SELF-ORGANIZATION IN CONSTRUCTION PROJECTS?
A STUDY ABOUT THE RELATIONSHIP BETWEEN THE ORGANIZATIONAL STRUCTURE AND SELF-ORGANIZING ACTIVITIES OF CONSTRUCTION WORKERS WITHIN A DUTCH CONSTRUCTION PROJECT

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Nijmegen, 15th of November 2017
Preface
With this master thesis, I am finishing the Master Business Administration in Organizational Design and Development at the Radboud University Nijmegen. This thesis describes the results of the research that I conducted in a Dutch construction project (which I, due to anonymity reasons, cannot mention by name). I have been working on this master thesis from February 2016 till October 2017 and it was a real learning experience for me.

Since the internship that I took to graduate from my HRM education in Applied Sciences, on the HR-department of a Dutch construction firm, I got especially interested in the construction sector. Therefore, when I was looking for an organization to conduct my master thesis at, I immediately had the idea to write my thesis about a construction project. Via some contacts of the construction company I have had my internship at, I came in contact with the site manager of a Dutch construction project in which I had the opportunity to conduct research and write my master thesis.

I would like to take the opportunity to thank some people. First of all, I would like to thank all the respondents for their time to take part in the interviews. All participants were very helpful answering all my questions and gave me a great insight into how they work in the construction project. Furthermore, special thanks to my supervisor from the main contractor of the construction project (for anonymity reasons I will not mention his name) for his support, feedback and enthusiasm. He allowed me to analyze the construction project and has always helped me whenever I had questions or asked for feedback.

Moreover, special thanks to my supervisor Matthijs Moorkamp from Radboud University Nijmegen who always gave me the necessary feedback to continue my research. Moreover, he has always inspired and helped me with all his knowledge, experiences and insights about the organizational design of temporary organizations. Lastly, I would like to thank my fellow students who provided me feedback, gave me tips and supported me in writing my master thesis.

I hope you enjoy reading my master thesis,

Ramon Albers

Nijmegen, November 2017
Abstract
Despite the many organizational control problems, such as time delay, cost overrun, waste and safety, more and more construction projects are performed nowadays. Within organizations that are confronted with a highly complex environment, such as a construction project, it can be argued that organizational control emerges through self-organizing activities of operators. Therefore, this research tries to discover how organizational control is developed by means of self-organizing activities of operators within a construction project and how this process is influenced by the structure of the temporary construction organization. In doing so, this study will answer the following research question:

In what way are self-organizing activities of operators within construction project X influenced by structural characteristics of the temporary project organization?

To answer the research question, a case study has been executed within a Dutch construction project. The aim of this case study was to develop a grounded theory. To do so, in total 12 interviews were conducted with different project participants. The interviews were transcribed and the data was subsequently analyzed to develop the grounded theory. This has resulted in the following ten hypotheses that discover the influence of the organizational structure of the temporary construction organization on self-organizing activities of construction workers.

- **Hypothesis 1**: Organizational control within construction projects is barely developed through self-organizing activities of construction workers, since construction workers often cannot solve problems independently;
- **Hypothesis 2**: The structure of the temporary construction organization is highly functionally concentrated;
- **Hypothesis 3**: The high level of functional concentration leads to a complex network of interactions (i.e. internal complexity), which influences the occurrence of disturbances and simultaneously impedes self-organizing activities to deal with them;
- **Hypothesis 4**: Within project teams of subcontractors there is a high level of differentiation of making, preparing and supporting activities;
- **Hypothesis 5**: The high level of differentiation of making, preparation and supporting activities leads to a complex network of interactions (i.e. internal complexity), which influences the occurrence of disturbances and simultaneously impedes self-organizing activities to deal with them;
• **Hypothesis 6:** Within project teams of subcontractors there is a high level of separation between operational and regulatory tasks;

• **Hypothesis 7:** Construction workers regularly have to deal with problems they cannot solve themselves, since there is a high level of differentiation between operational and regulatory tasks within project teams of subcontractors;

• **Hypothesis 8:** There is a high level of differentiation of regulatory activities over parts of the process within the temporary construction organization;

• **Hypothesis 9:** The high level of differentiation of regulatory activities over parts of the process influences the number of disturbances that arise within the temporary construction organization and impedes the self-organizing activities of construction workers to deal with them independently;

• **Hypothesis 10:** Structural coupling between different elements (i.e. subcontractors) within the temporary organization is largely made on a central level, with the aim to reduce the need for structural coupling on the construction site.
# Table of contents

**Chapter 1: Introduction** ................................................................. 6

**Chapter 2: Theoretical framework** .................................................. 11

- 2.1 Problems within the construction industry ........................................ 11
- 2.2 Temporary organizations .................................................................. 13
- 2.3 Self-organizing activities and organizational control ........................... 16
- 2.4 Organizational structure ................................................................. 17
- 2.5 Structural characteristics of construction projects ............................... 21
- 2.6 Conceptual model ........................................................................... 23

**Chapter 3: Research methodology** ................................................... 25

- 3.1 Research philosophy ........................................................................ 25
- 3.2 Research design ............................................................................... 25
- 3.3 Methods of data collection ............................................................... 27
- 3.4 Operationalization ........................................................................... 29
- 3.5 Data analysis .................................................................................... 29
- 3.6 Research criteria ............................................................................... 30
- 3.7 Research Ethics ................................................................................ 31

**Chapter 4: Background information** .................................................. 33

- 4.1 Team ............................................................................................... 33
- 4.2 Task ................................................................................................. 36
- 4.3 Time ................................................................................................. 37

**Chapter 5: How is organizational control developed through self-organizing activities of operators?** .......................................................... 38

- 5.1 Dealing with delays within the construction process ............................ 38
- 5.2 Dealing with procurements and deliveries ......................................... 40
- 5.3 Dealing with drawings ....................................................................... 41
- 5.4 Dealing with decision-making ........................................................... 43
- 5.5 Dealing with the subcontractor responsible for the concrete work ....... 45
- 5.6 Dealing with the tension between different subcontractors ................ 47
- 5.7 Dealing with instructions of site managers ....................................... 49
- 5.8 Conclusion: self-organizing activities of construction workers to solve problems ................................................................. 50

**Chapter 6: How do structural characteristics influence the abilities of operators to develop organizational control by means of self-organizing activities?** ......................................................... 52

- 6.1 Functional concentration ................................................................... 52
6.2 The level of differentiation of making, preparing and supporting tasks .................. 55
6.3 The level of separation between operational and regulatory tasks ......................... 57
6.4 The level of differentiation of regulatory activities over parts of the process ............ 58
6.5 Control structure: Structural coupling between subcontractors ............................ 61

Chapter 7: Conclusion ........................................................................................................... 63
  7.1 Self-organizing activities of construction workers ................................................. 63
  7.2 Structural influences on self-organizing activities ............................................... 63

Chapter 8: Discussion ......................................................................................................... 67
  8.1 Practical implications .............................................................................................. 67
  8.2 Theoretical implications ........................................................................................ 67
  8.3 Limitations of the research .................................................................................... 70
  8.4 Possibilities for further research .......................................................................... 71
  8.5 Reflection upon the role of the researcher ............................................................ 72

References ............................................................................................................................ 73

Appendix 1: Research model ............................................................................................ 78
Appendix 2: Operationalization ......................................................................................... 79
Appendix 3: Topic lists interviews ..................................................................................... 81
Appendix 4: Codebook ....................................................................................................... 85
Appendix 5: Scheme network of interactions .................................................................. 93
Chapter 1: Introduction
The financial recession had a major impact on the construction sector in The Netherlands. In the period from 2008 until 2014 many construction companies went bankrupt, had financial losses and a massive amount of people were laid-off (CBS, 2015). After these hard times, it is getting better in the construction sector in The Netherlands the last years. Although not all messages are optimistic (EIB, 2017), the general story is largely positive. There is an increasing amount of orders for construction companies and as a consequence the revenues are growing, the number of bankruptcies are decreasing and the employment rate within the construction sector is increasing (CBS, 2017). According to the Economic Institute for Construction and Housing (EIB), a Dutch economic research institute, the predictions for the coming years are also mainly positive (Wong, 2016).

Problems within construction projects
Due to all these developments in the construction sector, the expectation is that there will be an increasing number of construction projects executed over the next years. Despite all these optimistic messages, many construction projects perform poorly in economic, environmental and public terms. A substantial amount of large construction projects has significantly higher costs than expected, which could hinder the viability of the project (Flyvbjerg, 2003, p. 3-11). Moreover, at the same time, environmental and social effects of the project are often not taken into account during the development of the project (Flyvbjerg, 2003, p. 4).

Another serious problem is time delay: it has been called a part of daily routine that construction projects are delayed during project execution. The work is proceeding slower than planned, which leads to extra costs and conflicts among different project partners (Srdić & Šelih, 2015; Divya & Ramya, 2015). In addition, much waste is generated on construction sites, which directly impacts productivity, material loss and completion time (Hussin, Rahman & Memon, 2013). Simultaneously, safety is a big issue on construction sites. The Dutch governmental organization The Inspectorate SZW (2016), which works for healthy and safe working conditions in The Netherlands, claimed a substantial increase of serious, deadly accidents in the first half year of 2016.

Thus it can be argued that there is a paradox (Flyvbjerg, 2003, p. 3). Despite the high risks on cost overrun, time delays, waste and safety issues, an increasing number of construction projects are carried out. Many explanations for the current problems within the construction sector can be found in the literature, such as a lack of experience, poor site management and
supervision, inaccurate time and cost estimates, frequent changes in design and workers mistakes during construction (Hussin et al, 2013). To deal with these problems, much in the construction management literature is written about project management (Winch, 1989, p. 334). In this stream of literature, a process-oriented approach is chosen to deal with projects and to improve project results. In this research, the focus will be on the structural design of these construction projects to analyze the problems in the construction industry and to discover how the organizational structure of these construction projects influence the project. This approach is chosen because construction projects are not carried out by a traditional organization, but by a temporary organization which is a particular type of organization that has a specific form of organizational structure.

**Construction projects as temporary organizations**

To conduct a construction project, a temporary construction organization is formed. In general, temporary organizations are very suitable to execute complex, multidisciplinary tasks that have a small batch production of customized products (Modig, 2007, p. 808). This type of temporary organization, consisting of actors that come from different parent organizations, could be defined as: “An inter-organizational system of multiple organizations that cooperate to solve pre-defined tasks in a limited amount of time” (Bakker, 2011, p.13).

Furthermore, it can be stated that temporary construction organizations are confronted with a highly complex environment (i.e. external complexity). This external complexity seems to arise as a result of new standards construction projects continually have to deal with and the large variety of stakeholders involved in the project (Divya and Ramya, 2015, p. 47).

**Self-organizing activities and organizational control**

The problems that many temporary construction organizations have to deal with can be seen as control problems (cf. Achterbergh & Vriens, 2010). In complex and dynamic contexts, such as a construction project (Winch, 1989), organizational control cannot be developed through adding new procedures or by managerial decisions, since these are often badly suited to deal with these complex and dynamic circumstances (Dekker, 2000; Dekker, et al., 2011). Actually, organizational control within a complex context might be largely developed by self-organizing activities of interacting operators while doing their everyday normal work (Dekker, 2000). These self-organizing activities can be defined as: “Local and daily problem-solving activities performed by operators” (Dekker, 2005; Moorkamp, 2017).
The effect of organizational structure

According to De Sitter (1998), characteristics of the organizational structure, which can be defined as “the way activities are grouped and coupled to workstations in relation to order flows” (Moorkamp, 2017, p. 48), highly influence individual efforts to deal with complexity in a successful way. As such the division of labor impacts individual behavior since it is related to the number of problems occurring within an organization and the way operators can solve these problems (De Sitter, 1998; Moorkamp, 2017). As organizational control in complex organizations is developed through behavior and social interaction of individual operators (Dekker, 2000), the organizational structure is a crucial factor in facilitating the degree of self-organizing activities of organizational members and the extent to which this will lead to a controllable organization (Moorkamp, Wybo & Kramer, 2016).

Organizational structure within a temporary organization

As stated before, construction projects are facing external complexity and uncertainty. As a result, Winch (1989) describes the organizational structure of a construction project as highly dynamic. Moreover, a construction project consists of multiple parent organizations which cooperate in that project (Bakker, 2011; Modig, 2007). Through these specific characteristics, the organizational structure of a temporary construction project probably highly differs from the organizational structure of a traditional organization.

Based on principles of the Sociotechnical Systems Design (STSD) theory, the effect of organizational structures on self-organizing activities within traditional bureaucratic organizations is well known (De Sitter, 1998). However, within temporary organizations, there has been little research conducted on these topics. Therefore, this research will try to explore how self-organizing activities and organizational structures are related to each other within a temporary construction project.

Research goal

Based on the above, the research goal is the following:

‘The goal of this research is to provide insight into the way in which self-organizing activities of operators within construction project X are influenced by structural characteristics of the temporary project organization’.

Research object

The research will be conducted at a large construction project in The Netherlands. For privacy
reasons anonymity of this project will be ensured. In this project a second production-line (consisting of three large industrial buildings and a small one) and a new headquarter for a Dutch company are built. The execution of the project started in Augustus 2016 and is planned to be finished in October 2017. More information about the construction project (i.e. research object) can be found in chapter 4, Background Information.

Research questions
Based on the research goal, the main research question is the following:

‘In what way are self-organizing activities of operators within construction project X influenced by structural characteristics of the temporary project organization?’

To answer the main research question, the following sub-questions are formulated:

1. How is organizational control developed through self-organizing activities of operators?
2. How do structural characteristics influence the abilities of operators to develop organizational control by means of self-organizing activities?

Practical relevance
There are two practical implications of this study. Firstly, the results of this research could be used by practitioners within the construction industry to analyze their current organizational structure and its effect on self-organizing activities of operators. Secondly, practitioners within the construction industry can use the results of this research to design an adequate project organization which enables operators to perform self-organizing activities. To do so, this study gives practitioners more insight into how self-organizing activities are influenced by the design of the temporary project organization (i.e. organizational structure).

Scientific relevance
Although the aim of this research is practical, this research could contribute to several theories. Firstly, this research is relevant to the construction literature, in which less research has been conducted about self-organizing activities and the organizational structure of these construction projects up to now. Secondly, this research may contribute to organizational design theories, especially to the Sociotechnical Systems Design (STSD) theory of De Sitter because this theory will be used to analyze the structure of temporary organizations. Outcomes of this study could contribute to the application of the STSD theory on a temporary organization. Thirdly, this study could advance theory about temporary organizational
structures, especially because the relationship between self-organizing activities of employees (which create organizational control) and structural characteristics is researched. Outcomes could add to theories about how to adequately design a temporary organization.

**Outline of this thesis**

In the introduction the line of argumentation was given, this has led to the aim of this research and the main research question. In the second chapter, a theoretical background will be given. This literature review will focus on the main concepts of this research. Based on this literature review, a conceptual model will be made. This chapter can be seen as the analytical framework to interpret the results of this study. In the third chapter, Research methodology, the methodological choices (such as sampling techniques, data collection, data analysis and research ethics) will be explained. In chapter four, background information about the research object will be given. Furthermore, in chapter five, six and seven the results of the data collection will be described by answering the sub-questions of the research. In chapter eight, Conclusion, the main research question will be answered. In the ninth and final chapter, Discussion and reflection, the main practical and theoretical implications will be given, there is a critical reflection on the limitations of the research, suggestions for further research will be made and there will be an ethical reflection on the role of the researcher.
Chapter 2: Theoretical framework
In this chapter, a theoretical framework is outlined. Within this theoretical framework the main concepts of the research will be further elaborated, which will ultimately lead to the development of a conceptual model.

2.1 Problems within the construction industry
As stated in the introduction, there is a paradox in relation to construction projects: more and more construction projects are carried out at the moment, while, on the other hand, many projects perform poorly in economic, environmental and public terms (Flyvbjerg, 2003, p. 3). There are several serious problems within construction projects. The most significant issues are cost overrun (Jackson, 2002; Ahmed, Dlask & Hasan, 2014), time delay (Srdić and Šelih, 2015; Divya and Ramya, 2015), environmental issues (Hussin et al., 2013) and safety (SZW, 2016). These problems will be shortly outlined below.

2.1 Cost overrun
According to Jackson (2002, p. 1), the construction industry has a reputation for project delivery with higher costs than estimated. Flyvbjerg (2003, p. 19) states that it is even more difficult to predict what exactly causes these cost overruns in projects, than the fact that there will be cost overruns in many projects. The prediction of actual project costs is so difficult for the reason that many factors and variables, which influence costs, are difficult to predict (Ahmed et al., 2014). To discover causes concerning the problems of cost overrun, Jackson (2002) has performed a study under 114 construction projects within the UK. In his perspective the key reasons for cost overruns in these cases were the client-driven changes in project specifications (52% of all cases), an incomplete or too general design (in 36% of all cases) and a lack of information about the project design (32% of all cases). Other critical reasons for cost overrun were: the estimating method, team performance of construction team, management of the project, a lack of time and site conditions (Jackson, 2002).

2.2 Time delay
Current complexity and dynamics within construction projects have made the completion of a project on schedule a hard task and therefore construction projects are often delayed (Divya and Ramya, 2015). Even though projects are planned and prepared with a high accuracy, uncertainties and unexpected events will appear while the project is executed (Srdić and Šelih, 2015). Delayed activities of a single project participant could have large consequences, namely: a lagged completion of the project, productivity loss, increased costs and contract
termination (Divya and Ramya, 2015, p. 47). According to Ahmed et al. (2014), time delay is highly correlated with cost overrun. Moreover, delays also highly influence quality and safety (Divya and Ramya, 2015). Delay might be caused by clients, users, consultants, designers, owners, contractors and suppliers. Several illustrative causes for delays are delay in progress payments (owner), reworks due to errors (contractor), poor communication and coordination (contractor), shortage of material (supplier), equipment breakdowns, shortage or insufficient skills of labors and the obtainment of permits from municipalities (Divya and Ramya, 2015, p. 51-52).

2.3 Environmental effects
Flyvbjerg (2003, p. 4) states that environmental and social effects are often not taken into account within construction projects. The construction industry can be seen as a threat to the environment, as it is consuming large amounts of natural resources while it is one of the main polluters towards environment at the same time (e.g. through the emission of CO2) (Hussin et al., 2013). Moreover, much waste is generated by construction projects (approximately 10% of the total material cost is waste). Waste generation significantly reduces revenues, since it has a direct impact on the project its productivity, material loss and completion time. According to Hussin et al. (2013, p. 16-17), there are multiple reasons for the creation of construction waste, such as frequent changes in design, poor quality of materials, workers mistakes, errors in ordering and poor site management.

2.4 Safety
Safety is an essential issue on construction sites nowadays. As shown by a publication of the Dutch governmental organization The Inspectorate SZW (2016), there was a significant increase of both deadly accidents and serious accidents in the first half year of 2016. As a consequence, a construction site is considered to be one of the most dangerous places to work. For instance, the risk of a major injury is 2.5 times higher in the construction industry than in manufacturing. According to a literature review on safety within construction projects, provided by Khosravi et al. (2015), there are eight categories of factors that cause unsafe behavior in construction projects. These causes are classified as: individual characteristics (such as attitude and motivation of employees, age, experience and drug abuse), site conditions (e.g. unsafe equipment, hazardous operation (such as work at heights) and bad weather), workgroup (group norms, group attitude and teamwork), contractor (e.g. the larger the contractor, the more unsafe behavior and the more price-focus, the less attention to safety
is given), supervision (e.g. communication and performance pressure of supervisors), project management (e.g. management support and communication), organization (e.g. safety policies, safety culture, clear responsibilities and job design) and society (e.g. cultural and language problems, national culture and education) (Khosravi et al., 2015).

2.2 Temporary organizations
Construction projects are not conducted by a traditional organization but by a special type of organization, namely a temporary organization that is ad-hoc formed for the specific project (Modig, 2007). Modig (2007, p. 808) states that these temporary organizations are very useful to carry out complex and multi-disciplinary tasks and are characterized by a small batch production (or even only one specific end-product) which is usually highly customized. Burke and Morley (2016) define a temporary organization as: “A temporally bounded group of interdependent organizational actors, formed to complete a complex task” (p. 1237).

Construction projects are performed by a specific type of temporary organization, which can be described as inter-organizational project ventures (Bakker, 2011) or inter-organizational temporary organizations (Burke and Morley, 2016). Bakker (2011) defines this type of temporary organization as: “Inter-organizational systems of multiple organizations that cooperate to solve pre-defined tasks in a limited amount of time” (p. 13). Such a temporary organization could be seen as an ad-hoc formation of semi-autonomous building blocks that come from different parent organizations (De Waard & Kramer, 2008). This means that there are multiple parent organizations cooperating in the temporary organization which will continue to exist when the temporary organization terminates (Burke and Morley, 2016, p. 1238).

2.2.1 Basic concepts to characterize a temporary organization
There are four basic concepts to classify and characterize a temporary organization. These concepts will distinguish them from traditional organizations. The first concept is time (duration). A temporary organization has a limited time horizon (Lundin and Söderholm, 1995, p. 438) which is often proposed to be short (Bakker, 2011). Bakker (2011, p. 55) states that time is especially important, because the shorter the project, the less time is available to develop personal relationships, regular trust, shared knowledge and understanding.

The second concept of a temporary organization is its task. Generally, these organizations have only one single (or a limited number of) pre-defined task(s). This task is the reason why the temporary organization is created and exists (i.e. raison d’être) (Lundin and Söderholm,
This task can be characterized as complex, uncertain and ambiguous (Burke and Morley, 2016) and can vary from being unique or repetitive. The more repetitive a task, the more room to develop explicit knowledge, processes and routines to carry out the task more efficiently (Bakker, 2011, p.56).

The third concept mentioned by Lundin and Söderholm (1995) is team. This refers to the group of people involved in the project (Lundin and Söderholm, 1995). Within an inter-organizational context, team refers to the different organizations participating in the project. The higher the number of organizations involved, the more complex the project will be (Bakker, 2011, p.55). This is caused by operators that having a ‘home’ beside the temporary organization (i.e. their own parent organization) (Lundin and Söderholm, 1995; Burke and Morley, 2016). Because organizational members of temporary organizations come from a variety of locations, they have different (specialized) skills to carry out the task, have different experiences, levels of responsibilities, interests and point of views. Therefore, Ngige Chingbo (2013, p. 106) describes the initial structure of a temporary organization as chaotic.

The fourth concept of a temporary organization is transition. (Lundin and Söderholm (1995). More specifically, any temporal organization performs an element of change (i.e. a transition of a product from begin to end-state). Bakker (2011) has replaced transition with embeddedness (i.e. project context) and states that a temporary organization is embedded in two types of contexts: (1) (parent)organizations in which the temporary organization is embedded and (2) a wider social context (such as industry, personal networks and community) (Bakker, 2011, p. 45). Within inter-organizational temporary organizations, a crucial element of embeddedness is whether there are previous connections between project partners (e.g. previous collaborations), because it impacts issues as trust, experience and shared understanding (Bakker, 2011, p.56).

### 2.2.2 Continuum of temporary organizations

Modig (2007) has developed a continuum of organizations, ranging from stationary to temporary organizations. This continuum (Modig, 2007), as shown in figure 1 below, attempts to distinguish between different forms of organizations and their characteristics.
Construction projects can be found somewhere in the middle of this continuum and have several characteristics according to Modig (2007). Firstly, they consist of employees who have a long-term employment contract within a stationary organization (i.e. employees are contracted by different parent organizations). Secondly, work processes of construction projects are largely pre-defined, often by the parent organization or the main contractor. Work is predefined to reduce communication needs, uncertainty and the probability of conflicts. Thirdly, resources are largely provided by existing organizational networks of the contractor (to achieve economies of scale and secure access to critical materials) or existing networks of the subcontractor (Modig, 2007). The latter is also described by Burke and Morley (2016), who state that temporary organizations generally depend on resources allocation from their parent organization(s).

2.2.3 Environmental complexity

As stated by Divya and Ramya (2015, p. 47), construction projects continuously have to comply with new standards and frequently have to deal with changes in project specifications desired by the client. Moreover, it can be stated that construction projects become more complex as a result of the increasing number of stakeholders involved in the project (e.g. principals, architects, clients, users, regulators, contractors, subcontractors and consultants) (Divya and Ramya, 2015, p. 47). Furthermore, according to Winch (1989, p. 338), construction projects have to cope with natural uncertainty, as the weather and geological conditions may impact the project significantly. At the same time, construction projects are also confronted with contractual uncertainty, since the contracting of stakeholders is based on competitive tendering (i.e. (sub) contractors offer their services based on estimated costs). As a consequence, prices and project specifications are fixed up front and firms have varying economic interests (Winch, 1989, p. 338). Therefore, it could be stated that construction projects are confronted with a highly complex environment (i.e. these projects have to deal with a high amount of external complexity).
2.3 Self-organizing activities and organizational control

The problems that many construction projects are facing (i.e. delays, cost overrun, environmental effects and safety issues), can be seen as organizational control problems within construction projects (cf. Achterbergh & Vriens, 2010). Within an organization that has to deal with a highly complex environment, such as a construction project, organizational control is an emergent property (Dekker et al., 2011, p. 939). Moreover, a construction project could be seen as an organic type of organization in which the nature of the work, the working environment and the working conditions constantly change (Khosravi et al., 2014, p. 118). In these types of organizations it could be hard to develop organizational control by adding new procedures, policies and protocols, because these are often not appropriate to deal with the complex and dynamic circumstances the organization faces. Actually, more procedures and rules will probably only increase the complexity of the system. Furthermore, increasing organizational control through managerial decisions could be difficult as well. Because, although decisions can seem rational given the local circumstances and the goals, knowledge and attention of the decision makers, complexity of the system can make the outcomes of decisions unpredictable and undesirable (Dekker et al., 2011, Khosravi et al., 2014).

Instead of adding procedures and managerial decisions to develop organizational control, it could be stated that, within a dynamic and complex environment (such as a construction project), organizational control is largely developed by means of self-organizing activities of operators while doing their everyday, normal work (Dekker, 2000). These operators act based on unwritten routines, personal expectations, professional judgement and verbal influences of other people while they continuously have to deal with pressures and uncertainties during their normal daily work. To do their daily job, operators continually have to make trade-offs between various organizational goals (e.g. trade-offs between cost and quality or between time and safety) (Dekker, 2000).

While they develop organizational control, these operators act under ‘local rationality’. This means that they act reasonably given the goals they were trying to reach and the complexities, dilemmas, trade-offs and uncertainties involved at the moment (Dekker, 2013, p. 2). During this process of sense-making, they continuously try to interpret and assess the current circumstances, and based on the interpretation they make of this, they choose for the best possible action to create organizational control (Dekker, 2000; Dekker, 2013, p. 4).
Within a dynamic and complex environment, organizations are characterized by a necessity to act. This means that an operator can only discover what needs to be done by starting to act. The environment is this dynamic that it is impossible to develop a detailed protocol for each situation (Weick, 1979). Within such a dynamic context, organizational control is constantly under pressure. While trying to develop organizational control, an operator is in a difficult situation. On the one hand, the operators are confronted with new, complex and unpredictable situations, while they are supposed to follow fixed organizational rules and protocols on the other hand (which are often not suited to handle the specific situation). Thus, organizational control cannot be developed by just following rules and procedures. Instead it is about self-organizing activities of operators who continuously solve urgent and ad-hoc problems in interaction with other operators (Moorkamp & Kramer, 2014, p. 5-6).

In their research, Jolivet and Navarre (1996) studied uncertain and complex large-scale projects (projects that are innovative and/or have to deal with an unstable environment) in which a management style based on self-organization and meta-rules was used. Within this approach, the project organization consists of autonomous teams that use principles of self-organization. In these teams there is an emphasis on trust and individual responsibility rather than on systems, rules and procedures. Individuals are fully responsible to absorb the uncertainties within their work and are autonomous to make thousands of micro-decisions needed to cope with the continually changing circumstances. To be fully responsible and really autonomous, individual workers are given control of resources and have the freedom to organize and control their work. There is no standardization, instead individuals have the right to be different and there is a high degree of decentralization. Furthermore, there is only a small number of rules and procedures (which are defined as meta-rules) that provide the organization a legal framework (Jolivet and Navarre, 1996, p. 266-267).

2.4 Organizational structure

According to De Sitter (1998), characteristics of the organizational structure highly impacts the extent to which individuals can successfully deal with environmental complexity. Moreover, Kuipers et al. (2010) state that the organizational structure highly influences the social interaction network, interaction processes and the behavior of individuals within an organization. Since organizational control within complex organizations is highly developed by means of individual behavior and social interactions of individual operators (Dekker,
An organizational structure could be defined as: “the way activities are grouped and coupled to workstations in relation to order flows” (Moorkamp, 2017, p. 48). An organizational structure emerges when the overall activity (e.g. construction of a building) is split up into sub-activities (e.g. foundation, construction, roof and wall cladding etc.) and is divided over workstations (e.g. people or machines) (Achterbergh and Vriens, 2010). De Sitter states that the organizational structure could both directly impacts the number of the disturbances and indirectly influences the way operators can deal with these disturbances (Moorkamp, 2017, p. 48-49).

2.4.1 Direct effect of organizational structure on self-organizing activities

De Sitter describes an organization as a network of social interactions and states that the way activities are grouped and coupled over workstations (i.e. organizational structure) is highly related to the social network of interactions of an organization (Kuipers et al., 2010, p. 74). The more the work is divided across different workstations, the more complex the social interaction network will be and the higher the chance on disturbances, interferences (i.e. interactions that are contradictory) and mistakes are. For example, the chance on disturbances is higher when a task has many relations with its environment and when these relations are more variable (e.g. the number of different orders, messages, instructions etc.) (Achterbergh and Vriens, 2010; Kuipers et al., 2010). Therefore, the organizational structure (i.e. structural complexity) could directly impact the number of disturbances that arise in an organization, as a consequence of a complex network of social interactions. This can be described as the direct effect of organizational structure on self-organizing activities (Moorkamp, 2017).

The concept of the network of social interactions can be illustrated by the following image (figure 2) (De Sitter, 1998, p.7). This image shows the number of interactions that take place to complete an order at a single workplace. For example, an employee has to work together with his colleagues, team leader, manager, quality department, transport, communication etc. to perform his task successfully.
2.4.2 Indirect effect of organizational structure on self-organizing activities

Besides the direct effect, the organizational structure has an indirect effect on the way operators can deal with disturbances that arise (i.e. self-organizing activities) (Moorkamp, 2017, p.48). This is because the organizational structure influences the way operators can deal with disturbances through control capacity (De Sitter, 1998).

Disturbances can be described as problems in the work that require a solution. When a disturbance occurs, the work is not executed as it was intended, planned or agreed upon (Christis, Nijenkamp & Soepenberg, 2014, p. 5). As disturbances can never be fully eliminated, operators need regulatory potential to deal with the remaining disturbances and to make their work more controllable (Christis et al., 2014, p. 8). According to Christis et al. (2014) and Moorkamp (2017) the division of labor (i.e. organizational structure) could highly influence the extent to which operators can independently solve their own problems (i.e. internal control capacity) or that they need to involve others to solve the problem (i.e. external control capacity). Because the organizational structure impacts the regulatory potential of operators, the organizational structure has an indirect influence on how operators can deal with disturbances they encounter in their work and thus on self-organizing activities of operators to create organizational control (Moorkamp, 2017, p. 48).

2.4.3 Structural parameters

To gain insight into the strength of the direct and indirect effect of the organizational structure on self-organizing activities, De Sitter (1998) has developed seven parameters which can be used to analyze the current structure of any organization. These parameters describe relevant
characteristics of the organizational structure and the level of these parameters is therefore highly related to self-organizing activities that create organizational control (i.e. the higher the level of these parameters, the higher structural complexity and the lower control capacity of operators) (Achterbergh and Vriens, 2010).

1. The level of functional concentration refers to the grouping and coupling of operational tasks relative to order flows (i.e. the extent to which specialist activities are grouped into specialized functional departments);
2. The level of differentiation of making, preparing and supporting activities (i.e. are these activities divided over separate workstations or integrated into the same function);
3. The level of specialization of operational activities into small (often repetitive) subtasks;
4. The level of separation between operational and control activities (i.e. are operational and control activities divided over separate workstations or integrated);
5. The level of differentiation of regulatory activities over parts of the process (i.e. the degree to which every department has its own manager);
6. The level of differentiation of regulatory activities into separate domains (e.g. quality, finance, HR etc.);
7. The level of differentiation of regulatory activities into strategic regulation, regulation by design and operational regulation;
8. The level of differentiation of regulatory activities into parts (i.e. the extent to which different workstations deal with monitoring, evaluating and adjusting activities) (Kuipers et al., 2010; Achterbergh and Vriens, 2010; Moorkamp, 2017).

De Sitter (1998) makes a distinction between the production structure and the control structure of an organization. The production structure refers to the way operational transformations, such as making, preparing (e.g. design and planning) and supporting (e.g. quality control and administration), are grouped and coupled into tasks and related to orders (Achterbergh and Vriens, 2010; Kuipers et al., 2010; Van Hootegem, Van Amersfoort, Van Beek & Huys, 2008). The first three parameters describe this production structure, while the fourth parameter defines the relation between production and control structure. The control structure is about the way control tasks (such as measuring, evaluating and adjusting) are
divided across workstations (Achterbergh and Vriens, 2010). The last four parameters (five, six, seven and eight) characterize this control structure.

2.5 Structural characteristics of construction projects

As mentioned earlier, construction projects are confronted with a complex and uncertain environment. Moreover, the organizational structure can be described as highly dynamic as well, because each new contract with a subcontractor leads to a new structure of the temporary organization (Winch, 1989, p. 338). Furthermore, there are multiple parent organizations involved in a construction project (Bakker, 2011). Because of these specific characteristics, it can be assumed that the organizational structure of a construction project is different from the organizational structure of a traditional organization. Actually, besides the two studies which are highlighted below, there has been little research conducted about the influence of the organizational structure on self-organization within temporary organizations.

2.5.1 Construction projects

Karreman and Steffens (2007, 2008, 2009) have studied organizational control problems within construction projects from an organizational structure point of view. Within their research they have focused on three stakeholder groups (the client, architect and the main contractor) within a construction project, and in particular, when they got involved in the construction process. They have concluded that the organizational structure of a construction project could highly influence the number of conflicts, additional work (i.e. costs caused by unexpected circumstances; in Dutch: meerwerk) and the realization of the project (i.e. time, quality and costs) (Karreman and Steffens, 2007, 2008, 2009). Since these elements could be seen as aspects of organizational control, it could be assumed that the organizational structure of a construction project affects organizational control. Our research contributes to this topic because a perspective of individual operators, who attempt to create organizational control in cooperation with a large variety of stakeholders and under dynamic and complex circumstances, is chosen.

2.5.2 Comparison with the military context

Apart from the study of Karreman and Steffens (2007, 2008, 2009), limited research in construction projects is done about organizational structure and the effect on self-organizing activities of operators. However, it could be valuable to look at studies conducted in comparable temporary organizations. Based on a study of Modig (2007), it can be stated that temporary military organizations and construction projects broadly have the same
characteristics. Therefore, the structure of temporary organizations within the construction industry could be compared with those in the military sector.

Within the context of temporary military organizations, organizational control is largely developed through self-organizing activities of organizational members. This means that these operators might develop organizational control through daily interactions while doing their ‘normal work’ (Moorkamp et al., 2016, p. 251). The organizational structure of the temporary organization is a crucial factor in assisting the degree of these self-organizing activities of organizational members and the extent to which this will lead to a controllable organization (Moorkamp et al., 2016, p. 251), because the organizational structure has a high influence on the type and the number of problems these operators experience in their normal work (De Sitter, 1998).

The organizational structure of temporary military organizations consists of building blocks that are taken from (different) parent organizations and then merged into one temporary, ad-hoc organization (De Waard & Kramer, 2008). Since construction projects and temporary military organizations have the same characteristics (Modig, 2007), it could be the case that they also have a similar type of organizational structure. Based on a study of Moorkamp et al. (2016) organizational structures of military temporal organizations have the following characteristics:

- There is an absence of structural coupling;
- a complex network of interactions;
- functional concentration;
- functional specialization;
- problems to integrate different units;
- underdeveloped and inadequate rules and procedures;
- a constant rotation of units (e.g. constantly new units and partners during project execution).

2.5.3 Conclusion structural characteristics of construction projects

These two studies conducted within temporary organizations, have shown that the organizational structure could highly influence organizational control within construction projects and that in comparable organizations, namely temporary military organizations, organizational control is largely developed by means of self-organizing activities. Actually,
Besides these studies, there has been little research conducted on these topics within a construction project. To further discover these topics, this research will use concepts of the Sociotechnical System Design (such as the network of social interactions, structural parameters and control capacity) to analyze construction projects.

Based on the Sociotechnical System Design (STSD) theory, the effect of organizational structure on self-organizing activities that create organizational control within traditional organizations is well-known (De Sitter describes these traditional bureaucratic organizations) (De Sitter, 1998). The STSD theory is usually aimed to analyze and redesign traditional, bureaucratic organizations which are characterized by rigidity and stability (De Sitter, 1998). Although construction projects are composed of multiple organizations that often originate from bureaucratic parent organizations, construction projects themselves are not rigid and stable (these projects are namely characterized by high complexity and uncertainty). As a consequence, the STSD approach cannot be applied one-to-one to construction projects. Hence, the concepts of the STSD theory can be used as a tool to analyze the structure of the temporary organization and to discover in what way self-organizing activities and organizational structure are related to each other within a temporary construction project. The conceptual model on the next page will facilitate this.

2.6 Conceptual model

The conceptual model (figure 3) is an exploratory conceptual model that will be used to discover relationships between the central concepts of this study. These concepts are abstractly formulated and will be refined and detailed by means of the research (Verschuren & Doorewaard, 2007).

Literature study has shown that the problems many construction projects face, can be seen as organizational control problems (Achterbergh and Vriens, 2010). Within a complex organization such as a construction project, organizational control could be largely developed through self-organizing activities of organizational employees who act based on unwritten routines, personal expectations, personal judgement and verbal influences of others (Dekker et al., 2011). According to De Sitter (1998), these efforts of individual employees to create control might be highly influenced by the organizational structure. The organizational structure could directly influence the number of disturbances that arise in an organization as a consequence of a complex network of social interactions (direct effect) and could indirectly
influence the way operators can solve these problems (indirect effect) (De Sitter, 1998; Kuipers et al., 2010).

Besides the conceptual model below, a research model has been attached in Appendix 1.

Figure 3: Exploratory conceptual model of the research
Chapter 3: Research methodology
In this chapter, research methodology, will be described how the research is designed and will be conducted in order to answer the central research question. This chapter presents the following topics: research philosophy, research design, methods of data collection, data analysis, research criteria and research ethics.

3.1 Research philosophy
The first phase of the research (i.e. executing the interviews) is conducted from an interpretive research philosophy, in which the goal is to understand behavior of individuals instead of generalization and constructing central laws (Hudson and Ozanne, 1988, p. 509). Hereby interpretations of individuals are taken as the starting point to develop knowledge about the world (Duberley, Johnson & Cassell, 2012, p.21). By getting an understanding of the subjective meanings and interpretations actors give to phenomena (Duberley et al., 2012, p. 21), self-organization will be described by the use of an interpretive approach in the interviews.

Furthermore, this socially constructed reality (that has been discovered by means of the interviews) will be analyzed by the use of a conceptual model. Therefore, it can be stated that the second phase of the research (i.e. analyzing the results) is conducted with a more critical realistic research philosophy. Critical realistic philosophers assume that there exist an external world independent of our human perception and that our knowledge of the world is socially constructed (i.e. every individual develops its own reality) (Easton, 2010). In this research, a critical realistic philosophy will be used to explore whether the conceptual model reflects the reality of the respondents in a best possible way.

The chosen research philosophies impact all methodological choices which are described in the following sections. In addition, because the relationship between subject and researcher is interactive and participative and the researcher constructs its own reality as well, it is important that the researcher reflects on its own position and how this might have affected the research results (Van der Ven, 2007; Hudson and Ozanne, 1988). How this can be ensured, is described in the last section of this chapter (research ethics).

3.2 Research design
Since this research is providing knowledge and information that can contribute to detecting,
understanding and solving practical problems within the construction industry, it can be stated that this research is practice-oriented. There are five stages of practice-oriented research: problem analysis, diagnosis, design, intervention and evaluation (Verschuren & Doorewaard, 2007). This study is about the problem analysis stage, for the reason that it studies and tries to find explanations for possible organizational control problems.

Boeije (2014) makes a distinction between quantitative and qualitative research. For this study a qualitative research approach is preferred, since it is a method of inquiry that attempts to explore and understand a social or human phenomenon by means of studying meanings, experiences and points of view of individuals (Bleijenbergh, 2013; Boeije, 2014). Moreover, qualitative research is very suitable to study the organizational context (such as the organizational structure of the construction project) in which individual behavior (e.g. self-organizing activities) occurs. Additionally, since qualitative research is very useful to capture rich experiences of individuals (Bleijenbergh, 2013; Boeije, 2014), it helps to understand which problems operators face and how they can solve them. Within this study, two qualitative approaches will be combined: case study research and the grounded theory approach.

**Case study**

To answer the research question, a case study will be performed. A case study can be defined as an empirical inquiry that investigates a contemporary phenomenon (the case) within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident (Yin, 1994, p. 13). This type of research is particularly useful to deal with “how” questions and in situations in which no control or behavior events are required (Yin, 1994, p. 6-7). A case study is preferred because it gives a clear understanding of the context (such as organizational and managerial processes within an organization) in which the researched phenomenon takes place (Saunders, Lewis & Thornhill, 2015). Moreover, a case study is an appropriate research strategy to discover a phenomenon on which there has been little or no research conducted (such as self-organization within temporary construction organizations) (Swanborn, 2013, p. 53). Within

![Temporary construction Organization X](image)

*Figure 4: Single embedded case study*
this research, a single-embedded case study will be conducted, in which a specific construction project is the single case and there are multiple units of analysis that are embedded within that specific project (i.e. the different project participants) (Yin, 1994, p. 39). This is illustrated in figure 4.

**Grounded Theory**

A grounded theory will be developed based on this case study. A grounded theory is a theory that emerges out of the data and does not start with a thorough literature study (Kenealy, 2012; Saunders et al., 2015). It is a type of qualitative research that studies and tries to understand phenomena about which little is known (Richardson and Kramer, 2006, p. 497). Since little is known about the relation between self-organization and organizational structure within temporary organizations, a grounded theory approach is suitable. To develop a grounded theory an abductive strategy will be used. Abduction tries to make sense of new (or unknown) situations by developing useful explanations for observed facts. In an abductive approach the observed data is combined with general theoretical assumptions (which leads to an analytical reconstruction of the observed data) (Richardson and Kramer, 2006, p. 499-501). For this research, this means that normal work practices of operators (observed data) will be analyzed from a Sociotechnical System Design (STSD) theory perspective. The analytical reconstructions are often presented in the form of propositions or hypotheses (Richardson and Kramer, 2006, p. 501). To develop a grounded theory, four steps need to be executed: exploration, specification, reduction and integration (Wester and Peters, 2004). These steps will be illustrated in section 3.5 about data analysis.

**3.3 Methods of data collection**

To analyze daily work practices of operators within the construction project, data is collected by the use of interviews. Interviews are chosen as they give rich descriptions of individual experiences, problems and meanings (Alvesson and Ashcraft, 2012). The interviews are held face-to-face and are semi-structured. To conduct these interviews, a topic list is developed in which the formulation and sequence of (open and general) questions are to a large extent fixed (this topic list is included in Appendix 3). The aim of the topic list was to translate the central concepts of the research in such a way that these concepts correspond to the frame of reference of the respondents (Wester & Peters, 2004, p. 61). Moreover, as Wester and Peters (2004, p. 62) recommend, the topic list consist of probing questions which can support talking about these topics in depth. Due to knowledge gathering, this topic list has changed and topics became more specific during the interview process. To illustrate the development of the topic
list during the interview process, two topics lists are included in Appendix 3: a topic list that was made for the first interview and one that was used in the final interview. The main advantage of this topic list is that the researcher can guide and direct the interview and that all participants, to a large extent, are questioned about the same topics. (Bleijenbergh, 2013, p. 63). The interviews were recorded and transcribed.

Respondents were chosen based on the researcher’s judgement about which characteristics of participants are important in relation to acquiring all data necessary to achieve the research purpose (non-probability sampling) (Saunders, 2012, p. 39). However, it is important to consider that, sometimes researchers cannot get access to every respondent they would like to interview and are therefore forced to rely heavily on those people to which they can get access to (Alvesson and Ashcraft, 2012, p. 247). Moreover, snowball sampling is used, when respondents are asked to nominate other people that would like to participate in the research as well (Saunders, 2012). There are no hard guidelines about the number of participants that should be selected. Kvale and Brinkmann (2009) recommend a minimum sample size between the 5 and 25 respondents (Saunders, 2012, p. 45).

To get some general knowledge about the temporary organization and the construction process, first an exploratory interview with the site manager was held. Thereafter, eleven respondents were interviewed (an anonymous overview is given by the table below)

<table>
<thead>
<tr>
<th>No.</th>
<th>Respondent</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Exploratory interview site manager main contractor</td>
<td>35:41 min</td>
</tr>
<tr>
<td>B</td>
<td>Construction planner main contractor</td>
<td>01:12:23 min</td>
</tr>
<tr>
<td>C</td>
<td>Project manager client organization</td>
<td>01:02:36 min</td>
</tr>
<tr>
<td>D</td>
<td>Construction worker 1 main contractor</td>
<td>01:00:29 min</td>
</tr>
<tr>
<td>E</td>
<td>Construction worker 2 main contractor</td>
<td>52:17 min</td>
</tr>
<tr>
<td>F</td>
<td>Safety coordinator construction project</td>
<td>01:09:22 min</td>
</tr>
<tr>
<td>G</td>
<td>Site manager subcontractor X</td>
<td>01:08:01 min</td>
</tr>
<tr>
<td>H</td>
<td>Site manager subcontractor Y</td>
<td>01:01:06 min</td>
</tr>
<tr>
<td>I</td>
<td>Construction worker subcontractor Y</td>
<td>55:47 min</td>
</tr>
<tr>
<td>J</td>
<td>Foreman subcontractor X</td>
<td>51:40 min</td>
</tr>
<tr>
<td>K</td>
<td>Construction worker 1 main contractor</td>
<td>01:08:05 min</td>
</tr>
<tr>
<td>L</td>
<td>Site manager main contractor</td>
<td>01:22:49 min</td>
</tr>
</tbody>
</table>

*Table 1: Overview of interview respondents*
To create an open and trustworthy environment within the interview, the researcher has introduced himself and the research at the start of the interview. Besides, before the interview started, permission to record and transcribe the interview was asked. Hereby anonymity of participants and confidentiality of all information gathered in the interview is guaranteed. Moreover, besides the topic list, the interviewer had prepared a scheme to get insight into the network of interactions of the respondent (Appendix 5) and a table in which disturbances and solutions could be written down.

To prepare for the interviews, several relevant documents were analyzed since documents can cover a long period and can provide details of policies, procedures, agreements and records of events (Lee, 2012, p. 389). The following types of documents were used: the central planning of the project, a list of subcontractors, (several) minutes of meetings between different stakeholders during the project, the risk inventory and evaluation and the health and safety plan of the construction project.

3.4 Operationalization

As stated before, operators create organizational control by means of self-organizing activities of operators while doing their everyday, normal work (Dekker, 2000). To study these “daily” activities in the context of the construction project (i.e. within the interviews), the abstract concepts of this research need to be operationalized. This operationalization is attached in Appendix 2. Based on this operationalization, a topic list for the interviews has been created.

3.5 Data analysis

As mentioned before, the data analysis, in which the grounded theory is developed, is a process that consists of four steps: exploration, specification, reduction and integration. Within the phase of exploration (step 1), the aim was to get an in-depth understanding of the object under study, therefore as many codes as possible will be derived from the interview transcripts (Wester and Peters, 2004, p. 153-158). These codes are open codes, which are descriptive, stay close to what participants have said and reflect events from the point of view of the respondent (Kenealy, 2012, p. 413). A total of 93 open codes were used, that describe self-organizing activities of operators while doing their normal work. These codes represent all kind of disturbances construction workers encounter during their work and all possible solutions to deal with these disturbances.
In the specification phase, these 93 open codes were re-examined with regard to the (influence of the) organizational interaction network. By means of constant comparison within the material, axial codes were developed in this phase (Wester and Peters, 2004, p. 160-165). Axial codes combine open codes, form categories, delete overlapping codes and thus bring the coding process to a higher, more abstract, conceptual level (Kenealy, 2012, p. 413-414). A total of 19 axial codes were used to describe problems and solutions in relation to the organizational interaction network (i.e. in which the interaction network influences the number of problems that arise within the organization and/or influences the control capacity of operators to solve problems). Based on these axial codes, seven “dealing with-categories”, which describe disturbances and solutions to deal with them, were developed. The results of the exploration and specification phase are written down in chapter five, in which the first sub-question is answered. The codebook (Appendix 4) gives an overview of all open and axial codes (i.e. the exploration and specification phase of the data analysis).

In the third step, the reduction phase, connections between these central concepts (i.e. axial codes) were developed (Wester and Peters, 2004, p. 169-173). To do so, the first step was to derive the main structural characteristics out of the “dealing with-categories”. Thereafter, by means of an abductive strategy, the normal work practices of construction workers (which were described in the dealing with categories) were combined with the theoretical assumptions of the Sociotechnical Systems Design theory about the organizational structure. The main goal of this was to analyze the organizational structure of the construction project and its influence on self-organizing activities of construction workers. The results of the reduction phase are written down in chapter six, in which the second sub-question has been answered. In the last phase, integration (phase 4), the grounded theory was developed which requires that the relations between central concepts are written down and that hypotheses are developed (Wester and Peters, 2004, p.176-178). In this phase, conclusions were drawn and hypotheses about the organization structure and the relation with disturbances and self-organizing activities were developed. These hypotheses are reported in the conclusion, which is in chapter seven.

3.6 Research criteria
Since qualitative research is about subjectivity and interpretation, while quantitative research aims towards an objective truth, qualitative research cannot be assessed by quantitative criteria such as internal validity, generalizability, reliability and objectivity. To assess the
quality of a qualitative research, Symon and Cassell (2012, p. 207) have developed four criteria: credibility, transferability, dependability and confirmability, which can be used to assess the quality of this research.

Credibility is about whether the constructed reality of the respondent (i.e. how the respondent sees reality) and the reconstruction subscribed to them are similar (Symon & Cassell, 2012, p. 206). To meet the criterion of credibility, several methods will be used. First, peer debriefing with fellow master students and the supervisor will be used to encourage reflexivity. Second, to write down initial understandings and notes during the research, a research diary will be kept. Finally, by distributing the interview transcripts to the respondents, member checking will be used to check whether the opinions and views of participants were reproduced correctly.

The second criteria, transferability, refers to providing information about the context of the research so that readers can judge whether their own context is comparable and might benefit from the results of the research (Simon & Cassell, 2012, p. 207). Transferability will be ensured by giving a detailed description of the research case (which is written down in chapter 4, Background information).

Dependability is about showing which methodological changes and shifts in constructs are made during the process of research and why these revisions are made (i.e. which decisions are made during research practice) (Symon and Cassell, 2012, p. 207). These changes will also be captured within the research diary, to give people insight into these choices.

Confirmability refers to showing where the data came from and how data was transformed into the research conclusions that were presented (Symon and Cassell, 2012, p. 208). To meet this criterion a detailed description of the data (i.e. interview transcripts) and process of data analysis (i.e. coding scheme, Appendix 4) is available.

3.7 Research Ethics
Every researcher will inevitably be confronted with ethical issues during the practice of doing research (Holt, 2012). To behave ethically in research practice and because an interpretive approach is chosen to conduct interviews, reflexivity is an important tool for researchers (Guillemin and Gillam, 2014). Reflexivity can be defined as: “an awareness in the
researcher’s role in the practice of research and the way this is influenced by the object of research, enabling the researcher to acknowledge the way in which he or she affects both the research processes and outcomes” (Haynes, 2012, p. 72). Reflexivity is about stepping back from the research and thinking about how interpretation of data might be influenced by the researcher (e.g. underlying assumptions, personal values and use of language of the researcher) (Haynes, 2012, p. 72-73).

To increase reflexive awareness a research diary will be kept. Within this diary, assumptions (theoretically, experientially, methodologically etc.), thoughts and feelings will be written down. These notes will be revised to the extent that they have influenced the research findings. In addition, the interview recordings and transcripts will be used to analyze how the researcher might have affected the interview process. Lastly, the research process and outcomes will be discussed with fellow students to increase reflexivity.
Chapter 4: Background information
To give a detailed description of the research case, background information about the temporary construction organization will be given in this chapter. To characterize the temporary organization three of the basic concepts of Lundin and Söderholm (1995) can be used: team, task and time.

4.1 Team
The team of the temporary organization refers to the different organizations participating in the construction project (Lundin and Söderholm, 1995; Bakker, 2011, p.55). In the following section the team of the temporary construction organization will be illustrated.

The client organization has outsourced the whole coordination and execution of the construction project to a main contractor. To accomplish this successfully, the main contractor is supported by an architect, a constructor and a safety coordinator (who has been hired by the client organization and is responsible for a safe execution of the work). Moreover, the business park in which the client organization is located and the municipality are important stakeholders.

The main contractor has outsourced most of the work to main-subcontractors. In total there are between twenty and twenty-five main-subcontractors, who are performing work under a contract with fixed prices and conditions. While some subcontractors are responsible for broad tasks like all the groundwork or electricity, others have more specialized tasks like laying bricks or the installation of doors.

Several main-subcontractors are, under several conditions and under own responsibility, outsourcing their work to other subcontractors. For instance, one main-subcontractor, responsible for all the concrete work, has outsourced all his work to three sub-(sub)contractors. As a result, there are also between twenty and twenty-five subcontractors involved in the project. Lastly, even several subcontractors have outsourced parts of their work to other sub-subcontractors or freelancers. Because there are many different subcontractors involved, the team of the temporary organization is highly dynamic and will constantly change because new subcontractors enter the project at later stages, while other subcontractors leave the temporal organization once their work is done. Figure 5 on the next page, gives an overview of all stakeholders involved in the project. In the following section these different stakeholders are described in detail.
Client organization

Several stakeholder groups of the client organization are participating in the project. There are two management layers involved, namely: the general board who is responsible for the whole organization and the local board responsible for the specific plant. Moreover, a general project manager is responsible for coordinating the construction project, there are multiple people from the existing plant involved, there is one general project team (consisting of multiple disciplines such as planning, engineering and cost controlling) and there are ten internal executive project teams participating (e.g. a team responsible for the laboratory and a team that is responsible for the interior of the offices).

Project team main contractor/subcontractors

In general, the project teams of the main contractor and of the subcontractors involved in the project, consist of a project manager, construction planner, site manager and construction workers (as shown in figure 6). The project manager is mainly concerned with financial matters. Therefore, one of the main tasks of the project manager is concluding contracts with other subcontractors and suppliers and subsequently handing with contract variations. The
construction planner is responsible for the design phase and a broad variety of preparatory tasks (e.g. making drawings, preparing the procurement of subcontractors and suppliers). Once all the components have arrived on the construction site, the site manager is responsible for the execution of the work on the construction site by daily coordinating of people, subcontractors, material etc. Lastly, the construction workers are the people who are carrying out the work on the construction site. These executive tasks are to a large extent routine for construction workers, since they do not differ from executive tasks in other projects as construction workers explain (code D-260 and code G-666):

“It is not really like: our tasks are so special or difficult, we have no idea how to do this”

“Our executive tasks are nothing new for us”

Subcontractors

Many of the main-subcontractors that participate in the temporary construction organization have worked with the main contractor before. A lot of main-subcontractors also outsourced their work one, two or three times to other subcontractors. As a consequence, the temporary organization consists of more than 50 different subcontractors (that originate from different parent organizations) and in total more than 500 different employees have arrived on the construction site. All these different subcontractors have to converge with their own parent organization and are dependent upon external suppliers to get the material they need to execute their work.

Reasons for outsourcing work

The current construction industry is highly characterized by outsourcing. There are several reasons to outsource the work to other subcontractors:

1. Subcontractors are specialized in doing specific tasks, for instance because they have the specific knowledge or material to execute the task. As a consequence, they can perform this tasks better, faster etc., which is described by the following quote of a construction worker (code D-249):

“I can install one or two doors, while at the same time someone who is specialized and works with a specific form to install doors, can install seven or eight doors”
2. Contractors have an insufficient amount of employees to carry out the task itself. This has to do with the fact that many contractors have fewer construction workers employed since the financial recession.

3. Price advantage or making profit. Each subcontractor will approximately receive ten percent permission while outsourcing the work, even while they do not even carry out any executive tasks. A consequence of this is that margins will decrease for sub-subcontractors (they have to do the same job but will receive less money).

4.2 Task

The task of the temporary organization is to build a second production-line and a headquarter for a client organization. The new production line consists of three large industrial buildings and a small one. Therefore it could be stated that the task exists of several subprojects. As a consequence, the construction project and the construction site are relatively large. Every subproject is in a different phase. While one subproject is almost finished, another industrial building still only has a foundation.

The construction process can roughly be divided into two distinct phases: (1) the development phase and (2) the execution phase. In the development phase the main contractor has collaborated with architects, constructors and installers to come up with a definitive design for the project. Once all permits are arranged, the execution phase starts. The execution phase of the construction project is highly sequential, which means that the output of the first activity is the input for the following activity (Thompson, 2007). In general the construction process is the following: 1) Building the foundation 2) Production of the steel construction 3) Roof and wall cladding 4) Roof covering 5) Pouring the concrete floor 6) Installing the doors 7) Finishing off the construction. All these different steps, as shown in figure 7, are performed by (multiple) different organizations.

Sequential activities

The sequential activities of the construction project, as shown in figure 7, are divided over the different subcontractors that are participating in the temporary construction organization. This

![Figure 7: Construction process](image-url)
means that different subcontractors carry out (a small part of) these distinct sequential activities. For instance, one subcontractor is responsible for building the foundation and when that particular subcontractor has finished, the following subcontractor starts with producing the steel construction (then another subcontractor starts with the roof and wall cladding etc.).

4.3 Time
The design phase of the construction project started in 2015 and was finished at the beginning of 2016 (February 2016). Once the design was definitive, the required permits were requested and a definitive contract between the main contractor and client organization was made up. Thereafter, the execution of the construction project started, which was in August 2016. The project was initially planned to be ready in September 2017, however this final date had been delayed for several weeks and the project was finished in October 2017.
Chapter 5: How is organizational control developed through self-organizing activities of operators?

The fifth chapter focuses on self-organizing activities (i.e. locally and daily problem-solving activities) that construction workers perform to develop organizational control. This chapter starts with a description of how construction workers deal with the main disturbances (related to the organizational interaction network within the temporary construction organization) they face in their daily work on the construction site. Based on the exploration and specification phase of the coding process, these main disturbances are divided into seven “dealing with” categories. Thereafter, by means of these “dealing with”-categories, a more general description of self-organizing activities of operators will be given.

5.1 Dealing with delays within the construction process
The expected end-date of the construction project had been delayed for several weeks. This delay arose during the early stages of the construction project. According to the respondents, there were multiple causes for the delay such as: subcontractors who completed their work too late, construction materials that were late available, too slow decision-making etc. As stated in the background information, a construction project has a highly sequential character, which means that the first activity should have been finished before the second one can start. As a consequence, once a delay arises within the early stages of a construction project, this delay continues through the following stages of the project. This is explained by a construction planner (code B-153 and a construction worker (code E-476):

“It is crucial that the steel construction finishes at the right time, otherwise we cannot continue with the wall cladding. And if we cannot continue with the wall cladding, we cannot continue with the roof cladding and if that is not possible, we cannot close the hall”.

“If we want to pour the concrete floor, but the steel bender has finished too late, then we cannot start and our work activities have to start a week later”.

These delays continue through the construction project because it is often impossible to catch up with them. If there is a delay it is possible to hire more people, but more people does not directly increase productivity because it becomes overcrowded on the construction site. For instance, a site manager describes (code L-1363):
“At a certain point you are working in one room in which the ceiling has to be closed, an electrician needs to install a lamp, a painter needs to paint the wall and someone has to place the carpet. Then it becomes so busy that it is impossible to catch up time”

Moreover, problems with safety can arise, for instance if too many people work in the same small area (e.g. if there is someone working underneath someone who is installing a heavy element at height). A second option, working more hours, is often impossible because working hours are restricted on the construction site. Finally, delays could be caught up when all different subcontractors within the temporary organization take the sequenced process-steps into account, but often this does not happen as a construction worker explains: (code K-1195/1196)

“We can catch up with delays, but to do so, everyone should take each other into account to make it as easy as possible for each other. For instance by thinking about how to make something. Suppose you have to strike a wooden beam into steel, that you immediately strike in such a way that other construction workers can use it for their finishing carpentry work. That would save us a lot of work and time”.

For construction workers it is hard to deal with delays on the construction site. A construction worker describes (code K-1194):

“In general... the only thing we can do is doing our best and try to catch up with these delays: first we try to solve it independently, but if that is impossible we communicate it with our site manager”.

However, independently solving problems with delays is difficult for construction workers, because if something (such as a delay) influences the planning, it should be communicated to the site manager as construction workers explain (code E-476 and code D-266):

“If we have to pour the concrete floor and the bar benders have not finished yet... then our work is also delayed and we cannot start. So we have to communicate with our site manager because it is totally impossible to start”.

“If it is about the planning then we usually say: just go to the site manager, we do not know all details about that”.
5.2 Dealing with procurements and deliveries

The procurement process of subcontractors and suppliers is very complex due to time pressure, the number of stakeholders involved and because the main contractor is in a dependent position (i.e. the main contractor really needs a subcontractor to start on time). Because the main contract between the client and main contractor was settled at a late stage, the procurement process of subcontractors and suppliers had started relatively late. As a consequence, there was a constant lack of time to do all procurement and therefore organizations were acquired in order of priority. As a consequence, while the project was already in execution, still not all subcontractors were contracted as a construction planner explains (code B-101):

“In an ideal situation we would procure every subcontractor in advance and we would have settled all contracts with them upfront. But that is unfortunately not how it works in practice...Because of a lack of time, we had to procure subcontractors in order of priority”

There are several disturbances that have to do with procurement and deliveries of subcontractors and suppliers. The first disturbance is that several organizations were contracted too late. This has directly led to delays within the construction process (e.g. a subcontractor has started too late or raw materials were not delivered on the construction site when needed) where construction workers had to cope with. The following quotes describe this (code B-104 and code L-1252)

“The office was open for a few weeks because we did not receive the wall cladding yet”

“Subcontractor N is a nice example of contracting subcontractors too late. That organization was contracted, while it already should have started and ultimately they were starting with a delay of two weeks”.

Secondly, several problems with deliveries of raw materials on the construction site had occurred: materials were delivered too late or incorrect or damaged material was delivered. A construction worker gives an example (code E-444):

“We wanted to place frames on the front wall of the office, but yeah, half of the material was not available, so we could not continue”.
From the perspective of the main contractor, there are, in general, two causes for problems with materials. The first one is that the procurement of these deliveries was too late and that, as a consequence, materials were delivered too late. The second option is that disturbances are caused by the supplier (i.e. the supplier has delayed or has made mistakes). In this second option it could be stated that problems on the construction site could arise due to dependence on external organizations. Problems with deliveries directly influence the construction site. It can for instance directly lead to a delay or rescheduling of working activities of construction workers (e.g. they have to continue with other activities because they cannot do a particular task).

Problems with materials and subcontractors highly hinder construction workers. The following quote describes how construction workers try to deal with these problems (code E-447/450)

“If the materials are not available when needed, you have to adjust your work and have to try to make the best of it and work around it.. or we try to continue with other activities”

Construction workers cannot solve these problems with procurement independently, since they are not in contact with these subcontractors and suppliers and therefore they often have to contact their manager to solve the problem (code J-1058):

“Our site manager arranges the contacts with subcontractors and suppliers, so when there are problems, I am going to him and he deals with it”

5.3 Dealing with drawings

The process of designing the project and making drawings is carried out by the construction planner. Construction workers are not involved in these processes, although they could provide some very useful input within the design and drawing process, which is illustrated by a construction worker (code E-413/414):

“Sometimes it is a pity that we are not involved in the process of designing and making drawings. Because sometimes they do not really think about how we can install and can connect things on the construction site”
In this construction project, several disturbances with drawings occur. Firstly, definitive drawings are absent at the start of the working activities, which means that construction workers have to start their work with provisional drawings. A construction worker illustrates this (code D-311)

“Each time if we need to start somewhere, we barely have definitive drawings. I am feeling like I am always really lagging behind events”

Secondly, there are regularly differences between drawings and the situation on the construction site. For instance, when a construction worker sees drawings that are impossible to execute in practice (code D-268):

“I have made some racks over there, but they were drawn totally different. So I told the construction planner: that is impossible, if you do it like that you can never reach it anymore”

Another type of difference is when a construction worker notices that something could be executed easier than stated on the drawings, as a construction worker illustrates (code E-414):

“They just gave us the drawings for the wall cladding over there and we had to start our work. But they did not really think about how we could install them and then we just found out that it could have been so much easier”

A third example is that sometimes not all necessary sizes are available on the drawings (code E-455):

“We have drawings, but half of the sizes we need to carry out the work are missing”

When these disturbances with drawings arise, construction workers often contact their construction planner or site manager to solve this problem. As described by construction workers (code K-1126/1127 and E-455)

“If we have some issues with drawings which we cannot solve properly, we have to go to the construction planner. And often, the construction planner has to ask for external information to solve these issues”
“If some sizes are missing, we have to go to the construction planner to ask for it, because he has access to it on the computer”

If construction workers have to wait until they have got this information, they will continue with other working activities. Another consequence could be that construction workers need to adapt their work later on because of provisional drawings that have changed. Another construction worker describes that more communication is needed as a consequence of provisionary drawings (code D-313):

“If the drawings are still provisional, it is crucial to communicate with each other (e.g. colleagues, construction planner, site manager etc.) to make sure that you are not just doing some work and to prevent the occurrence of problems later on”

When there are differences between drawings and the situation on the construction site, construction workers contact their site manager or construction planner (code E-417/420):

“If there are differences I talk to my site manager and ask him: Could it not been designed in another way?. Often we find out that it could have been designed differently but that it is too late to change it and thus we have to make it in a more difficult way that will take more effort”

On the other hand, these differences between drawings and execution on the construction site challenge construction workers to think about possible solutions as a construction worker describes (code D-326):

“Many drawings are not really that detailed that you exactly know how to build everything. But you can just decide how to solve this during the work and let’s get ready to work”

5.4 Dealing with decision-making
One of the main disturbances within the construction project is the decision-making process itself, because sometimes it can take a long time before decisions (especially about large changes in the construction work or about additional work) are made. Some examples of these are decisions about the design of the laboratory, the front entrance or the distribution from the kitchen. The slowness of the decision-making process within the construction project is often
caused by the large number of stakeholders (i.e. all contractors that perform the work and suppliers that have to produce and deliver the material needed) that should be involved (as shown in figure 8 on the right).

Moreover, sometimes also the architect and constructor need to be involved as well (i.e. when their specialized knowledge is needed). The coordinating role of the contact persons that every organization has, is crucial to increase the speed of the decision-making process.

Because, when there is one contact person, it is clear which person from each organization is necessary to have contact with.

How a decision-making process looks like in practice is illustrated by a site manager (code L-1355):

“For instance, if the client organization wants to have an extra office within their headquarter, they cannot go directly to a subcontractor. That is not how it should go. First they should contact the main contractor. The main contractor communicates with his own subcontractors and they design the extra office and calculate a price for it. The next step is that the subcontractor contacts the main contractor again, the main contractor makes a decision and afterwards this proposal goes to the client organization”

Moreover, the decision-making process could be more complex and takes more time if information should go through the chain multiple times (e.g. for instance when a client organization needs more specialized knowledge from a subcontractor to take a decision or when there are additional demands).

Construction workers have said the following about dealing with a slow decision-making process (code I-905 and code K-1191):

“If we do not know how we should make it, then we definitely have to wait”
“For instance, at the drawing of the office building, there was a large circle around the front entrance: HOLD. Thus we had to wait until they had decided what it should become”

Thus it can be stated that disturbances that arise due to a slow decision-making process are hard to solve for construction workers. Construction workers just have to wait until crucial decisions are made and meanwhile, while they have to wait, they will carry out other working activities. Often they have the freedom to decide where to continue their work, for instance a construction worker explains (code J-1010):

“Mostly we can find another job ourselves, but if we really do not know what to do then we will ask our site manager”

5.5 Dealing with the subcontractor responsible for the concrete work

There are many disturbances that arise from the subcontractor responsible for the concrete work. This subcontractor has outsourced the work to three sub-subcontractors: a subcontractor responsible for the concrete formwork, another for the bar bending and another for pouring and finishing the concrete. Several types of problems arose within the execution of the work by these subcontractors:

Language problems

These sub-subcontractors choose to hire foreign construction workers (e.g. Polish or Romanian employees) because they are cheaper. These people often do not speak the Dutch (or English/German) language. As a consequence construction workers from other companies cannot communicate with them and miscommunications arise. For instance construction workers describe (code E-438 and code I-920/921):

“By using hands and feet I am trying to communicate with them, often they nod but still they do not understand what I mean”

“I do not talk with these foreign workers, they always say: “yes”, but they really have no clue”.

These language problems highly influence the work of construction workers and could hinder the quality of work and safety.
Quality problems:
The quality of work of these sub-subcontractors is insufficient. These problems arise because these workers try to spend as little time as possible to their working activities. For instance, they do not measure and control their work to check whether they have done it in the right way. These quality problems lead to more work later on in the construction project, because work that lacks in quality needs to be repaired or successive activities need to be adjusted to fit with the (bad quality of the) previous work.

Not cleaning the construction site:
These sub-subcontractors often do not clean their workplace when they have finished their work, because they want to leave as soon as possible. As a consequence, construction workers from other subcontractors need to clean the construction site.

Delays:
The problems described above directly leads to delays on the construction site. For instance, a site manager describes (code H-745):

"The building of those metal stud walls, which has been done by Polish workers..... I have never experienced that taking so long".

Moreover, these sub-contractors do not meet appointments about when they would be finished, and regularly finish later than agreed upon.

Individually dealing with these problems is difficult for construction workers, since they are unable to communicate with foreign workers (due to language problems). For instance, a construction worker describes (code I-930):

"We can solve many problems on the construction site, but if we cannot communicate with them.. then it is impossible"

As a consequence, construction workers contact their site manager, as they explain (code I-933 and code E-440):

"I communicate it towards people on higher positions, they can figure it out! I am not worrying about it any longer"
“I am trying to communicate with them, but when that is not successful, I communicate it to my site manager. He may solve it, I cannot influence it!”

Moreover, a construction worker describes that it is impossible to independently deal with quality problems of other subcontractors (code D-293):

“We cannot do anything with it, we tell our site manager that the quality is miserable and that it is hindering us. But we cannot solve it”

Furthermore, when they are confronted with a workplace that has not been cleaned, construction workers contact the site manager of the main contractor (code J-997):

“When a workplace has not been cleaned and we have to start our working activities over there.. then we have to clean it. But we will not do that before contacting the site manager, because otherwise our working hours will not been paid by the main contractor”

5.6 Dealing with the tension between different subcontractors
All subcontractors that are involved in the temporary construction organization are originating from different parent organizations. Therefore, every subcontractor has its own interest and is initially focusing on optimizing their own results (to complete their work with more profit and less costs). As a consequence, it could be stated that there is an ongoing tension between the interest of the different subcontractors that are involved in the construction project. For instance, whereas the main contractor focuses on the whole construction project (e.g. complete as cheap, fast, safe and with the best quality as possible), subcontractors are only concentrating on their own working activities (and do less care about the completion of the project as a whole). This tension is explained by a construction worker (code J-1091):

“The work is outsourced to many subcontractors and these different subcontractors do not care about the following working activities, they are not taking them into account and are actually only thinking about their own work”

However, this can differ between subcontractors as is mentioned by a site manager (code L-1328):
“Subcontractors that are longer involved into the project are more team-player and will pay more attention to general interests compared to subcontractors that only participate for a few days”

Two examples of situations in where subcontractors only think about their own performance are the following (code I-840/845 and code G-648):

“People have little respect for each other’s work. For instance if a conduit, that has been made earlier, is hindering them in their work, they just push or pull it away. In the past they would have approached you and have asked what to do, but times have changed and people nowadays mainly think about their own work”

“They stock their material everywhere on the construction site, not considering other organizations that have to work on the construction site”

To deal with this tension and to make sure subcontractors can optimize their own performance, there are detailed contracts between subcontractors within the temporary organization (which exactly describe for which activities a subcontractor gets paid). These contracts are concluded between two individual subcontractors (i.e. every single subcontractor has a contract with one other subcontractor (the one who had hired them to carry out work in the temporary construction organization) and there is no general contract with the construction project or with other subcontractors that are involved in the project. As a consequence of this contracting system, individual subcontractors only execute working activities that are included in their contract. When they have to carry out (a lot of) work that is not included, subcontractors first are going to bargain with the other contractor (before they actually start their working activities) because they want to make sure that they get paid for the job (i.e. no subcontractor wants to do work while taking the risk of not getting paid for it, because that could threat organizational performance of their parent organization). Moreover, to deal with these conflicting interests there is a lot of administration, checking and reporting between different subcontractors to examine whether everyone has executed their work in the way it was agreed in the contract.

When the problem (and solution) stays within the conditions of the current contract, construction workers can deal with the tension between different interests of subcontractors independently. However, in many cases problems that are related to this tension are going beyond the current contract. Then construction workers cannot independently deal with these
disturbances, since they always have to communicate working activities that exceed the scope of the contract (additional work) with their site manager and subsequently have to wait until a decision has been made. This is described by a site manager (code G-588):

“If my construction workers have to execute working activities that go beyond the scope of our contract, then they have to communicate this with me (site manager) so I can have contact with the project manager of the main contractor to ensure that we will get paid for that additional work”

Construction workers mention the following about how they deal with tensions between subcontractors (code J-1067 and code J-1076):

“I can clean the construction site because something is blocking our path. But if my site manager and the site manager of the main contractor do not know that... For instance, if I go to the site manager of the main contractor and tell him: “I have done some additional work, I have cleaned the construction site over there..” It could be that the site manager of the main contractor replies: “I have not seen any rubbish over there” So therefore it is essential that you communicate to both site managers, so that they know what you are doing”

“We (subcontractor Y) want to be sure that we are getting paid for what we are doing, if we are doing work for someone else that takes a lot of my time... and time is money”

5.7 Dealing with instructions of site managers

Construction workers, daily or weekly, get instructions from their site manager about which operational tasks they exactly have to do. The site manager often gives the construction workers several broad tasks with a clear deadline and as long as everything is ready in time, construction workers have the freedom to organize their work independently. For instance, construction workers are free to use the tools they want to use. The freedom to organize their work independently is described by a site manager (code L-1265/1269):

“The four construction workers know that we have four tasks which all should be ready at the end of the day.. the boys are professionals, so they know what to do”
Besides these planned working activities, construction workers often have to switch ad-hoc between different tasks (e.g. switch between different subprojects (that all are in different phases) or execute a temporary task) based on instructions of their manager. A construction worker describes (code J-1040):

“Sometimes I am very busy with a task and then out of a sudden they call that I have to help at another task somewhere else, while they really have no idea that I am in the middle of a trench laying sewers with several line lasers exactly put right towards it”

This ad-hoc switching between tasks happens regularly and this could sometimes be difficult for construction workers, since this requires a large amount of flexibility. This is illustrated by construction workers (code K-1114 and code E-380):

“I do never like it, it makes me feel uncomfortable.. my mind is at the first task and then suddenly I have to switch to other tasks. Sometimes that is very difficult for me”

“Sometimes it is hard to switch between tasks because you do not have the exact background knowledge about that specific activity”

Construction workers can barely influence the switching between tasks, they just have to accept it as they describe (code E-382 and code K-1115):

“In the beginning it makes me feel tired, but after a while I will get used to the new task and everything will be alright”

“How do I deal with that?... Uhh.. I just have to do it, so I am moving thoughts and go for it. And then it will turn out all right”

5.8 Conclusion: self-organizing activities of construction workers to solve problems

The disturbances that were described in the previous section have shown that construction workers have to deal with many problems on the construction site. When they face a problem they first try to solve it independently (individual or with others) and ad-hoc. In general it could be stated that construction workers can solve small problems within their professional discipline. But, as became clear in this chapter, construction workers often have to
communicate problems to their site manager and subsequently have to wait until their site manager has made a decision. Thus, construction workers have to deal with many, local problems that they cannot solve independently. This has been mentioned by a construction worker (code D-292):

“We cannot do anything to solve that. We mention it.. we mention that it is highly hindering us, but we cannot do anything to solve it”

Therefore, it can be concluded that organizational control within the construction project is hardly developed through self-organizing activities of construction workers, because construction workers are often unable to solve local problems independently.

Actually, as became clear within this chapter, many disturbances within the construction project are solved by people in the middle management (site managers, construction planners and project managers). These people are, in contrast to construction workers, continually solving urgent and ad-hoc problems. Together with other middle managers they solve problems by means of self-organizing activities. In doing so they make various trade-offs between different project goals. There is, for instance, a trade-off between cost and quality: ‘do they prefer to outsource work to a cheaper subcontractor by taking the risk that they will carry out the work with less quality?’ Another trade-off that middle managers have to make is between time and safety, especially when they have to deal with delays within the construction project (i.e. the more people work in the same area, the higher the safety risks in general are).
Chapter 6: How do structural characteristics influence the abilities of operators to develop organizational control by means of self-organizing activities?

This chapter presents the results of the reduction and integration phase of the coding process. By means of an abductive strategy the normal work practices of construction workers (which were described in the “dealing with” categories) are combined with the theoretical assumptions about the organizational structure of the Sociotechnical Systems Design theory. The main goal of this is to obtain information about how the organizational structure of the temporary construction organization looks like and how this structure is influencing the abilities of operators to carry out self-organizing activities. To do so, the main relevant structural aspects are derived from the “dealing with” categories and subsequently their influence on self-organizing activities is examined in the following sections.

6.1 Functional concentration

As stated in the background information, there are in total more than 50 different subcontractors (which are originating from different parent organizations) involved in the temporary construction organization. All these subcontractors are responsible for performing a specific task (i.e. a small part of the construction process) within the temporary organization. Therefore, it can be stated that there is a very high functional concentration between these subcontractors, which means that specialist activities are grouped in specialist, functional elements (i.e. subcontractors) within the temporary organization. This is mainly caused by outsourcing the work (multiple times) to these subcontractors. As a consequence, there are for instance specific subcontractors that perform all: demolition, concrete floors, roofing sheets, tiling, installing doors, painting, sprinklers etc. for the construction project. This means that one workstation (i.e. subcontractor) performs all specialized operational tasks of the same type (e.g. painting) for all (possible) order flows (e.g. all buildings within the construction project).

Complex network of interactions due to functional concentration

Since there are many functionally concentrated elements (i.e. subcontractors) involved in the temporary organization, which continuously have to communicate and coordinate their working activities, it can be stated that there is a complex interaction network between subcontractors within the temporary organization (i.e. a high internal complexity, as shown in figure 9 below). Moreover, there are many communication lines needed between
subcontractors, since, due to the contracting system, communication with subcontractors about large issues should always go via the main contractor who has hired them. An example is that when the main contractor wants to communicate to subcontractor B, it should always include main subcontractor B (see figure 9). A second example of this structural complexity is the following: if subcontractor B wants to communicate with subcontractor A, both main subcontractor B and main-subcontractor A (and possibly also the main contractor) should be included (see figure 9). This has two reasons: 1) by means of a detailed contract, every main-subcontractor is responsible for the subcontractors they have hired and 2) every contractor has the freedom to make their own appointments and other subcontractors do not want to interfere with these agreements. Moreover, also when agreements are made within central meetings, all main-subcontractors are expected to communicate these agreements to the subcontractors they have hired. So as a consequence, there are many communication lines between different subcontractors within the temporary organization and the interaction network between them can be seen as complex.

Effects of functional concentration on self-organization
Due to the high level of functional concentration, construction workers are often only responsible for a very small, specialized operation (for instance only painting walls). As a consequence they have limited process oversight: they often arrive on the construction site having no idea about the previous or following working activities within the construction process. Therefore also their ability to solve problems is limited to their specific, small part of operations. Moreover, due to functional concentration, continuous communication between many different subcontractors is needed to deal with disturbances. This level of functional concentration highly influences the way construction workers can deal with several types of

![Figure 9: Complex interaction network between subcontractors (internal complexity)](image-url)
disturbances: delays, procurements and deliveries, decision-making and the subcontractors which are responsible for the concrete work.

Firstly, dealing with delays is more difficult because there are many subcontractors involved in the construction project. All these subcontractors perform specialized activities and are following each other in time within distinct process steps. To effectively deal with delays (and catching up with them) all these subcontractors continuously have to communicate and adjust to each other, which makes dealing with delays very difficult. Secondly, dealing with procurements and deliveries is more complex, since there are many different subcontractors and suppliers that need to be contracted. This highly increases the time pressure within the procurement process. Moreover, functional concentration could make subcontractors dependent upon (many different) external organizations for the delivery of their material (i.e. when they choose to outsource working activities). This highly reduces the influence of the subcontractor on the delivery of materials (e.g. whether this is delayed, damaged or mistaken). Thirdly, due to functional concentration, the decision-making process within the construction project is more complex, since there are many different subcontractors that all want to be involved in the decision-making process (i.e. many subcontractors and suppliers who have to produce and deliver materials for all the construction project).

Lastly, functional concentration highly influences problems that can arise due to subcontractors (e.g. the subcontractor responsible for the concrete work). Due to the high functional concentration within the construction industry, main contractors are outsourcing more and more activities to subcontractors. The more the work is outsourced, the lower is the price the subcontractor receive, because every subcontractor approximately calculates 10 percent permission (this is, with fictional prices, shown in figure 10 on the right). Thus, whereas the main contractor receives €40,000,- for all the concrete work, a subcontractor will only get €32,400,-. Thus, although the working activities that a subcontractor should perform roughly stay the same (in terms of final results), the subcontractor would get paid a much lower price for it. These lower prices are one of the main reasons why problems with subcontractors arise (e.g. language problems, quality problems etc.). Moreover, when the work is outsourced multiple times, often not all agreements are completely and correctly communicated to all subcontractors. As a consequence, subcontractors could perform their

Figure 10: Financial consequences of multiple times outsourcing the work
work in another way than the main contractor has initially outsourced it, which could lead to miscommunications and disturbances (e.g. with less quality or less strict safety requirements).

6.2 The level of differentiation of making, preparing and supporting tasks
Construction workers have to deal with several disturbances regarding drawings and procurement and deliveries, as was described in the previous chapter, which they cannot solve independently. Actually, they often had to contact their construction planner, site manager or project manager to solve these problems (as shown in figure 11). Analyzing these disturbances and how construction workers deal with them, have shown that there is a high level of differentiation of making, preparing and supporting activities within project teams of subcontractors.

Whereas construction workers carry out all making activities, all preparatory and supporting tasks are executed by the project manager, site manager and construction planner. This means that construction workers have no preparatory and supporting tasks. Moreover, the high level of differentiation of making, preparing and supporting activities creates a complex interaction network, since construction workers, the project manager, site manager and construction planner continuously have to communicate and coordinate their working activities (i.e. internal complexity). This highly influences self-organizing activities of construction workers to deal with disturbances and is showed in figure 12. The previous will be illustrated by several examples below.

Effects of the differentiation between making, preparing and supporting tasks on self-organizing activities
The high level of separation between making, preparing and supporting tasks influences self-organizing activities in two ways. Firstly, all disturbances that have to do with other subcontractors involved in the project (and are therefore related to contractual matters) needs to be communicated to the site manager and the project manager. Which means that, when construction workers need to execute working activities that are going beyond the scope of
the contract, that they cannot solve this individually with construction workers of other subcontractors, but they both have to communicate this to their site manager and project manager (so that the project managers can solve it and can bargain about contracts, which is a supporting task). Secondly, construction workers can only handle small technical variations individually (i.e. procurement, deliveries and drawings), but larger technical variations always need to be communicated to the construction planner. This will be elaborated on in the following section.

The level of differentiation between making, preparing and supporting activities, highly influences dealing with procurements and deliveries, because the construction planner and project manager are responsible for all procurement of subcontractors and materials, while they are not working with them on the construction site. On the other hand, the site manager (who exactly knows when subcontractors are needed and how much of each material is required) and construction workers (who need to work with the materials on the construction site) barely are involved in the procurement of them. As a consequence of this separation, there is a highly complex interaction network between the construction workers, site manager, project manager and construction planner. For instance, construction workers continuously have to communicate with their site manager (who subsequently also continuously have to communicate with the construction planner or project manager) when materials are damaged or absent. Because of this structural complexity, disturbances could easily arise due to a misfit and miscommunication between the demand for subcontractors and materials (from the site manager and construction workers) on the one hand and the supply of subcontractors and raw materials (as carried out by the construction planner and project manager) on the other hand.

Secondly, the level of differentiation of making, preparing and supporting activities influences dealing with drawings, because there is a separate workstation (construction planner) responsible for making the design and drawings (preparation), which also have access to specific details about the drawings during execution (supporting) and there are other, separated workstations (construction workers), which have to use the drawings on the construction site to perform making activities. As a consequence of this differentiation, construction workers are not involved in the design and drawing process and cannot give their input in these processes. Moreover, while disturbances arise, construction workers cannot solve them independently and continuous communication between these different workstations is needed to deal with disturbances that arise.
Moreover, due to this differentiation, sometimes not all information construction workers need to execute their work is available on the drawings. When this is the case, construction workers need to go back to the construction planner to ask for additional information. This could lead to extra communication needs and small delays. Finally, when drawings are absent at the start of working activities, there is an extra need for communication about whether drawings have become definitive or have changed.

6.3 The level of separation between operational and regulatory tasks

As was described in the previous chapter, there are many local disturbances which construction workers cannot solve independently. Analyzing these disturbances has made clear that there is a high level of separation between operational and regulatory tasks within project teams of subcontractors. Members of the construction team (project manager, construction planner and site manager) are concerned with regulatory tasks and barely have any operational tasks (in the sense of doing executive tasks, such as carpentry or painting, on the construction site). On the other hand, construction workers who are performing these operational tasks hardly have any regulatory tasks (this is illustrated by figure 13).

Effects of the separation between operational and regulatory tasks on self-organizing activities

Due to the high level of separation of operational and regulatory tasks, construction workers have a highly limited regulatory potential (which is the main structural condition to solve problems independently) to carry out self-organizing activities. As a consequence, while doing their daily work on the construction site, these construction workers regularly have to deal with problems they cannot solve themselves (i.e. dealing with delays, procurement and deliveries, drawings and subcontractors responsible for the concrete work and tensions between different subcontractors). To solve these problems they have to contact people with enough regulatory potential, which are members of the construction team (site manager, project manager or construction planner), and have to wait until they have made a decision and have solved the problem. In the meantime, construction workers try to deal with these situations by carrying out other tasks.
Moreover, since there is a high level of separation between operational and regulatory transformations, construction workers get detailed instructions of their site manager about which operational tasks they exactly should carry out. Construction workers are expected to follow these instructions and have less freedom to deviate from these instructions. This could lead to difficulties for construction workers, especially when they are asked to switch ad-hoc between tasks (this could lead to disturbances, since a large amount of flexibility is required to deal with these instructions).

6.4 The level of differentiation of regulatory activities over parts of the process

As has been mentioned in the previous chapter, construction workers have to deal with many problems they cannot solve independently, because they have to communicate these problems to their own site manager (so that their site manager can solve the problem). In solving these problems, all these site managers strive to optimize their own working activities and the organizational performance of the subcontractor they work for (e.g. the subcontractor responsible for building the foundation mainly focuses on optimizing (better quality, faster etc.) its own performance). Since every subcontractor is responsible for performing (and tries to optimize) a specific part of the construction process, it can be stated that there is a high level of differentiation of regulatory activities over parts of the process. This is illustrated in figure 14. Moreover, as a consequence, the interactions between these functional concentrated parts of the process can interfere.

![Figure 14: Example of the high level of differentiation of regulatory activities over parts of the process](image)

**Effects of differentiation of regulatory activities over parts of the process on self-organization**

Since there is a high level of differentiation of regulatory activities over parts of the process, construction workers, which are all originating from different subcontractors, continuously have to deal with the tension between the interests of the subcontractor they work for and the other subcontractors involved in the construction project. To guarantee that every subcontractor can focus on optimizing their own working activities and organizational
performance, there are detailed contracts between subcontractors (which is already described in the previous chapter). These contracts are highly demarcating self-organizing activities of construction workers to solve local problems. When solving a problem exceeds the scope of the current contract (i.e. could probably lead to extra working hours or extra costs) then the construction workers cannot independently deal with the problem and they have to communicate this with their site manager and have to wait until a decision has been made. How this will influence several categories of disturbances will be described in the following section.

Firstly, it impacts the occurrence of delays, because as a consequence of this structural characteristic, individual subcontractors within the temporary organization initially think about their own tasks, to perform them as cheap and fast as possible, and have less attention (or oversight) to take into account tasks that follow later in the construction process (i.e. they do not perform their tasks in such a way that following tasks can be executed easier).

Secondly, the level of specialization of regulatory transformations into tasks, highly impacts the decision-making process within the temporary construction organization. As a consequence of the contracting system, all large changes and every decision that has financial consequences (i.e. has an impact on working time or budget) have to pass all these subcontractors, since it can influence their organizational performance. This leads to a complex network of interactions between different subcontractors within the temporary construction organization, as shown in figure 15. For instance: the client organization cannot take a direct decision with a subcontractor, because they do not have a direct contract with this subcontractor (and thus always have to involve the main contractor which is shown at the right side of the figure).

Thus, the decision-making process should follow all direct contracts between subcontractors within the temporary organization, because every subcontractor has to make a decision themselves (i.e. to optimize the results of the subcontractor they work for in line with their current contract) and subsequently gives an order to the next subcontractor. An example of this decision making is the bargaining about payments for additional work (work that is initially not included in the contract between subcontractors), which often takes a lot of time and could lead to delays, since the execution of work often does not start before decisions
about payments have been made. It could be stated that, due to the high level of regulatory 
transformations into tasks, the decision-making process is highly complex and the speed of it 
is highly reduced.

Thirdly, the high level of regulatory transformations into tasks, directly influences the arise of 
disturbances due to the subcontractor responsible for the concrete work. As stated before, 
because of outsourcing the work multiple times, sub-subcontractors receive a relatively low 
price for their doing their work. When sub-subcontractors will get paid less, they will 
subsequently choose to carry out their work in a cheaper way (to still be profitable as a 
subcontractor). As a consequence these sub-subcontractors try to save money in different 
ways:

- They hire foreign construction workers (e.g. Polish, Romanian, Bulgarian workers 
etc.) because the wages of these workers are much lower. This leads to language 
problems and miscommunications on the construction site. Moreover this influences 
the quality of work and could lead to delays and safety problems because of different 
safety standards of foreign workers.

- They try to do their work as fast as possible because this will save them time and 
money. This leads to quality problems, because these subcontractors do not check 
their own work or work less accurate. Ultimately these quality problems almost 
always lead to delays, because work has to be repaired or following activities have to 
be adjusted. Moreover, because they want to work that fast, they often do not clean 
their workplace.

- They use materials with less quality, which influences the quality of the work.

Lastly, the level of specialization of regulatory transformations into tasks creates tensions 
between different subcontractors, since every subcontractor wants to optimize its own 
performance. These tensions especially arise when the interests of subcontractors are 
conflicting (e.g. interests of a subcontractor are hindering the interest of the main contractor 
or other subcontractors). Moreover, the contracts between subcontractors are, as stated before, 
highly demarcating construction workers to deal with tensions between these subcontractors, 
since these tensions are mainly solved by people from the middle management.
6.5 Structural coupling between subcontractors

It can be stated that there is a high hierarchy between subcontractors within the temporary construction organization (i.e. a hierarchy of main contractor, main-subcontractor, subcontractors etc.), because, as a result of the contracting system, every main-subcontractor is responsible for the subcontractors they have hired (and have a contract with). This entails that, whenever there are problems with subcontractors, the main-subcontractor is the contact person and is accountable for solving these problems. Due to the hierarchy between subcontractors within the temporary construction organization, issues will often be centrally solved, because it is always necessary to involve the main-subcontractor who have an order to the subcontractor.

Moreover, when construction workers have to deal with problems that are exceeding the subcontractor they work for (i.e. they have to communicate with construction workers from other subcontractors) it became clear that communication and coordination of tasks with people from other subcontractors within the temporary organization was often done by the middle management (project managers, construction planners, site managers and the foreman on the construction site). Therefore, it can be stated that structural coupling between different subcontractors within the temporary construction organization is largely made on a central level. As a consequence of this central coordination, almost no coordination between construction workers of different subcontractors on the construction site is needed. So it could be stated that the aim of structural coupling on a central level is to prevent and solve interfaces between the work of different subcontractors on the construction site upfront in such a way, that the need for structural coupling between these subcontractors on the construction site is reduced. Moreover, due to a high functional concentration and fixed contracts between subcontractors, all these subcontractors are working highly individual on their tasks and multiple subcontractors hardly ever collaborate to complete the same task. As a consequence construction workers only accidentally have to coordinate their working activities with workers from other subcontractors on the construction site. The previous is illustrated in figure 16 (on the next page).
Before the work activities of subcontractors actually start, many of the interfaces have already been discussed. This happens in several ways: 1) by designing the project and making drawings by construction planners, 2) by detailed contracts between different subcontractors within the temporary organization, 3) by a central project planning, 4) by introductory meetings between middle managers and 5) by means of permits that are needed to perform specific working activities (to increase safety). Once the work has started, managing the interfaces and coordinating the work on a central level continues. Firstly, by individual coordinators of each subcontractor within the temporary organization (i.e. central contact persons) and secondly, by means of several cycles (daily and weekly) of meetings in which the work is coordinated and interfaces between subcontractors are managed.

**Effects of structural coupling on self-organizing**

As a result of structural coupling between different subcontractors on a central level, many of the (possible) disturbances between the work of construction workers of different subcontractors on the construction site are prevented or solved upfront. However, once (larger) disturbances, that have to do with other subcontractors, arise on the construction site it is difficult for construction workers to solve these disturbances independently. Actually, they have to communicate about these disturbances with their middle management (site manager, construction planner or project manager), so that these people can discuss these topics on a central level. This means that it could take more time until these disturbances are solved and that construction workers have to wait until a decision has been made by their middle managers. Only accidentally construction workers have to coordinate their working activities with other workers from other subcontractors on the construction site. If this is the case, their contact is really informal and construction workers mutually try to adjust to each other. For instance, this communication is about: where is everyone going to work, removing things for each other and how to make things in such a way that it will be easier to carry out following activities.
Chapter 7: Conclusion
This research was conducted to study the relationship of the organizational structure of a temporary organization with the arise of disturbances and the way operators could solve these problems. Therefore a construction project has been studied. To answer the research question, several hypotheses, that explore these concepts and the relationships between them within a construction project, were developed. The purpose of this research is to answer the following research question:

In what way are self-organizing activities of operators within construction project X influenced by structural characteristics of the temporary project organization?

7.1 Self-organizing activities of construction workers
The disturbances construction workers have to deal with in their daily work on the construction site, can be described by the use of the following categories:
- Dealing with delays within the construction process;
- Dealing with procurement and deliveries;
- Dealing with drawings;
- Dealing with decision-making;
- Dealing with the subcontractor responsible for the concrete work;
- Dealing with the tension between different subcontractors;
- Dealing with instructions of site managers.

Analyzing how construction workers deal with these disturbances have shown that construction workers can barely solve these problems independently. Actually, they often have to communicate many of these problems to their site manager and have to wait until the site manager has made a decision to solve these problems. Therefore, it can be stated that construction workers have to deal with many problems they cannot solve independently.

Hypothesis 1: Organizational control within construction projects is barely developed through self-organizing activities of construction workers, since construction workers often cannot solve problems independently.

7.2 Structural influences on self-organizing activities
Subsequently, these self-organizing activities of construction workers were analyzed to construct the influences of the organizational structure of the temporary construction
organization on these self-organizing activities.

7.2.1 Functional concentration

The organizational structure of the temporary organization is characterized by a high functional concentration, which means that specialized activities are performed by specific subcontractors within the temporary organization. As a result of this, construction workers are often responsible for a small, specialized tasks and their regulatory potential to solve problems is limited to this specific part of the construction process. Functional concentration leads to a complex interaction network between different subcontractors within the temporary construction organizations, because many different subcontractors that are involved in the construction project continuously have to communicate and coordinate their activities (i.e. internal complexity). This highly influences the occurrence of and dealing with: delays, procurements and deliveries, decision making and subcontractors responsible for the concrete work.

Hypothesis 2: The structure of the temporary construction organization is highly functionally concentrated;

Hypothesis 3: The high level of functional concentration leads to a complex network of interactions (i.e. internal complexity), which influences the occurrence of disturbances and simultaneously impedes self-organizing activities to deal with them.

7.2.2 Differentiation of making, preparing and supporting activities

Within project teams of subcontractors there is a high level of differentiation of making, preparing and supporting activities. Construction workers perform all making activities, while the construction team (project manager, construction planner and site manager) carry out all preparing and supporting tasks. As a consequence, continuous communication between these workstations is needed, which leads to a complex network of interactions (i.e. internal complexity). This highly influences the occurrence of and simultaneously dealing with two types of disturbances: procurement and deliveries and drawings.

Hypothesis 4: Within project teams of subcontractors there is a high level of differentiation of making, preparing and supporting activities;

Hypothesis 5: The high level of differentiation of making, preparation and supporting activities leads to a complex network of interactions (i.e. internal complexity), which
influences the occurrence of disturbances and simultaneously impedes self-organizing activities to deal with them.

7.2.3 The level of separation between operational and regulatory tasks
There is a high level of separation between operational and regulatory tasks within project teams of subcontractors. This means that construction workers, who have to carry out all operational tasks on the construction site, barely have any regulatory tasks. As a consequence, the regulatory potential of construction workers to carry out self-organizational activities is highly limited and thus, while doing their daily work, construction workers have to deal with problems they cannot solve themselves. Moreover, construction workers continuously have to deal with detailed instructions of their site manager.

**Hypothesis 6:** Within project teams of subcontractors there is a high level of separation between operational and regulatory tasks;

**Hypothesis 7:** Construction workers regularly have to deal with problems they cannot solve themselves, since there is a high level of differentiation between operational and regulatory tasks within project teams of subcontractors.

7.2.4 The level of differentiation of regulatory activities over parts of the process
The temporary organization consists of many subcontractors that are all responsible for a specific part of the construction process. Since every subcontractor is initially concentrating on enhancing their own working activities and own organizational performance, it can be stated that there is a high level of differentiation of regulatory activities over parts of the process. To serve the interest of every subcontractor, there are detailed contracts between these subcontractors. These contracts highly impact self-organizing activities of construction workers, since contracts are highly demarcating the regulatory potential of construction workers. Moreover, this structural characteristic highly influences both the occurrence of and dealing with the following types of disturbances: delays, decision making, problems due to subcontractors responsible for the concrete work and tensions between different subcontractors.

**Hypothesis 8:** There is a high level of differentiation of regulatory activities over parts of the process within the temporary construction organization;
Hypothesis 9: The high level of differentiation of regulatory activities over parts of the process influences the number of disturbances that arise within the temporary construction organization and impedes the self-organizing activities of construction workers to deal with them independently.

7.2.5 Structural coupling between subcontractors

Structural coupling between subcontractors is largely made on a central level, by means of detailed contracts between subcontractors, a project design, a central project planning and central meetings. The aim of this central coordination is to prevent and solve interfaces between construction workers of different subcontractors on the construction site upfront, in such a way that different subcontractors can largely work independently on the construction site (i.e. minimal structural coupling is needed on the construction site). The central structural coupling makes it difficult for construction workers to solve disturbances independently, since issues that have to do with other subcontractors that are involved in the temporary organization have to be communicated with people from the middle management.

Hypothesis 10: Structural coupling between different elements (i.e. subcontractors) within the temporary organization is largely made on a central level, with the aim to reduce the need for structural coupling on the construction site.

Based on this research, it can be concluded that there is a lot of internal complexity within the temporary organization, which means that there is a highly complex network of interactions between workstations. It can be argued that this internal complexity arises as a consequence of the design of the organizational structure (which is shown by means of the hypotheses above). As a result, the organizational structure influences self-organizing activities (to deal with external complexity (i.e. a complex environment)) in two ways:

1) It highly influences the arise of disturbances (i.e. direct effect)

2) It impedes self-organizing activities of construction workers to create organizational control (i.e. indirect effect)
Chapter 8: Discussion
Within this chapter the contribution of this research, both theoretical and practical, will be discussed. Subsequently, the main limitations and additional possibilities for further research are written down. The discussion ends with a reflection on the role of the researcher.

8.1 Practical implications
This research has shown that there are controllability problems within the construction industry, which can be related to the current design of the temporary organization. For instance, respondents said that “all” construction projects always have the same problems: they are always delayed, there are a lot of failure costs and the current system of outsourcing to cheaper subcontractors often lead to additional problems. So it can be stated that, within the construction industry, there is a need to critically analyze the organizational structure of temporary construction organizations. This research adds value, since it had shown that the STSD theory could be a very useful framework for practitioners to analyze the organizational structure of a construction project.

Moreover, site managers are thinking about options to redesign their temporary construction organization, which is mentioned in the following quote (code L-1385):

“I am thinking about organizing some parts of the work in another way, in which we choose to carry out some core activities ourselves again, instead of outsourcing them to multiple organizations”

The STSD theory, combined with a perspective of more self-organization of construction workers and a reduction of the complexity of the interaction work, could be used by practitioners as an alternative framework to redesign their temporary construction organization (for instance to create autonomous groups within the temporary organization, that are responsible for a parallel order flow (e.g. the construction of a part/subproject within the total construction project). However, more research should be done about how to (re)design the temporary construction organization in such a way to improve controllability.

8.2 Theoretical implications
This section describes the contribution of this research to existing theories. Within this research, the Sociotechnical Systems Design (STSD) theory of de Sitter has been used as a framework to analyze the structure of the temporary organization. Within standard bureaucratic organizations, the effect of organizational structure on self-organizing activities
is well known (De Sitter, 1998). However, within temporary organization, less research is conducted about these topics. This research adds value to the STSD theory, since the relationship between organizational structure and self-organizing activities has been researched within a temporary organization. Findings of this research, namely that high levels of structural parameters could highly hinder self-organizing activities, are consistent with findings within standard bureaucratic organizations (Achterbergh and Vriens, 2010; De Sitter, 1998). Within this research, the STSD theory was a useful tool to analyze these organizational structures, which is in line with what Van Hootegem, Huys and Benders (2011) describe in their article, namely that the STSD is appropriate to study inter-organizational collaborations.

However, applying the STSD theory to temporary organizations has shown some limitations, which may be seen as an opportunity to further develop the STSD theory to make it more applicable to temporary organizations. One important limitation is that the STSD theory does not focus on the relationship between parent organization(s) and temporary organization. However, this research indicates the importance of this relationship, since it can be stated that internal complexity within a temporary organization (e.g. functional concentration or a differentiation of making, preparing and supporting tasks) seems to originate from internal complexity within the parent organization (e.g. division of tasks across different departments). As a consequence, to fundamentally solve these problems related to internal complexity, it could be important to both redesign the parent organization(s) and the temporary organization. Moreover, another limitation is that the STSD theory does not provide any guidelines about how structural coupling can be made between different elements (i.e. subcontractors) that are originating from different parent organizations. In this way, this research adds to the STSD theory, because it discovers how structural coupling is made within this particular form of a temporary organization.

Moreover, this research adds to construction literature, since today little research has been conducted on the organizational structure of construction projects. This research states that organizational structures of construction projects (and project teams of subcontractors within these projects) are highly hierarchical organized: there is a high differentiation of making, preparing and supporting activities, have a high separation between operational and regulatory tasks and a high functional concentration. This is in line with findings of Karreman and Steffens (2007, 2008, 2009). Since the research of Karreman and Steffens (2007, 2008, 2009) only has focused upon the division of labor between the client organization, architect and the main contractor, this research adds value to their research as this research has analyzed the
division of labor between all subcontractors involved in the construction project, from a perspective of individual operators. Furthermore, there is a high influence of the organizational structure on the occurrence of disturbances and self-organizing activities of construction workers, which is also consistent with findings of Karreman and Steffens (2007, 2008, 2009) and Moorkamp (2017). However, in contrast with findings within the military sector (Moorkamp, 2017), there is no absence of structural coupling, there are developed and inadequate rules and procedures which coordinate the work between subcontractors and fewer problems to integrate units in the temporary construction organization (i.e. most units work independently on the construction site).

To deal with organizational control problems, much in the construction management literature has been written about project management (Winch, 1989, p.334) in which a process-oriented approach was chosen (Jackson, 2002; Divya and Ramya, 2015; Hussin et al., 2013). This research was conducted from an organizational design perspective and has shown that the organizational design of the temporary organization can highly influence the occurrence of problems such as delays, higher costs etc.

Moreover, in current literature, much have been written about complexity in construction projects (Winch, 1989; Divya and Ramya, 2015). Many of these authors do not distinguish between internal complexity (as a consequence of the organizational structure) and external complexity (created by a dynamic environment) within construction projects. However, this research has shown that it is crucial to distinguish between these two forms of complexity. This has two main reasons. Firstly, while construction projects are always confronted with a complex environment (cf. Winch, 1989 and Divya and Ramya, 2015), it can be argued that a lot of complexity in construction projects is created by a complex organizational structure of the temporary organization (i.e. internal complexity). Furthermore, this study delineates that internal complexity makes it impossible for operators to independently deal with external complexity. Based on the above, it can be stated that many of the construction projects are unnecessarily complex: to successfully deal with external complexity, the first step is to reduce internal complexity (by redesigning the organizational structure). And to do so, it is crucial to distinguish between internal and external complexity. Moreover, this research adds to theory about self-organization (Dekker, 2000; Dekker et al, 2011), since this study has shown that the organizational structure highly influences self-organizing activities of operators.
8.3 Limitations of the research

This research has several limitations, which are outlined in this section. Firstly, there is a methodological limitation regarding choosing respondents. Within this research, respondents were chosen based on researcher’s judgment and snowball sampling, which could possibly lead to a bias (e.g. when respondents only recommend to interview certain people). The respondents that were interviewed were mainly from the main contractor or from two larger subcontractors, because it was relatively easy to approach them. It was difficult to interview respondents from smaller subcontractors which has several reasons: the contracting system that highly limits choosing respondents (taking an interview costs time), smaller subcontractors that are only a few days on the construction site, the relatively high working pressure on the construction site (due to delay it was sometimes hard for construction workers to find time to do an interview) and language differences that made it impossible to interview foreign workers (since they do not speak English or Dutch). The research could be more valuable if also construction workers from more different (and smaller) subcontractors would have been interviewed.

Secondly, another methodological limitation is that, although the interviewer has started with an open mind, within interviews (and analyzing them) there was a specific focus on disturbances and problems that are caused by the organizational structure of the temporary organization. However, there probably are more disturbances occurring within this temporary organization. Moreover, there might be other influences that cause the disturbances and problems that were studied (other influences besides the organizational structure). Therefore, the organizational structure may not be seen as the only explanation for all disturbances and problems that arise in the temporary organization.

Thirdly, based on this study, several hypotheses that explore the organizational structure, self-organizing activities and the relationship between these concepts in a temporary organization were developed. However, these results cannot directly be generalized to other construction projects. Because these hypotheses are only exploratory, it might be that there are other organizational structures, self-organizing activities and disturbances in other construction projects. Therefore, when generalizing the results of the grounded theory, it is important to take the context of the construction project into account. The value of this exploratory hypotheses could increase when more construction projects would be studied and findings would be further specified.
The last limitation of this research is that this study only focuses on analyzing the organizational structure, self-organizing activities and the relationship between them. However, this study does not provide any guidelines to redesign the temporary construction organization in such a way to improve controllability.

8.4 Possibilities for further research

Based on the described limitations and the contributions of this research, there will be several suggestions for further research. The first possibility is to perform research to make the STSD-theory more applicable to temporary organizations. As stated before, two limitations are that the STSD-theory does not focus on the relationship between parent organization and temporary organization and that it does not contain any guidelines for structural coupling between different organizations within a temporary organization. Therefore the first suggestion is to further study these topics in depth.

Secondly, this study analyses the organizational structure and its effect on self-organizing activities, but does not provide any guidelines to redesign temporary organizations in such a way to improve controllability. Therefore there a two suggestions: firstly, find a construction project with low values on the parameters of de Sitter and study the influence and consequences for organizational control. A second suggestion would be to study how a temporary organization could be redesigned in such a way that complexity of the interaction network is reduced and the regulatory potential for construction workers to perform self-organizing activities increases.

Thirdly, the hypotheses that were developed in the conclusion are exploratory. To further develop these hypotheses (i.e. make them stronger and further specify them) a suggestion is to replicate this study in more construction projects. Moreover, another suggestion for further research is to study smaller subcontractors within a construction project, to see how the organizational structure of the construction project influences their regulatory potential to perform self-organizing activities. Finally, since this study argues that the organizational structures of parent organizations (from which the project teams of subcontractors are originating) also highly influence self-organizing activities to create organizational control within the temporary organization, a possibility for further research is to study the organizational structures of parent organizations and the influences of them on self-organizing activities in depth.
8.5 Reflection upon the role of the researcher

In qualitative research the researcher plays a central role in doing research, therefore reflection upon the role of the researcher is an important topic. To carry out the research in an ethical way, several things have been done. Firstly, notes during research were written down (i.e. research diary). For instance notes and thoughts about informal conversations, theoretical assumptions and the research methodology (e.g. to acquire more knowledge from construction workers, it was chosen to interview an extra respondent). This research diary has helped the researcher in continuously reviving the topic list of the interviews after each interview (i.e. to make this topic list more concrete based on knowledge gathering).

Moreover, the researcher has made use of peer debriefing with fellow students, the supervisor and the supervisor from the temporary organization. Peer debriefing with fellow students was for instance about how to conduct the data analysis process or how to efficiently transcribe the interviews. Moreover, the researcher has had several meetings with the supervisor, for instance after the first interview (i.e. to check whether the right information was gathered in the interview), after several interviews (i.e. to discuss the main results of the first interviews) and to discuss the first results of the data analysis. In addition, meetings with the supervisor from the temporary organization were held. These meetings were for instance about how to create an open and trustworthy environment in the interviews. Moreover, also the topic list was discussed with the supervisor from the temporary organization.

The interviews were well prepared, there was a topic list (specific for each respondent, with some general questions about their function for instance) and for each interview there was a scheme to get insight into the interaction network of the respondent (Appendix 5) and a table in which the main disturbances and solutions for these disturbances were written down. Furthermore, after each interview, the interviewer has asked the respondent for feedback about his own role during the interviews (i.e. what was good and what could be improved). Afterwards, each interview was immediately transcribed. This has helped the researcher reflect upon his own role during the interview (e.g. after the first interview I recognized that sometimes my questions were too directly and that it was better to stay silent for a while, because sometimes the respondent would elaborate on his/her answer). After the interviews, the transcripts were sent to the respondents to give them the opportunity to read them through and (when needed) to give comments and make corrections. However, no one had made comments for corrections. Furthermore, also the interview results were presented at the temporary construction organization and were written down in a small research report.
References


Appendix 1: Research model

The following figure shows the research model of this study. This research model is based on Verschuren & Doorewaard (2007). The left side of the figure shows the theories that have been used to develop the conceptual model. This conceptual model is studied within the research object, with the aim to reach the research goal (on the right of the figure).
## Appendix 2: Operationalization

The following table, which is based on the theoretical framework of the research, shows how the central concepts of this study are operationalized.

<table>
<thead>
<tr>
<th>Concept</th>
<th>Operationalization</th>
</tr>
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| **Temporary organization**          | *Time*: Duration of the project  
*Task*: What is exactly built and how does the process look like? How complex and unique is this task?  
*Team*: Which stakeholders are involved in the project? How and when were stakeholders involved? To what extent are mutual agreements fixed and detailed?  
*Embeddedness*: Wider context of the construction project, such as community and government |
| “Inter-organizational system of multiple organizations that cooperate to solve pre-defined tasks in a limited amount of time” |                                                                                                                                                                                                                  |
| **Disturbances**                    | All problems that arise during execution of work activities by construction workers:  
- Two categories: 1) problems that arise within network of interactions (direct effect of organizational structure) or 2) other problems that arise within the primary process.  
- Possible underlying problem categories: miscommunication, delays, insufficient quality, input of primary materials, norms, resources, environment, feedback on results and the work itself.  
- Probing questions: Why was this a problem? Why and when did the problem arise? What happened exactly when the problem arose (what were the consequences?) How often does the problem arise? |
| “Work is not executed as it was intended, planned or agreed upon” |                                                                                                                                                                                                                  |
| **Self-organizing activities**      | All possible solutions to deal with disturbances: How are these problems solved?  
- 1) Operator can independently solve the problem (internal control capacity) or 2) Operator has to involve others to solve the problem such as colleagues, managers etc. (external control capacity) |
| “Local and daily problem solving activities performed by operators” |                                                                                                                                                                                                                  |
| Organizational interaction network | The interaction network can influence the number of problems that arise and/or influence the control capacity of operators to solve problems. The interaction network will be measured through:

- With whom should an employee cooperate to successful carry out his tasks? (see appendix 5)
- Possible categories of collaborators: people or departments that originate from the client, main contractor, subcontractors and own organization.
- Probing questions: Why should an employee cooperate with these stakeholders? What are the roles (tasks and activities) of these stakeholders in the project? How often do they need to cooperate? |

| “The number of interactions that take place to complete an order at a single workplace” |  

- Probing questions: How did the operator independently solve the problem? Who was needed to solve the problem? Why was this person needed? How was the problem solved together? Was the problem successfully solved? |
Appendix 3: Topic lists interviews

Topic list first interview

Introductie
Ik studeer af in de Master Bedrijfskunde aan de Radboud Universiteit in Nijmegen. Het interessante aan een bouwproject vind ik dat veel verschillende (kleine) organisaties tijdelijk samenwerken aan hetzelfde project. Voor mijn afstudeeropdracht onderzoek ik hoe deze tijdelijke samenwerking de uitvoering van het project beïnvloed (onder andere op het gebied van dagelijkse werkzaamheden, qua tijd, geld en kwaliteit van het project) en daarnaast hoe deze tijdelijke samenwerking gecoördineerd wordt.

Daarom zal het gesprek gaan over de volgende onderwerpen:
- Taken en werkzaamheden (van jezelf en binnen het team)
- Context van het project
- Samenwerking tussen verschillende partijen binnen het project
- De coördinatie van het project
- Problemen en uitdagingen die je hebt ervaren tijdens de uitvoering van het werk
- Het oplossen van deze problemen en uitdagingen

Het gesprek zal ongeveer één uur duren en zal worden opgenomen. De informatie blijft vertrouwelijk en anoniem. In totaal houd ik ongeveer 10 gesprekken met medewerkers in de uitvoering van het project en leidinggevenden. Nadat ik het interview heb uitgeschreven zal ik je een exemplaar opsturen zodat je zelf het interview nog eens kan nalezen en eventueel opmerkingen hierop kan geven.

Taken en werkzaamheden
- Zou je jezelf kort kunnen voorstellen?
- Hoelang al werkzaam binnen organisatie X? Hoeveel mensen vanuit organisatie X zijn bij het project betrokken?
- Wat zijn jouw eigen taken, werkzaamheden en verantwoordelijkheden binnen dit project?
- Hoe is de werkverdeling binnen het team van organisatie X wat betreft dit project?
- Is het project relatief groot, complex of uniek?

Context project
- Hoe zag het ontwerpproces van dit bouwproject eruit?
- Wanneer worden onderaannemers ingekocht (voor of tijdens het proces?) en hoe ziet zo’n proces van inkoop eruit?
- Op welke manier worden taken van onderaannemers van te voren vastgelegd? In welke mate van detail beurt dit? Over welke onderwerpen worden afspraken gemaakt? Hebben onderaannemers vervolgens de vrijheid om hun werkzaamheden zelf te bepalen?
  a. Qua output (resultaat), bouwproces (wanneer en hoe wordt wat gedaan en welke hulpmiddelen gebruiken ze) en input (welke materialen ze gebruiken)?

Samenwerking
- Met wie moet u samenwerken om het werk succesvol te kunnen doen? Doorvragen: welke afdeling/personen van deze organisatie?
  a. Waarom is het noodzakelijk om met deze partij samen te werken?
  b. Wat is de rol en taak van deze partij in het project?
  c. Hoe vaak werken jullie samen?
  d. Is het succes van jouw werkzaamheden afhankelijk van deze partij?
Coördinatie middenkader

- Op welke manier proberen jullie als middenkader te voorkomen dat problemen ontstaan, door deze problemen van te voren te tackelen? (Ontwerpfase project bijvoorbeeld)
- Over welke onderwerpen worden afspraken gemaakt en wat is het resultaat hiervan?
- Op welke manier wordt er tijdens het project afgestemd met andere partijen en worden er afspraken gemaakt? (bijv. overleg? contactpersoon etc?) → zie partijen vanuit het samenwerkingsoverzicht

Problemen en uitdagingen in werk

- Terugkijkend op de afgelopen periode: Welke problemen/uitdagingen komen je tegen in het uitvoeren van je werk?
  a. Waarom was dit een probleem?
  b. Hoe is het probleem ontstaan?
  c. Welke partijen met wie je samenwerkt hebben het ontstaan van dit probleem beïnvloed?
  d. Wat zijn de gevolgen van dit probleem?
  e. Hoe vaak is dit probleem ontstaan? (was het eenmalig of is het vaker ontstaan?)

Hulpmiddel: een probleem/uitdaging vindt plaats wanneer iemand zijn werk niet doet, niet op tijd, niet volledig of niet op de goede manier doet. Denk aan problemen en uitdagingen zoals miscommunicatie/misverstanden, vertragingen, kwaliteit dat onvoldoende was, input (waren alle middelen nodig om het werk te starten op tijd, met juiste kwaliteit en juiste hoeveelheid), duidelijke instructies (wat moet worden gedaan en hoe?), juiste hulpmiddelen etc.

Oplossen probleem/omgaan met uitdagingen

- Toen je dit probleem tegenkwam, hoe heb je dit opgelost? Heb je het probleem zelfstandig opgelost of had je anderen hiervoor nodig? (bijv. andere aannemers, leidinggevende of afdelingen)
  e. Zelfstandig oplossen: hoe heb je dit probleem opgelost? (bijvoorbeeld ander werkt tempo, andere manier van werken, andere volgorde etc.)
  f. Anderen nodig om probleem op te lossen: Wie had je hiervoor nodig en waarom juist deze persoon/afdeling? Hoe is dit aangepakt? Hebben jullie het samen opgelost of heeft de ander een beslissing genomen?
  g. Is het probleem vervolgens ook echt opgelost of bleef het probleem bestaan?

Afsluiten interview

- Is er nog iets dat je wilt toevoegen aan dit interview?
- Bedankt voor het interview
- Herhalen vertrouwelijkheid en anonimiteit
- Verdere proces: ik zal de komende periode de overige interviews uitvoeren. Hierna zal ik de opnames uitschrijven en analyseren. Vervolgens zal ik mijn onderzoeksrapport uitwerken en de resultaten presenteren.
**Topic list last interview**

**Introductie**
Ik studeer af in de Master Bedrijfskunde aan de Radboud Universiteit in Nijmegen. Het interessante aan een bouwproject vind ik dat veel verschillende (kleine) organisaties tijdelijk samenwerken aan hetzelfde project. Voor mijn afstudeeropdracht onderzoek ik hoe deze tijdelijke samenwerking de uitvoering van het project beïnvloed (onder andere op het gebied van dagelijkse werkzaamheden, qua tijd, geld en kwaliteit van het project) en daarnaast hoe deze tijdelijke samenwerking gecoördineerd wordt.

Het gesprek zal ongeveer één uur duren en zal worden opgenomen. De informatie blijft vertrouwelijk en anoniem. In totaal houd ik ongeveer 10 gesprekken met medewerkers in de uitvoering van het project en leidinggevenden. Nadat ik het interview heb uitgeschreven zal ik je een exemplaar opsturen zodat je zelf het interview nog eens kan nakijken en eventueel opmerkingen hierop kan geven.

**Taken en werkzaamheden**
- Welke taken en werkzaamheden vervul je binnen dit project? (uitvoerend/coördinerend)
- Je bent niet bij het ontwerp betrokken geweest. Sinds wanneer ben je bij het project betrokken? Waarom is de keuze gemaakt om niet betrokken te zijn bij het ontwerp? Is dit soms lastig in de uitvoering?
- Hoe is de werkverdeling binnen het team van organisatie X wat betreft dit project? Voor welke onderwerpen stem je met wie af?
- Is het project relatief groot of complex voor jullie? Waarom?

**Samenwerking**
- Met wie moet je samenwerken om het werk succesvol te kunnen doen? Doorvragen: welke afdeling/personen van deze organisatie?
  - Waarom is het noodzakelijk om met deze partij samen te werken?
  - Wat is de rol en taak van deze partij in het project?
  - Hoe vaak werken jullie samen?

**Coördinatie project**
Er zijn drie momenten/manieren van coördinatie: 1) vooraf/begin van het project, 2)middenkader, 3) in de uitvoering (op de bouwplaats).
- Vanaf het begin moeten jullie continu samenwerken en rekening houden met andere aannemers. Hoe heb je dit gedaan? Hoe regel je dit bij de start van een bouwproject? Hoe worden al die verschillende organisaties geïntegreerd in één projectorganisatie?
- In hoeverre zijn taken van ondervlaanmers te voren vastgelegd? Over welke onderwerpen worden er vooraf afspraken gemaakt? Gedetailleerd? Is er vrijheid om hiervan af te wijken (qua resultaat, proces (wanneer en hoe) en input (materiaal)?
- Over welke onderwerpen worden in de coördinatie-overleggen afspraken gemaakt?
- Hoe wordt er op de bouwplaats door uitvoerende medewerkers van verschillende ondervlaanmers met elkaar afgestemd? Is dit nog nodig aangezien ze grotendeels hun eigen afgebakende taken uitvoeren?
- Welke besluiten kunnen jouw bouwplaatsmedewerkers zelfstandig nemen op de bouwplaats? En voor wat voor een problemen moeten ze jou inschakelen? In hoeverre sturen ze andere ondervlaanmers aan? (aanspreekpunt op de bouw bijv)
- Voor wat voor soort problemen moeten ondervlaanmers jou inschakelen en wanneer is dat niet nodig en kunnen ze het zelfstandig oplossen?
Hoe verloopt communicatie en afstemming over dit project bij organisatie X intern?

Als onderaannemers (of medewerkers) hun taak af hebben worden deze taken dan ook gecontroleerd als ze af zijn (soort check)? Hoe gaat dit? Wachtijd tot de volgende beginnen kan?

Hoe stuur je jouw bouwplaatsmedewerkers aan? En hoe stuur je medewerkers van onderaannemers aan?

In hoeverre kunnen bouwplaatsmedewerkers meedenken en meebeslissen? Hoe gaat dit?

Continu snel en direct oplossen van problemen. Ondanks veel gecoördineerd wordt ontstaan er continu kleine problemen/uitdagingen. Hoe ga je hiermee om?

Problemen en uitdagingen in werk

Terugkijkend op de afgelopen periode: Welke problemen/uitdagingen kom je tegen in het uitvoeren van je werk?

a. Waarom was dit een probleem? Hoe is het probleem ontstaan?

b. Welke partijen met wie je samenwerkt hebben het ontstaan van dit probleem beïnvloed? Wat zijn de gevolgen van dit probleem?

c. Hoe vaak is dit probleem ontstaan? (was het eenmalig of is het vaker ontstaan?)

Besluitvorming: Hoe snel gaat de besluitvorming binnen het project? Is dit lastiger door de hoeveelheid verschillende bedrijven? Besluitvorming opdrachtgever Voorbeeld

Vertraging: In hoeverre is het mogelijk om vertraging in te halen? Als je ziet dat vertraging ontstaat is dit dan op te lossen? Zo ja, hoe? Hoe beïnvloed dit de veiligheid van de bouw?

Wachtijd: Zijn er wel eens wachtijden dat medewerkers niet gelijk met hun werkzaamheden aan de slag kunnen? Hoe komt dit? Hoe oplossen? Voorbeeld

Veranderingen t.o.v. ontwerp: Vinden deze vaak plaats en hoe beïnvloed dat het bouwproces? Voorbeeld

Te laat inkopen van onderaannemers en materialen. Vindt dit vaak plaats? Hoe komt dit? Invloed hiervan op de bouw Voorbeeld

Dooruitbesteden werkzaamheden onder andere voorwaarden. Hoe ga je hiermee om? Hoe los je dit op als bepaalde afspraken niet zijn meegenomen hierin?


Communicatie met andere nationaliteiten: hoe vaak vinden hier problemen mee plaats en hoe los je dit vervolgens op? Hoe beïnvloed dit het werk (wachtijd)? Voorbeeld

Oplossen problemen/omgaan met uitdagingen

Toen je dit probleem tegenkwam, hoe heb je dit opgelost? Heb je het probleem zelfstandig opgelost of had je anderen hiervoor nodig?

Afsluiten interview

Is er nog iets dat je wilt toevoegen aan dit interview?

Bedankt voor het interview

Herhalen vertrouwelijkheid en anonimiteit

Verdere proces: ik zal de komende periode de overige interviews uitvoeren. Hierna zal ik de opnames uitschrijven en analyseren. Vervolgens zal ik mijn onderzoeksrapport uitwerken en de resultaten presenteren.
## Appendix 4: Codebook

<table>
<thead>
<tr>
<th>Exemplary quote</th>
<th>Open code</th>
<th>Axial code</th>
</tr>
</thead>
<tbody>
<tr>
<td>“Uh.. ja bijvoorbeeld was in het begin. Bril, ik heb normaal ook een bril, ik heb best wel slechte ogen. Maar in het begin moest ik de hele tijd lopen met een dubbele bril op. Nou dat is gewoon levensgevaarlijk. Maar ja hij moet op.” (Code 1187)</td>
<td>Dealing with safety requirements construction project</td>
<td>Dealing with safety requirements construction project</td>
</tr>
<tr>
<td>“Ja.. ja.. of je bent al verder en ze komen met dingen die eigenlijk niet meer kunnen. Dus dan moet je je leidingloop weer aanpassen terwijl je dus op een andere manier..” (Code 897)</td>
<td>Adapt work due to changed drawings</td>
<td>Dealing with drawings</td>
</tr>
<tr>
<td>“Maar ik heb altijd één aanspreekpunt van elke ondernemmer. Ik ga niet met elke zal ik maar zeggen individuele medewerker in discussie daarover. Ik heb één aanspreekpunt voor mijn ondernemmers, voor de binnenwanden heb ik één aanspreekpunt”. (Code 1124)</td>
<td>Contact of subcontractor communicates with own employees about contact with main contractor</td>
<td>Instructions of site manager towards construction workers</td>
</tr>
<tr>
<td>“Geen een dag is hetzelfde, je kunt zeggen van oh morgen ga ik verder met de chauffeursruimten, maar de uitvoerder kan zo zeggen van ja morgen moeten daar nog twee ankjes gesteld worden.. Nou dan ben je daar weer een halve dag mee bezig. Dus ja..” (Code 355)</td>
<td>Coordination of work with other subcontractors by means of a central contact person</td>
<td>Coordination of work between different subcontractors</td>
</tr>
<tr>
<td>“Het gaat allemaal via de uitvoerder. Gaat allemaal vanuit die vergaderingen he. Kijk hun vergaderen he en als er dingen te melden zijn dan doen ze dat eigenlijk via de uitvoerder. Want anders dan passeer je weer mensen en het is het duidelijkste als dat gewoon via één persoon gaat”. (Code 980)</td>
<td>Coordination of work with subcontractor with own sub-subcontractors</td>
<td>Hierarchy between organizations: main contractor, subcontractor and sub-subcontractors</td>
</tr>
<tr>
<td>“Eén op één zeg maar.. het is een beetje.. ja ligt een beetje aan het bouwproces, soms is het misschien wel makkelijk als de E en de Data en de Beveiligingman even bij elkaar komen. Dan doen we met z’n.. dan doe ik gewoon iedereen uitnodigen”. (Code 758)</td>
<td>Coordination of work between different organizations by the middle management</td>
<td>Coordination of work between different subcontractors</td>
</tr>
<tr>
<td>“Nou.. juist doordat je het bespreekt met elkaar en in de coördinatie-overleggen, de wekelijkse coördinatie-overleg gaat afspreken: van joh we gaan in die week daar, daar en daar aan het werk probeert ieder daar zijn werkzaamheden op af te stemmen. Kijk en op het moment dat het zo is dat iemand bijvoorbeeld even een dag moet stoppen omdat eerst even iemand anders erbij moet, dan moet dat in dat overleg kenbaar gemaakt worden”. (Code 659)</td>
<td>Coordination of work before the actual work starts</td>
<td>Coordination of work between different subcontractors</td>
</tr>
<tr>
<td>“Ja dat.. dat wordt eigenlijk al.. al in de beginfase wordt dat op.. op uh.. uitvoeringsniveau wordt dat al gedaan. Dus voor een bouw begint wordt dat al.. die afspraken gemaakt van..” (Code 855)</td>
<td>Decision-making within construction project</td>
<td>Dealing with decision making</td>
</tr>
<tr>
<td>“Alles wat echt financiële consequenties of grote wijzigingen met zich meebrengt gaat altijd in dit treintje. Altijd via de projectleider. Hij is eigenlijk het aanspreekpunt daarin”. (Code 1356)</td>
<td>Other working activities for construction workers when they have to wait</td>
<td>Self-organizing activities of construction workers</td>
</tr>
<tr>
<td>Exemplary quote</td>
<td>Open code</td>
<td>Axial code</td>
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<tr>
<td>-----------------</td>
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</tr>
<tr>
<td>“Ja dingen die spelen over ik weet niet hoe lang hoewen wij niets van te weten vind ik”. (Code 1176)</td>
<td>Construction workers and the central planning</td>
<td>within conditions of contract</td>
</tr>
<tr>
<td>“Ja uh.. even.. zou je even dat pijpje willen maken dat die wand dicht kan.. dan wordt dat gedaan. Of zou jij even dat wandje zo willen zetten..” (Code 743)</td>
<td>Construction workers can act independently</td>
<td>Self-organizing activities of construction workers within conditions of contract</td>
</tr>
<tr>
<td>“Ja.. uh.. als er echt een kostenplaats aankomt, dat ze zeggen van ja jongens.. dat ze zeggen van.. dat zit eigenlijk niet bij ons in.. Maar het moet toch even gebeuren.. ja.. dan gaat het even via de uitvoerder”. (Code 366)</td>
<td>Construction workers have to communicate with site manager</td>
<td>Self-organizing activities of construction workers within conditions of contract</td>
</tr>
<tr>
<td>“Dan heb je een werkvoorbereider.. die is, ja kan je wel redelijk zeggen gewoon fulltime. En een projectleider, maar een projectleider is ook niet fulltime”. (Code 678)</td>
<td>Construction team subcontractor</td>
<td>Division of work within project team subcontractors</td>
</tr>
<tr>
<td>“Wat het hier complex maakt is de samenhang van het totaal, daar gebeurt wat, daar gebeurt wat, daar gebeurt wat ... Dus het zijn heel veel deelprojectjes gelijktijdig en uh.. dat maakt dit project in mijn ogen complex”. (Code 80)</td>
<td>Complexity of construction project</td>
<td></td>
</tr>
<tr>
<td>“Alle administratie, projectadministratie gaat eigenlijk via YY en alle persoonsadministratie, de uren van de mannen en andere dingen, dat gaat via XX”. (1276)</td>
<td>Contact with parent organization</td>
<td></td>
</tr>
<tr>
<td>“Maar dan ga ik weer eigenlijk.. dan ga ik dus niet hier zitten maar dan ga ik hier zitten (contact met onder-onderraanwemer) en dat wil ik eigenlijk niet. Zo heb ik het ook niet uitbesteed”. (Code 1303)</td>
<td>Contact with subcontractor via the organization who has hired them</td>
<td>Hierarchy between organizations: main contractor, subcontractor and sub-subcontractors</td>
</tr>
<tr>
<td>“Nee, enige keer als we die zien is als ze daar weer een openingetje hebben van… of dat weer iets voor de eerste keer aangelegd is of wat dan ook..” (Code 393)</td>
<td>Contact with client organization</td>
<td>Coordination of work between different subcontractors</td>
</tr>
<tr>
<td>“Uh.. de taken zijn vastgesteld uh.. door het beschrijven van de werkzaamheden die we hier moeten uitvoeren en daar hoeveelheden en tarieven bij”. (Code 606)</td>
<td>Contracts of subcontractors</td>
<td>Freedom for construction workers and subcontractors within existing frameworks</td>
</tr>
<tr>
<td>“Je hoort het tegenwoordig ook echt steeds meer en dat zie je ook. Die jongens moeten ook steeds meer alles.. foto’s maken, rapporten maken.. alles..” (Code 883)</td>
<td>Checking of subcontractors</td>
<td>Dealing with the tension between subcontractors</td>
</tr>
<tr>
<td>“Mijn taak is dan natuurlijk weer.. dat op het moment dat een streng gelegd is.. dat ik weer controleer of die streng op de juiste hoogte in ligt”. (Code 663)</td>
<td>Checking of working activities</td>
<td>Dealing with instructions of site managers</td>
</tr>
<tr>
<td>“Ja, want kijk als ik wachturen heb dan heb ik daar natuurlijk financiële kosten van” (Code 656)</td>
<td>Invoicing of waiting time</td>
<td>Dealing with the tension between subcontractors</td>
</tr>
<tr>
<td>“Weet je wat ik wel eens merk.. precies wat je net zegt.. dat heel veel mensen iets ervan moeten vinden of iets ervan moeten zeggen. Dat er iets blijft hangen bij die persoon, dat het niet op de juiste plek komt”. (Code 802)</td>
<td>Communication of agreements to subcontractors by outsourcing work</td>
<td>Hierarchy between organizations: main contractor, subcontractor and sub-subcontractors</td>
</tr>
<tr>
<td>Exemplary quote</td>
<td>Open code</td>
<td>Axial code</td>
</tr>
<tr>
<td>--------------------------------------------------------------------------------</td>
<td>------------------------------------------------</td>
<td>----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>“Organisatie A heeft ook weer uitbesteed. Die heeft er nu een, een zzp-er ploegje zal ik maar zeggen”. (Code 24)</td>
<td>Subcontractor outsources work again</td>
<td>Outsourcing of working activities</td>
</tr>
<tr>
<td>“Ik oktober wordt het nu..” (Code 206)</td>
<td>End-date of construction project has been delayed</td>
<td>Dealing with delays</td>
</tr>
<tr>
<td>“Geven en nemen.. als er.. als ze mij wat vragen.. ben ik helemaal niet beroerd om even een handje toe te steken..” (Code 331)</td>
<td>Helping each other on the construction site</td>
<td>Self-organizing activities of construction workers within conditions of contract</td>
</tr>
<tr>
<td>“Je moet stelkozijnen maken.. die moet je helemaal aanpassen. Dan moet je hem nog afvissen.. dat moet weer aan gaan passen. De kozijn die erin gaat.. zit je dadelijk weer mee te hannesen” (Code 302)</td>
<td>Additional work because of problems that occurred earlier in the process</td>
<td>Dealing with subcontractors concrete work</td>
</tr>
<tr>
<td>“Nee dat is volgens mij de eerste keer dat we met organisatie S werken, of de tweede keer”. (Code 2)</td>
<td>No regular collaborator</td>
<td></td>
</tr>
<tr>
<td>“Het is groot.. uh.. wij zien het eigenlijk als 4 bouwen in één. Omdat je echt een gebied hebt.. en nog een gebied en nog een gebied”. (Code 375)</td>
<td>Size of the construction project</td>
<td></td>
</tr>
<tr>
<td>“Dit is dan meer zeg maar.. corporate executive level en.. maar je hebt in principe ook nog gewoon management level binnen deze vestiging”. (Code 196)</td>
<td>Hierarchy of management client organization</td>
<td></td>
</tr>
<tr>
<td>“Nou daar loop ik niet tegen aan, dat is voor mij heel makkelijk want dan kan ik gewoon zeggen: jij moet hem bellen en jij moet niet bij mij komen, jij moet hem bellen. Want ik heb die afspraak met hem, het moet zo gebeuren, zoals je het nu doet is het niet goed of zo is het niet afgesproken. Dan ga jij maar met hem praten, dat het zo afgesproken wordt zoals wij het afgesproken hebben”. (Code 1312)</td>
<td>Every subcontractor is responsible for its own subcontractors</td>
<td>Hierarchy between organizations: main contractor, subcontractor and sub-subcontractors</td>
</tr>
<tr>
<td>“Die heeft dan ook veel contact met de projectleider. Nou ja die tekenaar dat is meer mijn aanspreekpunt, van uh... om informatie te delen”. (Code 130)</td>
<td>Individual contact between main contractor and subcontractors by members of middle management</td>
<td>Coordination of work between different subcontractors</td>
</tr>
<tr>
<td>“Maar het ligt altijd aan de mensen die je krijgt. Want je hebt een timmerman die een 6 en een timmerman die een 8 levert. Als jij pech hebt en je gaat een huis bouwen en je hebt net de pech dat jij een timmerman met een 6je.. een klein 6je jouw huis maakt. Dan ben je het haasje..” (Code 309)</td>
<td>Individual attitude construction workers</td>
<td></td>
</tr>
<tr>
<td>“In de ruwbouw kan je nog een beetje inhalen, in de afbouw nooit. Ik heb nog nooit in de afbouw.. want de afbouw is altijd, dan wordt de intensiteit wordt groter”. (Code 1362)</td>
<td>Catching up delays within the construction process</td>
<td>Dealing with delays</td>
</tr>
<tr>
<td>“Ja dat is prioriteit van werken, dat kunnen we allemaal niet in één keer doen. Ja, ideale wereld is dus dat je alles, alles van tevoren hebt gedaan. Als je daar de tijd voor hebt, daar de tijd voor krijgt.. Ja dat klopt.. dan.. maar dat werkt in de praktijk niet zo” . (Code 101)</td>
<td>Procurement process subcontractors and suppliers</td>
<td>Dealing with procurement and deliveries</td>
</tr>
<tr>
<td>“Ja, ik ga.. ik zit in de zes weken planning. Dus de hoofdplanning is wel zeg maar mijn leidraad, maar ik maak mijn detailplanning. Dus ik ga echt naar die zes weken toe, want ik plan ongeveer zes weken vooruit elke keer, met twee weken eigenlijk wel daarachter”. (Code 1235)</td>
<td>Scheduling work</td>
<td>Coordination of work between different subcontractors</td>
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<tr>
<td>“Ja is heel lastig antwoord op te geven.. dat gaat eigenlijk vanzelf. Je komt hier de eerste dag, je stelt je voorneemjes in de keet. En ja dan ga je hier beginnen en dan groei je er als het ware in en dan leer je de mensen ook op de bouwplaats kennen. Dus ja.. op een gegeven moment heb je zelf wel door van die man heeft iets meer te vertellen als die”. (Code 729)</td>
<td>Integration between different organizations</td>
<td>Integration between different organizations</td>
</tr>
<tr>
<td>“We zitten hier met een man afz. En dat zijn dan engineers vooral, omdat het toch een techniek uh.. project is, maar ook een planner en een cost controller en een document controller en een kwaliteitspersoon”. (Code 178)</td>
<td>Internal project-organization client organization</td>
<td></td>
</tr>
<tr>
<td>“Vanuit de vergadering en de uitvoerder die hoort dat, schrijft het op en die komt dan bij ons en daar breidt dat weer uit, dan legt die het uit hoe we het gaan aanpakken”. (Code 1018)</td>
<td>Influence of central meetings on the execution of work on the construction site</td>
<td>Coordination of work between different subcontractors</td>
</tr>
<tr>
<td>“Ze meten gewoon alleen maar hup, hup, hup en boem.. stampen stampen.. Maar ze controleren niet even een keer van links.. of die maten van links naar recht wel kloppen..”(Code 337)</td>
<td>Quality of work of subcontractor is insufficient</td>
<td>Dealing with subcontractor responsible for concrete work</td>
</tr>
<tr>
<td>“Het minimale wat ze doen. Als wij een fundering maken en we gaan ankers zetten, zetten wij op de plek van de ankers zetten we schoren, Hier zie.. hier wordt gewoon een kist gezet en daarzitten enkel de schoren en dat het een beetje op z’n plek staat..” (Code 289)</td>
<td>Minimal effort for doing the work.</td>
<td>Dealing with subcontractor responsible for concrete work</td>
</tr>
<tr>
<td>“Dit project heeft best een lang voortraject gehad. Als ik het goed heb begrepen is dat.. heeft het al vijf jaar gelegen op de schap voordat we gingen beginnen en daardoor”. (Code 689)</td>
<td>Difficulties to conclude main contract of construction project</td>
<td>Dealing with procurement and deliveries</td>
</tr>
<tr>
<td>“Maar.. ik heb al en toe wel eens het idee van.. de mensen die hier komen, bijvoorbeeld van onderaannemer X. Die weten helemaal niet wat er in het VGM plan staat. Dus die communicatie, daar schort het wel aan en dat weet de hoofdaannemer ook”. (Code 547)</td>
<td>Not communicating agreements with main contractor to subcontractors to which work is outsourced</td>
<td>Hierarchy between organizations: main contractor, subcontractor and sub-subcontractors</td>
</tr>
<tr>
<td>“Uh.. als je een afspraak maakt in het coördinatie overleg: van dan zijn we klaar, dan ruimen we de rommel op en dan kan onderaannemer X verder met de werkzaamheden.. dat dat niet gereed is”. (Code 639)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>“Dat is dan ook een ongesproken regel, dat je nooit om de hoofdaannemer heen mag eigenlijk. En dat doe je dan ook niet, uh.. maar dat is wel gewoon””. (Code 194)</td>
<td>Subcontractors that do not meet agreements</td>
<td>Dealing with subcontractor responsible for concrete work</td>
</tr>
<tr>
<td>“Nou het zijn allemaal groepjes. Iedereen is zijn eigen ding aan het doen. Ook over het terrein heen en daar zijn ze, hier in de hal zijn ze sprinklerleidingen aan het installeren en daar voor zijn ze aan het metselen weet je wel. Dat zijn allemaal, maar iedereen doet eigenlijk hun eigen ding. Dus je hebt.. niet heel nauw veel last van elkaar. Dus als je gewoon je eigen ding kunt doen dan hoef je niet, heb je ook niet.” (Code 992)</td>
<td>Necessary for the client organization to contact the main contractor when having contact with subcontractors</td>
<td>Hierarchy between organizations: main contractor, subcontractor and sub-subcontractors</td>
</tr>
<tr>
<td>“Ik denk dat het algemeen is. Dat ieder bedrijf staat voor zijn eigen werkzaamheden</td>
<td>Subcontractors do only think of own tasks</td>
<td>Dealing with the tension between subcontractors</td>
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<tr>
<td><em>en daaromheen niet meer. En dat was vroeger natuurlijk wel</em>”. (Code 1097)</td>
<td>Mutually coordinating the work on the construction site</td>
<td>Organizations work independently and separately while executing the work</td>
</tr>
<tr>
<td>“Nou dat is eigenlijk gewoon in hoofdzaak: hoe en wanneer. Dat is de hoofdzaak in feite. En voorderest.. ja.. wordt er niet zo heel veel overlegd”. (Code 1159)</td>
<td>Vague requirements based on the design of the project</td>
<td></td>
</tr>
<tr>
<td>“Naja wat ik weet, en dat is in principe uh.. irritant voor mij in de uitvoering. Is dat er geëist is dat het dezelfde look and feel moet hebben als de huidige plant. Maar dat is nogal vaag, dus ja daar kan ik dan in de uitvoering dan nu heel weinig mee”. (Code 198)</td>
<td>Definitive drawings are missing at the start of the work</td>
<td>Dealing with drawings</td>
</tr>
<tr>
<td>“Dat wij telkens als we ergens aan moeten beginnen hebben we nauwelijks geen tekeningen.. Dat ik eigenlijk overal achter de feiten aanloop..” (Code 311)</td>
<td>Design phase of the construction project</td>
<td>Dealing with drawings</td>
</tr>
<tr>
<td>“De uitvoerder houdt zich met de uitvoering bezig, de uitvoerder houdt zich niet met het ontwerp bezig. En de projectleider was er ook niet echt bij betrokken”. (Code 88)</td>
<td>Establish relationships within the construction project</td>
<td>Integration between different organizations</td>
</tr>
<tr>
<td>“Zeg maar een voorbeeldje is.. door je gezicht te laten zien en af en toe gewoon even een praatje te gaan maken. En uh... eens een keer een bak taart of een bak broodjes of een doos broodjes of een doos taart mee te nemen” (Code 226)</td>
<td>Solving problems that arise on the construction site</td>
<td>Self-organizing activities of construction workers within conditions of contract</td>
</tr>
<tr>
<td>“Daar is een onderaannemer bezig, maar dat zijn Poolse jongens en daar kan je wel tegen praten maar dat heeft geen zin. Nou dat probeerik dan twee, drie keer en dan houdt het op en dan ga ik naar de uitvoerder toe en dan moet hij het oplossen”. (Code 740)</td>
<td>Cleaning up the construction site</td>
<td>Dealing with subcontractors concrete work</td>
</tr>
<tr>
<td>“Uh... je hebt ook aannemers, ik noem geen namen, maar je hebt ook aannemers die gooien alles maar van hun af en als ze klaar zijn dan racen.. ze het terrein af en wij moeten daarna de boel klaarmaken voor het straatwerk en kunnen dan gaan opruimen weet je wel”. (Code 994-997)</td>
<td>Meetings of middle management</td>
<td>Coordination of work between different subcontractors</td>
</tr>
<tr>
<td>“Daar is het niet zo.. dat alle onderaannemers ook bij die coördinatie overleggen aanwezig zijn.. in principe alle hoofdonderaannemers.. die zitten met elkaar aan tafel.. en niet daar weer de onderaannemers van”. (Code 601)</td>
<td>Problems with supply of material</td>
<td>Dealing with procurement and deliveries</td>
</tr>
<tr>
<td>“Uh... kozijnen plaatsen. Wil je kozijnen plaatsen zoals de hele voorvegel van het kantoortje, die bouw je elk als segment allemaal op. Maar ja, de helft is er dan weer niet.. en dan kun je niet verder.. of dan kom je daar achter van.. dat hebben we wel nodig maar.. is nog niet gemaakt”. (Code 444)</td>
<td>Reporting and administration</td>
<td>Dealing with the tension between subcontractors</td>
</tr>
<tr>
<td>“Je hoort het tegenwoordig ook echt steeds meer en dat zie je ook. Die jongens moeten ook steeds meer alles.. foto’s maken, rapporten maken.. alles..” (Code 882)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>“En Onderaannemer X die uh.. ja die hebben vaste ploegen stratenmakers en die.. en wij besteden het straatwerk in ieder geval.. met de hoeveelheden van deze besteden wij uit. Dat doen wij in eerste instantie omdat wij zelf daar te weinig stratenmakers voor in dienst hebben”. (Code 547)</td>
<td>Reasons to outsource the work</td>
<td></td>
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### Exemplary quote

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<tr>
<td>“Je bent meewerkend he, dus je werkt gewoon en ondertussen doe je gewoon aansturen”. (Code 949)</td>
<td>Function of foreman</td>
<td>Dealing with instructions of site managers</td>
</tr>
<tr>
<td>“Met de projectleider heb ik afstemming over vooral wijzigingen in het ontwerp, meer- en minderwerkzaamheden”. (Code 585)</td>
<td>Function of project manager main contractor</td>
<td>Division of work within project team subcontractors</td>
</tr>
<tr>
<td>“De uiteindelijke verantwoordelijkheid van mij ligt op planning en budget. Das uh.. ik heb dan geen eindverantwoordelijkheid maar ik rapporteer in principe uit naar executive level binnen deze organisatie over hoe, hoe zitten we met het budget”. (Code 176)</td>
<td>Function of project manager client organization</td>
<td></td>
</tr>
<tr>
<td>“Uh.. mijn taken zijn eigenlijk zal ik maar zeggen het aansturen, het dagelijks aansturen van het project. En dat heeft uh.. in mens te maken, dus mensen aansturen”. (Code 1220)</td>
<td>Function of site manager main contractor</td>
<td>Division of work within project team subcontractors</td>
</tr>
<tr>
<td>“Ja precies, zorgen dat de planning, dat we op planning lopen, controleren.. tussencontroles maken, materiaal op tijd, het goede materiaal natuurlijk uh.. verslagen maken, overlegjes over hoe de bouw erbij staat, met onderaannemers””. (Code 670)</td>
<td>Function of site manager subcontractor</td>
<td>Division of work within project team subcontractors</td>
</tr>
<tr>
<td>“Toen de binnenkant nog helemaal kaal was eigenlijk, dan komen hun van.. wij moeten daar de afvoer plaatsen.. moeten daar de afvoer plaatsen, maar daar staan geen binnenwanden op. Nou dan pak ik de tekening en dan ga je de binnenwanden maatvoeren op de grond. Potloodstreepjes zetten, smelligentjes zetten…” (Code 361)</td>
<td>Collaboration on the construction site</td>
<td>Organizations work independently and separately while executing the work</td>
</tr>
<tr>
<td>“Eigenlijk is onderaannemer Y maar.. dat zijn maar drie mensen… en die besteden alles uit.. alleen dat kan wel, mits je er zelf goed sturing op houdt en zelf ook de onderaannemers goed selecteert”. (Code 42)</td>
<td>Division of work between subcontractors</td>
<td>Outsourcing of working activities</td>
</tr>
<tr>
<td>“Oke, we beginnen met de fundering, dan de staalconstructie, dan uh… de beplating en het dak erop. Dakbedekker maakt hem dicht, dan de deuren, dan de vloer erin. Dat is een beetje de standaard en dat treintje wil je er altijd in hebben. Dus dan heb je dus opvolgende werkzaamheden”. (Code 1318)</td>
<td>Construction process is sequential</td>
<td>Construction process is sequential</td>
</tr>
<tr>
<td>“Hij zet daar losse pionnetjes allemaal neer, dus losse partijjes. En die losse partijjes communiceren niet met elkaar… Die doen alleen maar hun ding en voorderest doen ze niet.. ze zijn niet gezamenlijk een fundering maken”. (Code 19)</td>
<td>Badly outsourcing the work to subcontractors</td>
<td>Dealing with subcontractors concrete work</td>
</tr>
<tr>
<td>“Dat er.. dat wij met.. dingen bezig zijn.. dat wij vaak in de ogen van bepaalde mensen.. langer bezig zijn dan een onderaannemer. Nou.. dat klopt. Alleen de kwaliteit is ook anders wat er geleverd wordt”. (Code 299)</td>
<td>Tension between time/costs and quality</td>
<td>Dealing with subcontractors concrete work</td>
</tr>
<tr>
<td>“Maar je merkt gewoon dat als de druk hoger.. als er vertraging optreedt.. dat we dan vakertocht wat meer zaken tegelijkertijd gaan uitvoeren”. (Code 554)</td>
<td>Tension between safety and time</td>
<td>Dealing with delays</td>
</tr>
<tr>
<td>“Nee dat doet de uitvoerder regelen. En ik heb dat vanmorgen, ik heb de uitvoerder al gesproken. Ik zei: ja ik weet niet hoor, die zager is er nog niet. Ja, ja zei die.. misschien heeft die eerst die eerst</td>
<td>Site manager has to regulate the work of the construction worker</td>
<td>Dealing with instructions of site managers</td>
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<tr>
<td><em>die andere klus gedaan. Was niet afgesproken maar..</em>” (Code 1057)</td>
<td>Division of work between construction planner, site manager and project manager</td>
<td>Division of work within project team subcontractors</td>
</tr>
<tr>
<td>“Uh.. nou ja XX is projectleider. Dus Piet is degene die eigenlijk eindverantwoordelijk is voor alles. Dus en voor werkvoorbereiding en voor de uitvoering. XX is dan de werkvoorbereider die de voorbereidende taken op zich heeft. En mijn taak is om het in elkaar te zetten” (Code 1230)</td>
<td>Language problems on the construction site</td>
<td>Dealing with subcontractors concrete work</td>
</tr>
<tr>
<td>“Ja, ja en ze knikken allemaal ja, ja en ik zeg: ‘Snap je het? ja, ze snappen het’. En dan net wat je zegt: dan draai je je eigen om en dan gaan ze iets totaal anders doen als wat je afgesproken hebt”. (Code 1364)</td>
<td>Function of construction workers main contractor</td>
<td>The more work is outsourced, the more monotonous executive tasks are</td>
</tr>
<tr>
<td>“Nou zijn we meer ja.. uh.. maatvoering. Maar ook wel een hoop dingen die in het grijze gebied vallen. Die (lastig te verstaan) uitbesteden maar niet op papier staan. En het moet toch gebeuren”. (Code 1088)</td>
<td>Function of construction planner</td>
<td>Division of work within project team subcontractors</td>
</tr>
<tr>
<td>“Op het gebied van techniek, ja.. Ja dus dan net ook weer, was even niet duidelijk op.. kijk ik heb natuurlijk dat meer hulpverkenners onder de huidige chef de kantoor dit kan doe. En dan je moet je andere afvragen. Van B1.. ja.. Waar is B1? En dan moet je daar de maatvoering doen. Je bent er totaal niet mee bezig geweest. En dan moet je gewoon het van het ene naar het andere. Dus dat is echt continu schakelen”. (Code 379)</td>
<td>Subcontractors/suppliers that were contracted too late</td>
<td>Dealing with procurement and deliveries</td>
</tr>
<tr>
<td>“Nee hier hebben wij als onderaannemer bij de baas echt alles uitbesteed”. (Code 671)</td>
<td>Outsourcing the work to subcontractors</td>
<td>Outsourcing of working activities</td>
</tr>
<tr>
<td>“Wij waren dan op kantoor bezig met die wanden.. en dan zei de uitvoerder van je moet even naar B1.. Ja.. Waar is B1? En dan moet je daar de maatvoering doen. Je bent er totaal niet mee bezig geweest. En dan moet je gewoon het van het ene naar het andere. Dus dat is echt continu schakelen” (Code 415)</td>
<td>Challenge: ad-hoc switching between tasks</td>
<td>Dealing with ad-hoc switching between tasks</td>
</tr>
<tr>
<td>“De eerste uitdaging is, dat we het gefaseerd moeten uitvoeren omdat de fabriek gewoon doordraait. Dat hebben we op elkaar af moeten stemmen, dusdanig dat de werkzaamheden van de opdrachtgever wel gewoon door kunnen gaan” (Code 144)</td>
<td>Challenge: current factory needs to keep producing</td>
<td></td>
</tr>
<tr>
<td>“Nou ja, zoals met de griele elementen daar. Dan krijg je een briefje en waarmee koop je dan een.. en zo hebben er eigenlijk niet over nagedacht hoe het wordt bevestigd. Dan moeten wij dat allemaal gaan bedenken dan kom je er gewoon achter dat dat gewoon zoveel makkelijker en simpeler had gekend”. (Code 415)</td>
<td>Construction workers not involved in design and making drawings of the project</td>
<td>Dealing with drawings</td>
</tr>
<tr>
<td>“Je moet alles volgens tekening doen. Dus ja meeste dingen hoe je niet uh.. zelf te beslissen. Dat is al beslist”. (Code 1022)</td>
<td>Executive tasks of construction workers</td>
<td>Dealing with instructions of site managers</td>
</tr>
<tr>
<td>“Een deurenhanger die moet alleen maar deuren hangen.. die doet verder helemaal niks anders.. Een gipsbouwer die bouwt alleen maar</td>
<td>Variety of tasks of construction workers main contractor</td>
<td>The more work is outsourced, the more</td>
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<td><em>gipswanden en verder doet die helemaal niks..</em>” (Code 490)</td>
<td>monotonous executive tasks are</td>
<td></td>
</tr>
<tr>
<td>“Ja, met organisatie X doen wij heel veel.. uhh... dat is eigenlijk bijna, naja ik zal maar zeggen, 8 van de 10 bouwprojecten is organisatie X onze hoofdcontracteur”. (Code 3)</td>
<td>Regular partner of cooperation</td>
<td></td>
</tr>
<tr>
<td>“Daarnaast een stukje vergunning uitgeeft, dat is.. proberen om via vergunningen het stukje coördinatie te doen. Dat is een voorbeeld van mijn taak”. (Code 501)</td>
<td>Permits to carry out working activities</td>
<td>Coordination of work between different subcontractors</td>
</tr>
<tr>
<td>“Je ziet wel tekeningen, maar de helft van de maatvoering die wij nodig hebben staat er eigenlijk niet op. En dan ga je weer naar de werkvoorbereider toe en die tik tik... en die draait het weer uit. En dan krijg je een a4 formaatje en dan heb je de maatvoering wel..” (Code 455)</td>
<td>Differences between drawings and practical situation on the construction site</td>
<td>Dealing with drawings</td>
</tr>
<tr>
<td>“Dus ja, jullie houden er een mooi gebouw aan over tegen een acceptabele prijs. De hoofdjaanemer houdt er een... ook een mooi... en die onderaannemers houden er ook hun eigen... ja geld, winst, kwaliteit”. (Code 228-230)</td>
<td>Different interests of stakeholders within the construction project</td>
<td></td>
</tr>
<tr>
<td>“Een voorbeeld is die houtskeletbouw van uh B3, die komen dus veel te laat. En, in mijn ogen hebben die partijen gewoon de engineering laten liggen”. (Code 147)</td>
<td>Delays due to dependencies on external stakeholders</td>
<td>Dealing with procurement and deliveries</td>
</tr>
<tr>
<td>“Je bent gewoon tijd kwijt omdat je eerst daar bezig bent je kan je spullen weer alles opruimen je gaat weer ergens anders aan het werk, dan gaje daar weer verder.. op een gegeven moment moet je daar weer alles opruimen omdat je terug moet omdat je daar dat ene wandje moet doen... dus dat is tijd verloren”. (Code 749)</td>
<td>Delays due to ad-hoc switching between tasks</td>
<td>Dealing with ad-hoc switching between tasks</td>
</tr>
<tr>
<td>“Maar die staalconstructie moet wel op tijd af zijn want anders kunnen we niet met die gevel verder. En als die gevel niet verder kan dan kunnen we niet met de dakbedekking verder en dan kunnen we die hal niet dichtmaken”. (Code 153)</td>
<td>Delays are continuing through the construction process</td>
<td>Dealing with delays</td>
</tr>
<tr>
<td>“We willen één Nederlands sprekkende voorman op het werk hebben. Dat hangt een beetje van de werkzaamheden af, maar dat ik met die ene man zal ik maar zeggen goed kan communiceren en dingen door kan nemen”. (Code 1295)</td>
<td>Conditions for outsourcing work</td>
<td></td>
</tr>
<tr>
<td>“Ja hij krijgt die vrijheid ook, net wat ik zeg: we hebben een prijs afgesproken waarvoor je iets maakt, we hebben een planning en dat is een contractstuk.. en uh.. We hebben een aantal dingen wat misschien ik aan moet leveren maar in principe zijn ze daarin vrij”. (Code 1317)</td>
<td>Freedom for subcontractors to carry out their work</td>
<td>Freedom for construction workers and subcontractors within existing frameworks</td>
</tr>
<tr>
<td>“Wij hebben ook een heel grote vrijheid bij organisatie X. Ik bedoel.. zoals, ik bedoel wij worden niet achter de vodden aan gezeten.. wij moeten allemaal ons werk doen.. we mogen meedenken.. als we iets hebben wordt er niet meteen op afgeschoten.. er wordt geluisterd”. (Code 322)</td>
<td>Freedom, autonomy and thinking along (with site manager) of construction workers</td>
<td>Freedom for construction workers and subcontractors within existing frameworks</td>
</tr>
<tr>
<td>“En de werkvoorbereider die weet het vaak ook niet meteen hoor, moet die eerst ook weer dingen opvragen of...” (Code 1127)</td>
<td>Waiting until information is given</td>
<td>Dealing with drawings</td>
</tr>
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Appendix 5: Scheme network of interactions
The scheme below gives a small representation of the real scheme that has been used in the interviews. The explanation that has been given while using the scheme during the interviews is attached below.

Denk bijvoorbeeld aan de volgende partners:

- Mensen vanuit eigen organisatie (welke afdelingen bijv. werkvoorbereiding en planning) en bouwteam (bijv. voorman en collega’s op de bouw)
- Opdrachtgever (welke afdelingen/personen vanuit opdrachtgever)
- Hoofdaannemer (welke afdelingen/personen)
- Andere ondernemers verantwoordelijk voor andere werkzaamheden (welke mensen/afdelingen daarvan)
- Leveranciers van o.a. materialen en gereedschappen (hulpmiddelen)

Of denk aan:
1) Operationeel (uitvoerende activiteiten/daadwerkelijk bouwen) 2) Voorbereiding (inkoop, ontwerp, planning, gereedschappen, werkverdeling, werkvoorbereiding),
3) Ondersteuning (onderhoud, controle op kwaliteit, administratie etc.)
4) Organiseren: aansturen en afstemmen