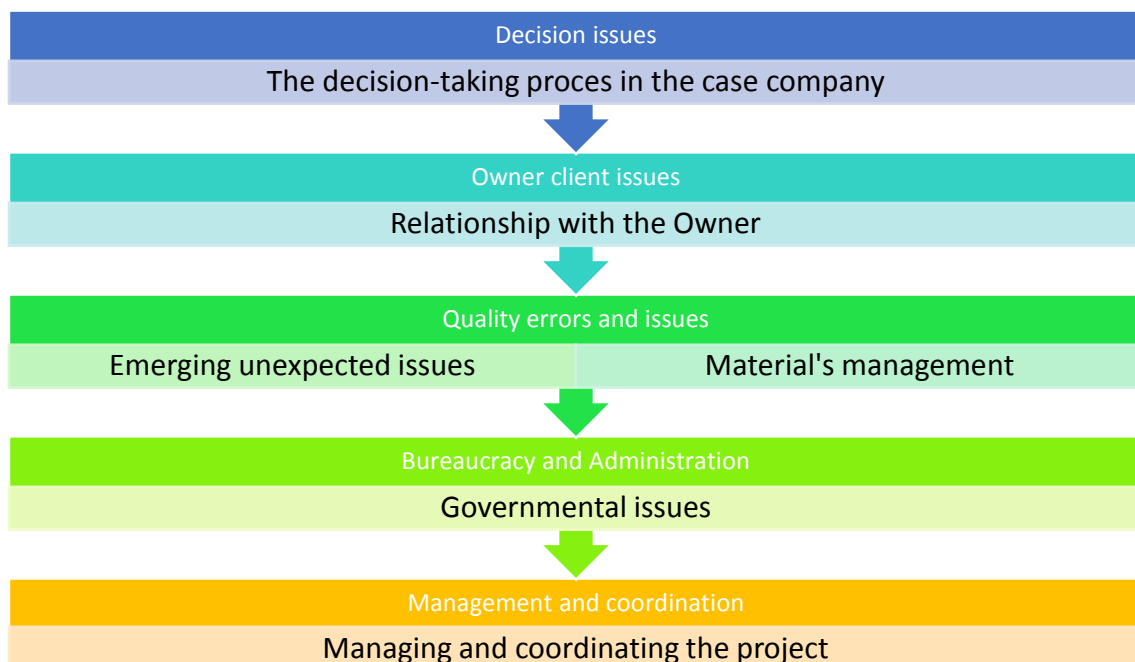


Illustration 37: Sequence of the chapter

6.2 Construction company context

Through the realization of the interviews some aspects were common to all the interviewed, these aspects are considered to have time consequences in the proper development of the project. The different managers explained the problems with time with their own words and terms, but all of them were referred to the same problems.

The biggest problem found in all the projects was the waiting because of the bureaucracy, there is one project that a manager has in Sevilla (Spain) that was finished two years ago, but nowadays and because of lack of capacity of the government, the project is not working yet. Another example of this bureaucracy issue is another project of 5.000.000€ budget that one project manager has in Herbas (Extremadura, Spain), the project is proved and ready to start but because of Spain has a caretaker government now, the final sign cannot be done and the project is stopped.

Among all the problems present in the construction project, all the interviewed highlighted that because of the crisis that exist now in Spain the suppliers company have no stock, and all the materials must be asked with prevision and this is guiding to increase the final construction time.

The project manager also highlighted that the most of the projects are not well-defined by the owner and this leads to unexpected issues and so, the increase of the time and money of the project.

Finally, one more issue was said by the managers, and is the relationship with the owner and the different stakeholders, because of disagreements and the mentioned bad definition of the project the communication between the owner and the client is constant along the life of the project and the decisions need to be discussed, also the relation with suppliers and subcontractors plays an important role in the final time of the project.

In order to give a background to the construction projects of the case company, some points and impressions will be given, this information is considering all the projects in which the project managers have worked.

Bottlenecks and time-thieves

- 80% of the projects on time
- 85% of the projects out of budget, the level of overrun is more or less the 10%, having some projects that have a final prize of more than the 25%
- The quality is never discussed during the realization of the project
- The time is the priority when carrying out a project

It is important to take into account the next formula in order to understand how the construction company creates benefits and understand why do they take the decisions that they take:

$$DC + IC = TC$$

$$B = I - TC$$

Where:

DC: Direct costs

B: Benefits

IC: Indirect costs

I: Incomes

TC: Total costs

The company aims to create benefits, in order to do so they have to reduce the total costs of the project, the importance of the reduction of the time for reducing the final cost of the project comes with the term of the indirect costs. This cost are the ones due to the contracts with the employees, subcontractors..., if the final time of the project or the task inside the project is too high, the cost due to the payment to the employees will raise a lot and so the benefits will be lower. The direct costs of the projects cannot be reduced and are the ones related with the materials.

These formulas are important to understand the relation between time and money and why the project managers prioritize always the time when doing the project.

6.3 The decision-taking process in the case company

When analyzing the decision making-problems the topic was divided in three main parts, the first one is in the pre-project and several factors during the life of the project; the second one was in order to know how the different stakeholders influence the decision time in the project and finally, the ones related with the managerial abilities of the manager, the questions were divided in these parts because of the previous theoretical analysis of the issue.

When facing a project, the owner just asks for a solution, all the things that have to be done in order to get it are on the manager, because of that, the manager when faces a project the first thing that he does is think in several alternatives that could fit for developing a final solution, as the solution is fixed by the owner, for example: I want a bridge in order to join these two shores. The difference between the alternatives and the difference with the competitors in order to get the project, are done in the construction process, the technical viability is the first aspect to consider, the better construction idea is the one that wins, once the technical viability is considered, the next step is to make it as cheap as possible. As the definition of the project by the owner is brief and he only aims to get a solution to his problem, the project is not well defined and these lead to several uncertainties and so, decisions that were not expected must be taken, in order to reduce the time of taking the decision is important to develop a good plan that can involve all these disagreements with the owner.

All the interviewed match in one thing, the experience is a critical factor when taking decisions, all of them think that as their experience and formation has increase the decision are taken faster, once you make a mistake you never do it again, learned lessons. They all feel that previous projects could have been better and faster with the knowledge that they have now.

Several aspects were studied in the theoretical part that affect the decision time, setting deadlines has been found an easy way to speed the project, when asking about that to the managers, the project managers have full authority once the project starts so the deadlines are set by the managers, both deadlines, the ones related with the

execution, and the ones related with the paperwork, some deadlines are set by the organizations.

The deadlines are affected by some important parameters that have to be taken into account, for example the weather conditions are critical in some projects, in the case of the project “Azud de la Marquesa” some parts of the deviation of the steam of water had to be done before the raining season, because the rain could lead to overtopping and so, the destruction of all the previous work. In the same project, due to the migration of the birds, some parts of the projects could not be done from February until July. All these inconveniences should be foreseen at the beginning of the project, and some time contingencies are always present for trying to limit the consequences.

During the lifetime of the project there are several parties that influence the decision-making process, the stakeholders play a relevant work when taking decision, although the managers have full authority there are several factors that need to wait or are influenced by the governmental concessions, all these governmental concessions could be avoided by a better definition of the project by the owner.

Also external consultants are used for the developing of the project, these consultants are necessary and are experts in the topic that they are asked for help, their performance is never felt as a delay, furthermore the managers feel that the consultant work more effective than them.

Another important stakeholder that has influence in the development of the project, are the subcontractors, the most of the tasks are performed by them and they have to receive the proper attention, when choosing the subcontractors the most of the time the manager select the same ones, the reason behind this selection is because of a trust relationship that they have, the owner is the final responsible so the selection of the subcontractors is done with the knowledge that they will finish on time, even though at the beginning of the project different subcontractors are considered, the final selection is almost known, they just deal with others in case they have a really good offer. The relation that the manager and the subcontractor have is a cordial and professional relationship trying to maximize the benefit for both parts.

6.4 Relationship with the Owner

As seen in the chapter 2, the relation between the owner and the client could be a source of disagreements all along the project and could lead to increase the final time, in this part, this relationship will be examined from the point of view of the project managers and their personal opinion and feelings.

It is important to know how the roles are distributed in the projects taken by the case company, in all the cases the owner is the government, that has to take care of the project with a public official, this public official check the progress of the project managers and a contractor delegate.

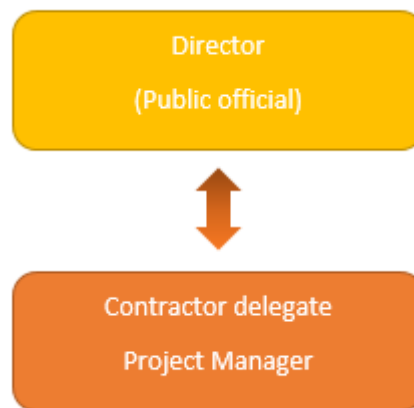


Illustration 38: Project actors

The relation between the government and the company is continuous along the project, they have meeting almost every week and they have contact with each other almost every day, either in the construction or by phone.

The meetings are mainly in order to finish the definition of the project, and try to solve the disagreements with the cost, the main problems are when the managers want to do something that was not properly defined in the project by the owner and this comes with costs. The time is usually not an issue in the relation.

Although self-interest is always present, the manager always tries to keep a cordial relationship with the owner, they found really important to have to trust of the owner, the really take care of the relation in order to maximize the efficiency of the project.

When asking about the phenomenon of the asymmetric information, they agree on the fact that not all the information is shared in order to maximize the benefits of the company, but this doesn't affect the good relationship that both parties have.

6.5 Emerging unexpected issues

This part aims to explain how do the managers in the company deal with the unexpected, what are the main reason behind them, and how do they face the issues

It is well known that during the realization of the project some unexpected issues can appear and change the future development of the project, these issues appear more often than wanted and they come with changes in terms of time and money.

During the realization of the project, this is divided in tasks, some of them are independent and others have a really close relation. During the execution of the project and due to the bad definition from the owner these tasks that were predicted at the beginning of the project can change, and even add some other tasks that were not predicted. The appearance of these issues can lead to a delay in the following tasks, and with the respective increase in the final cost of the project, the increase of the cost is due to the increase of the time which leads to more indirect cost, and also to the creation of new tasks, that involves the need of more resources.

In order to reduce these issues, the project manager is always 4 months over the execution, in this way he can study and predict the next problems and try to solve them before they arrive. The experience of the managers helps them to have a time contingency that will limit the consequences of the unexpected issues mentioned before.

During the project the tasks that conform the critical path are the ones that set the deadlines, are the ones that receive more attention by the manager because the

consequences of having a delay in one of them could increase the final time of the project significantly.

Some examples of unexpected issues can be found in the “Foia del Pou” and in the “Azud de la Marquesa”. For example, in “Foia del Pou” when building the pipes and the pond they have some problems with the farmers that own the lands, because of the limits of the plots. Another example was that in “Azud de la Marquesa” when digging, they found a Romanic wall, these lead to some legal procedures for determining if the wall should be kept or could be destroyed.

6.6 Material's management

Several problems have identified when dealing with the materials in a construction project, in this part the essence of this problem in the case company will be sort out, and the impressions of the managers about the issue as well.

The supply of the materials in the projects of the case company has not been a problem in the projects studied either during all the projects of experience of the managers, there are just a very few problems of quality, and almost every time the projects are on time at the construction site, if the materials are not of time is because of the managers fault, because of the crisis existing in Spain nowadays the companies have no stock, so the managers must order the materials soon enough to the material supply company. Sometimes and due to a lack of capacity the orders are not made on time, the managers have a lot of work to do in other tasks that are more important and they postpone the material's order and this leads to a delay in time, the problem is on the manager, not in the suppliers.

The problems with the inventory are also present in the case company, often they have material stole in the construction site, some objects that contain copper are susceptible to be stolen, in order to deal with the management of the inventory, they control everything with the software, they invest money in the correct management of the inventory, putting special effort to the materials needed in the tasks that conform the critical path.

When asking for the materials, several factors must be taken into account. On one side the decision of the supplier and on the other the amount of material needed. When choosing the supplier, the managers try to find a compromise between time and quality, not always are the same because depending on the region of Spain in which the project is taken place, one supplier is cheaper than others. On the other side, when asking the amount of materials, they are based on the initial prediction and the measures done in the theoretical project, for ordering the right amount of materials, in some of them like pipes, they manage a contingency of 10% based on their experience and because of unexpected issues and no controlled cases. Almost the 70% of the materials have contingencies, always trying to keep it as adjusted as possible.

The management of the materials receive an important attention from the manager because is the main component of the direct cost of the project, trying to have an efficient process here could avoid big variations of the cost.

6.7 Governmental issues

During the interviews the first concept that all the manager said when asking about the bottlenecks and time-thieves was the bureaucracy, is the most common time-optimizable in the case company and the one that involves bigger consequences, the only problem is that the source of the problem is outside the company and is due to an inefficient legal system.

All the managers had something in common, they consider completely unnecessary the most of the legal procedures that need to be done during the project, the only thing that they bring are delays. Asking for their impressions and some examples like the given in previous parts, the delays because of administration issues are felt as more than a 25%.

Obviously inside the company there are some administration problems, as the project is going bigger in terms of money more signs are needed, and sometime it takes time, but never more than a month.

The mandatory paperwork is perceived as completely unnecessary in more than the 50% of the cases, and only comes with the use of resources in terms of money and

employees, as the manager is the final responsible of the project, he supervises all the paperwork, and this takes time and money, they delegate for the writing of the most of the papers in other employees.

The need of prevision of these issues is patent in all the managers, they know that these problems are going to come, but sometimes they don't know when, they try to deviate some tasks to the waiting time, but the most of the time is impossible because the wait are too big or sometimes a sign is needed for keep with the project. These waiting time produce the illegalities for trying to safe time, all these waits have to be written and taken into account at the end of the project for possible compensations.

6.8 Managing and coordinating the project

Management and coordination have been found in the research made by SINTEF as the main bottlenecks and time-thieves, this part aims to explain how the managers in the case company manage their projects, what type of methods they use in order to create coordination between the employees and the subcontractors in the construction site, the way they create commitment will be also evaluated.

When managing the project, the managers divide the project in tasks, the managers are at the construction site as much as they can, they feel that being in the construction site streamline the process, they want to make sure that everything is being built properly, and being at the construction site avoid problems, the perception of the physical reality of the project helps the managers to predict the future issues.

Some problems with the management at the construction are because the project is not properly defined, the lack of definition is due to a lack of time and money, the owner want to the project too fast and they avoid things in order to save money.

The subcontractors are also a source of problems in the realization of the project, sometimes they don't work as good as desire and the quality of their tasks is not as said, because of that when choosing a subcontractor, the first one chosen are the ones that they know that work good, even though sometimes there are others cheaper.

The manager based on his experience tries to avoid some problems when coordinating, they cannot show that having a particular staff makes easier and faster the job, in every project they have they try to choose the staff from the company, the staff is chosen according to the quality of their work but also to the relationship, good relationship at work, increase the efficiency of the work.

For coordinating the work between the work between the staff, the managers have weekly meeting with the members of the staff, the meetings are not always necessary because of that the managers can cancel them if they think that are not necessary, they save time and resources. Hence, individual communication with the members of the staff takes place during the whole project, not all the members need to know everything, and the personal communication helps to create good relationships and specify the work for avoiding misunderstood. The meetings are set according to the need; the only time the meeting is fixed with a lot of prevision is when it involves many people for several departments.

The centrality and closeness of the staff has been considered a determinant factor for the proper development of the project, the manager tries to keep the staff close in order to help the communication but never in the same room, have all the staff in the same room has been found a source of distraction and so inefficiency, there are some projects like in "foia del pou" where the staff has to be in the same room because is the only way, the managers tries to have the staff close to the construction site.

For coordinating the project, the work package of every employee is divided in weeks or months, in this way they reduce the numbers of meeting. As the project is evolving the frequency of meeting change, at the beginning, during the design phase the meeting are more frequent, because of the high number of decision that have to be taken and also because the hiring of experts, the experts are expensive and their help should be reduced in time.

The human relationships between the members of the project is a crucial factor during the life of the project, a motivated employee works faster and better, the managers know that and try to have a good relationship with the employees, even though the level of professionalism is really high in the company and the quality of the work is never a problem, take care of the relationships helps to create a cordial environment in the

6. Analysis of the bottlenecks and time-thieves of the case company

project, *'the money is not everything, the first thing to consider the commodity of the employee'* said one of the managers. The managers try in every project their staff because the loyalty is a source of commitment and so of efficiency working.

The managers are not the only ones that try to improve the efficiency of the project, the company is the final responsible of everything and they want their employees happy, motivated and with the best formation available. The company imparts training courses during the year for introduce their employees the last software and measures for improving the efficiency of the projects. The company not only give these tools to the employees, they also try to distribute the managers in the projects they fit best, the company send the managers to the project that they think more convenient, there are some cases where the manager is really interested in a project and ask for it, but these happens just a few times.

6.9 Impressions of the managers

Once the interview was finished and the questions about the different time-optimizable were done, the managers where asked if they want to add something once the interviewed is finishes, as a conclusion, to complete something if they think so, or in order to help with the survey. The managers gave some final comments based on their experience and thoughts.

The experience as base of the project efficiency, the managers highlight that once their career past and they look back to previous projects there are a lot of things that they would have made different, in terms of the process and in terms of the relations with the stakeholders. *'The experience is the base of the formation'* said the manager with more experience, the experience is the one that help them to keep growing as managers, they share experiences and good relationships between each other that helps them to learn and have another perspective in the projects. But the experience not only helps them to make things different in the project, as said before also helps to manage the relations with the stakeholders, create good environment and get to know

the kind of employees they have is been said to be a crucial factor in the proper development of the project, even though it cannot be measure.

The software of control CPNs are found very useful in order to manage the projects but because of the lack of capacity are not updated as they should and so, their impact in the project is limited.

6.10 Summary of the Chapter

The figure of the project manager plays a critical role in the final performance of the project, as can be seen in all the topics studied in this chapter, the actions taken by the manager have direct repercussion in almost all of the topics, except the bureaucracy and administration that will be commented in a different way.

The manager is the final responsible of the project, and because of that they have to pay attention to all the procedures that take place in the construction project, their decisions are important for the success of the project, and the way they do the things is crucial for the project. Their experience and proper education is not only important when doing the tasks of the project, but also for the relationship with the different stakeholders and the prediction of the coming errors and unexpected; all these factors are found to have important consequences on the final time of the project.

Even though the role of the project manager is relevant, there are some issues in which the manager cannot do anything, the most important one, is the one that have bigger consequences in the final time of the project, the bureaucracy and administration, the managers can have several measures in order to limit the consequences of the bureaucracy, but the problem is that big that time of wait will appear no matter what the manager does.

Environmental factor that surround the context of the projects are also out of the manager scope, the actual economic crisis in Spain have cause some variations in the procedures and also in the time of the project, the managers and the companies have to deal with another issues and some differences come with the actual situation.

7. Comparison between the theory and the reality

This chapter aims to discover the validity of the research by comparing the theoretical research with the findings of the interviews, the chapter will evaluate every bottlenecks and time-thieve. The purpose of the chapter is to show that the case company is not so far from the theoretical measures and that the problems in the different bottlenecks and time-thieves are actually happening in real projects. Finally, at the end of the chapter, the measures that the company is taking are going to be compared with the one purposed in the theory.

7.1 Decisions

Several procedures are used by the managers of the company in order to take the best decision for the project, the managers study several alternatives in order to deal with the bounded rationality, as the theory pointed out, the bounded rationality is an important factor that has to be taken into account, not all the measures can be found, but with a good plan, like the managers of the case company do some issues can be predicted and avoided. The managers identified that the biggest reason under these procedures and the improvement of the performance of their projects was the experience, all of them said that the experience is the best weapon they have in order to take decisions, mistakes are not done again, the mentioned learned lessons, this fact match with the conclusion of Mullins et al. (1999), the experience of the managers is crucial for the performance of the project and the reduction of time.

One part of the interview was done in order to identify the influence of the stakeholders in the decision-taking process and the consequences that they have. The case company have in the owner one of the main sources of delay, the fact that the projects are not well defined and inconveniences appear all along the project lead to delay the project, the owner has to take his own decisions and this cannot be controlled by the managers. Other stakeholders, in the case of the company of study, they don't associate a main of

delay in these stakeholders, moreover they said that consultant have better time performance than them. The only issue that they have with the subcontractors is due to the fact that sometimes their work does not have the expected quality.

These influence of the stakeholders was identified by Wa'el Alaghbari et al., (2007), they identified the stakeholders as a source of two kind of delays, the "compensable delays" and the "Non-excusable delays". The "compensable delays" are the ones that are caused by the owner, as can be seen in the case company this fact is actually really important, and the owners are the main source of delay.

On the other hand, we have the "Non-excusable delays", these delays are caused by the influence of the suppliers, consultant and subcontractors, but this fact has not been considered as an issue in the case company, and as mentioned above the procedures of these stakeholders are found more efficient than the ones in the case company.

As said before in this chapter the abilities of the managers play and important role in the final time of the project, the evaluation of alternatives helps them to be prepare in case a problem comes, managers of the case company are realistic and they admit their own errors, even though the environment they work is complex due to the size of the projects and the stakeholders, they try to have a detailed plan in order deal with the most uncertainties that they can, although all the possibilities cannot be contemplated, Williams and Samset (2010) talked about the "bounded rationality" managers have a lack of knowledge of the present and the future so not everything can be foreseen.

7.2 Dealing with the owner

As identified several times during the thesis, the owner plays and important role in the delay of the project, because of several reasons identify the kind of relationship that the managers have with the owner is important to understand the time-optimizable.

As shown in the chapter 6, the reduction time by the manager is always an objective, because in this way they will reduce the final cost of the projects and will increase the benefits, the self-interest is always present but the quality of the work is never compromised from the point of view of the project manager of the case company.

Simms (1984) identify the main difference between the owner and the client in terms of self-interest, the owner aims to reduce the final time of the project in order to start with the benefits, on the other hand the contractor tries to optimize his performance.

The managers share all the information that they have with the owner, they aim to create a long-term relationship based on the trust, and in some cases they think that they have achieved it. A collaborative relationship, with honest communication and commitment is the key for the alignment of goals and the reduction of the issues (Suprpto M. et al., 2014). The manager shares all the information they have with the owner, but always trying to have an advantage in order to maximize the benefits, the phenomenon called as the asymmetric information identified by Schieg (2008) is present in the project, as mentioned before this phenomenon is based on the fact that one part has more information than the other.

7.3 Managing the quality and the errors

Two main factors are considered in this chapter; in one hand we have the issues related with the errors and how to manage them, and in the other we have the issues related with the material management.

7.3.1 Minimizing the effects of the errors

The projects have a lack of definition and this causes some problems and some tasks that were not planned need to appear, the managers have to place more resources than planned and the creation of new tasks is present in almost every project, in order to minimize the possible effects of these errors the managers pay more attention to the tasks that conform the critical path, these tasks are supervised in the construction site by the manager and he always tries to be one step forward in order to predict the future errors.

Lee S. (2006) explained how the impact of the uncertainty can be crucial in the project, not only because the consequences in the task that the error appears but also because the impact in one task can lead to problems in other, by the need of more resources and

also by the creation of new tasks needed to solve the problem. As can be seen the managers are aware of that and they implement measures in order to reduce the impacts and have the projects as controlled as they can.

7.3.2 Problems related with the materials

This point is the one that comes with more differences between the theory and the case company, the managers of the case company does not feel that they have a problem with the delivery of the materials. Despite the fact that this issue is not consider as a problem by the managers there are some similarities that should be mentioned in order to know the procedures used in the case company.

Ala-Risku T. et al. (2006) identify that the materials needed for a task should be placed in the construction site some time before it starts, and the consequences that it brings with the inventory. The managers of the case company have a full material plan at the beginning of the project and they order the materials with time, the only problems with the materials came when it is stolen from the inventory, as Ala-Risku T. et al., (2006) said the managers have to have an adaptable plan, sometimes this is not possible in the case company because of the lack of capacity.

7.4 Management and coordination

The management and coordination of a project is a big concept that involves different concepts; the ones related with the coordination in the construction site, the coordination between the different actors and the communication between them, and finally the abilities of the manager taken into account to manage the construction project.

Coordination and communication are two concepts with a close relationships and will be faced as one, the communication is needed in order to improve the coordination. The coordination in the construction site is a delicate issue because of the amount of subcontractors. Andy and Price list all the problems of the coordination in the

construction site (Illustration 12). The managers due to the particularities and the uniqueness of each project deal with the coordination as good as they can, the office space is insufficient and they have to be in the same room, also the poor project program due to the lack of capacity and not having an updated CPN. Sometime the manager feel that they cannot put the required attention because of the amount of work. These issues are related with the technical issues that by Andy and Price (2010) show in their study, the other issues are management system and staffing.

The management system issues have the cause with the biggest impact according to the research of Andy and Price (2010), the unclear job duties are the most important factor, the managers of the case company feel that due to the lack of definition they have to deal with some unclear tasks. The paperwork is considered as a delayer of the job because the amount of unnecessary papers that have to be filled, the communication is an important factor in the construction site because sometimes the manager or the employees do not know where the others are.

Finally, we have the issues related with the staffing, the managers do not feel that their employees are inexperienced for the work that they are assigned, the only issues they have with inexperience is related with the quality of the subcontractor's work. But, on the other hand the problems related with the insufficient staff are totally present in the company, the lack of employees causes lack of coordination in the construction site because the manager has to do another tasks considered as more important, also and despite the fact that the supervise all the paperwork, they feel that they do not have sufficient staff in order to help them with these duties.

Coordinate all the factors that affect the project is not an easy job, methods like meetings or plans are used more for convenience than effectiveness (Carlson and Davis, 1998) the coordination methods have to be considered because of their utility not for frequency this is a concept that the managers have always present, in order to deal with the communication and coordination of the work they make the meeting when are considered necessities, as Gorse and Emmitt (2003) find the managers have to make sure that the employees have clear they tasks and duties. The meetings have to be useful and because of that the manager is free to set them when needed, as Patrashkova-Volzdoska et al. (2003) said, too much communication could come with impediments

for the performance. The managers try to keep the project's staff as close as possible, not in the same room if it is possible but always close enough to safe a phone call, centrality is found in the theory as one crucial factor for the agility of the communication.

How the managers are and how to improve their abilities is another factor that affects the project, even though the company does not foment the education of the managers, they have another method to deal with the managerial skills and try to maximize the efficiency of the project. As Mumford et al., (2000) identify the abilities of the managers have to fit with the requirements of the position, in order to do so, the company choose which manager has to each project, trying to choose the best candidate.

As the size of the project increase the managers needs more help, as seen in the Illustrations 18,19 and 20, the managers of the case company as the complexity of the project increases ask more help, experts or other consultants are hired. The size of the project team is not big so as can be seen in the Illustration 20 helps to the final performance of the project, smaller teams bring with them better project performance.

7.5 Summary of the Chapter

As can be seen in the chapter, the grade of closeness between what is going on in the case company and what the theory says is close. The studies made in order to identify the issues under the bottlenecks and the time-thieves are found to be real in the case company, even though there are some problems that are not present in the case company because of the particularities of each country and project, the most of the issues are happening.

One of the main differences lays in the fact that the stakeholders that are not the manager, have better procedures than the case company and are not an issue when talking about time.

Another main issue is the fact that the training of the managers is found as one of the main factors for reduce the final time of the project but the company don't spend

7. Comparison between the theory and the reality

resources on that, a good program for improving the procedures and give the managers another tools could be an interesting way to improve the performance of the project.

8. Conclusion and further research

This chapter consists on the conclusion notes of the thesis, answering the research questions and pointing the findings and considerations found during the process, this chapter also includes their limitations and propositions for future research in the areas studied.

8.1 Answering the research questions

Companies and governments have realized that the current procedures when developing a construction project should be optimized, the SpeedUp project is an example of this though. When comparing the different bottlenecks and time thieves of Norway and the Spanish case company, the similarities where big, but the source of the issue is different in both cases.

The identification of the bottlenecks and time-thieves is a key step in order to purpose measures for improving the project performance, but when doing the interviews in order to discover them, and when going through the literature for study the current information a big complication was found, both concepts are too close to make a differentiation, what should be consider a time-thieve can also be consider as a bottleneck, the managers when asking couldn't make a differentiation between them, because of that the creation of a term that involves both is necessary, the concept of time-optimizable born here, this concept encompasses all the processes that could be optimized in order to reduce the final time of the project, issues that steal time and those which limit the process are considered.

This problem was born during the realization of the thesis and it is necessary to understand the development of the thesis.

The purpose of the thesis, was to study a construction company in Spain, identify his bottlenecks and time-thieves and then compare them with the ones found in the Norwegian construction company, also some measures are going to be purposed, based in both, in the theoretical survey and in the procedure made by the managers of the company. Three research questions were defined at the beginning of the thesis.

1. *What are the main time thieves and bottlenecks in the case company? Are the same in every project?*

This question is composed by two small ones, the first part of the questions is answered based on the interviews realized to the project managers of the company, even though the words used by them to describe them were not the same as the ones used by the previous research by SINTEF, the concepts are going to be change to the SINTEF nomenclature in order to make easier the understanding of the conclusions.

The bottlenecks and time-thieves of the company where the same in every project, although each one of them has different context and situations, and so consequences, the reasons behind them were the same, so can be said that the problems are the same for the whole company.

Among all the time-optimizable there was one considered by all of the managers to have the biggest consequences increasing the final time of the project, with some examples which consequences are too much, pointing out the actual situation of crisis in Spain, even though the managers have found that the things are going better there are still a lot of thing to do. This issue was the bureaucracy and administration outside the company, the big amount of paperwork and the waits because of lack of capacity of the government is the reason of the biggest delays in construction project in Spain, the managers think that this issue affects the final time of the project increasing it in more than a 25%. Not only the waits because of legal aspects are considered to affect, but also the time used by the manager filling the paperwork or reviewing it.

Another issue considered by the managers was the lack of capacity, this aspect has several cause, one of them is the absence of founds of the company, the crisis is reducing

the number of construction projects in the country and then the source of incomes of the company is being reduced, this is reflected in the company by having less staff than the desire, and so the managers has to do more work and postponing some tasks for the next day, this affects the order of materials and this incurs to not having them on time, also affects by not having an updated CPN software, have one employee only updating it is considered by the managers to have considerable impacts on the project, but the company cannot afford it. The other source of lack of capacity is not inside of the company and is, as mentioned before, the big amount of paperwork because of the loyal procedures, distracts the managers of other activities that would be more necessary for the project.

Also the bad definition of the project has direct consequences on the project, but bad definition was not considered as one of the bottlenecks and time-thieves by the SINTEF research, so asking more about it to the managers, several time-optimizable came:

- Decision issues
- Owner-client issues
- Management and coordination

As can be seen an issue that has the origin outside the company affects the projects in a considerable way, how the bad definition affects the mentioned bottleneck and time-thieves is going to be following explained.

As the projects is not properly defined by the owner, the project manager evaluates his solution for solving the problem, he purposes the final outcome and the procedures that are need in order to get it, but during the realization of the construction there are some issues that have to be discussed with the owner, this takes time because the negotiation with the owner, the owner always try to avoid it to make the process faster and cheaper and the manager has to make him see that is necessary to make the things are planned. The relationship between the client and the owner is continuous all along the project and self-interest is present in every discussion or negotiation. The lack of definition also involves the increase of uncertainties during the projects, there are some objects for example that were not plan to be there and so they involve consequences in terms of time and resources as explained in previous chapters.

These confusions and misunderstandings between the owner and the client have doesn't have to have consequences in the coordination of the project, although they have, the managers deal with the changes and are aware of the possible uncertainties that are going to come.

However, the bad definition of the project is not only the source the bottlenecks and time thieves mentioned above, when doing the interviews and asking some further questions in the project some reasons for these bottlenecks and time thieves came because of managerial issues or other aspects.

As a summary of the bottlenecks and time-thieves of the case company, can be said that the ones that they have are:

- Bureaucracy and administration
- Lack of capacity
- Decision issues
- Owner/Client issues
- Management and coordination

2. Are these bottlenecks and time-thieves different from the ones that we found in Norway?

This question aims to discover the similarities and differences of the bottlenecks and time-thieves between the case company and the Norwegian construction industry, and try to explain the reasons behind them.

First of all, in the previous questions the bottlenecks and time-thieves of the case company are explained, showing their causes and triggers, there are some procedures that come from inside the company and others that come from outside, creating between all of the final list of time-optimizable.

The Norwegian construction company has their own bottlenecks and time-thieves, the list of them was shown in the Chapter 2, in the illustrations 7 and 8. During the

development of the thesis the most important ones were studied and analyzed, but the main list is composed by some others more.

Before going to the analysis of the bottlenecks and time-thieves I would like to say that, the list covers a lot of concepts that not necessarily has to be considered as independent, the relation between all of them is really close and as will be explained when asking the next question, just putting some measures for reducing a few of them will have direct consequences in all of them.

In a first look to the illustrations 7 and 8, can be observed that the list of bottlenecks and time-thieves is bigger than the one for the construction case company, the time-optimizable that the case company has are in the list of the Norwegian case company, so we can affirm that mainly the same problems are patent in both. But it is interesting to say that quality issues and errors was considered one of the time-thieves identified by more managers in the construction company, but it was not an issue for any of the managers in the construction company, the problems of the quality issues and errors were associated in one part to the supply of materials, but in the company this was not consider an issue. As can be seen comparing both list; management and coordination, administration and bureaucracy, decision issues, lack of capacity and owner/ client issues.

Not just looking at the list, but also to the importance of the different bottlenecks and time-thieves could be interesting. All the managers of the case company, with no exception say that the bureaucracy and administration issues was a problem in all of the projects that they have had during their career, another important fact is the lack of capacity, in the research about the Norwegian construction company was consider an important fact but not as important as considered in the case company.

Both cases (Norwegian construction industry and the case company in Spain) have mainly the same bottlenecks and time-thieves, with some expectable differences, but can be said to be similar. The main differences between both cases came when looking at the frequency of appearance of them, the different context of both countries lead to the differences in the importance of time-optimizable.

3. Which measures are they applying in order to deal with them?

The third and last question tries to identify the procedures used by the managers of the case company in order to reduce the impact of the bottlenecks and time-thieves.

One concept that appeared during the interviews was the loyalty, the managers with loyalty with the subcontractors and the employees. Referring to the subcontractors, the manager in order to avoid or limit the bad results from part of the subcontractors try to select every time the same ones, because they know how they work, the trust each other and they have a cordial relationship that helps the work. Although sometimes this is not possible, because the projects don't take place in the geographical area of the subcontractor, but the manager tries to do everything he can for bring them with him. The money is not an important factor when selecting the subcontractors or the suppliers, despite the manager send the offer to different companies, they always have in mind which one are they going to select, but they are open to surprises if one of the others is really cheap.

On the other hand, the loyalty with the employees is also an important factor the managers know that a good environment in the project helps to improve the performance, because of that he chooses the employees whenever he can, he chose them because of loyalty, the employee is committed with the manager and because of that he is more motivated and more efficient at the work.

Reduce the uncertainty is one the main challenges in the construction projects, managers cannot do too much for dealing with the bad definition from the owner, but they can take measures for reduce the uncertainty, and so take decision faster, coordinate better the staff and the subcontractors, and have a better plan for the materials supply. Several measures are taken in order to deal with the uncertainty, one of them is the hiring of experts at the design phase, even though not all the managers do that, some of them ask for help to experts in order to get a better solution in terms of performance. In all the projects there are several parts that have to be done by

external consultants, all the managers work with them and they perceive their performance as crucial for the development of the project and really effective, they do not bring delay to the project.

Another measure was identified in the theory for reducing the uncertainty, the use of CPN methods for have a better control on what is going on in the construction site, the use of software as Microsoft project has been found to have a direct repercussion in the project, not only the managers are aware of that but also the company, the last year they were taught to use a CPN software, although they cannot have a daily update in the software because of the lack of capacity, they use this kind of tools and are aware of their utility.

The managerial style is also taken into account by the company, they choose the project manager for each one of their project, according to capabilities and availability. The company does not sponsor the studies of the managers, but some of them are aware of the need of more information and techniques and they take master by themselves in order to increase their knowledge and abilities.

In order to coordinate the project faster and improve the communication between the employees, the manager tries to be all the time that he cans in the construction site, in this way they solve problems fast, and they can be ahead of the construction for preventing future problems. The manager is not the only one in the construction site but also the project staff of the company, the managers try to have the staff close, not in the same room because this provokes distractions, but they have to be as close as possible in order to make the communication easier.

The relation with the owner is also an aspect to consider when making a construction project, the managers have constant and direct contact with the governmental employee in charge of the project, they share information they whole time and they discuss procedures because of the bad definition of the project, in order to make the things easier the managers try to keep a cordial and nice relationship with the owner, in this way the reduce the reduction time, if the owner trust in them they avoid some disagreements and negotiations, both want the best for themselves but they have some flexibility because of the trust.

Finally, there are some other interesting measures taken by the company in order to avoid some discussions and economical inconvenience. The use of a drone in the construction helps them to take pictures right at the construction and in this way justify with the owner, the information collected by the drone helps them with the claims, in this way they justify way the things were not in time, but also they use it to check the subcontractors, if they are using all the resources that they should according to the contract, in this way they not only save time in the negotiations but also they save money if things are not going as expected.

8.2 Final conclusions

In this chapter I want to give my personal opinion and my personal conclusions obtained during the realization of the whole thesis.

Firstly, the case company have really good performance when doing the project, they follow the most of the measures proposed in the theory, even though they have some issues to fix, that they could do in order to improve their efficiency, the project manager training is an issue that could have direct consequences in some of the issues that they have, as Petter Eik-Andersen and others (2015) show in their article about the remedies for managing the time-thieves and bottlenecks, the project management training is useful in order to improve the communication, the skills, the methods the correct use of the resources and finally will help in the decision making process.

Another important issue are the contingencies, even though the managers are aware of their limitations, they barely use contingencies, they have good results in terms of money but the use of time-contingencies will help them to reduce the final delays in the project.

Is important to know that the actual economic situation in Spain in bringing direct and indirect consequences to the performance of the construction projects of the company, because of a lack of governmental capacities there are less personal that needed in the administration and these leads to delay because of bureaucracy and administration. But not only the actual crisis has consequences in the government, the company need more

employees, there is a lack of capacity due to not having enough money, the managers have to do more work than they are capable and this leads to postpone some activities that at first were not considered important, but finally incurs with some delay in the final time of the project. The company also feels the crisis when dealing with the suppliers, as they don't have enough money, they have no stock and this cause that the managers have to be more aware of when to ask for a material, because some specific materials like pumps or valves need at least 4 weeks to be built.

After the literature study I realized that were two main reasons behind the most of the bottlenecks and time-thieves, this two reasons are the uncertainty and the relation with the stakeholders, putting an extra effort on reduce them will have relevant consequences on the performance of the project, the methods for reducing the uncertainty have been purposed during the thesis as the ones to create a better relationship with the stakeholders.

8.3 Limitations and further research

The results of the thesis have shown utility when comparing the case company in Spain and the previous research made by SINTEF and the NTNU, and has obtained useful information for understanding the current bottlenecks and time-thieves in the construction industry, there are also some limitations that should be mentioned.

The first limitation to point out has to do with the research methodology used. The Qualitative research used in these interviews is susceptible to criticism, the same data but with the interpretation of another person could lead to different conclusion. For limit this issue could be seen that the data obtained in the interviews are closed to the ones found in the theory, with some particularities but in general terms the information could be consider valid.

Other limitation is the number of interviews, just five projects have been evaluated, although the project managers have experience in more of them, the lack of projects available make the relevance of the study smaller that could have been, also because

other managers can have different opinions, but the closeness between all the answers lead us to think that the problems are mainly the same.

Finally, another limitation is that the measures proposed for the company cannot be evaluated even though there are just a few because the company's procedures are close to the theoretical optimum, it would have been interesting to see the results, despite the fact that one of them is more for the medium-term like is the training of the managers. Some of the issues have been related with the actual situation of Spain but it would be interesting to see the project managers working in other environments like Norway to see their performance without such crisis, but with another issues.

Interesting further research could be to have the same kind of interviews with managers of the construction company in Norway, ask them the main sources of their problems and try to see in this way, why the list of bottlenecks and time-thieves in the Norwegian construction industry is bigger than the list of the Spanish case company, is because of a lack of understanding of the concept of bottlenecks and time-thieves or is because some issues can be grouped into others, like for example communication issues could be consider as part of the management and coordination and part of the relation between the owner and client.

It would be interesting where does the managers in Norway think that the problems have their origin, in think about Spain, some problems are due to the economic crisis as mentioned before.

Other important issue is to have interviews and data from other companies and project managers in Spain for making the study more relevant, and try to make it at the level of the country, not only the case company.

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Appendix A: Interview Guide

Following the set of questions asked in the interviews are going to be written divided by topics.

Introduction

This part aims to make a first contact with the interviewed, try to make him feel comfortable with the questions and establish trust between both, are easy questions about his context and a brief description of the thesis and the topics studied.

The interview starts with a brief description of SpeedUp, the bottlenecks and the time-thieves, to make sure that the interviewed is aware of the concepts. Then a brief talk about the different found in the Norwegian construction industry is done.

The first questions are about the project manager:

- How many years of experience do you have in the construction industry?
- How many projects have you been working in?
- How many project have you been project manager?
- Are you satisfied with the results of the project in terms of time, money and quality?
- What is the most important of the three in the Spanish construction industry?
- Which time issues have you found during your working experience? Bottlenecks and time-thieves

Once the bottlenecks and time-thieves are identified by the project manager several questions are asked about the ones studied in the survey in order to identify the procedures and how do they identify the problem.

Decision issues

First of all, an explanation about this topic is done.

- When you have to evaluate a project, how do you face it?
- Do you identify several alternatives for the resolution of the project, or you just work with the first idea?
- Do you consider that when your experience and education grows your decision time is lower?
- How do you manage the deadlines? Do you set it by your own or are they given by the owner?
- Do you feel any kind of influence by someone (companies, government, organizations) when you have to make a decision or are you completely free?
- In case that you feel influenced, for who and in which way?
- Do they make you be slower?
- Do you consider them necessary?
- Do you work with external consultancies?
- Which kind of relationship do you have with them?
- Is it mandatory and useful?
- Do you work with subcontractors?
- Always the same ones?
- Which kind of relationship do you have with them?
- Do you have any kind of formation once you start working as project manager?
- Would have you make something different in precious project with the experience that you have now?
- What are these changes about?

Owner-Client

- Which kind of relationship do you have with your boss?
- Do you feel that he trusts in you?
- Which kind of relationship do you have with the project owner?
- When you have any disagreement with him, why do you feel that you have the problem, because of quality? Time? Money?
- Do you feel any kind of own interest in the projects by the project owner to finish as soon as possible?
- Which kind of communication do you have with the owner?
- Do you trust in him?
- Do you share all the information with the owner?

Quality issues and errors

- Do you usually have unexpected errors during the project?
- How do they affect the final time? And the money?
- Do you use work packages for dividing the project's tasks?
- When this kind of issues appear, how do they affect the others?
- Do you have to create new tasks in order to solve the problems?
- Do you have any kind of contingency?
- How do you manage the contingency?
- Which are they main factors that affect the contingency? Experience, help?
- Which kind of consequences do this issues have in terms of resources?
- Do you deal with all the tasks in the way?
- How do you face the most important ones?

Now we change to talk about the materials and their delivery.

- Have you feel any kind of problem with the materials?
- Because of what: quality, time, storage?
- How do you manage the inventory?
- Do you use money or staff?
- Is the material on time?
- If so, how do you do it? Which kind of methods do you use for asking for the material to the suppliers?
- If not, which kind of measures do you use?
- Do you make a plan of all the materials needed at the beginning of the project?
- Do you use contingencies?
- Which with method?
- Which suppliers do you choose?
- Based on what?
- How do you face the topic of the material's delivery?
- Do you have any kind of problems with the inventory?
- Which kind of problems do you have?
- How do you solve them?

Bureaucracy and administration

- Do you think that they affect to the development of the project?
- Where are the main problems, inside or outside the company?
- Do you consider the paperwork unnecessary?
- Do you supervise all the papers?
- Do you delegate in someone?

- How many days do you consider that you lose because of legalities?
- Do you think that these days could be used for the development of the project?
- Do you consider all these procedures necessary?

Management and coordination

- How many subcontractors have you had in the project?
- How have you managed their tasks?
- Do you personally supervise all the tasks?
- Do you consider that being in the construction site makes the project faster?
- Why do you do it: you make sure that everything is going as planned or do you go there for solving possible problems?
- Do you consider that the projects are well defined?
- Do you usually have unexpected problems?
- Do you have problems with the subcontractors?
- How do you assign the project's staff?
- Do you choose it or the company assigns you the staff?
- How do you coordinate the team?
- Do you ask for more help in the design phase?
- Do you change the coordination method as the project keeps going?
- Why and how?
- How often do you have meeting with the different stakeholders of the project?
- Do you think is useful?
- Do you choose it or it comes by procedures?
- What do you do in order to make the meetings useful?
- Do you have the employees close?
- In the same office?
- Do you feel any kind of change in the performance of the project when the staff is motivated?
- How do you deal with the commitment?
- Do you choose your own projects?
- Does your company assign you to a project?

Final Questions

This last set questions cannot be placed in other chapter and are done at the end of the interview, have to do with the measures for dealing with the time-optimizable.

- In the front-end phase of the project, do you hire any expert?
- Do you compare with other projects in order to start yours?
- How do you increase your knowledge?
- How is your relationship with your employees?
- Do you think that a good relationship is useful for the development of the project?
- Do you use any kind of software for planning your project?
- Do you deal with it every day?
- Do you use any kind of tool in the project?
- After all the interview, any other think that you would like to add?