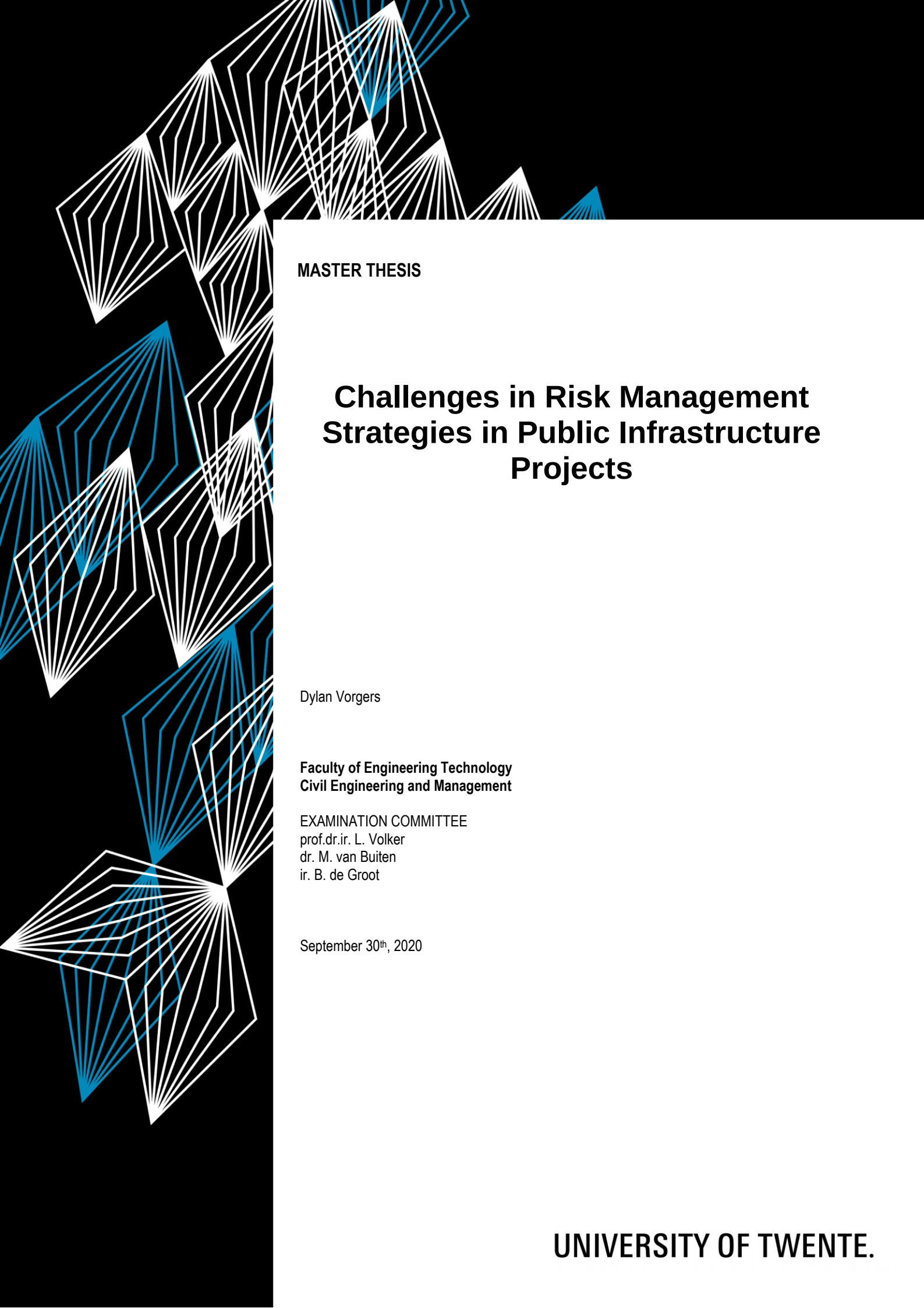




MASTER THESIS

# Challenges in Risk Management Strategies in Public Infrastructure Projects

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## Abstract

Public infrastructure projects today operate in a rapidly changing environment where uncertainty is high and where risks that threaten project objectives can emerge quickly. Frequently scholars doubt whether the current approach of risk management, as it is embedded in public infrastructure projects, is dynamic enough to safeguard the project objectives as a result of which this interpretation of risk management comes under pressure. A significant element in this discussion is the risk management strategy selection of the project management team to cope with the risks in the project. In this study, we aim to gain insight into the risk management strategies that project management teams select in public infrastructure projects, and what factors influence this strategy selection. To this end, we have conducted an in-depth case study of a project-based organization that conducts public infrastructure projects: Rijkswaterstaat – the executive agency for the Ministry of Infrastructure and Water Management in the Netherlands. A document review and a set of semi-structured interviews with project management team members and their executives at the parent organization shows that selecting the most appropriate risk management strategy is in practice more challenging than theory suggests. We illustrate that the current risk management approach sometimes falters due to this inability to select the most appropriate risk management strategy and introduce challenges that project-based organizations should address to enhance their risk management practices.

## Keywords

Risk management; risk management strategies; public infrastructure projects; project-based organizations.

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## 1. Introduction

Public infrastructure projects are often characterized as complex, nonlinear, and dynamic processes that include specific uncertainties and interdependencies among a large number of stakeholders (Khan et al., 2016). Unexpected events are today rather the norm than an exception, which often makes public infrastructure projects highly uncertain and difficult to predict (Florice et al., 2011). Project management teams (PMTs) must, therefore, be flexible so that they can respond adequately to changes in the project environment (Perminova et al., 2008). This high degree of uncertainty demonstrates the importance of a well-functioning risk management approach that can cope with the risks that can rapidly emerge in this quickly changing and hard to predict environment.

The current interpretation of risk management at public infrastructure projects has a strong emphasis on planning, communication, and evaluation of risk; it stresses the importance of planning as one of the major routines, supporting other activities such as risk identification, analysis, monitoring, and control (Perminova et al., 2008). Other characteristics of this interpretation of risk management are

accountability (e.g., the appointment of a risk owner) and the quantification of risks in terms of probability and consequence (Mikes, 2009).

This approach to risk management is under increasing pressure, as more studies are questioning the effect of this form of risk management on project success (de Bakker et al., 2010; Kutsch & Hall, 2005; Mikes, 2011). Some scholars argue that this current interpretation of risks management leads in practice to most risks being controlled, acceptance of risk is minimal (Mikes, 2009; Power, 2009; van Staveren, 2015). Van Asselt and Rotmans (2002) add that uncertainties from which risks arise can often consist of ‘unavoidable uncertainties,’ such as aspects that are unknown, unpredictable, or immeasurable. The effect of risk management that focuses on risks arising from these uncertainties is limited.

The discussion on how best to approach risk management continues. What is interesting here is that it demonstrates the pivotal role of the risk management strategy selection, that is how the PMT handles the risk (e.g., accepting or controlling a risk). So far, there is little empirical evidence that explains why PMTs in public infrastructure projects select a specific risk management strategy. For this reason, we choose to further investigate the selection of a risk management strategy in the context of public infrastructure projects.

In this study, we aim (1) to gain insight into the risk management strategies that PMTs select in public infrastructure projects and (2) identify what factors influence the selection of a risk management strategy. Given the limited empirical evidence on the topic, we decided to adopt an exploratory research approach (Bluhm et al., 2011; Miles & Huberman, 1994). The research involved an in-depth case study of a project-based organization that conducts public infrastructure projects: Rijkswaterstaat – the executive agency for the Ministry of Infrastructure and Water Management in the Netherlands. We used a document review and semi-structured interviews with PMT members and their executives at the parent organization as the method of data collection. Findings are presented in twofold, corresponding to both research objectives. Based on these findings, we comment that selecting the most appropriate risk management strategy for a risk can be challenging. Factors attributable to both the PMT and the parent organization influence this. The inability to choose the most appropriate risk management strategy can lead to an inefficient allocation of project management resources, which can threaten the contribution of risk management to the project’s success.

This study contributes to the literature on project risk management (Kutsch & Hall, 2005; Perminova et al., 2008; Sanchez et al., 2009) by showing what implications this inability to select the most appropriate risk management strategy can have on risk management in projects, such as on the efficiency in project management resources. Furthermore, the study contributes by means of the challenges we introduce for specifically public project-based organizations, but also for project-based organizations in general.

This article is organized as follows. We first present a literature review covering risk management strategies and the factors of influence on selecting a risk management strategy. In the subsequent section, we clarify the research methodology, divided into two parts, namely the research methodology, including data collection, and the data analysis. The results section presents the findings on the presence of the risk management strategies in the case, and the factors that influence the selection of a risk management strategy categorized into factors which are attributable to the PMT and which are attributable to the parent organization. We then provide a discussion on risk management under pressure and the challenges that project-based organizations should address. We end the article with a general conclusion.

## 2. Literature review

### 2.1. Risk management strategies

Risk management is today seen as an essential component of project management, which is why risk management is part of the Project Management Body of Knowledge (PMBOK) by the Project Management Institute. Furthermore, over the years, a consensus has been reached on the primary steps of risk management, this has led to standards like COSO-ERM and ISO 31000 – risk management (Aven, 2016; Raz & Michael, 2001), a further explanation of the risk management standards can be found in Appendix E. These standards form the basis of today's interpretation of risk management that has by many organizations been integrated into a standardized system that has established a foothold mainly in projects (Sanchez et al., 2009).

This risk management process, as it is carried out in the project follows the steps of setting goals, identifying risks, classifying risks, controlling risks, evaluating risks, and communicating risks. Furthermore, it is a cyclical process that is repeated several times during the lifetime of the project.

The process places a strong emphasis on the documentation where risks are kept up to date in a risk file. During the classification step, a quantification of the risk is made, the PMT estimates the size of the risk in terms of chance and consequence. The result is a risk file that contains a ranking of all risks that the PMT has identified. Subsequently, the PMT applies one of the four risk management strategies, which is to *transfer*, *avoid*, *accept*, or *control* a risk. *Transferring* risks entails, for example, that the risk ends up with the contractor. *Avoiding* a risk can be done by, for example, adjusting the design so that the risk can no longer occur. *Acceptance* refers to that besides monitoring the risk is unaffected. *Controlling* implies that the risk is reduced with *preventive* (chance reduction) or *corrective* (consequence reduction) measures to reduce the size of the risk (Claassen, 2009; NEN, 2009). One must note that *preventive* and *corrective* measures have different implications. Where *preventive* measures are aimed at ensuring that the risk does not occur, *corrective* measures are not. *Corrective* measures are, after all, only aimed at the consequences of a risk.

In practice, it is often the case that *avoiding* or *transferring* a risk does not always apply. *Avoiding* risks often happens in the design phase, where a different design choice is made so that the risk can no longer occur. *Transferring* risk can be to the contractor, for example, but this may not always be possible because there are risks that are not feasible for the contractor to bear.

Applying the appropriate risk management strategy shows parallels with the classic economic risk-return theory described by Markowitz (1952). The essence is that when one wants more return, this is typically accompanied by taking more risk. For PMTs, the term return can be replaced with project management resources. *Accepting* risk takes little project management resources but entails a certain amount of risk. The same holds for *corrective* measures; these only consume significant project management resources if the risk materializes, so again, more risk and more return.

In the financial industry, where frameworks such as COSO-ERM have a firm foothold, this trade-off between risk and return is mainly dictated by risk thresholds (Mikes, 2011). Here, risks are quantified using models and then examined to see whether the risks exceed the threshold. If this is the case, the risk is *controlled*, and if not, the risk is *accepted* (see figure 1).

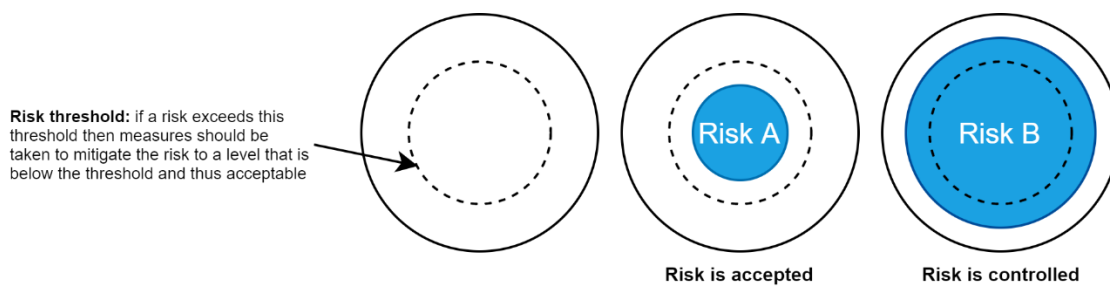


FIGURE 1: VISUALIZATION OF RISK THRESHOLDS

The limitation of these risk thresholds is that the focus is mainly on the level of risk; the management potential is not considered here. According to Ward (1999), the control potential must always be taken into account when managing risk because the risks can be substantial but difficult to *control*. It might then not be worthwhile to devote project management resources to *controlling* this risk.

An increasing number of organizations tend to become aware of the trade-off between *controlling* and *accepting* risks, recognizing that optimizing this balance can lead to more effective risk management (Banham, 2004). There is consensus on that such a balance calls for a central organizational approach in which a clear line is set out in how risks should be managed throughout the organization (Gordon et al., 2009; Liu et al., 2013; Wu & Olson, 2010). Gordon, Loeb, and Tseng (2009) describe this trend as a paradigm shift from a silo-based perspective to a holistic view of risk management. Enterprise Risk Management is a framework that attempts to accommodate this holistic view by providing guidelines on how risk management can be structured throughout the organization (Wu & Olson, 2010). Organizations are increasingly starting to adopt the principles of ERM (Hoyt & Liebenberg, 2011).

When ERM is fully implemented, quantitative risk thresholds are set at the project- and at the portfolio level (these are referred to in the ERM framework as risk tolerance levels). These risk thresholds are derived from a risk appetite statement, which is entirely qualitative and formulated by the board of the organization, indicating the amount of risk an organization is willing to *accept* in pursuit of value (COSO, 2012).

Scholars are divided on the contribution of the full implementation of ERM in construction. Zhao et al. (2014) show that construction firms struggle with increasing their ERM maturity. In a follow-up study, Zhao et al. (2015) show that a lack of data to quantify risk is a significant causal factor. This insight aligns with the findings of Van Staveren (2018) and Perminova et al. (2008), pointing out that quantification is difficult when there is a large amount of uncertainty. Hallowell et al. (2013) show that in several state departments of transportation ERM allows risk throughout the organization to be managed more efficiently and consistently.

## 2.2. Factors of influence on risk management strategy selection

In the literature, there are several concepts described that can help understand what factors influence the selection of a risk management strategy. We distinguish between concepts that are attributable to the PMTs themselves and concepts that are more related to the parent organization.

### 2.2.1. Factors attributable to the PMT

A term that is closely linked to the selection of a risk management strategy is risk attitude. Risk attitude is defined by ISO (2009) as: “an organization’s approach to assess and eventually pursue, retain, take, or turn away from risk.” Hillson and Murray-Webster (2007) add that risk attitude is not restricted to the organizational level, but individuals or PMTs can also adopt a risk attitude towards a particular risk.

Studies that describe the risk attitude are valuable in providing insight into what affects the selection of a risk management strategy.

When describing risk attitudes, the spectrum of Hillson and Murray-Webster (2007) is mostly used. The spectrum distinguishes five risk attitudes: *risk paranoid*, *risk-averse*, *risk-tolerant*, *risk-seeking*, and *risk-addicted*. Risk attitude at an individual level is often associated with risk perception. The idea is that when an individual sees a risk, it then assesses the risk in terms of chance and consequence; subjectivity and the interpretation of the available information always plays a role here. Risk perception is often described as the subjective judgment that people make about the characteristics and severity of a risk (Slovic, 2000). Van Staveren (2015) state that a person's risk attitude determines how someone will handle a risk based on his or her risk perception. Many studies are describing the risk perception of individuals. Some examples are Ingram and Thompson (2011), who conclude that risk perceptions vary based on someone's background, beliefs, or environment. Gardner and Steinberg (2005) show variations in risk perception based on the age of individuals.

In addition to the just provided studies, some studies do not differentiate between individuals on how they perceive risk. For example, there is the Ellsberg paradox that proves the existence of uncertainty aversion; people prefer known risk over unknown risk where the chance and consequence dimensions cannot be set (Ellsberg, 1961). This preference for certainty is especially relevant in the context of public infrastructure projects where, as mentioned earlier, uncertainty can be high.

The central lesson to be learned from the studies above is that risk perceptions of project management team members can be very different. These differences can lead to the adoption of varying risk management strategies.

In a project, however, the risk management strategy is set by the PMT rather than on an individual basis. The PMT must agree on their collective risk management strategy. This process occurs in a group setting as a result of which group dynamics play an essential role in the group decision-making process leading to a particular risk management strategy (Vugt & Schaller, 2008). Again, the studies vary widely, all describing different effects in different group settings. One effect that is acknowledged to play an important role in group dynamics is group thinking. Group thinking occurs if the drive for consensus overrides a realistic appraisal of decision alternatives (Janis, 1982). It is, therefore, necessary to create an environment where there is room for criticism of each other's perceptions, but where this criticism is not at the expense of group cohesion (Janis, 1982). Postmes, Spears, and Cihangir (2001) argue for explicit norms that can guarantee this environment. Keeping the focus on current factual information, maintaining a balanced power structure, and keeping the group goal in mind can offer a remedy in this respect (Eisenhardt et al., 1997). Another well-known effect is evaluation apprehension, which is not daring to contribute to a group out of fear of being judged by the group (Cottrell et al., 1968). The role of a leader who gives direction to the group process is also frequently mentioned (Fox et al., 2000). A lack of guidance increases the likelihood of conflicts within a group. From this perspective, the role of a risk manager who directs a risk management session seems very important. While these are just a few studies describing some known effects within group dynamics, it can be concluded that the group process can have a significant effect on the risk management strategy selection of the PMT.

Until now, we have mainly discussed studies that are attributable to the PMT, especially those that show the relevance of individual risk perception and the group dynamics with respect to risk management strategy selection of the PMT. In addition to this perspective, there is the perspective that focusses on the parent organization where the PMTs are part of.

### 2.2.2. Factors attributable to the parent organization

The body of knowledge that describes the risk attitude of organizations is extensive. For example, some studies show differences in risk attitude between organizational types. A well-known example that is relevant in this paper are studies that show differences between public and private organizations. Public organizations tend to have a more risk-averse attitude, which is visible among public employees in their risk decision-making, but also at an organizational level in, for example, policymaking (Chen & Bozeman, 2012; Paape & Speklé, 2012).

Criticism that is often mentioned is that this risk-averse attitude entails that fewer risks are taken, and thus the benefits are also lower in the long run. As a result, public organizations are lagging on private organizations that take more risks (Kim, 2010). Kim (2010) and Clark (2016) argue for more entrepreneurship in the public sector. The political environment is often identified as a leading cause. Top officials are more easily held accountable for incidents such as a risk that materializes, where shareholders in the private sector test their directors more on long-term performance (Chen & Bozeman, 2012).

This discussion about differences in risk attitudes between the public and private sectors shows us the importance of accountability and measuring results. A subject that also forms an integral part of organizational literature. Müller (2009) illustrates that a parent organization can organize the monitoring of project progress and results in different ways. Müller (2009) provides a model that is broadly recognized as a model for project governance. In this model, a distinction is made between outcome control and behavior control. Outcome control means that the project management team is addressed by the parent organization on the actual results, or milestones in terms of time and money, for example. Behavior control focuses more on the way the project management team fulfills its tasks. Müller and Lecoivre (2014) show that there are significant differences in how project progress is monitored; they show variations per project size, per project type, and country. Further research by Joslin and Müller (2016) shows no direct correlation between control mechanisms and project success; one approach is not necessarily superior to the other. Output control is a form of project governance that aligns with the conventional methods of COSO-ERM, ISO-31000, in which risks are quantified in terms of time and money so that they can be incorporated into the project budget and planning (Claassen, 2009; NEN, 2009).

When we proceed with looking at the studies that describe risk attitude in organizations, the organizational culture is also a recurring aspect, among others in studies by Chen and Bozeman (2012) and Wang and Yuan (2011). Schein (1986) defines 'culture' as a pattern of underlying assumptions – invented, discovered, or developed by a given group as it learns to cope with its problems of external adaptation and internal integration. Wang and Yuan (2011) illustrate that the organizational understanding of value - i.e., the collective conviction of what is right and wrong is part of the organizational culture and affects the risk attitude in the project.

Another aspect that defines the organizational culture and thus influences the risk attitude is the atmosphere of trust, referring to the extent to which individuals feel free to give criticism and the area to which negative feedback can be expressed without having personal consequences (Cheung et al., 2011). If there are no direct personal consequences, then individuals have more room to think critically about what matters for the organization rather than what impact it has on them. The openness of information sharing is also often mentioned as part of the organizational culture, involving the degree of open mutual communication between the PMT and the parent organization in which sensitive information is shared. This openness of information prevents internal tensions and increases decisiveness on the project (Karlsen, 2010; Khatkhat et al., 2020). A supportive culture with open mutual communication is vital to avoid surprises for directors of the parent organization (Karlsen, 2005). Again,

it must be noted that organizational culture is a comprehensive concept that has many components. What the above studies do show, however, is that the organizational culture has an influence on decision making in PMTs and, therefore, also on the risk management strategy selection.

Based on the theoretical insights into the different concepts related to the risk management strategy of the PMT, we created a framework that brings together all the identified concepts and thus forms a basis for interpreting the results of this study, see figure 2.

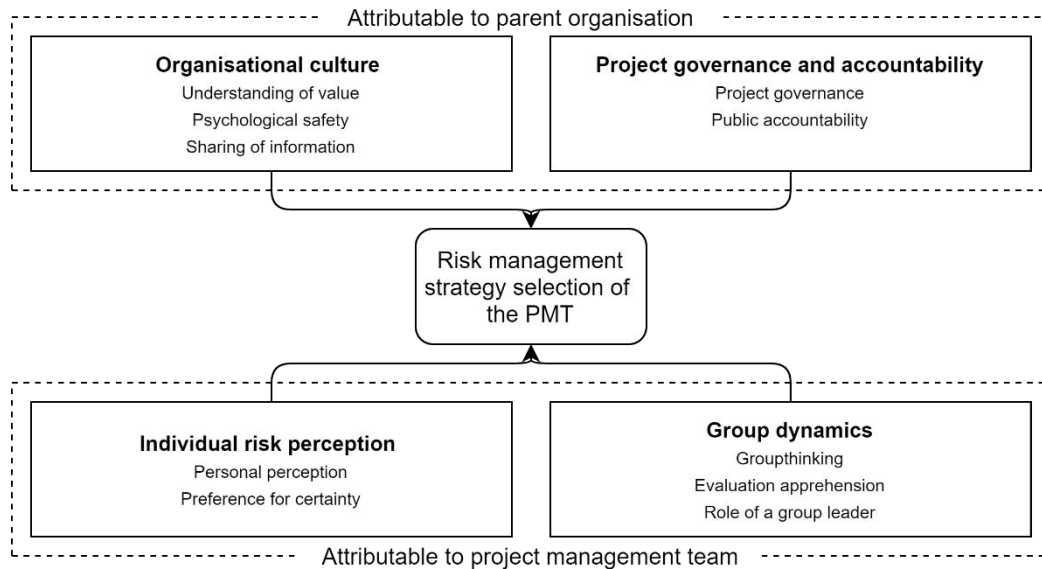


FIGURE 2, FRAMEWORK OF FACTORS AFFECTING THE RISK MANAGEMENT STRATEGY SELECTION OF THE PMT

### 3. Research approach

#### 3.1. Research methodology and data collection

This study aims to gain insight into the selection of risk management strategies in public infrastructure projects and determine what factors affect this decision. So far, empirical research on the subject is limited. Hence, an exploratory qualitative research approach was chosen (Bluhm et al., 2011; Miles & Huberman, 1994). We chose Rijkswaterstaat for an in-depth case study. Rijkswaterstaat is the executive agency for the Ministry of Infrastructure and Water Management in the Netherlands. Rijkswaterstaat uses projects for maintenance, reconstruction, and renewal of infrastructure facilities and is organized as a project-based organization (Rijkswaterstaat, 2020). Rijkswaterstaat has embedded risk management in its projects, where the process is based on established standards such as the COSO-ERM and ISO 31000 risk management frameworks (Aven, 2016; Raz & Michael, 2001).

The first step of data collection focuses on the first research aim, namely gaining insight into the risk management strategy selection in public infrastructure projects. We conducted a document review as this is an efficient and effective way to gather initial data (Bowen, 2009). We examined research reports on the implementation of risk management within Rijkswaterstaat, supplemented with internal frameworks and guidelines describing the risk management process. Furthermore, we analyzed 16 risk files from a variety of projects. We used the purposeful sampling strategy of ‘maximum variation’ to obtain an overall impression (Patton, 2015). The dataset comprises projects that spread across multiple regions in the Netherlands, there were water, road, and an ICT project included. The projects were also in different phases of their life cycle; some projects were still in the planning phase, were others were already nearing completion. Appendix A contains an overview of the documents used in this study.

Subsequently, in the second step of data collection, we conducted semi-structured interviews focusing on PMTs. We chose three projects and included the entire PMT as respondents, i.e., the project leader, technical manager, contractual manager, stakeholder manager, and the project control manager. The latter is responsible for project planning and risk management within the project. The selected projects were part of different organizational divisions to safeguard variation in the dataset. In total, five respondents were selected per project, making a total of 15 respondents. We chose semi-structured interviews as this allows us to strengthen the data obtained from the document review (Sekaran & Bougie, 2016), and at the same time, collect data that contributes to the second research aim, namely to identify what factors affect the risk management strategy selection.

Next, the third step of data collection was carried out in which again semi-structured interviews were conducted, this time focusing on the parent organization. In this last step, we focused on enhancing the data that contributes to the second research goal. We chose to select respondents that were related to the respondents from the first round. The respondents were mostly the senior management of the respondents from the first round, which made it possible to explore earlier findings further. Respondents from the second round included the senior manager of technical management, the senior manager of project control, a respondent involved in portfolio management, and two directors responsible for some of the selected projects.

In total, we conducted 20 semi-structured interviews, of which 15 with project management team members and 5 with their representatives at the parent organization in the period from May 2020 to July 2020. All interviews were conducted via an online video connection and lasted 30 to 45 minutes. Furthermore, all interviews were recorded and transcribed. During the interviews, we focused on asking singular and neutral questions to encourage our respondents to talk freely about the topics of interest and avoid the imposition of predetermined responses (Patton, 2015). An interview protocol was used for both interview rounds (see Appendix B). Furthermore, both interview rounds started with a brief discussion on the background of the interviewer and interviewee to align before the main topics were discussed. Both series of interviews also contained general closing questions where the interviewee could give his or her impression of the interview or provide recommendations for the study.

Interviews with PMT members focused on questions aimed at encouraging the respondent to give his or her impression of how risks are managed in the projects. Also, several questions were posed on how the parent organization influences risk management in the project.

In the interviews with those involved in the parent organization, the questions focused more on earlier findings on risk management strategy selection. This triggered the respondents because they often feel responsible based on their function. Then questions were asked about what causes the PMT to adopt a particular risk management strategy towards a risk. Figure 2 illustrates the data collection process of this study.

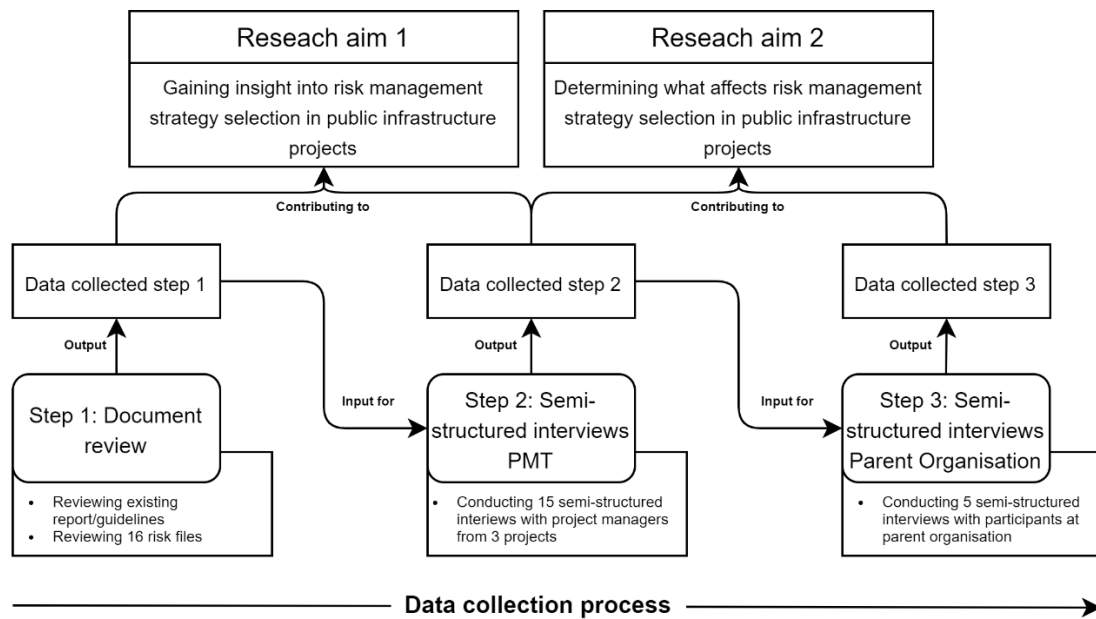


FIGURE 3, AN OVERVIEW OF THE DATA COLLECTION PROCESS

### 3.2. Data analysis

We have chosen to apply the inductive approach for qualitative data analysis in this study (Thomas, 2006). The document review was carried out following the steps of skimming (superficial examination), reading (thorough examination), and interpretation, as is described by Bowen (2009).

Also, we have specifically looked for clues that indicate the selection of a risk management strategy. Concerning the risk files, we also investigated the extent to which preventive and corrective control measures had been applied, based on earlier described insights from the literature.

With regard to the interview transcripts, we have applied coding, as described by Miles and Huberman (1994). For the coding process, the software program Atlas.ti was used. The initial step of this coding process involved ‘open coding,’ which means that all interview transcripts were gone through line by line, whereby codes were assigned to the respondent’s comment to determine the main themes. After that, previously identified codes were cross-checked, and matching codes were merged to create overarching codes; this process is also known as ‘axial coding.’ Subsequently, these overarching codes were verified with existing grounded theories to come to the final code tree that allows us to structure and interpret the findings; appendix C illustrates the code tree that was used in Atlas.ti.

## 4. Findings

### 4.1. Risk management strategy selection in public infrastructure projects

#### 4.1.1. Diversity in risk management strategy selection

In relation to research aim one, namely to gain insight into what extend the various risk management strategies are applied in public infrastructure projects, we found that in general, the diversity is limited. Where the risk management theory prescribes that a selection should be made between reducing, transferring, avoiding, or accepting a risk, the risk file indicates that such an assessment is seldom made. An impression that is also confirmed by several respondents in the PMTs, one respondent stated: *“the choice between the four management strategies is not an explicit decision in our team.”* An insight that was further reinforced during the interviews because not all respondents were aware of the different strategies for handling risks. The finding that only a limited choice is made between

different management strategies does not mean that the different risk management strategies are not chosen subconsciously. Interviews with the respondents in the PMTs reveal that the risk management strategy to accept a risk is chosen only to a limited extent. A common remark was: *“we are actually mainly trying to reduce the opportunities and consequences of a risk,”* which confirms the focus on the risk controlling strategy.

As a result of this indecisiveness between the various management strategies, a trend seems to be present in which the standard approach is to control risks. This trend is also reflected in the risk files, which often contains one or more control measures for almost every risk. In larger projects, this sometimes results in a significant number of control measures that have to be implemented, which raises the question of how feasible it is to implement and keep track of them all. Maintaining an overview seems complicated, a project leader confirmed this: *“It is difficult to keep everybody engaged with a very large risk file with many control measures.”*

In addition to the results just given, we also found examples that do indicate the risk management strategy to accept a risk. More specifically, 11 out of 15 respondents indicated that risks are also accepted in their projects. A respondent stated: *“in the planning phase you do not really want to accept risks. In the realization phase, it may well be the case that all possible control measures have been taken and that a risk is still present; we then accept this residual risk.”* Acceptance of ‘residual risk’ is also reflected in the risk files. However, it is the case that these examples represent the minority in the dataset, the strategy selection to accept a risk does occur. However, risk controlling predominates, whereby this risk management strategy selection does not always seem to be a deliberate decision.

#### 4.1.2. Preventive and corrective control measures

In addition to the various management strategies, we also examined in more detail the strategy of controlling risk, i.e., the balance between preventive (chance-reducing) and corrective (effect-reducing) control measures. Risk files reveal that 89% of all control measures focus on limiting the probability of a risk materializing. This specific percentage does not say that much in itself; however, it does portray where the focus of the PMT lies. This insight was further strengthened during the interview with the PMT members because 12 out of 15 respondents expressed a preference for preventive control measures. One respondent stated that *“prevention is better than the cure,”* other respondents gave similar answers.

In line with previous findings, respondents here too indicated that they did not always consider whether to apply a preventive or corrective control measure. A few respondents indicated that they simply came up with a control measure and did not always consider whether it is preventive or corrective. However, the overall picture does show that there is a clear emphasis on the preventive control of risks.

## 4.2. Factors influencing risk management strategy selection in public infrastructure projects

The second research objective of this study was to identify factors that influence risk management strategy selection in public infrastructure projects. In this study, we found several factors of influence. We distinguish between factors that are attributable to the PMT itself and factors that are attributable to the parent organization.

### 4.2.1. Factors attributable to the PMT

During the interviews with PMT respondents, it stood out that there are significant differences in how respondents look at risks. For example, some respondents indicated to be quite willing to accept risks where other respondents indicated a strong need to control risk as much as possible. PMTs seem to

be aware of these differences, as multiple respondents stated that there are often discussions about the size of risks and how the risks should be handled. A comment from a PMT member summarizing the message of multiple respondents was that: *“we attach great value to our collective risk sessions because they make it possible to enter into dialogue and where necessary there is also room for criticism.”* A project leader added that *“if a risk owner scales a risk high in terms of chance and consequence, then this risk owner is challenged to justify to the group why ‘his risk’ has to score this high.”* These results show that differences in risk perception are visible. It seems that group sessions in which all participants engage constructively are a valuable instrument for filtering out an individual over- and underestimation of risk. Without these group sessions, the risk management strategy selection of PMTs appears to be vulnerable to individual estimates whose are less reliable.

As mentioned above, variations have been found between individuals in the extent to which they are willing to accept risk. We tried to find out if there was a trend in this. What stood out during the interviews is that technical managers are more inclined to see technical risks as controllable. One technical manager stated: *“technical risks are often not easily exogenous, often they are issues that the PMT can do something about. This is different in the case of stakeholder risks where the influence is sometimes minimal.”* This notion recurred more often with regard to technical risks, an example which was also given several times involved soil risks. Respondents indicated that an additional soil investigation often reduces the risk considerably. If the impression exists that technical risks are better controllable, this view might result in a strong presence of the risk control strategy for technical risks. Risk files could not validate this insight as projects vary too much in nature, and it is difficult to draw a generalization from this. Results are therefore not conclusive here, yet there is some indication tending towards differences between risk categories in the PMTs.

#### 4.2.2. Factors attributable to the parent organization

From the perspective of the parent organization, we found several factors that influence the risk management strategy selection of the PMT. For example, this study shows that organizational culture is important. Seven respondents from the PMT stated that the focus to control risk is part of Rijkswaterstaat’s culture. When asked what exactly was meant by this, several explanations were provided. A respondent said: *“Rijkswaterstaat must guarantee the water safety of the Netherlands and takes little risk in doing so. This philosophy is deeply rooted and culturally embedded. As a result, the project team wants to be in control as much as possible,”* another respondent from a PMT added that: *“It is unpleasant to accept that as a PMT you are not in control, accepting risks does not fit in this.”* There was also regularly mentioned that an intrinsic drive is present within the organization to *“make the most of it,”* accepting risks does not seem to be in line with these views. Opposing these values is experienced by many respondents in PMTs as walking on thin ice. What this demonstrates is that the organizational culture leaves a clear mark on the risk management strategy selection of PMTs. In the case of Rijkswaterstaat, this tends to a preference for controlling risks.

Results also showed that the risk file plays an essential role in how the project’s progress is monitored. A project leader stated that: *“the risk file is a means of communication that is often used during interactions with the parent organization, as well as with the environment of the project.”* Moreover, the risk file is an input document for project planning and budget. To provide this input for these reports, risks must be expressed in terms of time and money. Especially for this reason, the quantitative approach seems very important. A point that can sometimes cause somewhat tricky situations when it involves risks that are difficult to quantify because of their uncertainty and unpredictability. Many respondents in the PMTs indicated that this is a problem.

On the other hand, we also see the interest of this quantification at the parent organization because it allows the project progress to be monitored and facilitates comparisons among projects based on

figures. Also, a respondent at the parent organization indicated that these quantified risks are used in contractual negotiations with contractors, which demonstrates that the risk file containing the quantified risk is also used as a steering tool for various applications. The important function of the risk file also makes it essential to have the risk file properly organized as PMT, at least this counts for the 'top risks' in the file. A project manager stated: *"as a PMT, you want to show that you are fully engaged with these top risks."* This necessity appears to result in the formulation of control measures by which the PMT demonstrates to be involved with the risk; this influences the risk management strategy selection.

This accountability sentiment is also a factor often mentioned by respondents in the context of being a public organization. A public organization conducts projects financed by federal funds, entailing a moral imperative to handle these funds responsibly from the perspective of society. Respondents indicated that this makes it difficult to accept a risk that costs money if it occurs. For example, one person involved at the parent organization stated the following: *"If a risk is taken once in a while and this risk materializes, parliamentary questions might be raised on what the cost were."* Ten out of the fifteen respondents at the PMT and all those involved in the parent organization indicated that this public accountability aspect plays a significant role in the risk management strategy selection of the PMT.

## 5. Discussion

Based on the results, we see the following points of discussion, (1) risk management under pressure and (2) challenges in risk management strategy selection.

### 5.1. Risk management under pressure

Results show that controlling a risk is the most commonly used risk management strategy, with an emphasis on preventive control measures, risks are accepted only to a limited degree. An insight that is in line with earlier findings indicating risk-aversion at public organizations (Chen & Bozeman, 2012; Paape & Speklé, 2012). An explainable standpoint given that these public infrastructure projects involve public funds that are used to serve a wide-ranging public interest.

However, where on the one hand this risk management strategy selection can be explained in this context; the results also indicate a downside. An illustration of this is that the risk files can expand to the point where the file becomes hard to oversee due to the number of control measures. This effect shows similarities with 'over management' as described by Mikes (2009), Power (2009), and Van Staveren (2015). In this situation, little attention is paid to the control potential of a risk, which significantly reduces the resource efficiency of project management resources, where this should be a target that PMTs must strive for (Ward, 1999). Especially in the complex setting where public infrastructural projects take place.

Risk management standards like COSO-ERM and ISO 31000 – risk management point out the importance of that the PMTs make decisions on what risk management strategy it selects (Aven, 2016; Raz & Michael, 2001). In practice, this selection appears to be more difficult. To what extent these insights are generalizable is difficult to say because this study consists of a single case of a public project-based organization that conducts public infrastructure projects. It is for this reason possible that the findings do not hold at a private project-based organization or a project-based organization outside the infrastructure sector. Further research on risk management strategy selection at another type of organization or sector would contribute significantly to the discussion. What does hold and therefore contributes to the literature on project risk management (Kutsch & Hall, 2005; Perminova et al., 2008; Sanchez et al., 2009) is the understanding that the current approach following the well-

known risk management standards can falter if the PMTs are unable to select the most appropriate risk management strategy. An insight that is not tied to an organization type or sector.

Furthermore, this study has identified factors that affect the risk management strategy selection and are attributable to the PMT as well as to the parent organization. Again, it must be mentioned that due to the exploratory nature of this study, it might be the case that not all factors and underlying reasons affecting risk management strategy selection have been identified. A repetition of this study at another public project-based organization would contribute a lot to the discussion. Nonetheless, due to the iterative data collection, whereby triangulation has also been applied, we expect that the most relevant factors have been identified. Based on these factors, we introduce four challenges that (public) project-based organizations need to address to advance their risk management practices so that it can withstand in today's dynamic and complex project environment and thereby contribute to the project success.

## 5.2. Challenges in risk management strategy selection

First, in order to be able to determine which risks matter to PMTs, i.e., which pose the greatest threat to the project objectives, but mostly which risks have significant control potential, PMTs must be able to make the best possible estimates on risks in the project. Results of the study show that there are substantial differences in the risk perception among individuals, which therefore confirms previous studies (e.g., Bosschaart et al., 2013; Gardner & Steinberg, 2005; Ingram & Thompson, 2011). To prevent over- and underestimation of risks, diversity in a group in a PMT seems essential, and in addition, there should always be room to debate on risks. Organizations should attempt to establish such a project management environment—an insight that holds for both public- and non-public project-based organizations.

Secondly, this study shows, in line with previous findings (e.g., Karlsen, 2005; Wang & Yuan, 2011), that cultural factors play an essential role in the risk management strategy selection of PMTs. Especially in organizations where the risk management strategy to accept a risk contradicts with the 'values' of the organizations, it can be difficult for a PMT to accept risk. If a PMT is convinced that it is better to accept a risk or apply a corrective control measure, it requires the parent organization to create this space. Of course, there are limits here, and there need to be clear guidelines for this, which can vary a lot per type of organization. Earlier in this study, during the literature review, the development of Enterprise Risk Management was pointed out. A component of Enterprise Risk Management is a risk appetite statement, which is entirely qualitative and formulated by the board of the organization, indicating the amount of risk an organization is willing to accept in pursuit of value (COSO, 2012). Although Enterprise Risk Management is only one example, the parent organizations must provide guidance in this to the PMTs.

The third challenge has everything to do with the sometimes poor quantifiability of risks, a point already introduced by studies by Zhao et al. (2015) and Perminova et al. (2008) and finally visible in the results. Several scholars (e.g., Junior & Carvalho, 2013; van Staveren, 2018) therefore called for a more qualitative form of risk management in which the numbers are dropped so that there is more room for recognition of uncertainties. However, this study also highlighted the clear benefits of quantifying risks, such as in monitoring project progress, comparing projects, and their application in contract negotiations. Moreover, there is no indication that all risks are hard to quantify. For a significant part of the risks, the current risk management approach seems to work well, making it too short-sighted to conclude that the current quantitative approach to risk management is unsatisfactory. However, the inability to select the most appropriate risk management strategy, which tends to over management, is a clear illustration that the current approach sometimes lacks. So where the quantitative approach is still strongly represented by the risk management frameworks, the voice for

a qualitative approach also becomes louder. This study shows that both forms have advantages and that choosing between them has inevitable disadvantages. Further research into an approach that preserves project steering and at the same time allows to cope with risks that are difficult to quantify would be a valuable follow-up study.

Whereas the first three challenges were not necessarily attached to one type of organization, the fourth focuses on public project-based organizations. The study showed that the accountability sentiment is important within public organizations. PMTs feel the pressure to show that they have done everything possible so that if something goes wrong, the political top can eventually justify that everything has been done to prevent the risk from materializing. Kim (2010) argues for more entrepreneurial public organizations in which losses are occasionally taken, and this does not have immediate political consequences. Again, it is clear that a public organization is not an investment company. Still, public organizations must be transparent about risks, i.e., recognize that risks are sometimes poorly controllable, and accepting them or applying corrective control measures is sometimes the preferable option. It is apparent that public accountability is embedded in how these organizations are designed. However, this study shows that this has significant consequences on the risk management strategy selection in projects, which ultimately reduces the performance of the organization as a whole. A follow-up study on how this public accountability is retained, and at the same time, the PMT is less influenced by this pressure is a useful direction for further research.

## 6. Conclusion

With this study, we aimed to gain insights into the risk management strategy selection of PMTs in public infrastructure projects. We also looked for factors of influence on risk management strategy selection in public infrastructure projects. We found that the diversity in risk management strategy selection is limited. The emphasis is on the control strategy, where preventive control measures are most strongly represented. Furthermore, we found various factors that influence the risk management strategy selection, which can be attributed to the PMT and the parent organization.

The current approach to risk management allows risks to be systematically and structurally handled, making risk management, in essence, useful to address the threats to the project objectives. However, due to the increasingly complex and dynamic project environment in which also public infrastructure projects are located, high expectations are set for risk management in these projects, as risks can emerge quickly and unexpectedly. PMTs are therefore required to optimize the allocation of their project management resources and deploy these resources where they are most needed. To accomplish this optimization, PMTs must be able to select the most appropriate risk management strategy, where this study shows that this poses serious challenges that (public) project-based organizations need to overcome. The quantification- and public accountability challenge both have the potential to entail significant changes in how (public) project-based organizations are organized today. However, to maintain a risk management approach in the projects that can keep up with the changing project environment, it is inevitable that (public) project-based organizations face the challenges introduced in this study.

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## 8. Appendices

### Appendix A – Documents used for review

[Excluded for confidentiality reasons]

## Appendix B – Interview protocols

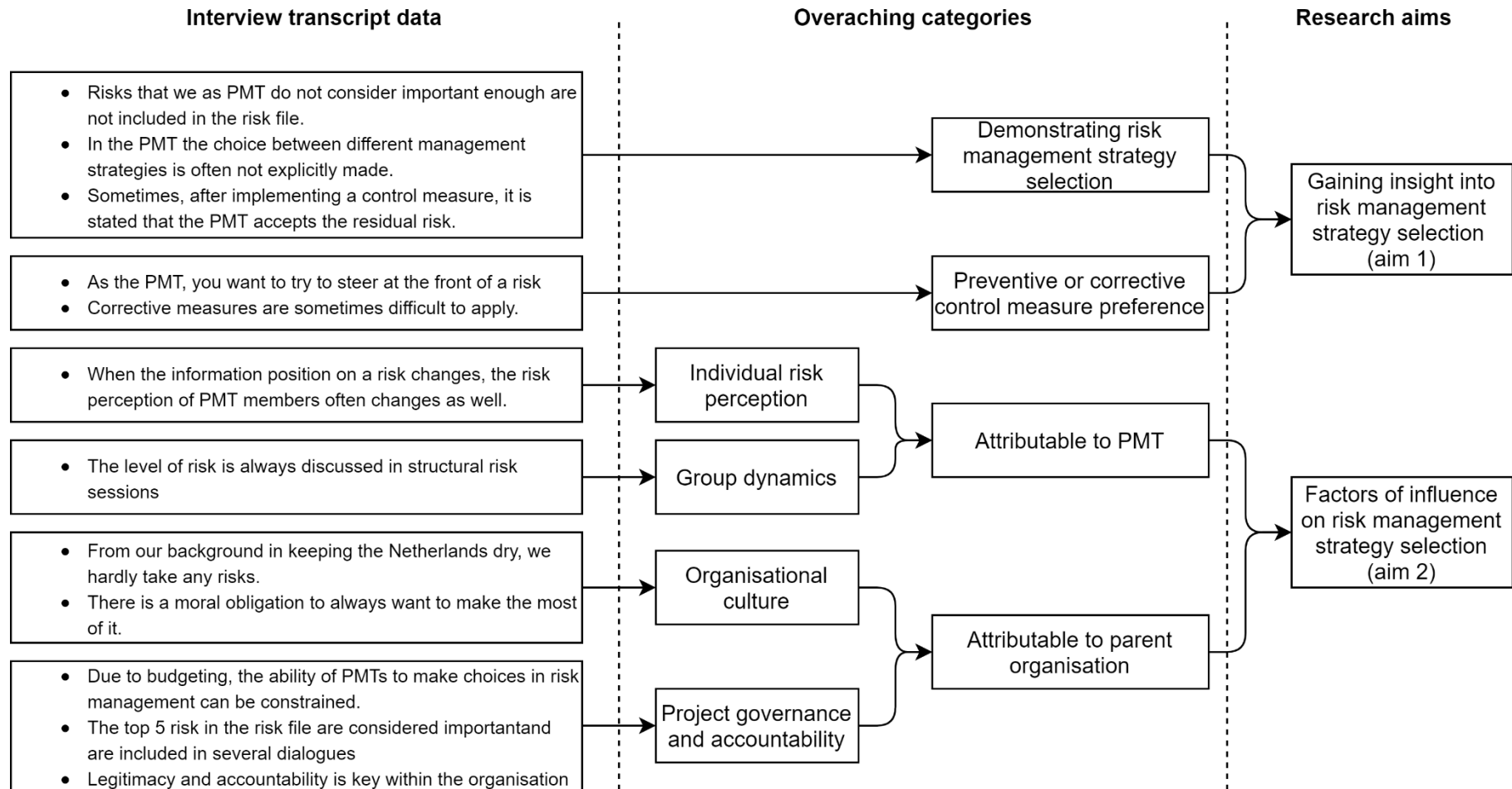
### INTERVIEW PROTOCOL PROJECT MANAGEMENT TEAM

| Topic list                                                                    | Interview vragen                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|-------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Introductie</b>                                                            | <ul style="list-style-type: none"><li>• Wie ben je?</li><li>• Wat is op dit moment jouw functie en welke rol speel je binnen een project?</li></ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Het risicomanagement proces algemeen</b>                                   | <ul style="list-style-type: none"><li>• Hoe gebruiken jullie risicomanagement in jullie project?<ul style="list-style-type: none"><li>◦ Zijn doelstellingen bepaald en worden risico's in relatie tot die doelstellingen geïdentificeerd?</li></ul></li><li>• Kun je hier een voorbeeld van geven?</li><li>• Zijn er stappen van het risicomanagementproces die je lastig vindt?</li><li>• Zijn er stappen van het risicomanagementproces die je makkelijk vindt?</li></ul>                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Hoe worden risico's geïdentificeerd (identificatie/classificatie stap)</b> | <ul style="list-style-type: none"><li>• Zitten alle risico's in het risicodossier?<ul style="list-style-type: none"><li>◦ Kun je een voorbeeld noemen van risico's die niet in het risicodossier zitten?</li><li>◦ Wat zijn de redenen dat niet alle risico's in het risicodossier zitten?</li><li>◦ Wat voor een risico's moeten altijd in het risicodossier zitten?</li></ul></li><li>• Wat maakt nou dat risico's wel of niet in het risicodossier opgenomen worden?</li></ul>                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Hoe wordt er met risico's om gegaan? (Controleer stap)</b>                 | <ul style="list-style-type: none"><li>• Hoe wordt bepaald aan welke risico's veel aandacht wordt besteed?</li><li>• Welke beheers strategieën worden in jullie project toegepast? (Accepteren, verkleinen, overdragen, vermijden)<ul style="list-style-type: none"><li>◦ Wat zijn denk je de belangrijkste redenen dat bepaalde beheers strategieën niet worden toegepast?</li><li>◦ Stel een risico wordt geaccepteerd, heeft dit dan gevolgen voor bijvoorbeeld de begroting of planning van het project?</li></ul></li><li>• Gebruik je vaker preventieve of correctieve maatregelen?<ul style="list-style-type: none"><li>◦ En waarom?</li></ul></li><li>• Hoe kiezen jullie de passende beheersmaatregel?<ul style="list-style-type: none"><li>◦ Speelt de mate van kwantificering (bijv. een hoge kans of een hoog gevolg) hier een rol in?</li></ul></li></ul> |
| <b>Rol van top risico's</b>                                                   | <ul style="list-style-type: none"><li>• Waar wordt het lijstje met top risico's in een project voor gebruikt?</li><li>• Komt het wel eens voor dat jullie de top- en risico's niet erkennen en dat er dan iets in aangepast wordt?<ul style="list-style-type: none"><li>◦ Zo ja, wat dan?</li></ul></li><li>• Zit er een verschil tussen de dagelijkse risico's waar het projectteam mee bezig is, en het lijstje van top- en risico's uit het risicodossier?<ul style="list-style-type: none"><li>◦ Zo ja, waarom is dit?</li></ul></li></ul>                                                                                                                                                                                                                                                                                                                        |
| <b>Verbinding lijn- en projectorganisatie</b>                                 | <ul style="list-style-type: none"><li>• Worden risico's als dit van toepassing is ook bij het managementteam gealloceerd? (Hierbij doel ik dus niet op de reguliere T-rapportages, het gaat hier om MT leden die de projectteamleden in de lijn vertegenwoordigen)</li><li>• Welke invloed heeft de lijnorganisatie op het beheersen van de risico's in de projecten?</li><li>• In hoeverre beïnvloedt het project de risicobeheersing in de lijnorganisatie?</li></ul>                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Afsluitend</b>                                                             | <ul style="list-style-type: none"><li>• Terugkijken op dit interview, wat is het belangrijkste punt dat je zou willen meegeven (m.b.t. risicobereidheid of de acceptatie van risico's)?</li><li>• Waar hebben we het niet over gehad met betrekking tot risicobeheersing tussen project en lijn wat je nog wel kwijt zou willen?</li><li>• Wat zou je boodschap zijn aan het lijnmanagement in één zin? (In dit kader van de verbinding tussen lijn- en project)</li></ul>                                                                                                                                                                                                                                                                                                                                                                                            |

## INTERVIEW PROTOCOL PARENT ORGANIZATION

| Topic list                                      | Interview vragen                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|-------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Introductie</b>                              | <ul style="list-style-type: none"> <li>• Wie ben je?</li> <li>• Wat is op dit moment jouw functie en welke rol speel je binnen een project?</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>I – Vertalen van doelen</b>                  | <ul style="list-style-type: none"> <li>• In het beleidsstuk 'Koers2020' staat duidelijk beschreven wat de doelstellingen voor RWS zijn en wat dit betekent voor GPO. Zowel het lijnmanagement/portfoliomanagement moet ervoor zorgen dat dit handen en voet krijgt in de projecten. Kun je aangeven hoe dit nu gebeurt?</li> <li>• In hoeverre wordt er gestructureerd met risico's omgegaan die deze doelstellingen in gevaar kunnen brengen?</li> <li>• Rijkswaterstaat gebruikt projecten om hun doelstellingen te realiseren, welke rol spelen de risico's in de projecten bij het risicomanagement op het portfolioniveau als ook bij het lijnmanagement?</li> <li>• Hoe draagt het risicomanagement in de projecten bij aan het risicomanagement in de organisatie als geheel?</li> </ul> |
| <b>II – Risico-overzicht</b>                    | <ul style="list-style-type: none"> <li>• Hoe worden ervan uit portfolio- en lijnmanagement 'early warnings' op gespoord over mogelijk risico's die kunnen ontstaan? <ul style="list-style-type: none"> <li>○ (Indien van toepassing) Hoe wordt er dan gewaarborgd dat dit soort signalen dan ergens landen zodat er iets mee gedaan wordt?</li> </ul> </li> <li>• In hoeverre wordt er bij het portfolio- en lijnmanagement geprobeerd om vaak terugkomende risico's te identificeren? <ul style="list-style-type: none"> <li>○ Zo wel, wat wordt hier dan mee gedaan als een dergelijk risico in verschillende projecten in het portfolio terugkomt?</li> <li>○ Zo niet, waarom gebeurt dit niet?</li> </ul> </li> </ul>                                                                       |
| <b>III – Preventieve mitigatie in projecten</b> | <ul style="list-style-type: none"> <li>• Hoe komt het dat vrijwel alle risico's in de projecten preventief gemitigeerd worden?</li> <li>• Wat zou een bewustere keuze in hoe om te gaan met risico's mogelijk kunnen maken?</li> <li>• Welke rol speelt het portfolio- en lijnmanagement hier nu in?</li> <li>• Welke rol zou het portfolio- en lijnmanagement hierin kunnen spelen?</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Afsluitend</b>                               | <ul style="list-style-type: none"> <li>• Terugkijkend op dit interview, wat is het belangrijkste punt dat je zou willen meegeven wat mij zou helpen met deze studie?</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |

## Appendix C - Code tree



## Appendix D – Interview transcripts

[Excluded for confidentiality reasons]

## Appendix E – A literature study on risk evaluation terminology

This appendix is attached in separate file