A.J. RODENBURG

PROJECT MANAGEMENT UNCERTAINTY, WICKED PROBLEMS AND DECISION MAKING

PROJECT MANAGERS IN PRACTICE SOLVING WICKED PROBLEMS

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Colophon

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Foreword

In April 2014 I graduated from the HBO bachelor Architecture and Construction Engineering at Hogeschool Rotterdam. This study was primarily focussed on the engineering and construction of buildings. After this study I finished the premaster Architecture at Technical University Delft. This study was primarily focussed on designing the built environment. Since I find both topics really interesting I was looking for a new challenge in which I could combine both topics. The master track Management in the Built Environment at Technical University Delft offered me that new challenge. This study is focussing on project development, real estate strategies and project management of the built environment. The thesis which you are reading right now is the last assignment of my master track and will hereby finish my study career.

Dev_real estate granted me the opportunity to conduct my graduation research within their company. This resulted into me being able to use their knowledge, facilities and network to conduct my research. They granted me this opportunity since my research topic match their daily business. So, the outcomes of my research can be used to evaluated their problem-solving process as well as new insight in how a project manager within this firm solves a problem.

This foreword is concluded with a wish. I hope that all readers enjoy reading my thesis and find it in some way worth the raid. Also, I would like to welcome all comments and discussion about my research.

Bart Rodenburg
Delft, June 2018

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Executive Summary

Introduction

Centraal Bureau van de Statistiek (in English: Central office statistics) (CBS) shows us that the construction sector is increasing in volume each year. Several factors like: increasing demand of dwellings, increasing price of construction materials, etc are causing this effect. These mentioned factors lead to an increase of construction projects executed each year. All these construction projects need to be created efficiently and effectively so that they meet the needs of the client. Project management strives to create projects efficiently and effectively.

Several factors may cause inefficient and ineffectively projects. One of those factors are problems. Problem is a very broad term and can be divided into four kinds of problems, namely: technical problem, political problem, untamed technical problem and wicked problem. This research focusses on wicked problems. A problem can be classified as wicked when there is lack of information and when stakeholders have contradictory interests. There will be a lack of information regarding problem formulation as well as unclear feasible solution directions on the aspects time, budget and quality.

At this moment it is unclear how project managers in practice react and make decisions in order to control a wicked problem in their projects. This leads to the following problem statement which is used in this research: ''It is unknown which kind of decision-making process is used by project managers in practice to solve a wicked problem.''

To research the mentioned problem statement, the following research question is used in this research: ''How do project managers solve wicked problems in construction projects?''

Main findings

This research is conducted as an inductive research which means that observations and findings out of the case studies are translated into a hypothesis how wicked problems are solved in practice. This hypothesis is also the answer to the main research question stated above. The hypothesis will provide a decision-making framework which is used by the project managers in practices according to this research.

Project managers in practice solve wicked problems in construction projects by going through processes in order to make decisions. During these processes, a project manager makes several decisions (see figure 0.1). It can be concluded that a project manager tries to solve a wicked problem as it is a technical problem. To solve a technical problem the project

manager uses the rational decision model of Black and Porter (2000). This model is based on taking seven steps to go from problem formulation to solution. However, by following the steps the project manager notices that there is a lack of information regarding problem formulation and solution direction. Black and Porter (2000) state that their model can be used to solve problems where all information is available upfront (technical problems. Since this is not the case with a wicked problem, the project manager notices that he needs to collect information in order to proceed to the following steps within the rational decision model.

The contradictory interests of the stakeholders influence the entire solving process of the project manager. These contradictory interests may cause a lack of information regarding problem formulation or solution direction. This results the iterative design thinking decision making in order to solve the wicked problem.
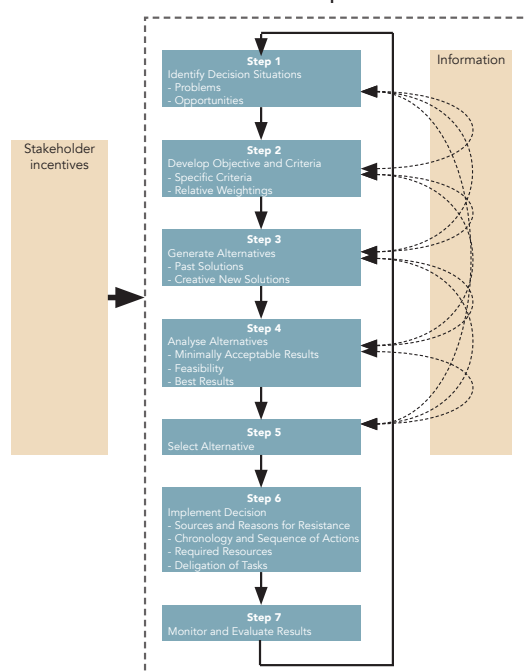

Fig 0.1 Iterative wicked problem-solving process (own image based on Black and Porter (2000))

Methodology

This research has an inductive character which means that a hypothesis is be drawn out of the results of the research. The results of this research where reached by an empirical study. Case study research is conducted in order to collect data. Three cases were subject of study in this research. All three cases were selected within Dev_ real estate. The selection criteria for the cases were as follows: the problem can be defined as ''wicked'', the problem is solved by a project manager of Dev_real estate and one case is selected within an office project, retail project and leisure project.

After the data collection a hypothesis is drawn. This hypothesis is described earlier in this summary. To draw a hypothesis theory building is used by Eisenhardt (1989). Forming the new hypothesis started with within-case analysis for each selected case. After the within-case analysis, a cross-case analysis is conducted. Within the cross-case analysis the outcomes of the within-case analysis are compared with each other and also compared with the findings out of the literature research. After the cross-case analysis, a conclusion is drawn in which the new hypothesis is formed.

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Background

1

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1. Introduction

Due to the financial crisis, the construction industry collapsed. 2013 was the year in which the bottom of the construction industry was reached (Trouw, 2013). From that year on, the construction industry started to recover. This can be seen in numbers presented by Centraal Bureau voor de Statistiek (CBS). The demand of new dwellings and other functions is increasing each year which leads to increased prices of construction (CBS, 2018a). Due to this increase, the volume of construction work is increasing each year (CBS, 2018c) and will increase over the coming years. A result of this is that also the price of construction materials is increasing each year (CBS, 2018b).

All mentioned factors lead to an increase of construction projects executed each year. All these construction projects need to be created efficiently and effectively so that they meet the needs of the client (Winch, 2010). A waste in materials is always a loss, but with these high material prices waste can result in an even higher loss on a project. There are four different kinds of business demanding a construction project, namely: residential, office, retail and leisure business. Managing a project strives to create efficiently and effectively in order to reduce the loss within a project.

Project management was already important but becomes even more important. Project management is needed for the project in general, as well as for each project activity. How project management works depends on the used approaches and tools. There are many different approaches and tools available (Wrike, 2018). According to Ritz, project management is all about three words: plan, organize and control (Ritz, 1994). Where project management approaches and tools are used to plan, organize and control the project, the project manager will take decision in order to steer the project.

Decision need to be taken in order to manage information within a project (Winch, 2010). A fundamental problem in taking decisions is lack of information required to take the initial decision. The future is by definition unknowable and uncertainty ensues from this. However, experience from the past can be used to predict the unknown future. Even though a project manager probably has experience from the past, he always needs to make decisions to steer and manage a project.

1.1. Research problem

Project management can be defined as managing the predictable and as managing the unpredictable (Lousberg, 2009). Problems where project managers have to deal with these days are more and more concerning complexity in projects, e.g. unexpected, uncertain, unstable or unique situations (Lousberg, Heintz, & Prins, 2015). Management tools and approaches are used to help managing the predictable by using a framework to create a closed system for the project. The unpredictable events will try to break the closed systems so the project will fail. These unexpected, uncertain, unstable or unpredictable situations might be called ''problems''. A project manager has to react and make decision in order to control problems in his project. The decisions made regarding problems, will steer the project in a specific way so it will not fail.

As Lousberg concluded in his research on project management is that there is relatively less know about how to deal with these unpredictable events. Research should be conducted on specific context-dependent practise and grounded in what practitioners say about this in practise (Lousberg, 2009). This suggestion on further research is confirmed by Ruiz Pion (Ruiz Pion, 2017). He suggests that more research should be conducted regarding people's reasoning of why they act and how they act, the more human factor in decision making. Instead of why actors make certain decisions, what they do and how they do should be researched (Lalonde, Bourgault, & Findeli, 2012).

As mentioned, just project management tools are not enough to manage a project. Steering and decision-making of a project manager on unpredictable events is needed. There should be more research conducted regarding the human factor in decision making focussed on uncontrollable events in projects. This research focusses on a specific problem, namely: wicked problems, which is a kind of uncontrollable event. How a wicked problem is defined will be elaborated further in this thesis. It is unknown what kind of decision making process has a decisive influence on the solution of a wicked problem. it is also unknown which decision-making process is used by project managers in practice. The following problem statement will be researched:

''It is unknown which kind of decision-making process is used by project managers in practice to solve a wicked problem.''

1.2.   Research objective

In order to solve the mentioned problem above, the objective of this research is to conceptualize what the problem is. The conceptual model explains the main problem which will be studied and the presumed relationships among them. As the model explains, a wicked problem occurs in a project and a project manager has to make a decision to steer the outcome of the problem.
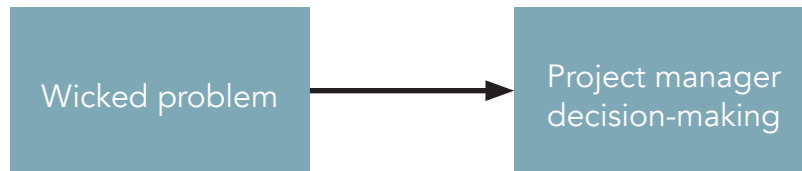
Fig 1.1. Conceptual model own figure based on (Miles & Huberman, 1994)

The following research objectives are formulated:
'' (1) Define project management, (2) define wicked problem, (3) define decision making and (4) research how a wicked problem is solved in practice.''

1.3.   Research main-question

To research the gap in literature and solve the mentioned problem, research will be conducted. This research is guided by a main research question. The main question of this research is:

''How do project managers solve wicked problems in construction projects?''

1.4.   Research sub-questions

As mentioned, the objectives of this research are: (1) define project management, (2) define wicked problem, (3) define decision making and (4) research how a wicked problem is solved in practice.''

Six research sub-questions are formulated in order to achieve these objectives. The first sub-question relates to the first objective, sub-question two relates to the second objective, the third objective relates to sub-question three and the last three sub-questions relate the fourth objective.

Research sub-questions:
1.   What is project management?
2.   What is a wicked problem?
3.   How can decision making be defined?
4.   What are the perspectives on the problem formulation?
5.   Which of the decision-making processes are used by project managers?
6.   How can wicked problems be solved?

1.5. Relevance

1.5.1. Societal relevance

In society, a new approach of preparing projects might result into higher chance of project success. Project managers are, in theory, better prepared for the unknown factors in projects. If projects have a higher chance to be successful, the society will benefit from this fact. Less money will be lost during project failures. Also, the duration of projects may be shorted due to the fact that the project manager has to steer less.

1.5.2. Scientific relevance

As the problem statement defined above indicates, there is a gap in research results concerning decision making of project managers. This research is conducted to fill a gap in research results. Future project managers can take these results into account while preparing a project. When a project is prepared by project managers they will have more knowledge on how to handle and control unknown actions, events and factors in their projects.

1.5.3. Graduation company relevance

The outcomes of this research can be used by the project managers to understand how they make decision in order to solve a wicked problem. When a project manager is aware of a wicked problem happening in his project, he might threat the problem different and change his decision-making process. This can result into better solutions or better decision-making processes.

During the research conducted within Dev_real estate, 12 interviews will be conducted (see chapter 3, methodology). Out of the 12 interviews, 8 will be conducted with people from outside the company. These people are clients, contractors or other involved parties which were involved during the project. During the interviews, the interviewer will ask what the influence of this project is on the project success of the interviewee as well as how they experienced cooperation with the project manager of Dev_real estate. This is not a part of the research and will not be elaborated further within this thesis. However, the outcomes of the interviews will be shared within the employees of Dev_real estate. The outcomes can be used by the project managers and employees to prevent certain discussions happen or change their strategy in order to have all involved parties collaborate instead of arguing.

1.6. Readers guide

This thesis can be divided into 4 parts, namely:
- Part 1: Background;
- Part 2: Theories;
- Part 3: Practices;
- Part 4: Synthesis.

Each chapter within the 4 parts will be ended with a chapter summary.

Part 1: Background

This part of the thesis forms the introduction of the research. It introduces the main concepts and research statement. Chapter 1 ends with the research sub questions and main research question of this thesis.

Part 2: Theories

Part 2 consists out of two chapters, namely literature research and methods. This part is the theoretical basis of the thesis. In chapter 2 the literature study of the research is presented to get an overview of the existing theories and knowledge regarding the research topic. Chapter 3 presents the research methods used in this thesis.

Part 3: Practices

In this part of the thesis the empirical analysis of this research is presented. This part consists out of chapter 4. Chapter 4 presents the analysation of three cases separately.

Part 4: Synthesis

The outcomes of the three cases in chapter 4 are compared in a cross-case analyses which is presented in chapter 5. Chapter 5 ends with a comparison between the empirical and theoretical findings. In chapter 6 the conclusions drawn out of this research are presented. Chapter 6 ends with a discussion on the research results. Finally, a reflection on the research process by the research is presented in chapter 7.

Theories

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2. Literature study

In this chapter, the existing literature regarding described topics is researched. This literature forms the theoretical framework and backbone of the research. Sub question one, two and three will be answered in this chapter: (1) what is project management? (2) what is a wicked problem? (3) how can decision making be defined?

2.1. Project management

In this part of the literature study, the division between predictable and unpredictable factors of project management will be explained in general. The research of this thesis will be focussed on the influence factors of project management. In this chapter will be explained why this part of project management will be researched.

2.1.1. Project

Before project management will be defined, the term ''project'' will be defined. Multiple researchers determined what a project is. According to Turner and Muller (2003) a project is *''a temporary organisation to which assets and resources are selected to undertake a unique, novel and temporary effort managing the uncertainty in order to bring beneficial objectives of change''*. Basically, the definition of a temporary organisation is working on a unique and temporary project such as creating a new product.

The third edition of the handbook of project-based management gives a definition of project (Turner, 2009). *"A project is a temporary organization to which resources are assigned to do work to deliver beneficial change"*. This is the actual same definition of a project as defined by Turner and Muller in 2003 (Turner & Muller, 2003).

PM BoK (Project management Body of Knowledge) gives the following definition of a project (Project Management Institute, 2008). *"A temporary endeavour undertaken to create a unique product, service or result"*.

PRINCE2 gives a similar definition of a project compared to the three above (Murray, 2009). *''A project is a temporary organization that is created for the purpose of delivering one or more business products according to an agreed Business Case."*

The managing construction projects book gives a more specific definition of a construction project (Winch, 2010). *''Projects create a physical asset which can be exploited to achieve social and economic ends – factories for manufacturing goods, offices and shops for delivering services, hospitals for health care and tunnels''.*

All definitions above differ in a way from each other, but they all indicate that a project is characterized by its temporary in which a unique end result will be created within the constraints of a particular situation. Projects are also characterized by the life-cycle. The following phases are part of this life-cycle (Murray, 2009; Turner, 2009):
- Proposal and initiation;
- Design;
- Execution and control;
- Finalization.

After each particular project phase, pre-defined goals will be individually evaluated resulting in a go/no go decision (Murray, 2009; Winch, 2010). Based on this evaluation, the project can continue to the next phase, adjusted or stopped. This evaluating is done to detect early project failure. A project should add value for the involved stakeholders (Murray, 2009; Winch, 2010). The term ''value'' is different for each different stakeholder (what value is in this report will be explained in the chapter: project success). This is also a reason why between each phase the goals will be evaluated. When failure is detected early, cost can be saved during the following project phases (Turner, 2009).

2.1.2. Project management

Now that it is clear what a project is, project management can be defined. Projects have been managed since time immemorial (Winch, 2010). Management does not present random activity but activity with a purpose and a direction, like a project (Bruil, Heurkens, & Lousberg, 2015). This means that management of products and processes is focused on goal, realization and effectiveness. It is focused on problems in practice. Project management is basically the identification of a team responsible for the effective delivery of the project mission of the client (de Leeuw, 2002; Winch, 2010). Sometimes a manager wants to solve the problem, sometimes he can't solve the problem and sometimes he applies strategies to solve a problem (Bruil et al., 2015). The project manager as a chief executive will be responsible for motivating the project team and achieving the objects of the project (Turner & Muller, 2003).

Some researchers make a division between management and leadership (de Leeuw, 2002). Management is focused on the aspects which are manageable and predictable. Leadership is than focused on the aspects of inspiring, renewal and creating vision on the unpredictable. Thus, in project management a division can be made between the predictable and unpredictable of a project (Lousberg, 2009). The vision that there is a division between the predictable and unpredictable is very important during the rest of the thesis research. The table below shows

a framework for analysing project management between the predictable (type I, predict-and-control) and the unpredictable (type II, prepare-and-commit) (Koppenjan, Veeneman, van der Voort, ten Heuvelhof, & Leijten, 2011).

Predict-and-control versus prepare-and-commit		
	Type I	Type II
	Predict-and-control	Prepare-and-commit
Terms of Reference	Blueprint	Functional
Task definition	Narrow for best control	Broad for best cooperation
Contract	Task execution	Functional realisation
Incentives	Work-task based	System-output based
Change	Limit as much as possible	Facilitate as much as needed
Steer	Hierarchical	Network
Information Exchange	Limited, standardised	Open, unstructured
Interface management	Project management task	Shared task

Table 2.1. Framework of analysing project management (Koppenjan et. al., 2011)

Type I predict-and-control

Project management tools and approaches are developed to manage the predictable (Lousberg, 2009). Different management approaches are available for each particular project type of scenario. Depended on the characteristics of the project, a management approach and management tool has to be selected (Wamelink, 2006). To explain what these management approaches or tools are, an fundamental example of both are given below (The Bridger, 2017). Next to the four fundamental project management approaches, an additional approach is added since it has a different perspective on project management. Examples of project management approaches:

1. Agile (scrum). Agile management approach is useful when a project has to be delivered in high speed or when the targets and requirements continuously change (Baskerville & Pries-Heje, 2013);

2. Iterative. This management approach can be used when there are activities which are repeated in the project. When something returns repeatedly, a framework can be created for this activity (Li & Willis, 1992);

3. Stakeholder-oriented Project Management. This management approach is different from the other approaches mentioned above. The difference is that projects are managed in a research and design (R&D) approach. This means that the focus of the project management is on what the stakeholders need to get as end product instead of what is asked by the stakeholders upfront. The flexibility of this management approach is higher during the production of a product (van Gunsteren, 2011).

Examples of project management tools:

1.   PM BoK (Project management Body of Knowledge). According to the PM BoK sytem, projects usually consist out of predetermined and well-structured processes. The approach consists out of ''4 P'S'', namely: plan, process, people and power (Project Management Institute, 2008; Winch, 2010);

2.   PRINCE2. PRINCE2 is a product-based planning structure approach. This approach is based on identifying all of the products that contribute to achieving the project objectives. PRINCE2 is commonly used by government organizations or projects (Murray, 2009).

Which project management tool or approach should be used mostly depends on the level of uncertainty in the project (de Leeuw, 2002).

Type II prepare-and-commit

During projects, there are many factors which are unpredictable and can influence the project process. Many of these factors are unknown upfront and need to be managed or steered during the project. These factors can be called uncertainty. Uncertainty is defined by many researchers and is listed below. Uncertainty is:

''The lack of all information required to take a decision at a given time'' (Winch, 2010).

''An absence of information, knowledge, or understanding regarding the outcome of an action, decision, or event'' (Heerkens, 2002).

''Hard to predict and ambiguity'' (de Leeuw, 2002).

All three definitions are common on the fact that there is information missing regarding the project. However, all researchers say that uncertainty cannot be viewed separately. Uncertainty and complexity are multi-dimensional concepts (Koppenjan et al., 2011). Uncertainty and complexity in a project are the dominant factors that require steering or management (de Leeuw, 2002; Turner & Muller, 2003; Winch, 2010). Both complexity and uncertainty are important in this thesis research. How complexity is influencing this thesis research will explained further on in this literature research.

Even in uncertainty a distinction can be made between predictable uncertainty and unpredictable uncertainty. Predictable uncertainty can be managed and this is mostly called risk management (de Leeuw, 2002; Heerkens, 2002; Turner, 2009; Winch, 2010). *''Risk is a measure of the amount of uncertainty that exists''* (Heerkens, 2002). Heerkens illustrates in figure 2.2 how uncertainty and risk relate to each other (2002).

No information

Some information

Complete information

Total certainty

Amount of Risk

relative Uncertainty
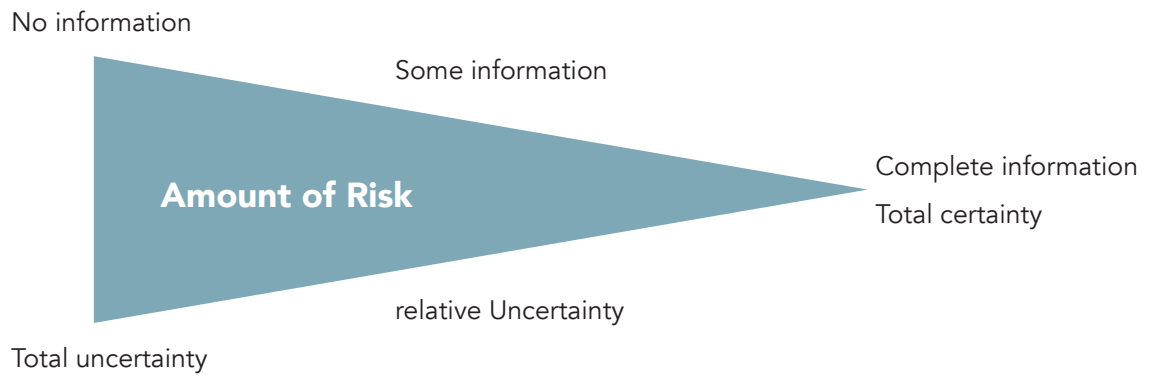
Total uncertainty

Fig 2.2. Risk relationship between information and uncertainty (Heerkens, 2002)

Predictable uncertainties are events which occurred in projects and might also occur in another project or are events which can be foreseen. According to de Leeuw (2002) and Winch (2010) there are four steps on how to manage risk.

1.   Identification of risk;
2.   Quantification of risk;
3.   Analysis of the risk;
4.   Response of the risk.

These steps are forming a loop (see figure 2.3) which can be executed to manage the risk.

Identify
- Process-drive
- Data-driven

Control
- Monitor
- Close out

Risk Register
- Opportunities
- Threats

Assess
- Qualitative
- Quantitative

Respond
- Proactively
- Reactively
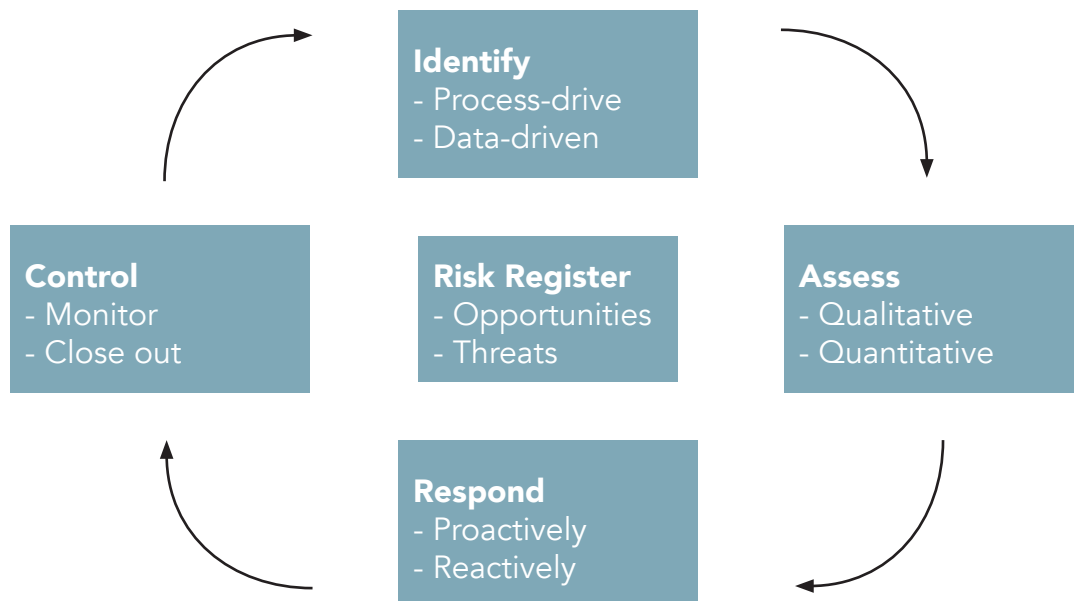
Fig 2.3. Risk-management process (Winch, 2010)

For this thesis research the unpredictable uncertainty is important. Uncertainty can be defined into two kinds of uncertainty, namely: substantive and procedural uncertainty (Dosi & Egidi, 1991). Procedural uncertainty is that there is no competence in information processing between involved actors. Substantive uncertainty is that here is a lack in information and creates competence between the involved actors. This last kind of uncertainty is important for this thesis research.

2.2. Wicked problems

One of the uncertainties rising from substantive uncertainty is: uncertainty on knowledge and disagreement (Koppenjan & Klijn, 2004). These kinds of uncertainties are called ''wicked problems'' (Koppenjan & Klijn, 2004; Korsten, 2016). A characteristic of this wicked problem is that next to the lack information, there are two other sources of uncertainty:

1.   Uncertainty or conflict about knowledge: there is not a lack of knowledge, but the status or interpretation of that knowledge is unclear;

2.   Uncertainty or conflict about the yardstick used to determine the nature and degree of seriousness of the problem and also the effectiveness of the proposed solutions: parties can look at the problem from various frames of references.

Koppenjan & Klijn (2004) distinguished these two sources of uncertainty and found four types of problems (see table 2.2):

1.   Technical problems: about which there is no societal conflict and where knowledge and technique are not problematic. For these problems, a Type I response is adequate: solutions are possible by engaging experts and conducting research;

2.   Untamed technical problems: where everyone agrees they must be solved, but for which there are no agreed upon technical solutions. For instance, there is a worldwide consensus that HIV/Aids need to be addressed, but a medical– technical solution is still lacking. In the pursuit of this, experts may compete with each other and knowledge conflicts may emerge;

3.   Untamed political problems: where technical solutions are available but where their application meets with societal conflict. Consider, for example, the technical capability to manipulate the gender of a human embryo. The application of this technique is controversial;

4.   Finally, there are problems where both knowledge uncertainty and societal disagreement are present. This type of problem is a wicked problem.

		Certainty on (scientific) knowledge	
		Large	Little
(Societal) agreement on problem formulation	Large	Technical problems	Untamed techincal pro-blems
	Little	Political problems	Wicked problems

Table 2.2. Four types of problems (Hoppe, 1989)

Problems which have little certainty on knowledge and little agreement on problem formulation are called wicked problems. Usually in wicked problems, several actors are involved (Korsten, 2016). This is because there is not a single person which has all the responsibilities, tools, authorizations or activities to act effectively. All involved stakeholders have different intentions and goals. Even though, if one stakeholder is 100% sure that he has the right solution to the answer, he can't push this through and go for his solution. All involved actors need to gather around the table to come to a solution. That the intentions of goals between all stakeholders differ does not mean that they cannot be changed (Koppenjan & Klijn, 2004).

According to Korsten (2016), there is no standard procedure or quick fix to cope with a wicked problem. This however does not mean that people handle and make decision based on nothing. According to Korsten (2016), a collaborative strategy should be made to create understanding for each stakeholder. This collaborative strategy can be managed by a project manager. Project managers will react on wicked problems by making decisions. These solutions on a wicked problem are not true-or-false but good-or-bad (Rittel & Webber, 1984). Important is to understand that creating a solution to a wicked problem is a one-shot operation since there is no opportunities to learn by trial and error. Every decision made regarding wicked problems counts significantly.

There is no definitive formulation of a wicked problem (Rittel & Webber, 1984). However, a definition will be given for this research. Whenever the term ''wicked problem'' will be used, a problem is mend which has little or no agreement on the problem formulation between the different actors and has little or no certainty on knowledge on the different actors. This is actual the definition given by Hoppe (1989). To make this definition more specific, a definition has been made out of the literature together with the use of explorative interviews (Interviewee 4, 2018; Interviewee 8, 2018; Interviewee 9, 2018; Interviewee 17, 2018). A wicked problem in this research is:
1.   There is a lack of information:
      a.   There are multiple problem formulations which are contradictory;
      b.   It is unclear if the solution directions of the problem are feasible on the aspects time, budget and quality;
2.   Stakeholders have contradictory interests. With an important interest of the client, namely: daily business influenced negatively.

2.3.   Complex projects

After the term wicked problem is defined, it is important to define the term ''complexity''. As mentioned in earlier chapters not only uncertainty influences project management and requires decision making, but also the complexity of projects influences project management and requires decision making. That complexity is important in this research is confirmed by research. *''Although the complexity of projects and their environment obviously influences important decisions on and in project management, complexity as such is often taken intuitively or from previous experiences''* (Bosch-Rekveldt, 2011).

The basis of this chapter is the research by Bosch-Rekveldt (2011) regarding measuring complexity in projects. She developed a model to measure complexity in projects. In this chapter will be explained why her model will be used during the thesis research.

2.3.1. Defining project complexity

Complexity can be divided into two different concepts. The first distinguished concept is focussed on the complexity in the actor dimension (Waldrop, 1992). This means that complex systems or projects consist out of multiple actors or stakeholders that have to interact continuously with a physical/technical environment. The second concept defines complexity as systems that consist out of a large number of components that heavily interact with each other (Simon, 1962). Concluded out of these two concepts, projects can be considered as complex systems. Heerkens (2002) explains in his project management book that projects vary considerable in complexity. With this statement he argues, and agrees on the conclusion above, that projects can be considered as complex systems.

Next to the fact that it is know that a project can be considered as a complex system, there is no clear definition of complexity yet (Bosch-Rekveldt, 2011). Despite the fact that there is no clear definition of complexity, a definition of project complexity should at least include structural, dynamic and interaction elements (Whitty & Maylor, 2009). So, complexity in projects could then be considered related to structural elements, dynamic elements and an interaction of these. This means that complexity is more than just the technical or the technological domain (Bosch-Rekveldt, 2011). In her research, Bosch-Rekveldt (2011) compared different models and researchers and concluded that complexity should actually be broken down into technical complexity, organizational complexity and complexity of the environment. With the complexity of the environment, she refers to the direct environment of the project such as location and stakeholders.

2.4. Decision making

Project management is perceived as a practice that is realized through action (Lalonde et al., 2012). One of these actions is making decisions regarding for example wicked problems. This chapter is exploring what decision making is and what kind of decision making processes are used. From management perspective three decision making models/processes are explained. Afterwards a fourth decision making model/process is added, namely design thinking.

2.4.1. Management perspective

A characteristic of effective leaders and effective workgroups is their ability to make decisions that are appropriate, timely and acceptable (Bruil et al., 2015). How decision making can be conducted is described in this part of the chapter.

In project management, decision-making is defined as a process of specifying the nature of a particular problem or opportunity and selecting among alternatives the best one to solve a problem or capture an opportunity (Bruil et al., 2015). Decision making has two aspects, namely: the act and the process. The act of decision making is choosing between alternatives. The process of decision making are several steps. These steps can be divided into two categories (Black & Porter, 2000; de Leeuw, 2002):
1. Problem formulation. Identifying a problem, gathering information, developing desired expectations and identify the causes and relations of factors effecting the problem;
2. Problem solution. Generating alternatives, selecting a solution and implementing the decided course of action. After these steps, following the implementation so that the project managers can monitor which solution is successful.

A distinction can be made between on how individuals make decisions or on how groups make decisions (Bruil et al., 2015). This research is focused on the decisions made by the project manager. This means that the individual decision-making process will be studied, the group decision making process will not be taken into account.

Black & Porter (2000) and de Leeuw (2002) both did an attempt to described the decision-making process. They tried to describe this in three models, namely:
1. The rational/ classic model;
2. The administrative or bounded rationality model;
3. The retrospective decision-making model.

The rational/classic model

The rational/classic model involves seven basic steps, see figure 2.4.

Step 1
Identify Decision Situations
- Problems
- Opportunities

Step 2
Develop Objective and Criteria
- Specific Criteria
- Relative Weightings

Step 3
Generate Alternatives
- Past Solutions
- Creative New Solutions

Step 4
Analyse Alternatvies
- Minimally Acceptable Results
- Feasibility
- Best Results

Step 5
Select Alternatvie

Step 6
Implement Decision
- Sources and Reasons for Resistance
- Chronology and Sequence of Actions
- Required Resources
- Deligation of Tasks

Step 7
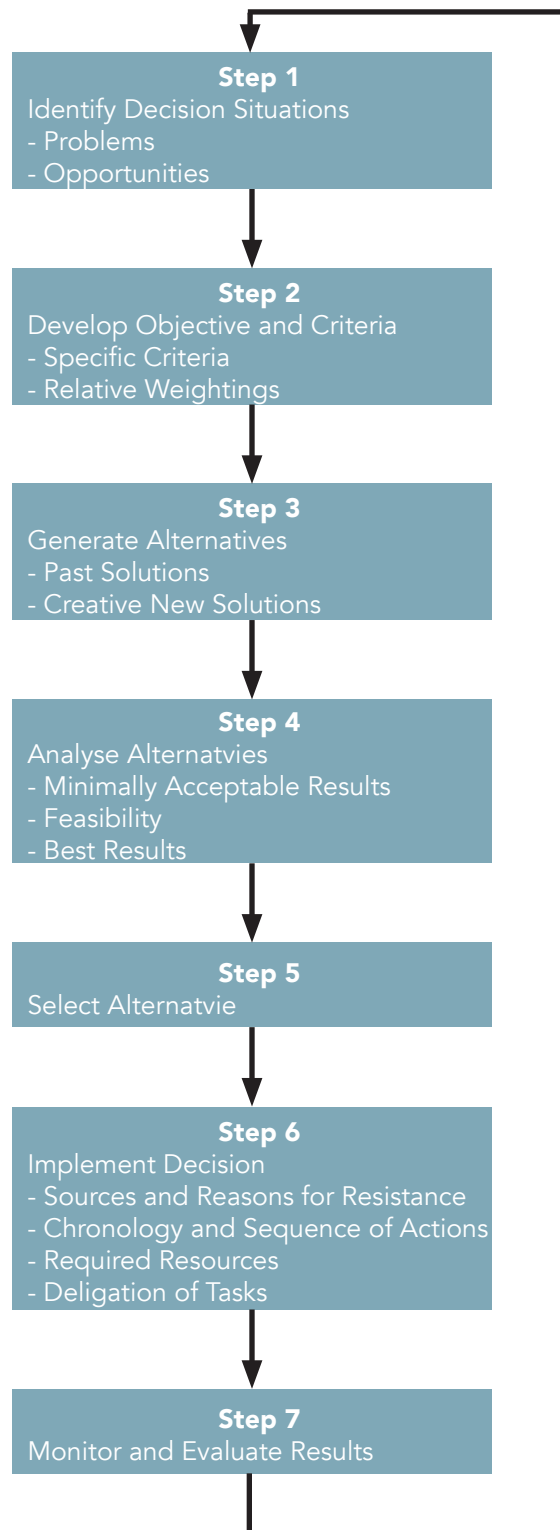Monitor and Evaluate Results

Fig 2.4 Classical decision-making model (Black & Porter, 2000)

In this classical model, the decision maker beings with the recognition of a problem. A problem exists when a project manager detects that there is a gap between existing and desired performance (Bruil et al., 2015). Few of these steps are comparable with the key elements of the planning process (de Leeuw, 2002).

It is important to understand that some assumptions are made for this decision-making model (Black & Porter, 2000). These assumptions are:

- Problems are clear;
- Objectives are clear;
- People agree on criteria and weights;
- All alternatives are known;
- All consequences can be anticipated;
- Decision makers are rational;
  - They are not biased in recognizing problems;
  - They can process all relevant information;
  - They appropriately incorporate immediate and future consequences into decision-making;
  - They search for the alternative that maximize the desired result.

A large body of research has shown that people are not as rational as the classical model assumes (Bruil et al., 2015). Thus, while the rational or classical model shows how decisions in project management should be made, it falls somewhat short concerning how decisions actually are made.

The Bounded Rationality Model

The bounded rationality model is originally developed by Simon (1962). This model does not assume individual rationality. Instead of the rationality, the model assumes that people which make decision, while they seek for the best solution, usually agree with a less successful outcome (Bruil et al., 2015). This is because the decisions they confront with demand greater information processing capabilities than they possess. The decision makers seek for a bounded rationality in decision making.

The concept of this system is based upon three mechanisms (Black & Porter, 2000; de Leeuw, 2002):

1. First, using sequential attention to alternative solutions, people examine possible solutions to a problem one at a time. When an acceptable solution is found, people stop searching for new alternatives.
2. The second mechanism is the use of heuristics. A heuristic is a rule that guides the search for alternatives into areas that have a high probability for yielding success. According to the bounded rationality model, decision makers use heuristics to reduce large problems to manageable propositions so decisions can be made rapidly.
3. The third mechanism is the concept of satisficing. Satisficing is a selection of a minimally acceptable solution rather than pushing farther for an alternative that produces the best results.

This decision process is quite different from the rational/classical model. With this decision model a decision maker does not search for the best solution but for the acceptable solution (Bruil et al., 2015). The bounded rationality model is more a phenomenon which occurs during decision making instead of a separate decision-making model.

The Retrospective Decision Model
The third decision model is focused on how decision makers attempt to rationalise their choices after they are made (Bruil et al., 2015). This means that decision makers attempt to rationalise their choices made based on intuition. This approach of decision making is described as followed in management literature: ''Human decision makers tend to make decisions on the basis of "gut feeling". By this we mean that deeply felt and sometimes emotionally laden convictions, beliefs and persuasions may have a much greater influence in arriving at a decision than explicit arguments and considerations. These arguments and considerations then provide the rationalisation which must legitimise the decision (de Leeuw, 2002)''.

According to literature (Black & Porter, 2000; de Leeuw, 2002), intuition is no accident. Even if the decision maker can explain, after a choice he made, why he made this particular choice, it can be seen that this is the right decision quite often. Actually, more often than it can be called coincidence (Bruil et al., 2015). ''Intuition is an implicit form of rationality which cannot be made more explicit (de Leeuw, 2002). It is also said that ''intuition is fast thinking''(Bruil et al., 2015; Kahneman, 2011).

2.4.2. Thinking fast and slow

To elaborate further on the retrospective decision model, the book Thinking Fast and Slow of Daniel Kahneman (2011) will be used. In his book, he concluded that decision making will be executed in two different systems. These two systems are fast thinking system and slow thinking system, respectively called system 1 and system 2 (Kahneman, 2011):
- System 1, fast thinking. Operates automatically and quickly, with little or no effort and no sense of voluntary control;
- System 2, slow thinking. Allocates attention to the effort mental activities that demand it, including complex computations. The operations of system 2 are often associated with the subject of experience of agency, choice and concentration.

The two systems are described here as separate systems, but according to Kahneman (2011) system 1 is the ''hero'' system. System 1 is originating impressions and feelings that are the main sources of the explicit beliefs and choices of system 2. System 1, which operates automatically, generates complex patterns of ideas. Only the slow thinking

system 2 can construct thoughts in an order of steps. Kahneman (2011) gives some examples which are executed by system 1, the examples are in order of complexity:

- Detect that one object is more distant than another;
- Orient to the source of a sudden sound;
- Complete phrase ''bread and…'';
- Make a ''disgust face'' when shown a horrible picture;
- Detect hostility in a voice;
- Answer to 2 + 2 = ?
- Read words on a large billboard;
- Drive a car on an empty road;
- Understand simple sentences.

To conduct these mental events, little or no effort is required. They occur automatically.

Some of the events and actions listed above are involuntary (Kahneman, 2011). This means, for example, that you cannot prevent from understanding simple sentences in your own language or know that 2 + 2 = 4. The control of attention is shared by the two systems. For example, orienting to a loud sound is normally an involuntary operation of system 1. But this action immediately activates the voluntary attention of system 2. The operations executed in system two have one thing in common, they require attention and are disruptive when attention is drawn away. Kahneman (2011) also gives some examples of events executed by system 2:

- Brace for the starter gun in a race;
- Focus attention on the clowns in a circus;
- Focus on the voice of a particular person in a crowded and noisy room;
- Look for a woman with white hair;
- Search your memory for identifying a surprising sound;
- Maintain a faster walking speed than is natural for you;
- Monitor the appropriateness of your behaviour in a social situation;
- Count the occurrences of the letter a in a page of text;
- Tell someone your telephone number;
- Park in a narrow place;
- Compare two washing machines for overall value;
- Fill out a tax form;
- Check the validity of a complex logical argument.

By executing all these actions, you must pay attention. Also, you will probably perform less well or not at all if you are not ready or if your attention is directed inappropriately. There is a limited amount of attention what can be allocate to activities. When trying to use more attention than there is possible on different actions, the task will fail. It is possible to do several things at once, as long as they are easy and undemanding. Intense focussing on a task can make people effectively blind, even to stimuli that normally attract your attention.

Interaction of system 1 and system 2

According to Kahneman (2011) sometimes the systems work separately from each other but sometimes they interact with each other. Since system 1 runs automatically, system 2 is normally in low-effort mode. System 1 is generating suggestions for system 2 continuously. Suggestions like (Kahneman, 2011):

- Impressions;
- Intensions;
- Feelings;
- Intuitions.

If the suggestions of system 1 are endorsed by system 2, this system will turn the suggestions into beliefs and will turn impulses into voluntary actions. System 2 adopts the suggestions of system 1 with a little modification.

When system 1 faces difficult problems, system 2 is activated to support. It is activated to support into more detailed and specific processing that may solve the problem (Kahneman, 2011).

Conflict of system 1 and system 2

As mentioned above, system 1 and system 2 interact with each other. System 1 generates a suggestion and system 2 modifies the suggestion and turns it into belief or an action. However, the outcome of both systems can also conflict with each other. One of Kahneman's findings is that system 1 will fail if a problem faces probability or statistics. To demonstrate the conflict between both systems, Kahneman (2011) created an example.

Do not try to solve the following problem, but listen to your intuition (Kahneman, 2011).

> *''A bat and ball cost € 1,10.*
> *The bat cost one euro more than the ball.*
> *How much does the ball cost?''*

This example exercise shows that the outcome of both systems also can be different from each other and even conflict. If you solve this example with using system 1, the number which came up in your mind was probably 10 cents. Solving the example with system 2 will result in the correct answer, namely 5 cents. In this case, the suggestion of system 1 (10 cents) is not modified and made into a belief by system two but is changed to a new answer or solution (5 cents).

Sometimes the results out of system 1 and 2 can also conflict with solutions which are statistical more likely. He states that these conflicts or errors are not random, but predictable. According to Kahneman (2011) this has to do with biases of the brain.

By solving some problems, both systems use information which may be irrelevant to create a solution. Kahneman gave also an example of this phenomenon (Kahneman, 2011).

> ''There is a man called: Steve.
> He is a tidy soul with a passion for detail and very little interested in people.
> This guy is drawn at random from the American population.
> Is it more likely that Steve will end up working as a librarian or a farmer?''

Intuitively the given answer will be librarian, which is probably wrong. Statistically there are more farmers in America than librarians which means that the chance that he will be a farmer is higher. This is a typical example of the biases of the brain which is a different way of conflict between system 1 and 2. Since Steve meets the characteristics of a librarian, the wrong answer will be given by system 1.

Intuition

Concluded can be that system 1 is based on impressions, intensions, feelings and intuitions where system 2 is based on effortful, infrequent, logical, calculating and conscious (Kahneman, 2011). The focus of this research is decision making of which the retrospective model now is divided into system 1 and system 2 thinking. Since system 1 is always active and used first. It is important to understand how this system works. As explained before, system 1 is driven on intuition. In this part of the research, intuition will be defined to understand how system 1 works.

Intuition can be defined as four different approaches (Groeneveld, 2006), namely:
1.   Intuition as a process;
2.   The intuitive experience;
3.   Intuition as a quality that people are supposed to have;
4.   Intuition as a skill.
For each of the four different approaches, a definition is given by researchers.

Intuition as a process

''Intuition as a process is the entire process from the moment a person opens up to his deeper and subconscious thinking layers until the moment that the contents are made conscious and concrete'' (Elders, 1994; Jung, 1971).

According to this definition, intuition as a process starts when a person makes a conscious decision to be open for contact with the inner conscious layers. This can only be accomplished when a person is capable of shutting down his habitual thinking temporary (Groeneveld, 2006). Especially at daily tasks or business (think of work) the influence of our frame of mind will be bigger.

The intuitive experience
''The intuitive experience is the moment that the information is fused together at an unconscious level to a synthesis, which is experienced by the person as the moment that all pieces of the jigs are together" (Goldberg, 1997; Thiele Dohrman, 1992). *''The intuitive experience can also be the moment that a person feels a connection with deeper and possibly collective layers of his subconscious. In extreme cases, we can then speak of a mystical experience"* (James, 1963).

The intuitive experience is described by many researchers (Groeneveld, 2006). Depending on the degree to which intuition is filtered, there can be spoken of a more or less pure intuitive experience (Blackwell, 1987). At a less pure intuitive experience, thinking will be filtered by senses, emotions and rational thinking. At a pure intuitive experience person can let their thinking patterns go unstrained which let him reach the same level of what he sees or what he is doing. The intuitive experience can be seen as fusion of a person's thoughts and actions with what he sees.

Intuition as a quality that people are supposed to have
"The intuitive characteristic is the predisposition a person has to be able to look inside and to transfer observations through unconscious path" (Jung, 1995).

Jung defines intuition as one of the four psychological functions or characteristics of the conscious of a human being (Jung, 1971). The other three functions or characteristics are sensory perception, feeling and thinking (Groeneveld, 2006). *''Sensory perception tells us that something exists, thinking tells us what it is, feeling tells us whether it is pleasant or not, and intuition tells us where it comes from and where it is going"* (Jung, 1995). The conclusion of Jung (1995) is that the development of intuition is connected to the development of the four different psychological functions or characteristics, which is connected to the development of a human being. This development arises due to the fact that the four psychological functions or characteristics are balancing out more and more (Groeneveld, 2006). If the four functions or characteristics are balanced out, there is no more separation between the four but they will function as one. This is called the transcendent function (Jung, 1995).

Intuition as a skill
''The intuitive skill is the extent to which a person can make quick decisions by using a set of possible solutions" (Agor, 1989).

Especially in the management literature and in literature focussed on decision making, intuition is seen as technique or skill (Groeneveld, 2006). The reason why these researchers are interested in intuition is that they concluded that these days it is not possible anymore to take decision just on rational grounds. The restrictions of the

brains are an important reason why an individual is not able to handle all received information (Mintzberg, 1994; Simon, 1984). According to Simon (1984) and Mintzberg (1984), using intuitive decision-making techniques should compensate the lack of analytical options.

Definition Intuition
In this research, the last definition by Agor (1989) will be used. Intuition as a skill which can be used in decision-making.

Characteristics fast and slow thinking
Fast and slow thinking are two decision-making systems which can operate separately, interact with each other or be in conflict with each other. Fast thinking is the system which is always active, mostly working on intuition. Slow thinking is the system which is a consciously decision-making process. In this system arguments are considered and a well overthought decision will be made in the end.

2.4.3. Unconsciously deciding

To describe unconsciously deciding, the book ''Het slimme onbewuste'' of Dijksterhuis has been used (Dijksterhuis, 2010). In his book, he concluded that there are three decision making processes, namely:
1. A fast decision;
2. Consciously deciding.
3. Unconsciously deciding;
Before the most useful decision-making process according to Dijksterhuis will be explained, a short definition of the three decision making processes will be given.

A fast decision
According Dijksterhuis (2010), is this decision-making process based on fast thinking without, or barley no, thinking. Fast decisions are made on intuition. These decisions are made in a split second and almost always executed directly. When the fast decision of Dijksterhuis (2010) is studied, the conclusion that it is comparable with the fast thinking theory of Kahneman (2011) can be drawn.

Consciously deciding
If this decision-making process is used, a person first records all information. After all the information is recorded, all the information will be analysed. While analysing the information, a list of plusses and minuses will be made. The importance of the different aspects is analysed. After these steps, an alternative will be selected which is concluded as the best solution according to the analysation.

This decision-making process of Dijksterhuis (2010) is comparable with the bounded rationality model introduced in this chapter (Black & Porter, 2000; de Leeuw, 2002). Recording information, creating alternatives and selecting an alternative which his most satisfying.

Unconsciously deciding

If this decision-making process is used, first the information which is important to make the decision will be recorded. A solution might already pop up but a decision will not be made yet. After recording the information, the person should go to sleep for a night. literally, sleeping a night over it. After waking up and the solution which first popped up might still ''feel good'', the decision can be made. It can also be the case that after waking up the solution pops up which ''feels good''.

Use which decision-making process?

Dijksterhuis argues in his book which of the decision-making processes is most preferable. His first conclusion is that if a decision is complex, a fast decision-making process should not be used. So, he argues between consciously and unconsciously deciding. As mentioned, the consciously decision-making process can be compared with the bounded rationally model. Simon (1962) argues that when the bounded rationally model is used the solution might not be successful. He says that when this is used, an alternative is selected which is satisfying but not a good solution. The reason for this phenomenon is that if the decision is complex, the human mind is not capable of solving this. The more complex the decision is, the harder it gets for a person to solve this (Simon, 1962). Dijksterhuis (2010) made a comparable conclusion. He says: the more complex a decision gets, the harder it is to solve it by using the conscious decision-making process. Dijksterhuis (2010) uses the following figure to describe this.

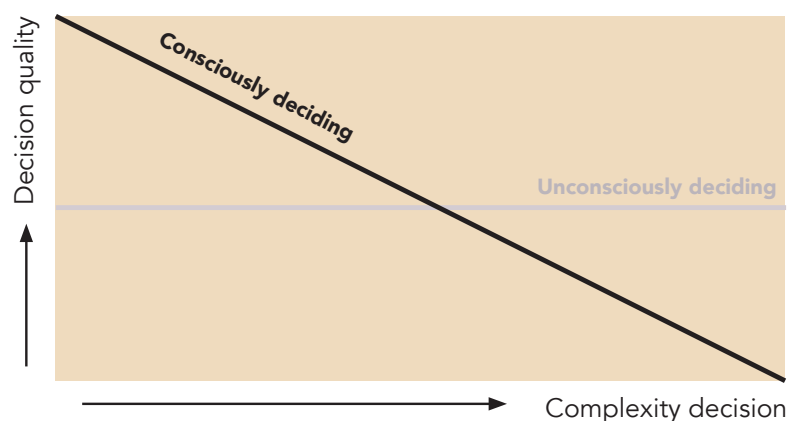*Fig 2.5 Complex decision and decision quality (Dijksterhuis, 2000)*

The black line in the figure represents consciously deciding, the grey line represents unconsciously deciding. As can be seen, if the decisions are more complex the quality of the solution is higher when unconsciously deciding will be used. Dijksterhuis (2010) thus argues that if the decision is complex, unconsciously deciding is preferable.

2.4.4. Design thinking

Design thinking is an ambitious term (Carlgren, Rauth, & Elmquist, 2016). First design thinking will be defined before it is explained how design thinking in project management, particular on decision making, can be used. Defining the meaning of design thinking is done by comparing different definitions given in literature.

Brining designer principles, tools and methods to solve problems is the concept of design thinking (Brown, 2009). Design thinking is originated on the innovation-based way of how designer think (Brown, 2008). It can be considered as an inspiration to other disciplines according to Brown (2009). The concept behind design thinking is that these other disciplines can acquire knowledge from the designers work approach (Brown, 2009). They can eventually apply this to their own operations.

A more general definition of design thinking is as follows (Wylant, 2010): ''*design thinking is the discipline of understanding how sense can be made of something, by going through multiple contextual exercises of placements. Given this, a designer is than able to choose which contexts should be prevalent and the manner in which they should*''.

According to Kimbell (2011), design thinking can be described in three manners. Those three manners are (Kimbell, 2011):
1. As a cognitive approach of designers which are involved in problem solving;
2. As a theory in which design is a field of discipline with the focus on solving wicked problems;
3. As an organizational source for organizations and businesses in need of innovative thinking.

Design thinking can also be described as a tool to deal with situations which are ill structured. Within this ill structured situation the problems are not connected or linked (Mahmoud-Jouni, Midler, & Silberzahn, 2016). Design thinking can be used as an approach to identify and solve problems. Design thinking is an approach to define and solve problems which will be formed into a hypothesis. This hypothesis should stimulate thoughts by actions, to inspire and form better hypotheses. The definition given by Mahmoud-Jouini et al. (2016) is in line with a definition given by Liedtka's (2014) definition. ''*Design thinking is a hypothesis-driven process that is focused on problem and situation*'' (Liedtka, 2014).

The last definition given regarding design thinking is a definition which can be discussed as two different discourses (Johansson-Sköldberg, Woodilla, & Cetinkaya, 2013). Designerly thinking and design thinking:
1. Designerly thinking.
    '' *Designerly thinking links theory and practice from a design perspective and is*

established in the academic field of design. It refers to the professional designer's practice, practical skills and competence, and how to interpret and characterize this non-verbal competence of the designers".

2. Design thinking.
    ''This is a term for the discourse where design practice and competence are used beyond the design context, for and with people without a scholarly background in design, particularly in management. 'Design thinking' then becomes a way of describing a designer's methods that are integrated into an academic or practical management discourse".

When the main points of these various definitions are combined (Brown, 2009; Johansson-Sköldberg et al., 2013; Liedtka, 2014; Mahmoud-Jouni et al., 2016), a definition in which design thinking will be used throughout this research can be defined. The definition is as follows: design thinking is an approach that takes designer's approach, methods and tools into account to allow defining and solving problems. Design thinking is an approach of dealing with complexity in projects.

Characteristics Design thinking
Design thinking can be characterized as follows. As mentioned above, design thinking is defined as an approach that takes designers approach, methods and tools into account to allow defining and solving problems. While using design thinking, problem defining and creating solutions occurs at the same time.

2.4.5. Design thinking in project management

Researchers recognized that project management approaches and tools (as mentioned earlier in this chapter) do not work properly when it comes to changes (Mahmoud-Jouni et al., 2016). Particular when it comes to projects with high uncertainty and/ or complexity. As mentioned earlier in this chapter, project management can be divided in the predictable and the unpredictable (Koppenjan et al., 2011; Lousberg, 2009). In the standard project management approaches and tools, project should as much as possible be predictable and not change during the course of a project (Heerkens, 2002). As explained before, the project management approach of van Gunsteren (2011) differs from this vision but will not be taken into account in this research.

In large projects where the complexity is high and uncertainty is common (can be called the unpredictable (Koppenjan et al., 2011)) this management approach leads to poor performance (Brady & Davies, 2004; Lenfle, 2008). In these large projects with high complexity and uncertainty, problems lack formulation and solution and also the requirements of the customer might not be known at the start. This is defined as wicked problems (read earlier in this chapter). Therefore, the basic project management approach does not work (Mahmoud-

Jouni et al., 2016). Design thinking can add value in decision making in complex projects with high uncertainty. This because design thinking, as it is defined earlier, strives to solve wicked problems and reduce project complexity by using the designer's approaches, methods and tools (Carlgren et al., 2016; Johansson-Sköldberg et al., 2013).

2.5. Chapter summary

In this chapter is defined that project management can be defined into the predictable and the unpredictable. A project manager needs to react on those unpredictable factors. Since unpredictable factors is a broad term this is narrowed down to one of those factors, namely problems.

A problem can be defined into four types, namely: technical, untamed technical, political and wicked. How a problem is classified has to do with the available information upfront. This research focuses on the fourth type, namely wicked. One of the results of this literature research is that there are definitions give regarding wicked problem, however there is no clear definition within existing literature. To define the term wicked within this research, the definition of Hoppe (1989) together with explorative interviews are used. This results into the following definition: a wicked problem is a problem with a lack of information regarding problem formulation and feasibility of the solution direction. Also, there are contradictory interests of involved stakeholders influencing the solving process.

Out of the literature research several decision-making processes has been studied. These different theories explain how a certain process is used in order to solve problems or create solutions. For example, the rational decision model of Black and Porter (2000) can be used to solve technical problems and fast and slow thinking is used to take decisions between alternatives or answer small problems.

No literature has been found which determine how to solve a wicked problem. Also, each particular decision-making theory does not determine how it can be used to solve wicked problems. This is where the gap in research results arises. Out of this literature research can be concluded that there is little literature defining the term wicked and there is literature describing how to make decisions in order to solve problems. However, there is no literature which combines those different theories in order solve wicked problems.

Chapter 3 will investigate how to research which of the decision-making theories are used in order to solve a wicked problem. That chapter will elaborate on how the research results will be compared with literature research results and how the new theory regarding solving a wicked problem will be formed.

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3. Methodolgy

The objective of this chapter is to determine and present the research methods. This is done by presenting the type of study, literature review and case studies. At the end of the chapter, a reflection on research ethics is conducted.

3.1. Type of study

The aim of this research is to explore how project managers in practice make decisions regarding wicked problems in project management (see chapter 2.5.). To call a process research, it has to have some characteristics. This research aims to generate new theories so it has an inductive character (see figure 3.1.). In the end of the research a hypothesis of a new theory will be generated, not a completely new theory. The hypothesis will suggest further research in order to transform it into a new theory. To conduct inductive research, qualitative research is appropriate (Bryman, 2005). Qualitative research methods tend to be concerned with words rather than with numbers (Eisenhardt, 1989).
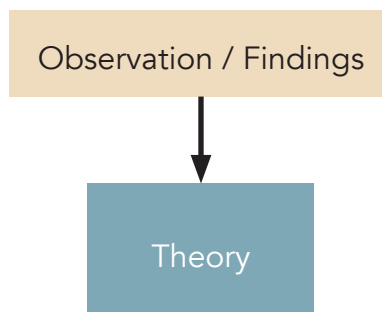

Fig 3.1. Inductive research approach (Bryman, 2005)

Because of the inductive research study, a more inductive approach of theory building will be used (Yin, 2003). A theory building approach from case study research will be used to develop a hypothesis from the empirical findings of the case studies (see table 3.1.) (Eisenhardt, 1989). The hypothesis developed in this research will be how project managers in practices solve wicked problem. This hypothesis will be presented in chapter 6 conclusion and discussion.

Part 1: Background	
Method	Literature research
Objective	Getting an impression of topic area and current theories
Sub-questions	What is project management?
Part 2: Theories	
Method	Literature research and explorative interviews
Objective	Explore possible research gaps
Sub-questions	What is a wicked problem? How can decision-making be defined?
Part 3: Practices	
Method	Case study research
Objective	Collecting data, analysis and comparison
Sub-questions	What are the perspectives on problem formulation? Which of the decision-making processes are used by project managers? How can wicked problems be solved?
Part 4: Synthesis	
Method	Theory building
Objective	Drawing empirical lessons
Question	What empirical lessons can be drawn from the findings out of the case study compared with findings out of the literature study?

Table 3.1. Methodological framework. Own table, based on (Eisenhardt, 1989)

3.2. Part 1: Background

The first part of the graduation research consists of an explorative literature review. In this literature review an overview of concepts and theories related to project management, wicked problems and decision-making processes is presented. There are different kind of literature reviews. This explorative literature review is a ''narrative review'' (Bryman, 2005). According to Bryman (2005), a narrative review is an examination of theory and research relating to the field of interest that outlines what is already known. The outcomes of the narrative review will frame and justify the research questions.

3.3. Part 2: Theories

Systematic literature review overlaps with the explorative literature review and both are linked to each other. That both overlap and are linked to each other is because the explorative

literature review forms the basis for the systematic literature review. ''The aim of systematic literature review is to minimize bias through exhaustive literature searches of published and unpublished studies'' (Bryman, 2005).

The explorative interview is used to develop a more specific definition of a wicked problem. As described in the literature review, a wicked problem is difficult to define and is hard to find in existing literature. The explorative interviews were conducted as unstructured interviews (Bryman, 2005) and used to define the term wicked problem. Next to defining wicked problem, decision making will be defined. Together with the definition of project management, the theoretical framework for this research is formed. In this part of the thesis, the three sub questions mentioned in table 3.2 will be answered.

Objective	Explore possible research gaps and getting an impression of topic area and current theories
Sub-questions	What is project management? What is a wicked problem? How can decision-making be defined?
Methodology	Systematic literature review and explorative interviews

Table 3.2 Object, sub-question and methodology

3.4. Part 3: Practices

In this part of the thesis practice will be researched. As mentioned before, researching practices will be conducted by case study analysis. A case study could be studying an individual, a group, a community, an event, a subgroup or a population (Brasters, 2000; Kumar, 2011). According to Kumar, a case study should focus on a bounded subject that is either very representative or extremely atypical for the researched topic. The case study subject of this research is very representative for the research topic, namely a wicked problem in a construction project solved by a project manager. This subject will be elaborated further on in this chapter. Table 3.3 shows the three sub-questions which will be answered by case study research.

Objective	Collecting data
Sub-questions	What are the perspectives on the problem formulation? Which of the decision-making processes are used by project managers? How can a wicked problem be solved?
Methodology	Case study research

Table 3.3 Object, sub-question and methodology

3.4.1. Case study description

Out of the literature research can be concluded that technical problems (see chapter 2 for definition) occur in projects and that a project manager makes decisions in order to solve it. The unit of analyse within this research will be three single cases. A wicked problem in a construction project which is solved by a project manager, or where the project manager suggested a solution, will form the case (see figure 3.2).
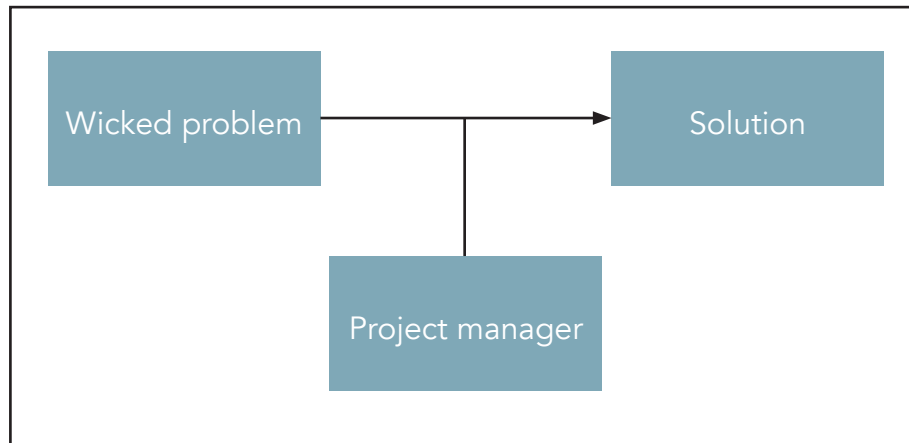

Fig 3.2. The case

3.4.2. Case selection criteria

Since the objective of the case study is to collect data, the cases should contain the defined objects of the theoretical framework. A criterion sampling method is needed. In this method, cases are selected on the basis of meeting particular criteria (Bryman, 2005).

Bryman (2005) mentions that findings from one case can only be used if it is a representative case. This is a pitfall of a single-case study. A multiple-case studies may be preferred over single-case designs (Yin, 2003). The pitfall of a two-case study is that replication might occur. Replication means that the outcome of the two cases will not be empirical. Therefore, Yin (2003) suggest that having more than two cases will produce a stronger effect. This means, the more cases the better results. How many cases will be studied will be explained below.

Since three or more cases is still broad, in this part of the case selection criteria the number of cases will be selected. Construction projects can be categorized in four groups (see chapter 1), namely:
1.   Residential;
2.   Office;
3.   Leisure;
4.   Retail.
As mentioned before, the third aspect of a wicked problem is that the business of the owner or renter of the building generates pressure on solving the wicked problem. This is the case in an

office project, leisure project and retail project. There is probably also pressure from residential projects but this is no pressure generated out of daily business but more on an earlier selling time or renting time. So, this results into selecting one representing wicked problems for each construction project category.

To summarize, the three cases will be selected on the following criteria:
- The wicked problem occurred in one of the three mentioned construction project categories (one case per problem type);
- The wicked problem is solved, or the solution is proposed by a project manager;
- The studied problem meets the definition of wicked problem as defined in chapter 2.2.:
    o   There is a lack of information:
        a   There are multiple problem formulations which are contradictory;
        b   It is unclear if the solution directions of the problem are feasible on the aspects time, budget and quality;
    o   Stakeholders have contradictory interests. With an important interest of the client, namely: daily business influenced negatively.

3.4.3. Case selection

All three cases are selected and studied within Dev_real estate. At Dev_real estate wicked problems occur in their daily work activities. The researcher will conduct a graduation internship at Dev_real estate to study those wicked problems. Dev_real estate is chosen as graduation company because:
- They are acting as consultant in:
    o   Development;
    o   Real estate;
    o   Real estate owner;
    o   Project management;
- Wicked problems occur in daily work activities;
- They have experience with guidance of graduation interns.

The three cases will be studied inside the graduation organisation, as mentioned, Dev_real estate. If one or more cases cannot be supplied by the graduation organisation, the cases will be searched outside of this organisation.

Out of explorative interviews, the following three cases are selected based on a hypothesis of a wicked problem formed by the interviewee:
1.   **Case 1 Stibbe (office)**
      The schedule of the interior was not reached due to several factors. A result of this could be that lawyers firm Stibbe could not move into their new office building in time (Interviewee 4, 2018);

2. **Case 2 Holland Casino Amsterdam West (leisure)**
   More installations are constructed on the roof of the casino, more than designed upfront. A demand from the owner of the building is that the installations may not be seen by guests from the hotel. A result of this could be that Holland Casino may not open in time since they need to solve the installations which are insight of hotel guests (Interviewee 8, 2018);

3. **Case 3 SushiSamba (retail)**
   During the construction of the project one of the contractors was delayed according to the schedule. This contractor did not report this in time. the results of this delay can turn out negatively for the tenant (SushiSamba) and for the other involved parties (Interviewee 9, 2018).

3.4.3. Data collection

The following sources of evidence will be used to conduct the case study research (Yin, 2003):

- Observation of participants. During the graduation research, the researcher might get involved in the projects that are subject of the case study;
- Semi-structured interviews. Interviews with project managers;
- Documentation. Analysing project documents, reports, internal minutes and other related documents.

Observation of participants

The observation of participants is only used to create context of the decisions made. During events where the project manager has to react and make decisions, the researcher will see how the project manager reacts. As mentioned, this is just used to understand the context of the decision made. Observation of participants will not be used as a main data source, this is because this research technique comes with major challenges towards biases. Biases are caused by the observer within the project which can influence the outcome of the case study (Yin, 2003).

Semi-structured interviews

Semi-structured interviews will be conducted in order to collect data. Together with documents this is one of the sources from which data will be achieved. A semi-structured interview means that some questions will be used to introduce a certain topic. After this question there is room for the interviewer to start a conversation with the interviewee regarding this topic and ask more questions where needed.

The interviews will be used to get understanding in the topics which will be researched. Those topics are: wicked problem formulation, solution and decision-making of project manager. Because of the semi-structure of the interviews, open questions will be asked in order to start a conversation regarding the topic relating to the question. The semi-structures allow the

interviewer to ask extra questions to get more in depth. Which questions will be asked and how they are related to the research topics will elaborated further in this chapter.

The following persons will be interviewed during the case study:

- Project manager who solved the wicked problem;
- Important stakeholders which are related to the wicked problem:
  - Client;
  - (Sub) contractor;
  - Another important stakeholder during the project.

The project managers will be interviewed since they are the research topic. The related stakeholders will be interviewed to research their perspective on the wicked problem. The expectation of the researcher is however that the project manager did solve the wicked problem. Because of this reason, the stakeholders will be interviewed in a way to research their perspective on how the project manager solved the problem.

For each case, the project manager who solved the wicked problem will be interviewed. This together with the most important related stakeholder. Which stakeholder is most important and related will be concluded out of the stakeholder analysis (will be explained further on in this chapter). In each case, this number of interviews regarding stakeholders will be between a minimum of two and a maximum of four. This together with the project manager interview.

Documents

All documents which are available per case will be studied. However, a focus will be on the following documents:

- Minutes of meetings;
- Memo's;
- Schedules;
- Drawings;
- Budgets.

Data collection plan

In this part of the case study protocol, each data collection will be matched to the mentioned research question. This will be done in table 3.4 below.

	Observation of participants	Semi-structured interviews	Documentation
• Analysing wicked problem • Analysing project organistion • Analysing contracts • Analysing GOTIK	X	X	X X X X
Which of the decision-making processes are used by the project maangers?	X	X	
How can a wicked problem be solved?		X	X
How did the solution of the wicked problem contribute to project succes?		X	

Table 3.4 Data collection plan

Before the semi-structured interviews can be conducted, the interviews need to be prepared. There are two topics which need preparation, namely: the context of the wicked problem and the involved stakeholders. Both topics can be prepared by analysing project documents.

The selected cases are mentioned earlier in the case study protocol. Each of these cases are introduced by the project manager in the conducted explorative interviews. By analysing project documents, the wicked problem can be analysed and made clear. After the wicked problem is made clear, the involved stakeholders will be analysed. When these both topics are analysed and defined, the interviews can be conducted with the project manager or involved stakeholders.

3.4.4. Data analysis

Within-case analyse

The first of the two techniques to build theories out of case studies is in-case analysis. The in-case analyses will be manually conducted. The main analytical techniques used is pattern matching and explanation building (Yin, 2003). The case will be analysed as follows:
1.   Background, organisation and context of the problem;
2.   Stakeholder analysis. A web in which involved actors will be placed and linked to each other;

3.   Perspectives on problem formulation;
4.   Decision making by project manager;
5.   Solution to the wicked problem.

Interview protocol

The semi-structured interviews will be used in order to collect data to fill the gap in research results. All the questions in the interview are asked in order to introduce a certain topic coming out of the literature research. Below are the six questions which will be asked to introduce 6 research topics. After the questions is displayed, an explanation is shown how the particular question relates to the topics coming out of the literature research.

1.   Can you introduce yourself and your relevance to the particular project?
      This question is asked as an introduction to the interview and to get insight in the background of the interviewee. The results of this question will not be taken into account during this research;

2.   Can you tell me in detail what the project was about?
      This question is asked as an introduction to the particular project in which the wicked problem occurred;

3.   Can you tell me in detail what the problem was according to you?
      According to the definition of wicked problem, there is a lack of information regarding problem formulation. This means that there are different unknown perspectives on the formulation;

4.   Can you tell me how the process looked like during solving the problem?
      The project manager made decisions in order to solve the wicked problem. This question investigates what kind of processes the project manager used;

5.   Can you tell me what the final solution to the project was?
      According to the definition of wicked problem, there is a lack of information regarding solution direction. This means that upfront it was unknown how the problem should be solved. This question investigates the different directions and which direction is chosen;

6.   How did this wicked problem influence the project success in your perspective?
      This question is not a part of the research. The researcher is curious what the perspective of the stakeholders is on the influence of the problem on their project success.

3.5.   Part 4: Synthesis

The results out of the case study research will be the input of the synthesis of this research. In the synthesis of this research, a hypothesis will be drawn. Drawing a hypothesis will be done by the theory building approach (Eisenhardt, 1989). The main steps of this theory building approach are a within-case analyses, a cross-case analysis and confronting those results with the existing theories. In part 4: Synthesis, only the cross-case analysis and confronting those results with theories will be conducted.

Cross-case analysis

A cross-case pattern analysis will be used to learn from the different case studies. In this analysation, the information will be categorized into the different topics researched. These topics are:

- Wicked problem formulations;
- Decision-making by project manager;
- Solution to the wicked problem.

This data is tabulated and added up to each other (Eisenhardt, 1989).

Discussion of results

To draw a hypothesis, the results out of the cross-case analysis will be compared with the findings out of literature research in chapter 2. The discussion of results will be conducted on the following three topics:

- Wicked problem;
- Decision-making;
- Solution of wicked problem.

Mentioned three topics are extracted out the literature study in chapter 2.

3.6. Conclusions

Although there is a lot of research regarding project management, wicked problem and decision making, there is no research focused on combining these theories (see chapter 2.5). Since this research has an inductive character, a hypothesis will be drawn. This hypothesis strives to describe how project managers in practice solve wicked problems by making decisions. The hypothesis will be drawn in the shape of a framework which is used by the project managers in practise to solve a wicked problem.

In the end of the research, the conclusion will answer the main research question: ''How do project managers solve wicked problems in construction projects?'' This answer will form the drawn hypothesis. The main findings out of this theory building approach are validated both internally and externally. This will be elaborated in the remaining of the chapter.

3.7. Validity

In this section of the case study protocol, the relation between the research design and validity and reliability is evaluated. Validity can be divided in construct validity, internal validity and external validity.

Construct validity

To make the analysed data more constructive valid, two steps will be/ have been taken, namely: triangulation of data and test interviews.

The first step is triangulation of data (Brasters, 2000; Knight & Ruddock, 2008; Yin, 2003). This is done by using three sources of data (see figure below):

•   Observation of participants;

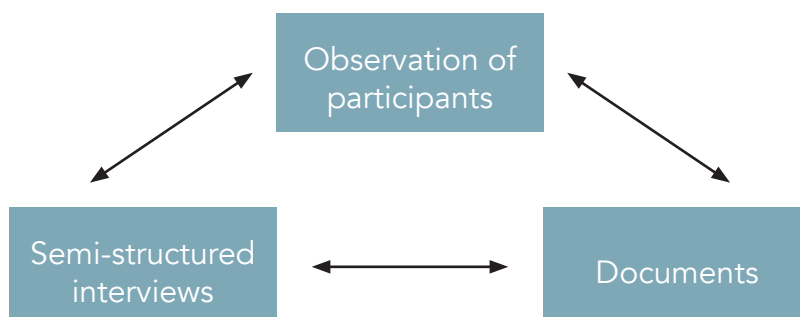•   Semi structured interviews;

•   Documents.

Fig 3.3. Triangulation of data (own figure) based on (Yin, 2003)

The second step how constructive validity is being achieved is by conducting test interviews. Two test interviews will be conducted to test if the interview questions generate the answers which are needed for this research.

Internal validity

In order to secure internal validity, explanation building technique will be used. In this strategy, a hypothesis will be developed to explain the studied phenomena within a case study.

By conducting more than one case study it should be possible to reform a hypothesis. The hypothesis will be formed after the first case is analysed. This hypothesis will be modified and reformed after the second case is analysed. Modifying and reforming of the hypothesis will continue till all case are analysed.

External validity

External validity concerns to which extend findings from the case studies can be generalized to other situations (Yin, 2003). Since the research takes place within Dev_real estate, the research will be quite specific and based on project managers working at this company. All project managers which are available to be analysed are subject of study during the case studies.

An attempt to be able to generalize these findings is done by choosing representative cases. As mentioned in chapter 1, there are 4 types of business: residential, office, retail and leisure. In the case study protocol is elaborated on the selection procedure of the cases. This selection procedure strives to select 1 case representing each particular business. However, more research can be conducted in order to determine if the case is representing the particular business.

In order to external validate the outcomes of the case study research, a cross-case validation will be conducted. The outcomes of the three cases will be compared within the cross-case analysis in order to generate outcomes which are generalized and usable to be compared with literature in chapter 5.5 discussion of results.

Reliability

To ensure the reliability of this research, two steps will be taken. The first step is developing a case study protocol. In the protocol is explained how the case study research will be conducted. The second step is developing a case study database. In this database the results of the interviews, the analysed data, research notes, documents, etc. will be stored.

3.8. Chapter summary

To fill the research gap determined in chapter 2, new research will be conducted. This chapter builds the methodological framework which elaborates how the research will be conducted within this thesis. As mentioned in the chapter conclusion of chapter 2 there is a gap in research results regarding decision making of project managers in order to solve wicked problems.

Since the inductive character of this research, qualitative research will be conducted in the remaining of this thesis. Case study research will be used to conduct qualitative research. Three cases will be subject of study in this thesis. A case is a construction project in which a wicked problem occurred and is solved by a project manager. All three cases are selected within Dev_real estate and meet the following selection criteria: the problem can be defined as wicked according to the definition given in chapter 2, the problem is solved by a project manager and the problem is selected in one particular construction type (one in office, retail and leisure construction project).

The following topics will be researched: perspectives on problem formulation, decision-making process of project manager and the solution of the problem. All mentioned topics are identified in the literature research chapter. Three side subjects will be studied, namely: background of the interviewee, background of the project and influence on project success. To gather data regarding mentioned topics semi-structured interviews, documents and observation of participants are used.

All the gathered data regarding the mentioned topics will be analysed in order to draw a hypothesis in the conclusion. The first analysis is a within-case analysis which will be conducted for each particular case. After the within-case analysis a cross-case analysis will be conducted. In this analysation all outcomes of the within-case analysis are compared with each other and with the outcomes of the literature study. In the end the outcomes will be used to draw a hypothesis on how project managers in practice solve wicked problems. The hypothesis will be drawn in the shape of a framework which is used by the project managers.

Practices

3

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4. Case studies

In this chapter the studied cases will be introduced and analysed. The following three cases are studied: case 1 Stibbe, case 2 Holland Casino Amsterdam West and case 3 SushiSamba. Firstly, the cases will be analysed individually. After the individual analysation, the findings out of the cases will be compared with each other in a cross-case analysis. The cases will be analysed on the following four topics: important stakeholders, perspective on problem formulation, decision-making by project manager and problem solution. These four topics are extracted out of sub questions four, five and six: (4) What are the perspectives on the problem formulation? (5) Which of the decision-making processes are used by project managers? (6) How can wicked problems be solved?

How the cases are selected is elaborated in chapter 3. The list of references used sources in the case study analysis is added in appendix A. Appendix B contains all the summaries and transcriptions of the interviews. Due to privacy concerns all findings are made anonymous. This results into not referring the interviewees by name and company but by interviewee number. Which interviewee belongs to which interviewee number is known by the researcher, the supervisors from the Technical University Delft and the supervisors from Dev_real estate.

As mentioned before, the case study research is conducted within the graduation company Dev_real estate. Dev_real estate changed their name in December 2017. Before December 2017, Dev_real estate was called DVPC. Some of the studied cases were executed before December 2017 so this leads into having two sources of evidence, namely: DVPC and Dev_ real estate. So when DVPC is mentioned in this chapter, the same company as Dev_real estate is mend.

4.1. Case 1 Stibbe

Fig 4.1 Stibbe office building

4.1.1. Case introduction

Stibbe is a lawyer's firm originally formed in 1911 in Amsterdam. They operate out of seven countries worldwide, namely: Amsterdam, Brussels, Luxemburg, Dubai, Hong Kong, London and New York (Stibbe, 2018).

The headquarter of Stibbe is located in Amsterdam for more than 100 years. In 1991 Stibbe moved into the so called ''Stibbe Tower'' located on the south axis in Amsterdam. This case concerns the new office building of Stibbe in Amsterdam located at Beethovenplein in Amsterdam.

The project can be divided into two separate projects, namely: the base build and the fit out. The base build of the new office building is designed by architect Jo Coenen (Stibbe, 2018), the fit out is designed by Fokkema and Partners. Stibbe's new office building is intended to facilitate collaboration in teams. The building is shaped into three wide wings with a central atrium. This atrium stretches up to the top floor. These wings are designed as open workspaces where flexible collaboration can take place. The table below elaborates on the project size. The construction of the fit out started December 1st 2015 and should be delivered on July 9th 2016 (DVPC, 2015). At the 10th of July, Stibbe moved into their new office building.

Square meter	15.000 m² (Coenen, 2018)
Budget fit out	€ 11.670.000 (DVPC, 2016)
Type of project	Office

Table 4.1 Project size details

4.1.2. Project description

Before the case will be analysed, a summary of the project in detail will be given. This description forms the background of the analysation. This case focusses only on the fit out part of Stibbe office project.

The schedule was an important factor during the construction of the fit out (Interviewee 4, Explorative interview, 2018). During the fit out tender, a specific start and end date of each particular activity were determined. In case of the subcontractors, table 4.2 displays a summary of the most important dates during the tender.

	2017								2018			
	May	June	July	August	September	October	November	December	January	February	March	April
Kabels												
Walls												
Kitchens												
Entrance security												
Furniture												
AV-installations												
Floors												
Workspace furniture												
Movable furniture												
Legend	Tender time			Choise contractor		Start construction						

Table 4.2 Tender schedule fit out (DVPC, 2015)

In the table can be seen that most parties had to start in March 2016 and some parties in April 2016. The competing parties had to take these dates into account in their tender. After the tender and selection of the parties, a final schedule has been made. In this schedule can be seen that all activities are linked to each other (DVPC, 2015). According to this first schedule, the subcontractor responsible for the walls should start with their first activities on the 21st of December and deliver all their activities on the 26th of December 2016.

The activities of the subcontractor responsible for the walls were linked to the activities of the subcontractor responsible for the floors. When the walls were finished on a particular level, the floors could be constructed.

These specific dates were strict due to the current rent contract of Stibbe. Stibbe cancelled that contract because their demand to the office space changed. Because of the descending rent contract, Stibbe had no housing anymore after the expiring contract. This fact created time pressure on the project, since Stibbe had to move into their new office building when their current rent contract expired.

4.1.3. Stakeholders

A lot of stakeholders were involved during the construction of the Stibbe office building. In this part of the project description, the most important stakeholders will be analysed in this part of the case analysation. Comparable in the division of the project in base built and the fit out, the same division can be made when analysing the stakeholders. Figure 4.2 displays the project organisation of the fit out part of Stibbe.
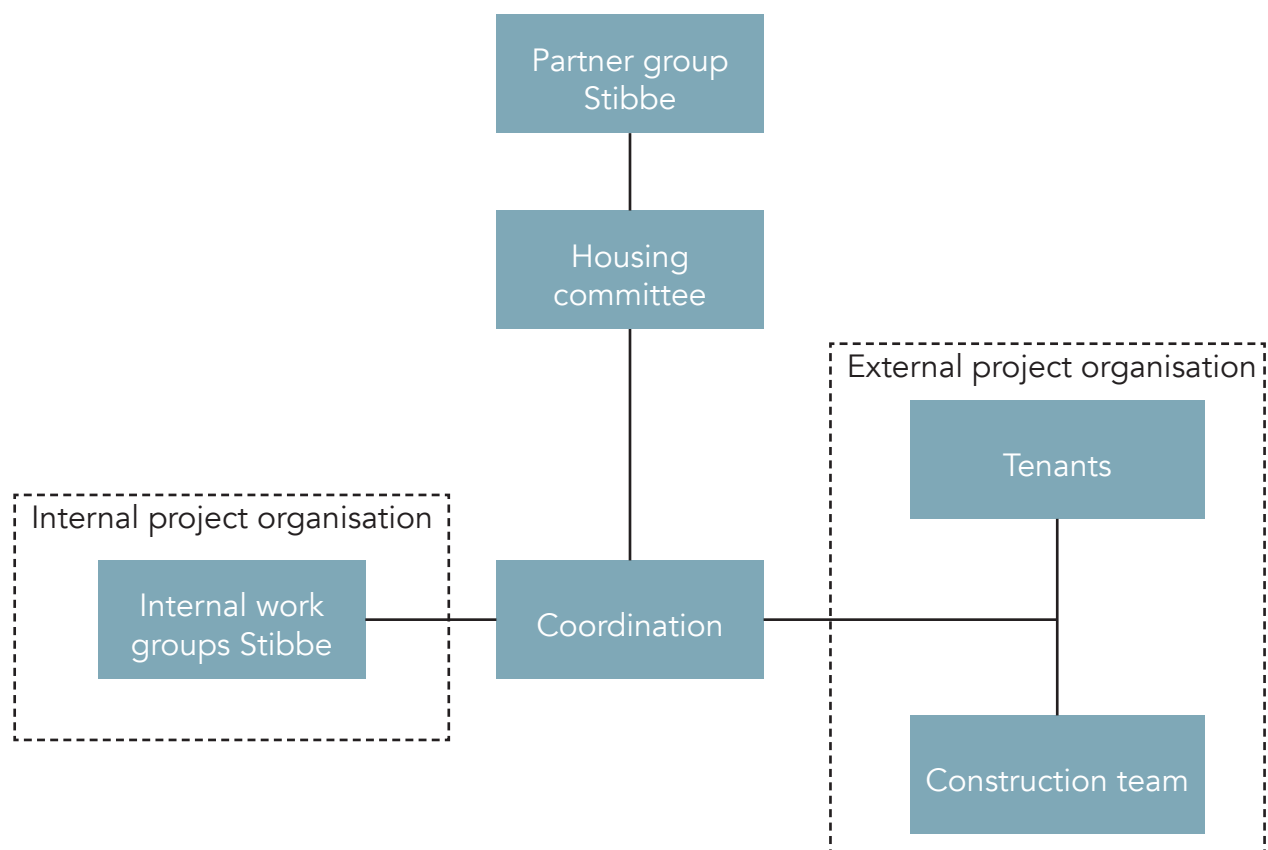
Fig 4.2 Project organisation Stibbe (DVPC, 2015)

As can be seen in the figure above, there is a division between internal and external project organisation. For this case it is important to understand the role of housing committee (in Dutch: huisvestingscommissie, HVC) and construction team (in Dutch: bouwteam).

The HVC consists of the following parties (DVPC, 2014):
*   Stibbe. Role: future tenant;
*   DVPC. Project management consult;
*   Willimas;
*   Fokkema and partners. Role: architect fit out.

The goal of the HVC is to align project management between DVPC and Stibbe. In the meetings of the HVC the progress of the construction will be discussed together with possible deviations regarding GOTIK.

Before the construction team was formed, a design team was formed and functioned as a forerunner. The design team was organized in a way that the construction team could be formed out of this team. Most important parties part of the construction team are mentioned below:
- Smeulders. Role: furniture;
- Gielissen. Role: furniture;
- Sepa. Role: walls contractor;
- De Kruijff. Role: floor contractor;
- Limpidblue. Role: Installations;
- Avex. Role: audio and video installations;
- Ooijevaar. Role: construction work;
- Fokkema and Partners. Role: architect fit out.

The parties of the construction team are connected to each other by two contracts, namely the building contract and coordination contract.

Building contract

The building contract was signed between the involved parties and Stibbe. In this case, Stibbe was the Client. The content of the building contract is for each party the same, the details change. Most important parts of the contract for this case are: order, contract sum, commencement, construction time and delay.

The construction schedule is added as appendix of the signed contracts. A part of the contract is that the particular party needs to fulfil his activities according to the schedule. If the schedule is not met, a fine will be imposed. This fine will be a discount on the contract sum for Stibbe. The discount for Stibbe, if the party cannot meet the agreements in the contract, is € 1.000 for the first week, € 2.000 for the second week and € 3.000 euro for the third week and more.

Coordination contract

Every party signed the coordination contract. In this coordination contract all parties agreed that they would give their full cooperation in order to achieve the schedule goals and construction plan. They also agreed that they would fulfil their own activities as good as possible and always give their full cooperation in a way that they, or the other parties, can fulfil their activities. One coordination contract was signed by all the parties, so not one contract between Stibbe and each party.

4.1.4. Perspectives on problem formulation

As mentioned at the definition of a wicked problem, a part of the definition is that there is no clear perspective on the problem formulation. In this part of the case study analysis, the different problem perspectives within this case are analysed. Out of the interviews and document research can be concluded that there are three problem perspectives, namely:
1. The schedule is delayed due to parties not completing their activities in time;
2. Due to organizational problems, the project was uncontrollable and therefore a lot of mistakes happened;
3. There is no problem.

The schedule is delayed due to Sepa no completing their activities in time

This problem perspective can be seen within two interviews and within the documentation of the project.

The project has been documented in mainly minutes of meetings and memo's. These files state the following (DVPC, 2016) (DVPC, 2016) (DVPC, 2016): *''The problem which occurred during the construction of the new office of Stibbe concerns the schedule of the project. What happened is that due to failure of Sepa, the made schedule could not be met by them. A result of this is that the activities from other parties are influenced by this delay.''* and *''That Sepa was delayed in their activities became known in March during meetings. This is the month in which originally the other parties should start. There was no time to adjust to this so a problem occurred.''*

Two interviewees mentioned the same problem formulation. According to interviewee 1 the problem statement is as follows (Interviewee 1, 2018): *''Due to failure of other parties, his company was not able to start according to the made schedule. Every time they wanted to start their activities on a new floor, they were told to stop due to other parties which needed to complete their activities first.''* According to interviewee 4 the problem statement is as follows (Interviewee 4, 2018): *''Sepa had problems with the design and production of the walls. Due to this problem, Sepa could not deliver according the schedule. This delay in schedule cause a chain reaction in delay at the other parties.''*

Due to organizational problems the project was uncontrollable and therefore a lot of mistakes happened

Interviewee 3 mentioned the following regarding the problem statement (Interviewee 3, 2018): *''A tight schedule removed required time to adjust on mistakes and problems. Due to organizational problems, products were not engineered detailed enough and mistakes occurred. Other parties delayed because of not reaching schedule goals by other parties.''*

There is no problem

Interviewee 2 mentioned the following regarding the problem statement (Interviewee 2, 2018): *''The mock-up created by Sepa did not meet the required quality and sound isolation. This was solved in time. there were some issues regarding the schedule but the project is delivered in time, so there is no problem.''*

4.1.5. Decision-making by project manager

According to the project manager who solved the wicked problem, he conducted the following steps (Interviewee 4, 2018):
- Identifying the problem;
    - o Analysing the actual problem and effects of this problem.
        - a Analysing the problem on technical aspects.
        - b Analysing the stakeholders and interests of these stakeholders.
    - o Analysing what problems needs to be solved ad-hoc.
    - o Analysing what problems have more time to be solved.
- There are two directions in which solutions can be made. The direction of solution can also be a combination of both;
    - o Claim with consequences and legal actions.
    - o Come to a solution without legal actions and collaborate on trust.
- Defining possible solutions;
    - o Analyse the effects of the possible solutions.

  o   Creating solutions based on minimalizing the negative effects on the project.

The project manager makes most decision based on his experience. His experience shows him what the real problem is and when a problem starts to arise.

As soon as the problem ''shows up'', the project manager starts defining possible solutions. These solutions are not made split second but are overthought. Loops are made in order to collect information in order to formulate the problem and create possible solutions. In this case, the project manager drawn different solutions and discussed these with colleagues. Drawing the different solutions is used by the project manager to design the final solution. During drawing it becomes clear what the solution direction should be. The different solutions according to the project manager (Interviewee 4, 2018):
1. Do nothing. Let the involved parties come to a solution together;
2. Keeping the contracts and steer on claims and pressure;
3. Collaborate and inventory which demands are feasible.

Deciding has to do with timing. During designing the solution, sometimes the project manager notices that he is lacking information or that he needs to overthink some information a bit more. When all information is available, a decision can be made.

According to interviewee 2, the project manager of the project proposed a solution (Interviewee 2, 2018). Involved stakeholders agreed on this solution and continued. Every decision is made by the project manager, which aligns with the part mentioned above. The other involved interviewees defined the same way of problem solving compared with the one mentioned by the project manager (Interviewee 1, 2018) (Interviewee 3, 2018).

4.1.6. The solution of the wicked problem

There were two kinds of different solutions to the problem according to the project manager, namely: (1) ad hoc solution and (2) solutions which had more time available to be solved (Interviewee 4, 2018).

Ad hoc solutions:
- A plan on how to solve the problem;
- A proposal to Stibbe to not start any legal actions (DVPC, Notulen HVC, 2016);
- Continuing the production of the walls and make sure that the activities of the other contractors were not being influenced by this problem.

Solutions with more time available:
- Continuing engineering of walls to achieve the demand quality;
- Creating a new schedule with Sepa and other contractors (Interviewee 1, 2018) (Interviewee 2, 2018) (Interviewee 3, 2018) (DVPC, 2016) (DVPC, 2016);
- Making new contractual agreements and steer on achieving those. To achieve this, the parties had to be flexible throughout the project. Trust between the involved parties into a successful completion of the project was needed (Interviewee 3, 2018).

4.2. Case 2 Holland Casino Amsterdam West

Fig 4.3 Entertainment complex VEN with Holland Casino Amsterdam West

4.2.1. Case introduction

Amsterdam West is the new location of Holland Casino in the Netherlands. This new location will replace the location Schiphol. Holland Casino Amsterdam west will be a part of the entertainment complex ''Ven''. Ven exists out of a casino, hotel, restaurants, bars and fitness centre (Holland Casino, 2018). The other mentioned facilities will not be operated by Holland Casino but by other parties. Ven will be realised in the old office building of KPN located near station Amsterdam Sloterdijk next to the A10. This means that Ven is easy to access.

The entire complex will be around 40.000 square meters divided over ten floors. Holland Casino will take 5.168 square meters and is thereby a mid-sized location of Holland Casino. The idea of this location however is that it will be a prestige location. High-end quality is used to make it a prestige location. One of the extraordinary things inside this location are the climate installations. They are designed in a way that it is always 22,8 degrees Celsius inside, no matter how many people are inside the building.

The installations are measuring the humidity, temperature and composition of the air continuously (Meneer Casino, 2018). By a system of pipes in the walls, the climate inside the casino can be managed all the time and kept at the optimum condition. Out of research is concluded that 22,8 degrees Celsius is the temperature in which people feel most comfortable. That why this degree is important and managed all the time.

It is important to understand that Holland Casino Amsterdam West is a part of the entertainment complex Ven (as mentioned above). The owner of the building in which Ven is located is DYDL Propco. This party is responsible for the base built of the building and is advised by Stevens Van Dijck. Their architect, responsible for the exterior of the building, is ZZDP Architects.

Square meter	5.168 m² (Meneer Casino, 2018)
Budget fit out	€ 29.154.952 (Dev_real estate, 2018)
Type of project	Leisure

Table 4.3 Project size details

4.2.2. Project description

As mentioned before, Holland Casino is not the building owner but a tenant. This resulted in a division of construction responsibilities. According to the explorative interviews, there was a clear demarcation between fit-out and base built (Interviewee 8, Explorative interview, 2018). The building owner (DYDL Propco) was responsible for the base built, Holland Casino was responsible for the fit-out of the casino.

The installations needed for the casino were going to be constructed in a part of the basement. These installations were designed in a way that the biggest part was going to be situated in the basement and a small amount on the roof. In the basement around 415,2 m2 was designed for the installations and on the roof a few spots for installations were designed (CE-design, 2016). On the roof in a particular way that they would all fit under a small canopy (CE-design, 2016). So, in the original design there was already a canopy designed in a way that the installations would fit under it. This can be seen in the cross-section below.
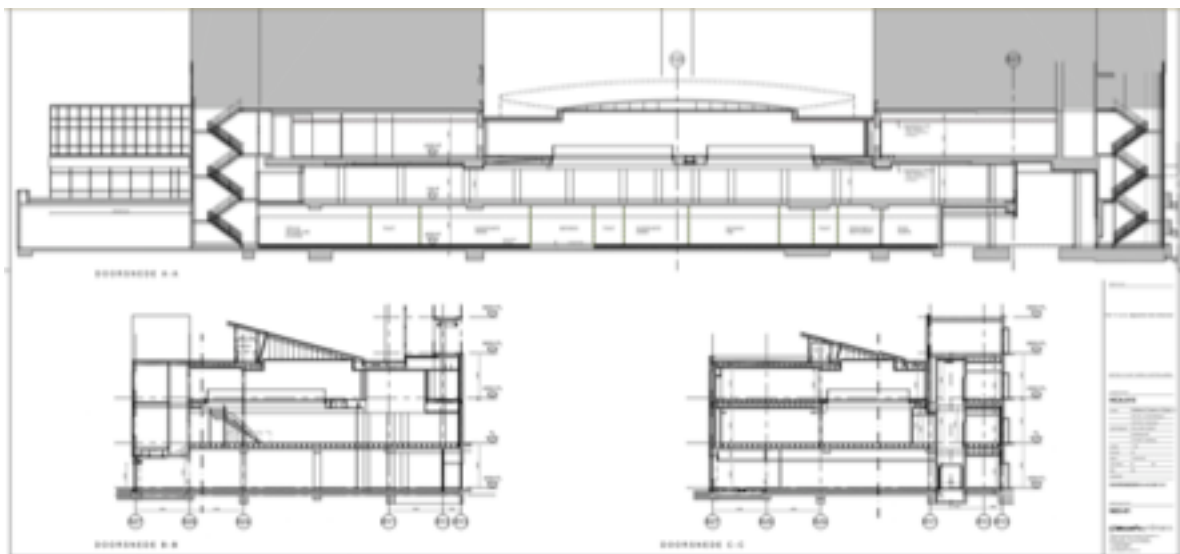

Fig 4.4 Cross-section building including canopy (CE-design, 2016)

The drawing above was one of the drawings used to request the required permit to start construction. After requesting, the permit has been granted by the municipality of Amsterdam which means that there is a permit for a small canopy. However, the commission responsible for external appearance of buildings within the permit (in Dutch: welstand), had strict demands and feedback regarding the canopy.

DYDL Propco had a strict demand, namely: the installations constructed on the roof may not be seen by any hotel guest. They argued during meetings that the Holland Casino may not open if there is no provision which is covering the installations. Due to these arguments, a time pressure arose during the project.

4.2.3. Stakeholders

Several parties where involved during the construction of the casino. In this part of the case description, the most important stakeholders regarding the wicked problem will be analysed. Dev_real estate made a project organisation scheme in which all involved parties or actors are displayed (Dev_real estate, 2015) see figure 4.5 below.
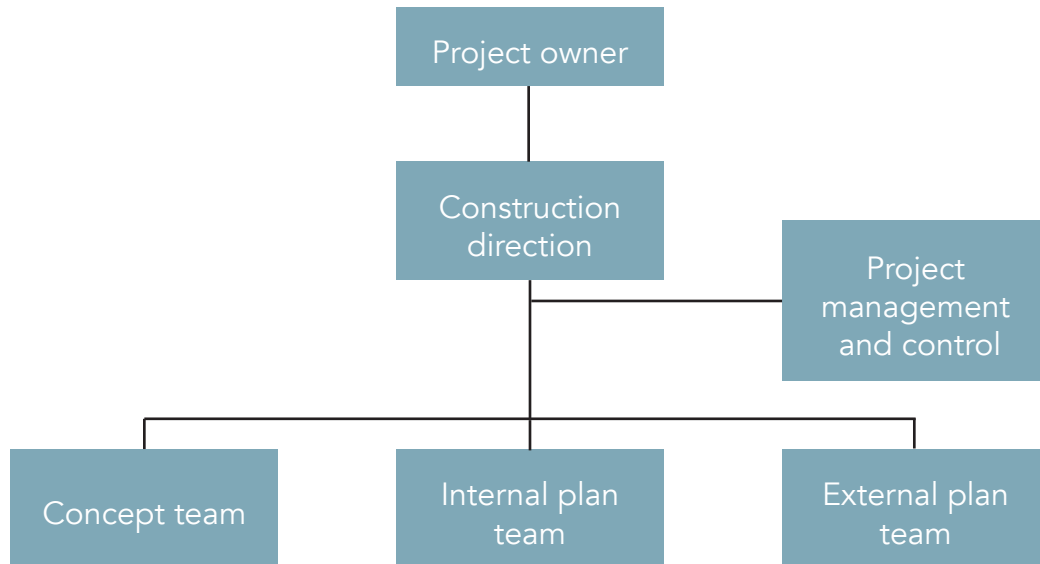

Fig 4.5 Project organisation HCA2 (Dev_real estate, 2015)

As you can see in the figure above, there are three teams. Of these three teams, the external planteam is the most important one for this case. This team was involved by solving the wicked problem in this case. A part of the external plan team is *''uitvoerende partijen"* (in English: executing parties). In this stage of the project, these executing parties were unknown yet and were later involved in the project. The following parties were the most involved constructing parties in the wicked problem:
•   Ooijevaar. Contractor;
•   Bouwbedrijf Berghege. Contractor;
•   Smeulders. Interior;
•   CE-design. Architect Holland Casino;
•   Kropman. Installations.
Holland Casino is advised by Dev_real estate during the design and construction of the casino. The parties mentioned above are all contracted by Holland Casino (Dev_real estate, 2016).

4.2.4. Perspectives on problem formulation

As mentioned at the definition of a wicked problem, a part of the definition is that there is no clear perspective on the problem formulation. In this part of the case study analysis, the different problem perspectives within this case are analysed.

Out of the interviews and document research can be concluded that there are three problem perspectives, namely:
1.   Because of internal and external factors, high time pressure arose. The responsibilities demarcation of the building owner and tenant is unclear during the project;
2.   A canopy has to be built and needs to be constructed as soon as possible;
3.   Due to more installations on the roof, the design changes.

Because of internal and external factors, high time pressure arose. The responsibilities demarcation of the building owner and tenant is unclear during the project
Interviewee 7 mentioned the following problem statement during the interview (Interviewee 7, 2018): *''Because of internal and external factors, a high time pressure in the project arose. Also, the demarcation between involved parties was unclear. This resulted in a delayed opening of Holland Casino Amsterdam west.''* Interviewee 8 stated several problem factors. The one below is comparable with the problem state by interviewee 7 (Interviewee 8, 2018): *''Coordination with the building owner was difficult during the project.''*

A canopy has to be built and needs to be constructed as soon as possible
Interviewee 5 mentions the following problem statement during the interview (Interviewee 5, 2018): *''A canopy has to be constructed as quick as possible. The canopy has to fit into the current design and has to be technical feasible. If the canopy is finished the hotel can open, if the hotel can open the casino can open.''* Documents report the following problem (Dev_real estate, 2018): *''Creating the canopy is the only mild reaction on the claims of DYDL. High priority on the canopy track from now on.''* Interviewee 8 stated several problem factors. The one below is comparable with the problem stated by interviewee 5 (Interviewee 8, 2018): *''The engineering and construction of the canopy took a lot of time.''*

Due to more installations on the roof, the design changes
Interviewee 6 mentions the following problem statement during the interview (Interviewee 6, 2018): *''Because the canopy changes, there is no permit for the new canopy. Instead of the building owner, Holland Casino will request a new permit. The drawings and design will be changed so it will fit the demand.''* The analysed emails and minutes of meetings state the following problem which is comparable with the statement form the interviewee above (Dev_real estate, 2018; Dev_real estate, 2017):

31-01-2017:
''Installations changed and the next step is to design a new canopy.''

08-08-2017:
''DYDL is claiming that the canopy needs to be constructed as soon as possible. A sketch of a new canopy has been approved. Detailed drawings are going to be made by the architect.''

4.2.5. Decision-making by project manager

According to the project manager who solved the wicked problem, he started with creating several possible solutions. Those solutions were (Interviewee 8, 2018):
1.   Proving why the arguments and claims of DYDL are a non-argument;
2.   Working together with DYDL to investigate how the canopy can be constructed and how DYDL can realise this;
3.   Holland Casino designing and constructing a canopy.
After creating the three solutions, interviewee 8 selected the third solution. He based this decision on his experience. *''If we choose solution 1, it takes a lot of time with the risk that the canopy still needs to be constructed. This results in loosing time. I am sure that DYDL will never cooperate and collaborate to realise the canopy.''*

Choosing the third solution was based on arguments created by the project manager. These arguments are based on the interests of Holland Casino. ''These arguments form primarily on intuition or experience''. After these arguments are formed by the intuition or experience, a long thinking process starts. In this thinking process, he keeps the other solutions with

matching arguments in his mind too. This thinking process is done by overthinking the formed arguments and being impressionable by external factors. During this overthinking information is collected in order to make a clear formulation and chose a solution. The external factors may sharpen his arguments and solutions. Finally, the project manager decides which solution is best for Holland Casino and does the recommendation. This recommendation is based on the interests of Holland Casino.

However, according to other interviewees a different step is taken before different solutions are developed. Interviewee 5 mentions the following step (Interviewee 5, 2018): *''Interviewee 8 started solving the problem by defining the problem definition for each stakeholder. Next to this definition, the interest of most important stakeholders by a solution is mentioned."* This problem statement is recognized by interviewee 6 and 7. *''Interviewee 8 first made clear for each involved party what the particular problem is"* (Interviewee 6, 2018). *''Interviewee 8 started solving the problem by making clear what the particular problem is and what all the interests are"* (Interviewee 7, 2018).

4.2.6. The solution of the wicked problem

The final solution is a canopy which fits over all installations situated on the roof of the casino. All interviewees, as well as the analysed minutes and emails, mention a new canopy as the solution of the problem (Interviewee 5, 2018; Interviewee 6, 2018; Interviewee 7, 2018; Interviewee 8, 2018; Dev_real estate, 2018).

Holland Casino will pay the design and construction costs of the canopy and take the responsibilities of granting a permit (Interviewee 7, 2018; Interviewee 8, 2018; Dev_real estate, 2018). By taking the initiative in this part of the project, Holland Casino is able to steer on the process and progress.

4.3.   Case 3 SushiSamba Amsterdam

Fig 4.6 SushiSamba Amsterdam

4.3.1. Case introduction

SushiSamba is a blend of Japanese, Brazilian and Peruvian culture and cuisine. The restaurant is born out of these three distinct cultures. In the early 20th century thousands of Japanese emigrants travelled to South America to cultivate coffee plantations and find a new life and fortune (SushiSamba, 2018). The roots of SushiSamba are formed in these years in cities like Lima and Sao Paulo where the integration of the Japanese, Brazilian and Peruvian Cultures started.

The first SushiSamba restaurant opened its doors in New York City in 1999. Since then, the more restaurant opened its doors in Miami, Las Vegas, London and recently in Amsterdam. In Amsterdam the restaurant is located on the Max Euwplein 64 and shares the building with Holland Casino Amsterdam.

During the renovation of the building and the realisation of the restaurant the casino was in full operation (Ooijevaar, 2018). The high limit area of the Casino and the restaurant were renovated, the new conservatory was a new construction next to the existing building.

SushiSamba renovation can be divided into two parts, namely the base built and the fit out. The base built renovation was part of Holland Casino project, the fit out was a separate project initiated by SushiSamba. It is important to understand that there was a division in the project.

Square meter	900 m² (Dev_real estate, 2018)
Budget fit out	3.800.748 (Dev_real estate, 2018)
Type of project	Retail

Table 4.4 Project size details

4.3.2. Project description

As mentioned before, there was a division in the project between base built and fit out. However, to save time the project team decided to start the fit out project while the base built was getting finished. The same project team of the base built would also design and build the fit out of SushiSamba.

To start the fit out of SushiSamba, a concept schedule has been made. In this schedule can be seen that the start of construction is scheduled at the first week of November 2016 and the delivery of the fit out project would be in the first week of March 2017 (Dev_real estate, 2016). After the concept schedule, all involved parties agreed on creating a lean schedule together. Out of interviews can be concluded that the delivery date of the restaurant was already fixed before the schedule was made (Interviewee 12, 2018). All parties had to schedule their activities in a way that they finished their construction activities before this delivery date. This delivery date was strict due to training of SushiSamba employees which was schedule at this point in time. To train the employees, SushiSamba hired people from England and America. In the lean schedule can be seen that the SushiSamba had scheduled their employee training in the last week of June 2017 (Dev_real estate, 2017). Due to the employees of SushiSamba which were already contracted and paid, a high time pressure arose during the project.

Since the involved parties were already known during the start of the project, there was no tender needed to select construction parties.

4.3.3. Stakeholders

As mentioned before, the fit out project started while the base build project was finished. Due to this overlap in both projects no clear start has been made for the fit out part of the project. Out of Dev_real estate there is no project organization scheme. It is important to understand how the hierarchy during the project was divided. The project scheme below is made based on two interviews (Interviewee 9, 2018; Interviewee 12, 2018).
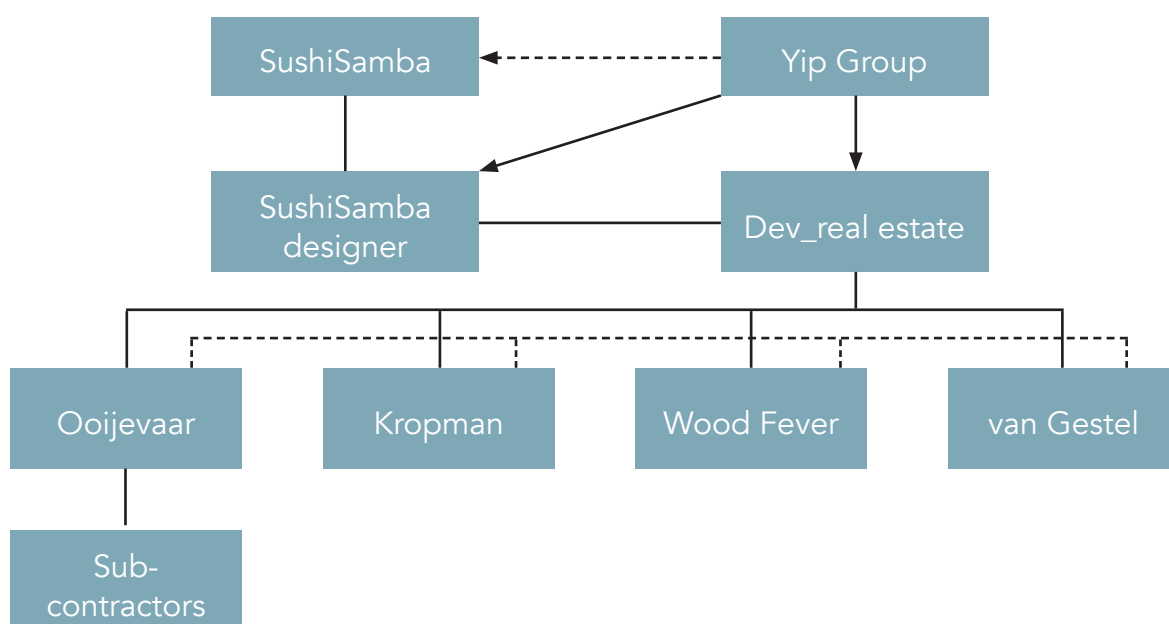

Fig 4.7 Project organisation SushiSamba (own figure)

As you can see in figure 4.7, Yip Group and SushiSamba are the parties at the top of the organization scheme. SushiSamba is the company owning the restaurant. Yip Group is the initiator of brining the restaurant to the Netherlands. However, Yip Group is also co-owner of SushiSamba. SushiSamba has its own designer who determines the demand. This designer is also influenced by Yip Group. Yip Group is also the direct client of Dev_real estate.

Dev_real estate is in this case the project manager and consultant of Yip Group. They report to Yip Group and are responsible in managing the project. Communication from SushiSamba or Yip Group goes through Dev_real estate to the contracted parties.

Out of Dev_real estate two main contractors are contracted, namely: Ooijevaar and Kropman. In this case Kropman is responsible for all the installations of the restaurant. Ooijevaar is responsible for the architectural and constructional adaptations. However, Ooijevaar is also contracted to coordination the construction on site (Interviewee 9, 2018) (Interviewee 12, 2018). They have to manage and steer all parties on the construction site and make sure that they perform according to the schedule and their responsibilities. Wood Fever designed the interior and furniture of the restaurant. Van Gestel is the designer and
supplier of the kitchen.

4.3.4. Perspectives on problem formulation

As mentioned at the definition of a wicked problem, a part of the definition is that there is no clear perspective on the problem formulation. In this part of the case study analysis, the different problem perspectives within this case are analysed.

Out of the interviews and document research can be concluded that there are three problem perspectives, namely:
1. Due to an unfeasible schedule and lack of information, there was no detailed engineering and designing possible;
2. One of the contractors never reported their delay according to the schedule. When this turned out, steering was not possible anymore;
3. Because of parties not being transparent during the project, agreements were not fulfilled.

Due to an unfeasible schedule and lack of information, there was no detailed engineering and designing possible
Interviewee 10 mentioned the following problem statement during the interview (Interviewee 10, 2018): ''*At the start of the project the demand of SushiSamba was unclear. The project still started which resulted into many changes during construction. Because of the changes from SushiSamba, no detailed engineering and designing was possible.*'' Interviewee 12 formulated the problem on several aspects, the problem statement matching the one mentioned by interviewee 10 is as follows (Interviewee 12, 2018): ''*The schedule made upfront was not feasible.*''

One of the contractors never reported their delay according to the schedule. When this turned out, steering was not possible
Interviewee 9 mentioned the following problem statement during the interview (Interviewee 9, 2018): ''*One of the contractors never reported their problems regarding meeting the schedule goals. Since the problem is reported or noticed a few weeks before delivery, there was no steer possible.*'' During the interview, interviewee 11 mentioned the following problem statement which is comparable with the problem statement mentioned by interviewee 9 (Interviewee 11,

2018): ''*Due to a delayed contractor, other contractors also got delayed in their activities.*''

Because of parties not being transparent during the project, agreements were not fulfilled
Interviewee 12 mentioned the following problem statement during the interview (Interviewee 12, 2018): ''*Because of parties not being transparent, the delivery dates in the schedule could not be met. Also, the demand of the restaurant was unclear and changing during the project. These factors made it difficult to create a feasible schedule and fulfil agreements.*''

4.3.5. Decision-making by project manager

According to the project manager who solved the wicked problem, he started with making an inventory of what the actual problem is and what the status of completion is. Out of this inventory, ad hoc and long-term solutions needed to be made. Several rounds between the stakeholders needed to be made in order to formulate what is going on and how this can be solved.

The ad hoc solutions are made by the project manager himself. He was working on the construction site himself in order to solve all the ad hoc problems.

For the long-term problem solving, there were two possible solution directions. These were: (1) quit the construction process and restart the left-over project as new and (2) push the project and let as much as possible continue. Decision-making was not really needed here according to the project manager because only solution direction 2 was a real option. This due to the nature of the client and the project manager. The project manager knew already upfront that this was the only solution which fits the interests of the client. So, choosing solution direction 2 was never a rational decision but was chosen based on experience.

According to the interviewees the project manager organized two crisis consultations (Interviewee 10, 2018; Interviewee 11, 2018). During the first consultation, the problem was identified. In the second consultation a plan was made on how to solve the problem. That the project manager took the required decisions is confirmed by the other interviewees. Sometimes he made decision alone, sometimes with the client. The project manager made decision based on intuition and mostly experience.

4.3.6. The solution of the wicked problem

The problem had to be solved in a way that SushiSamba would not be, or as less as possible, influenced negatively. To achieve this, a hands-on mentality was used on the construction site. Every party was present at the construction site and did what they could to finish their activities. All the actions executed by the involved parties were done in a way to prevent any further damage (Interviewee 9, 2018) (Interviewee 10, 2018).

The solution to the problem studied in this case is assessing and hiring other parties to finish the activities of Kropman. All interviewees mentioned accessing other parties as a part of the solution (Interviewee 9, 2018) (Interviewee 10, 2018) (Interviewee 11, 2018) (Interviewee 12, 2018). They also mentioned that the schedule changed as a part of the solution. The schedule changed in a way so that SushiSamba could still start training their employees on the planned date. To let SushiSamba start in time, the construction activities of all the involved parties were sometimes separated or moved (forward or backwards) in the schedule. This resulted in SushiSamba training their employees on the planned date. However, the training took place

on the construction site. The restaurant was not finished and parties were still performing construction activities during the training of the employees. There were more than 200 people on the construction site at that time, which made it difficult to perform construction activities or training (Interviewee 9, 2018) (Interviewee 12, 2018).

4.4. Chapter summary

The wicked problem occurred in project Stibbe concerned the schedule. Between all involved stakeholders there were three different problem perceptions, namely: (1) the schedule is delayed due to parties not completing their activities in time, (2) due to organizational problems, the project was uncontrollable and therefore a lot of mistakes happened and (3) there is no problem. This problem is solved by the project manager by identifying the problem, creating possible solutions, analysing the possible solutions and choosing a solution. The solution are agreements in order to continue the project with less negative effects as possible for all parties resulting into new contractual agreements and a new schedule.

The wicked problem occurred in Holland Casino Amsterdam West concerned the design. Between all involved stakeholders there were three main different problem perceptions, namely: (1) because of internal and external factors high time pressure arose, (2) a canopy has to be built and needs to be constructed as soon as possible and (3) due to more installations on the roof, the design changes. This problem is solved by the project manager started by creating possible solutions. The next step he took was selecting a solution which fits the interests of Holland Casino most. However, according to the other interviewees the project manager started with identifying the problem. This resulted into a canopy covering the installations on the roof, initiated and paid by Holland Casino.

The wicked problem occurred in SushiSamba concerned the schedule. Between all involved stakeholders there were three different problem perceptions, namely: (1) due to an unfeasible schedule and lack of information, there was no detailed engineering and designing possible, (2) one of the contractors never reported their delay according to the schedule and (3) because of parties not being transparent during the project, agreements were not fulfilled. The problem is solved by the project manager of the project by first identifying the problem. After the problem was identified, a hands-on approach was used by the project manager. All the parties had to do what they could to finish their activities. Decision made in order to solve the problem were mostly based on experience and intuition. This resulted into hiring other parties to finish the activities of Kropman. Everything to prevent further damage for SushiSamba.

Synthesis

4

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5. Cross-case analysis

This chapter presents the cross-case analysis that is made. The aim of this cross—case analysis is to identify similarities and differences between the outcomes of the within case analyses from chapter 4. Techniques used to make a cross-case analysis are described in chapter 3. Three topics will be analysed in this chapter, the same as in chapter 4, namely: (1) perspective on problem formulation, (2) decision-making by project manager and (3) the solution of the wicked problem.

5.1. Perspective on problem formulation

In table 5.1 below the analysation is shown regarding the different perspectives on the problem formulation. The topics which came out of the interviews with the involved stakeholders are used to define the topics in the table below.

	Case 1	Case 2	Case 3
Problem according to project manager	The schedule is delayed due to parties not completing in time	A canopy has to be built and needs to be constructed as soon as possible	One of the contractors never reported their delay. No more steering possible to react on delay
Problem according to client	There is no problem	Due to internal and external factors, high time pressure arose	Because of parties not being transparent during the project, agreements were not fulfilled
Problem according to contractor	Due to organizational problems the project was uncontrollable	A canopy has to be built and needs to be constructed as soon as possible	Due to an unfeasible schedule and lack of information, there was no detailed engineering possible
Problem according to other	The schedule is delayed due to parties not completing in time	The design changes due to more installations on the roof (there is no problem)	Due to an unfeasible schedule and lack of information, there was no detailed engineering possible
Influenced factor by problem	Time	Design, resulting in time	Time
Same heaviness of problem	No	No	Yes
Same direction towards cause of problem	Yes	No	No
Same reason of problem	No	No	No
Timing of the problem	At the start of construction	Halfway of construction	Two weeks before delivery of the project

Table 5.1 Problem formulation analysis

Within each case, three different perspectives on the problem formulation are mentioned by the interviewees. These problem formulations are all contradictory which means that the involved parties do not share the same perspective on the formulation of the problem. What is different within the three cases is the heaviness of the problem. In case 1 and 2, two interviewees mention that they do not recognize a problem. In case 1 this is the client of the project and in case 2 this is the architect. What is meant with the heaviness of the problem is if these stakeholders believe if the problem is an issue on or not.

The client of case 1 mentioned that the delivery date of the schedule is met and therefor no problem occurred. However, the other two problem formulations mention that there is a serious problem regarding the schedule. One of the interviewees mentioned that he could not execute his activities since another party did not deliver in time and got delayed. The interviewed sub-contractor mentioned that he could not perform as he agreed upon due to internal factors. In case 1 a problem occurred regarding the time and schedule within the project, the delivery date was at risk. In case 3 a similar problem occurred, namely: a problem concerning the time and schedule of the project. However, in this case none of the interviewees mentioned that there was no problem. The problem which occurred in case 2 concerned the design of the project. However, time is also a serious issue in this case. Due to the claims of the building owner the problem has to be solved as soon as possible. Holland Casino cannot open if the canopy is not finished. Due to the design and construction time, the time pressure arises.

Case 3 was the only case with every formulation mentioning a problem within the project. In case 1 and 2, all interviews point in the same direction concerning the responsible party causing the problem. However, the reason of the problem differs. This is similar in case 3. All interviewees mention different reasons of the problem. However, also the direction concerning the responsible party differs in this case.

5.2. Decision-making by project manager

In table 5.2 below the analysation is shown regarding the decision-making by the project manager. How the three project managers made decisions in order to solve the problem is the topic of analysation. Since all project managers mentioned steps they conducted in order to solve, all taken steps are compared.

	Case 1	Case 2	Case 3
Solving approach	Analysing	Analysing	Hands-on
First step	Identifying the problem	Identifying the problem	Identifying the problem
Seccond step	Develop directions and criteria	Generate possible solutions	Creating solutions
Third step	Generate possible solutions	Analysing effects of possible solutions	Choosing the solution
Fourth step	Analysing effects of possible solutions	Choosing the solution	
Fifth step	Choosing the solution	Develop criteria	
Taking decisions based on	Experience	Experience	Experience
Tools used to develop solutions	Drawing out alternatives	Overthinking arguments	Hands on

Table 5.2 Decision-making analysis

Within all three cases can be recognized that the project manager took decision in order to solve the problem. However, the approach of the project managers differs. What is similar in all three cases is that the project manager starts solving the problem by identifying the problem. After identifying the problem, the steps conducted by the project managers differ.

In case 1 and 2 both project managers use a more analytical approach to solve the problem where the project manager in case 3 uses a more hands-on approach. This results into different steps taken. What is meant by analytical or hands-on approach is that by the analytical approach the project manager takes time to analyse the problem and possible alternatives, where the hands-on approach project manager starts solvable problems right away. This project manager mentioned that he cleaned the construction site by himself if he had to, example of hands-on approach.

The steps taken by the project manager in case 1 and case 2 are comparable. Three steps are taken by the project manager in case 3. After defining what the problem is, he creates a solution to this problem and selects this solution. In case 1 and 2 the project managers create different alternative solutions and analyse the effects of the possible solutions. According to the project manager in case 3, there was no decision needed to select a solution since only one solution would have been accepted by the client. This had to do with the incentives of the client as well as the incentives of the project manager.

Creating the alternatives is done differently by each project manager. In case 1 the project manager draws the possible solutions, in case 2 the project manager overthinks the arguments of the solution and in case 3 the project manager goes for the only possible solutions and starts implementing it right away.

They all took the decision to go for one of the possible solutions. All project managers mentioned that they take this decision based on experience. Within case 1 and 2 can be recognized that the project managers mention designing when it comes to creating alternative solutions.

5.3. The solution of the wicked problem

In table 5.3 below the analysation is shown regarding solution made by the project manager. Together with the final solution, factors influenced to come to a solution are analysed as well.

	Case 1	Case 2	Case 3
Possible solutions	3	3	2
All solutions taken into account	Yes	No	No
Influenced factor by solution	Time	Design, resulting in time	Time
Client lowered his norm	Yes. Lower quality demand	Yes. Financial loss because of financing solution	Yes. Financial loss because of inactive employees
Contractor lowered his norm	Yes. Financially	No	Yes. Financially
Loss of business for client	No	Yes. 1,5 years delayed opening of casino	Yes. 4 weeks delayed training of employees
Project delivered on time	Yes	No	No
Financial claims	No	No	Yes

Table 5.3 Solution analysis

All three cases are solved by the project manager resulting in a solution. The solutions for the cases differ. This is surprising since chapter 5.1 explains us that all three problems concern time. The solutions in case 1, 2 and 3 are:
1.   Case 1. A new schedule and contractual agreements;
2.   Case 2. A canopy covering the installations on the roof;
3.   Case 3. Other parties to deliver and install the remaining work.

Each project manager mentioned at least 2 possible solutions to the problem, however only the project manager in case 1 took all possible solutions into consideration. The project manager in case 2 and 3 both mentioned that going for a different solution was not possible or would not have been accepted by the client.

Within all three cases can be recognized that all interviewees agreed upon the solution. This is surprising because even the interviewees which mentioned that there was no problem, mentioned a solution. What can be recognized in all cases is that, different compared with problem formulation, all interviewees agreed upon the solution formulation.

What differs between the three cases is that not all problems were solved in time. Solved in time means that there was no loss of business for the client. In case 1, the project was delivered in time so that Stibbe was able to move from their old office building to the new constructed office. In case 2, Holland Casino was delivered 13 months after the original scheduled delivery. However, there were many other factors influencing the delivery of the project next to the problem analysed in this research (Interviewee 7, 2018) (Interviewee 8, 2018).

In each case one or more of the involved parties had to lower their norm to come to a solution. Surprisingly, the client lowered his norm in every case. In case 2 and 3 the client lowered his norm financially due to delay in the project. The delay caused extra costs which can be seen as the client lowering his norm. In case 1 the project is delivered in time. However, the client lowered his quality demand in order to come to a solution. Comparing all three cases (1) the client reduced his norm in order to deliver the project according to the schedule or (2) the project is not delivered in time which results in financial loss for the client (lower norm).

5.4.   Evaluation

In this part of the cross-case analysis the remarkable outcomes are evaluated. Each problem analysed within the case analysis influences time. This is mentioned by each interviewee and can be recognized within the different problem formulations. However, a remarkable fact is that in case 1 and 2 not all interviewees mention a problem. In case 3 all interviewees mention a problem.

Within the decision-making the project managers used different approaches to solve the problem. In two cases the project managers used an analysing approach, where in case 3 the project manager used a hands-on approach. The project manager which used an analysing approach conducted more steps in order to solve the problem. Three steps were conducted by the project manager which used a hands-on approach. Remarkable is that, no matter which approach, all project managers started to solve the problem by identifying the problem. The project managers which used a more analytical approach conducted the same steps to solve the problem but in a different order. All project managers mentioned that they take decision in order to solve the problem based on their experience. Again, the kind of

approach used makes no distinction.

Each project manager mentioned possible solutions. However, only one project manager took all possible solutions into account. Project manager in case 2 and 3 never took the alternative solutions into account. This can be recognized in the conducted steps described in the section above. These project managers do not develop criteria to test their solution, they develop criteria so it meets their chosen solution. Remarkable is to see that all clients lowered their norm to come to a solution or by a financial loss of the solution.

5.5. Discussion of results

In this part, the three analysed topics within the case study will be compared with the literature findings in chapter 2.

5.5.1. Wicked problem

Perspective on problem formulation will be compared with the literature findings on wicked problem. As mentioned in chapter 3 and the case study protocol (appendix A), the three cases are selected on a hypothesis formed by a project manager in explorative interviews. The hypothesis they formed was a possible wicked problem occurred in a project. In this part of the chapter, all three cases are compared with the formulated definition in order to determine to what extend the problem was wicked.

The definition of a wicked problem is given in chapter 2.2. Two factors define a wicked problem, namely:
1.   There is a lack of information:
    a.   There are multiple problem formulations which are contradictory;
    b.   It is unclear if the solution directions of the problem are feasible on the aspects time, budget and quality
2.   Stakeholders have contradictory incentives. With an important incentive of the client, namely: daily business influenced negatively.

All three studied cases mentioned three different problem formulations. These three problem formulations were contradictory which means that the problem formulation is unknown for the involved stakeholders in each case. Within each case, two or more different possible solutions were developed by the project managers. These different possible solutions were in every case facing each other. This means that it unclear if the solution is feasible. The business of the clients in case 2 and 3 is influenced negatively by the problem. This has to do with the timing of when the problem occurred. In case 1 the business of the client is not influenced negatively because the problem was solved before it could influence the business, however if it was not solved in time the business of the client would have been influenced negatively. This problem occurred earlier in the project compared with case 2 and 3.

5.5.2. Decision-making

According to Korsten (2016), there is no standard procedure or quick fix to cope with a wicked problem. This however does not mean that people handle and make decision based on nothing. Project managers will react on wicked problems by making decisions. This can be recognized within the interviews. Each interviewee mentions the project manager as problem solver.

Out of the cross-case analysis can be recognized that the project managers in all cases conduct different steps in order to solve the problem. The steps conducted by the project managers can be recognized by the steps in the rational model (Black & Porter, 2000). Table 5.4 shows the steps conducted within the rational model and compares those with the steps conducted by the project managers in case 1, 2 and 3.

	Rational model (Black & Porter, 2000)	Case 1	Case 2	Case 3
Step 1	Identify problem situation	Identifying the problem	Identifying the problem	Identifying the problem
Step 2	Develop objectives and criteria	Develop directions and criteria	Generate possible solutions	Creating solutions
Step 3	Generate alternatives	Generate possible solutions	Analysing effects possible solutions	Choosing the solution
Step 4	Analyse alternatives	Analyse effects possible solutions	Choosing the solution	
Step 5	Select alternative	Choosing the solution	Develop criteria	
Step 6	Implement decision	Not mentioned	Not mentioned	Not mentioned
Step 7	Monitor and evaluate results	Not mentioned	Not mentioned	Not mentioned

Table 5.4 Rational decision model compared with project managers steps

None of the project managers mentioned that they implement the decision or monitor their decision. This however does not mean that these steps are not conducted by the project manager.

Within the first five steps of the rational model of Black and Porter (2000)) design thinking can be recognized (Brown, 2009). All project managers mention that they use their experience to create solutions. This can be recognized within the design thinking theory from Brown (2009). Brown mentions that formulating problem and creating solutions are the characteristics of design thinking (Brown, 2008, 2009) mentioned in chapter 2. A part of this design thinking is experience. Experience is used during designing. Surprising is that the project manager in case 1 mentions designing in particular when it comes to creating possible solutions

Fast and slow thinking theory can be recognized within the step select alternative or choosing the solution, in particular slow thinking. Slow thinking is actively and consciously deciding which of the alternatives should be selected (Kahneman, 2011).

Unconsciously deciding is one of the other studied decision-making theories (Dijksterhuis, 2010). Within the outcomes of the cross-case analysis, this theory cannot be recognized. However, this does not mean that this theory is not used. For example, one of the aspects of this theory (see chapter 2) is that the decision is made by the unconscious which is active during, for example, sleeping. None of the project managers mentioned that they decided unconsciously. The project manager in case 2 mentioned that he knew based on experience which solution was the best one and created criteria for this solution afterwards (see table 5.4). However, unconsciously deciding might me the used theory in this case.

The biggest difference between the decision-making of the interviewed project managers is between the first two cases and case 3. In case 3 the project manager mentions that he makes decisions mainly on experience and intuition. This can be recognized in the cross-case

analysis presented in this chapter (table 5.2). Because of the approach of this project manager, no alternative solutions are developed and analysed. The slow thinking theory of Kahneman (2011) can be recognized within this decision making. Where the project managers in case 1 and 2 both create a solution with design thinking (Brown, 2008, 2009) uses the project manager in case 3 mainly slow thinking to create a solution. He mentioned intuition which can be connected to fast thinking decision-making and he mentioned experience which can be connected to slow thinking decision making (Kahneman, 2011). To create a solution the project manager in case 3 mostly uses conscious active thinking and uses his experience to adjust his intuitive thinking.

In the literature research the Bounded-rationality decision model is studied (Simon, 1962). This theory suggest that project managers do not seek for the best outcome for each involved stakeholder but choose the solution which all stakeholders probably will accept. In case 1 and 2 this theory is not recognized. Both project managers in these cases generated possible solutions and analysed the effects of these possible solutions for all stakeholders. The project managers mention that a good project manager seeks for a solution which is good for all involved stakeholders. However, since the project manager in case 3 acts on intuition and experience it might be the case that the project manager generates a solution which is accepted by all stakeholders but is not the best solution possible.

5.5.3. Solution

As mentioned in the section above, project managers have to react on wicked problems by making decisions. The solutions they make by reacting are not true-or-false but good-or-bad (Rittel & Webber, 1984). This is because solving a wicked problem is a one-shot operation and the solution to the wicked problem is unique. Since the solution is unique, there is no opportunity to learn by trial and error. There is no literature available regarding the topic: how should a wicked problem be solved. This means that comparing the solutions to other studies was not possible at this time.

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6. Conclusion and discussion

In this chapter the conclusion and discussion of this research are presented. The conclusions in this research are formed by answering the main research question. Afterwards, a discussion on these conclusions is presented.

6.1. Conclusion

In this part of the thesis the main research question will be answered. The main research question, presented in chapter 1, is: ''How do project managers solve wicked problems in construction projects?'' Since this research is conducted as an inductive research, the aim of this research was to advance knowledge about how project managers in practice make decisions in order to solve wicked problems.

A wicked problem, as defined in this research, lacks information regarding problem formulations and solution direction upfront. There are multiple contradictory problem formulations and it is unclear if the solution directions are feasible. Next to this, involved stakeholders have contradictory interests. Interest of the client is an important interest, namely: daily business influenced negatively. The hypothesis formed in this thesis is a decision-making framework showing how project managers in practice solve wicked problems.

Project managers solve wicked problems in construction projects by going through processes in order to make decisions. During solving the wicked problem, a project manager makes several decisions. What can be concluded is that a project manager tries to solve a wicked problem as it is a technical problem (see chapter 2.2 for definition). To solve a technical problem the model of Black and Porter (2000) is most appropriate for the project manager. This model is based on taking seven steps to go from problem formulation to solution. However, by following the steps the project manager notices that there is a lack of information regarding problem formulation and solution direction which results in unsolvable. Black and Porter describe that their model can be used to solve problems with all information available upfront. Since this is not the case at a wicked problem, the project manager notices that he needs to collect information in order to proceed to the steps within the rational decision model. Solving the wicked problem as it is technical may let the project manager use a step by step approach to guide him from formulation to solution. However, using this approach at a wicked problem the incentives and formulations of the stakeholders will not be satisfied. A different approach is more appropriate in order to reach a solution satisfying all involved stakeholders.
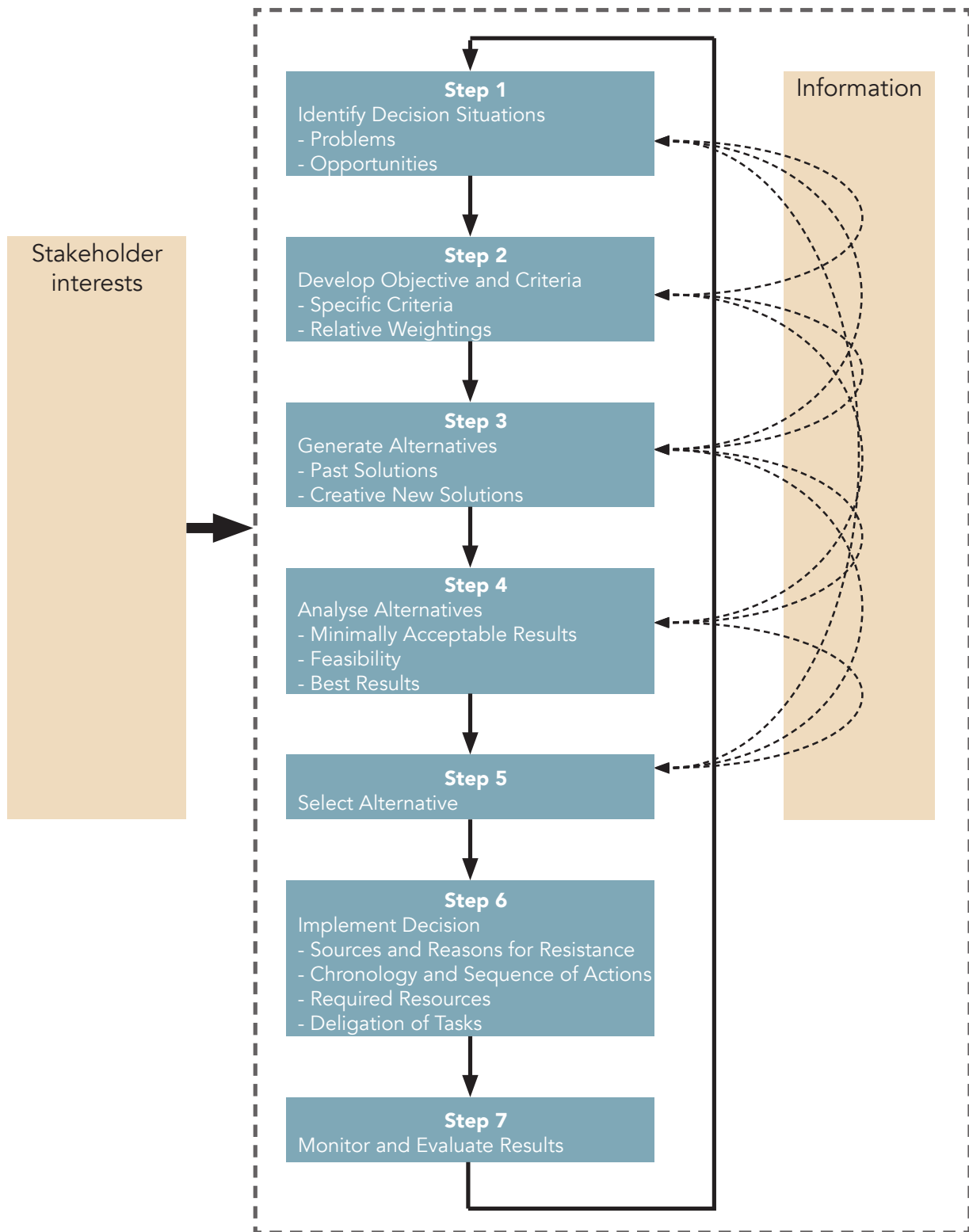
Fig 6.1 Iterative wicked problem solving process (own image based on Black and Porter (2000))

Fig 6.1 Iterative wicked problem-solving process (own image based on Black and Porter (2000)) To collect missing information, a project manager makes loops between the first five steps of the rational decision model. How many times and between which steps is looped is not mentioned by the project managers. This depends on the complexity of the problem and available information upfront. During these loops design thinking can be recognized. Design thinking characteristics are formulating problem and create the solution at the same time. This

is what project managers do while they solve a wicked problem. They loop between step 1 till 5 in order to formulate the problem and generate several possible solutions. This entire process is an iterative solving process which happens unconsciously.

At step 5 one of the possible solutions will be selected by the project manager. Selecting one of the possible solutions is a rather conscious decision. Slow thinking is recognized at this step. The project managers mention that they need to justify their decision to the client so it has to be a conscious decision taking interest into account. At this step, the problem formulation and possible solution directions are clear for the project manager which means that all needed information is available. While using slow thinking a decision is made based on the available information and interests of the involved stakeholders. However, these interests may change.

However, the solving process is influenced by the stakeholders. One of the definitions of wicked problems is that the stakeholders have contradictory interests. Since the interests are contradictory and changing, they influence the solving process. Due to these interests a lack of information can arise which results into the project manager changing his solving process.

In the section above the main question of this research is answered with a decision-making framework (figure 6.1). This decision-making model is a hypothesis of how project managers in practice solve wicked problems. The process displayed in the decision-making framework is not unique. Solving process used by project managers can be recognized by all three studied project managers. However, the solution to a wicked problem is unique and not applicable on other problems.

None of the project managers mentioned that they evaluate their decision-making and formed solution. The chance of learning on trial and error is therefore more difficult. Since the solutions are unique, making comparisons with other solutions is not possible and makes evaluating the problem difficult. Evaluating what would have happened when chosen for a different solution is not possible since solving a wicked problem is a one-shot operation (Korsten, 2016). Satisfaction of stakeholders can be evaluated. So, since the solutions are unique and not repeatable the decision-making for each problem needs to be processed from the beginning again.

With this research the knowledge regarding project managers solving wicked problems is increased resulting into a new theory. The outcomes in this research can be used by project managers in a way that they can make themselves aware when a problem can be defined as wicked. If project managers are aware of this, they can try to collect the information in time and down scale the problem from wicked to technical. When a problem is technical, the rational decision model of Black and Porter can be used (2000) as it is defined to be (having all information available at step 1).

Additional conclusions from this research can be specified into three topics, namely: lowered norm, problem and solution and collaboration. In each case the project manager is contracted by the client. In all cases however, the client lowered their norm (initiated by or result of the project manager). Thus, the project managers do not create a solution which fits only the client demands but create a solution which fits the greater perspective of the problem. All project managers mention that a good project manager can make a solution which fits the interests and demands of all stakeholders instead of just the interests and demands of their client. Even though if the client hired and contracted the project manager. A different perspective on this conclusion is that the project manager is looking for a solution which will negatively influence the time, costs and quality in the project as less as possible for all stakeholders. The interests of all stakeholders need to be reconsidered including the interests of the client. If the clients do not lower their norm, it might be the case that their financial loss will become even higher which can be seen as an even more lowered norm.

A surprising finding is that in two of the three cases one of the involved stakeholders do not recognize a problem at all. However, during the interviews they all mention a solution. Even the interviewees mentioning no problem. Within each case there are three different problem formulations mentioned which are contradictory. However, within each case all interviewees mention the same solution to their problem formulation. Concluded can be that a solution fits multiple problem perspectives or that involved stakeholders are convinced that a particular solution is the solution to their problem statement.

As can be seen in the cross-case analysis, all clients lowered their norm in order to solve the problem or due to the end solution. However, all clients mention that they value the collaboration with the project manager as positive. In case 1 the client mentions that the project manager performed well and that they had trust in their decision making. This can be recognized in the other cases. In case 2 the client mentions that he felt like he was performing as a team with the project manager. Concluded can be that collaboration between client and project manager can be valued as positive even if they had to lower their norm in order to solve the problem.

6.2. Discussion

This section covers a discussion on the most important limitations that might have impacted the quality of the findings and formed conclusions. The following topics will be discussed: (1) quality of research findings and (2) quality of sampling.

6.2.1. Quality of research findings

The aim of this research is to identify how project managers make decisions in order to solve a wicked problem. During the literature research, presented in chapter 2, no research results

were found regarding solving wicked problems. However, this does not mean that no one is acting or performing in order to solve a wicked problem. Out of the interviews conducted in for this research concluded can be that a project manager indeed acts to solve problems like these. In this research is studied and explained how a project manager make decisions by comparing several decision-making theories. It might however be the case that making decisions is just a part of solving a wicked problem. Thus, a limitation of this research is that the focus is on a project manager solving the problem by making decisions and the research not focussing on other actions he might conduct to solve. For example, lowering the norm of their client is not taken into account. Also, the actions they take to collect information is not taken into account. This research does show however that they collect information in a way. How a solution is implemented in a project is also not studied but might influence the decision-making or solving of a project manager.

The second topic which is not studied within this research is the human factor in decision-making. A difference between solving approaches can be recognized in the three studied cases. In case 3 the project manager mentions that waiting and analysing everything is not ''in his nature'' (Interviewee 9, 2018). The nature or human factor of a project manager is something which influences their decision making and in particular their approach to solve a problem. During the research the researcher recognized that the three project managers which were interviewed all have their own way of approaching a problem and reacting on stakeholders. How personality influences decision-making but also how personality influences the acceptation of a possible solution by the involved stakeholders is a limitation in this research.

6.2.2. Quality of sampling

Within this research three cases are studied. All three cases represent a particular type of construction project, namely: retail, leisure and office. A limitation in this research can be the biases of the researcher in selecting the particular cases. Also, it might be possible that a selected case is not representative for the type of construction project where it falls under. It can match the case selection criteria but not be representative due to other factors.

The quality of the outcome of the cases can be influenced negatively by the biases of the researcher. Since all three cases are studied through each other, it might be that asked interview questions are asked with a direction to specific answer. A certain direction might be noticed by the interviewer and the conversation might be steered towards this direction in order to get the desired research results.

If the interviewees did not speak freely enough, it might be that the findings out of a particular case might be influenced by not getting all the desired information. However, since multiple stakeholders are interviewed and multiple sources are used this bias is probably overcome.

6.3. Recommendations

The first recommendation for further research relates to the actions a project manager conducts to solve a wicked problem. Suggested is that, next to decision-making, a project manager conducts more activities in order to solve the problem. Further research is recommended to identify what other actions a project manager conducts in order to solve a wicked problem. This research can be focussed on collaboration with involved stakeholders. As mentioned in the conclusions, the project manager discusses which interests and demands are feasible or need to be reformed. Further research is suggested on how project managers conduct these actions and take decisions in what is feasible or not and why.

As mentioned in this chapter, a limitation of this research is the human factor in decision-making. Within the cross-case analysis (chapter 5) can be recognized that the project managers use different approaches, namely analytical or hands-on. Suggested is that this has to do with the human factor in decision-making. Further research is suggested regarding the influence of the nature of a project manager in decision-making. Also, what the influence is on decision-making and problem solving by the education of a project manager is suggested as further research.

To generalize the findings out of this research, the research as it is conducted in this thesis is recommended with cases studied within a different company. If the outcomes are comparable a more quantitative research approach can be used in order to research if the outcomes out of both researches are comparable. If the outcomes differ and no comparisons can be found, further research regarding the quality of sampling is suggested.

One of the questions in the interviews was how the wicked problem and solution contributed to project success. As described in chapter 3 the outcomes of this question are not taken into account in this thesis but were only asked for the interviewer's interests. Some of the answers given by the interviewees regarding this question were surprising. Stakeholders which suffered a financial loss due to the wicked problem sometimes still mentioned that they experienced a successful project. Further research is recommended regarding the influence of a wicked problem on project success.

The last research recommendation is an addition to the existing body of knowledge regarding the topic solution of wicked problem. As can be concluded in chapter 2 and 5, there is no existing research regarding the solution of a wicked problem. There is no literature describing that the solutions cannot be compared, however research is suggested in order to investigate if it is able to determine new theories and research if this might be possible.

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7. Reflection

A personal reflection on the research conducted in this thesis is presented in this chapter. The reflection focusses on the research process, research topic and research methods.

7.1.   Research process

The conducted research process knew ups and downs. What I mean with this is that at some moments the process was smooth and easy and at other moments more difficult and stiff. Especially the start was smooth and easy, this due to a good preparation after retaking my P2. The moments when it became more difficult and stiff were those when I needed information from colleagues. As a graduate intern I was at a low priority compared to their daily activities (which I understand). My supervisor within Dev_real estate told me that if I really needed information I just had to go for this information and pressure those colleagues a little. Since I am new in the company, and doing research instead of working, I found this sometimes difficult. However, I managed to get all the information in time.

If I could start the research process all over again than I would change the case selection. What happened now is that I took four weeks to select cases by conducting explorative interviews with project managers. But during the research I noticed that some cases were not suitable for my research which resulted into selecting new cases. Selecting new cases took too long and this resulted into the fact that I still needed to collect data after my P3 presentation for one case. This turned out well, looking back, but gave me some stress at that time. Also, I would be stricter in selecting cases. For example, I wanted to study a wicked problem in de Beurs van Berlage project. So, I started searching for one with the responsible project manager but after conducting three interviews I found out that this case was not suitable which resulted in a loss of time.

I learned that I need to be stricter in what is suitable for my research, in particular which cases and which data. From my research process I learned that not everything has to be conducted chronologically. What I mean with this is that I can start analysing data from one case if I am still collecting data from a different case. I tried to do everything chronologically now which resulted in some time pressure now and then.

7.2. Research topic

Project management is the main research topic of this thesis. Within the graduation laboratory, project management was one of six topics to conduct research in. Looking back, research project management was the right choice for me. I was always in doubt if I would like to work in project management or project development after my graduation. With the insights during my graduation internship, analysing projects and conducting interviews I found out that project management is the field where I want to work in. In that way I could motivate myself every day to work on the research since I found the topic interesting.

To go a little bit more into depth regarding the research topic, I learned a lot during the research. In particular from the literature study and case studies. The literature study was focused on two main topics, namely: what is project management and how does decision-making work. The topic project management was really interesting to study and also gave me the opportunity to study this more in depth. During my study the broad project management approaches were taught, with the literature study I could focus more in depth how this works and how this is applied in projects.

A part of the literature study is focussed on decision-making. While studying the different kinds of decision-making theories, my interest grew. In particular the fast and slow thinking theory. I learned a lot on how decisions are made by a human mind and how both systems influence decision-making.

To conclude, during my research I learned the most from the interviews. I conducted all interviews at the office of the particular interviewee which gave insight in how different kind of companies are situated and operate. Most of the interviewees also gave me a tour through their company which was really interesting to see. During the interviews I asked people about their experience and perspective on my colleagues and how they work. This gave me insight in how Dev_real estate approached projects and stakeholders. It was very educational.

7.3. Research methods

To reflect on the used research methods, I think I used the right once for this research. Not only the desired outcome was generated by using case study analysis, but also the conducting case study research was enjoyed by me. As mentioned before, I enjoyed conducting interviews since I met interesting people which I added to my own personal network. This is in my opinion very helpful when I start working as a project manager.

All cases which are studied in this research were cases within Dev_real estate. Most of the colleagues there worked on those cases. Since I started my graduation internship at Dev_real

estate without knowing anyone, studying cases from colleagues helped me to connect with them. Within my interviews I investigated different perspectives on the problem formulation and collaboration. My colleagues were very interested in those different perspectives and were always willing to discuss those with me. They told me that those different perspectives also gave them insight on how the other involved stakeholders experience their activities.

One of my study goals upfront was to learn how to conduct interviews without giving information to the interviewees. I did spend special attention to this in order to ask questions which are not pushing the interviewee in a certain direction. During the transcription of interviews, I reflected this topic and made notes on how to improve this in future interviews. When reflecting on the conducted interviews, I think that I improved myself after 12 interviews and that the last four interviews were more open and less steering into a certain direction.

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Appendices

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Appendices

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Appendix A - Case study references

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Appendix B - Interviews

Due to privacy concerns, the interviews are not added in this thesis. To see or discuss the interviews please contact the researchers, contact details are elaborated in the colophon.