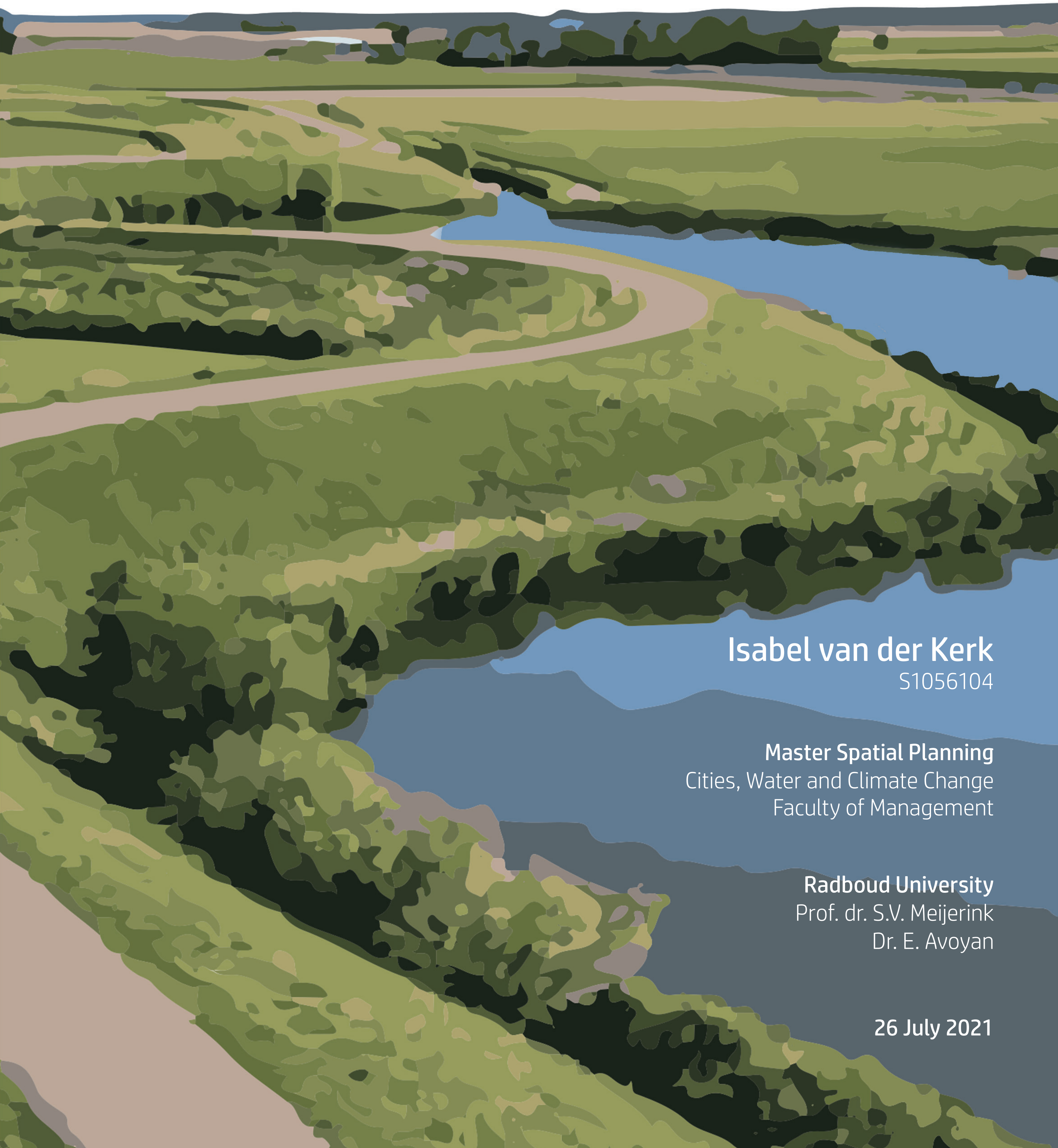
Collaborative governance and technical innovation in dike reinforcement projects in the Netherlands

A mixed method study contributing to the All-Risk research projects



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Abstract

Due to revised safety standards, dike infrastructures across the Netherlands need to be reinforced. The Dutch Flood Protection Program (HWBP) is, as the overarching program, responsible for the dike reinforcement projects and recently published its Knowledge & Innovation Agenda (2019) that aims at providing guidance for innovations, including a framework for stimulating cross-sector collaboration. As innovation being one of the main goals, the program seeks to generate efficient dike reinforcement technologies, while cross-sector collaboration is the preferred strategies for accomplishing this goal.

Literature seems to agree on the notion that collaboration spurs innovation. However, little is written about how a collaborative process can exactly contribute to the generation of technical innovative solutions. This study therefore aims to provide knowledge on the enabling and constraining collaborative conditions for the creation of technical innovations. By executing a mixed method research strategy, this study gives a quantitative as well as a qualitative insight in the collaborative process behind the HWBP dike reinforcement projects. The research therefore contributes to collaborative flood risk management studies and how it can spur technical innovation.

Key words: collaborative governance, technical innovations, dike reinforcements, flood risk management.

Preface

Hereby, I proudly present my master thesis on collaborative governance and technical innovation in dike reinforcement project in the Netherlands. A thesis written in my final academic year that was slightly different than I had imagined. Instead of doing a research internship in a bubbly office and consulting fellow students at my new university, COVID-19 interrupted these tempting opportunities.

Nonetheless, I had the honour of writing my thesis as part of the All-Risk research project which provided me the intriguing context that encouraged me of doing a mixed-method study on dike reinforcements. It also allocated me to having prof. dr. Sander Meijerink and dr. Emma Avoyan as my supervisor and co-supervisor, who carefully met with me (online) every few weeks and were always available for constructive feedback.

I couldn't have completed this thesis without the VU University Amsterdam that, against governmental advice, opened their library for all students across the country. Fortunately, most friends from my bachelor program joined me almost every day to complete our collective task: finishing our master thesis. Thank you, my friends, my boyfriend, my brother, and my parents just for always being there for me.

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1. INTRODUCTION

1.1 Context

Because of the increasing effects of climate change, the sea level is rising, the soil is gradually sinking, and water extremes are occurring more often (Deltaprogramme, 2018). The latter resulted in recent high-water levels in the rivers in July 2021, causing dike breaks and flooding in parts of the Netherlands, Belgium, and Germany (Waarlo, 2021). The Netherlands, with almost 60% of its surface prone to flooding, has a long history of securing the land from water by a far-reaching flood defense infrastructure (Avoyan & Meijerink, 2019; Delta Programme, 2018). For generations, the country is being protected from water by dikes, dunes, and storm barriers. The necessity of this extensive flood defense infrastructure was confirmed once again in July 2021, when the south of the country got flooded.

To accommodate the increasing risk of flooding, new safety standards were incorporated in the Dutch Water Law in 2017 (Avoyan & Meijerink, 2020). Regarding these new norms, multiple flood risk infrastructures across the country need to be reinforced (All-Risk, 2021a; HWBP, n.d.). The Dutch Flood Protection Program (HWBP) is the umbrella program that coordinates and channels the implementation of new measures within different dike projects across the country.

Developing technical innovative solutions are crucial to achieve the current dike reinforcement task, both for affording the enormous reconstruction, as well as to protect and preserve the surrounding dike areas as much as possible (HWBP, n.d.). The country has therefore formalized its ambition to implement innovative technical solutions for flood protection (Delta Programme, 2018). For this purpose, the Dutch government provides funds for specific studies on technical innovation (Van Loon-Steensma & Vellenga, 2019), as well as encouraging cross-sector collaborations.

Moreover, the HWBP recently published its Knowledge & Innovation Agenda (n.d.) that aims at providing guidance for innovations, including a framework for stimulating collaborative governance. As innovation being one of the main goals, the program seeks to generate efficient dike reinforcement technologies, while cross-sector collaboration is the preferred strategy for accomplishing this goal. Because dike reinforcements often incorporate large-scale infrastructures, complex collaborations between a diverse range of stakeholders are inevitable (All-Risk, 2021b). For this reason, understanding how collaborative governance leads to technical innovations becomes essential.

1.2 Research aim and question

This research aspires to present insight into enabling and constraining collaborative conditions for generating technical innovation within the HWBP program and its collaborative projects. The study focusses on the HWBP projects' exploratory phase, which took place roughly between 2017 and 2019. By doing so, a mixed methods research strategy is applied that allows both quantitative and qualitative methods to answer the research question. Using a mixed method strategy usually requires more time, resources, and expertise than a single method study (McKim, 2015), but is valuable when the combination of the two methods provide a comprehensive understanding of the research aim.

This thesis aims to contribute to one of the ongoing All-Risk research projects. The All-Risk research project supports the HWBP by providing scientific research on both technical findings as well as insights in collaborative policy strategies (All-Risk, 2021a). This specific project explores how different attributes of collaboration influence the development of quality solutions that (1) incorporate technical innovation, (2) integrate multiple sectoral interests and (3) are considered legitimate (All-Risk, 2021b). Hence, this study contributes to understanding the first component: more specifically, the collaborative processes behind generating technical innovations within the HWBP projects.

The research question is therefore:
What are the enabling and constraining collaborative conditions for generating technical innovations within the HWBP projects?

The research question will be analysed through the following sub-questions:
- *Which collaborative dynamics and elements affect the development of technical innovative solutions in the HWBP projects?*
- *What is considered to be technical innovation and how was it developed in the IJsselwerken Zwolle-Olst project?*
- *Which collaborative conditions enabled or constrained the creation of technical innovations in the IJsselwerken Zwolle-Olst project?*
- *How did the institutional setting of the HWBP influence the process of generating and approving technical innovation?*

1.3 Scientific relevance

The concept of innovation has received widespread attention in academic literature. The term suggests an improvement or development of something new, that can either refer to a product or a process. However, further specification differs amongst literature (Crossan & Apaydin, 2010; Verweij et al, 2020). Innovation in the public sector is essential to enhance economic performance, social welfare, and environmental sustainability as it promotes organisational efficiencies and aims to produce public value (Torfing, 2019). In flood risk management, innovation is mostly focused on innovative solutions to face the uncertain effects of climate change and socioeconomic developments (Van Loon-Steensma & Vellenga, 2019). In the context of flood risk management, innovation is predominantly considered to be technical, where technologies are used to produce products that improve flood protection and water-resilience (Crossan & Apaydin, 2010; Delta Programme, 2018; Van Loon-Steensma & Vellenga, 2019).

Scholars also tend to agree on the notion that collaborative governance is important to achieve demanded action (Emerson et al., 2011): collaborative governance leads to certain changes or outcomes that can be attributed to the effectiveness and success of the collaboration (Douglas et al., 2020). More specifically, cross-sector collaborations tend to stimulate and accelerate the diffusion of successful innovation (Torfing, 2019). Yet, little is written about the collaborative dynamics involved in the implementation of innovation and studies exploring the link between technical innovation and collaborative governance are not common (Loon-Steensma & Vellenga, 2019). However, understanding the causal mechanisms between collaborative governance and the creation of innovative solutions, is valuable. As the dike reinforcement issue in the Netherlands demands innovations, as well as it requires collaboration between multiple stakeholders, this research aims to fill in that gap.

1.4 Societal relevance

As the July 2021 flooding inevitably proves, the reinforcement of the current dike infrastructure is crucial. The Netherlands, as well as its social economic centre, the Randstad, is prone to flooding, as it primarily situates below sea level (Jorissen et al., 2016). Securing the country from future flooding is thus compelling, to prevent large social-economic disasters. To achieve the reinforcement assignment, the creation of innovative solutions is vital, in order to afford and guarantee high-quality flood defences. This research provides an insight in the enabling and constraining collaborative conditions that will increase the development of technical innovation. It therefore intends to foster the collaborative process within the HWBP dike projects, that strive to generate innovative solutions.

Within the larger societal challenge of climate change, this study aspires to contribute to collaborative processes in spatial adaptations. The research therefore aligns with the national Delta Programme – of which the HWBP is part of – that aims at assuring climate-proof and water-resilient spatial adaptation in the Netherlands (Delta Programme, 2018).

1.5 Research outline

The research starts by exploring different concepts on both collaborative governance and technical innovation, as well as on the Dutch Flood Protection Program (HWBP). In the theoretical framework, an emphasis has been put upon Emerson, Nabatchi and Balogh's (2011) Integrative Framework for Collaborative Governance. The three collaborative dynamics - principled engagement, shared motivation, and capacity for joint action - that together form the Collaborative Governance Regime, serve as the foundation for this study. The collaborative dynamics allow the researcher to operationalise the concept of collaboration. Following this operationalisation, an earlier conducted survey was analysed as part of the quantitative study. To obtain an in-depth view in the collaborative process and procedural settings of the HWBP program, a case study research was employed on the reinforcement of the IJsseldike between Zwolle and Olst. By analysing existing documents and conducting semi-structured interviews, the researcher gained a more comprehensive understanding of the case's collaborative process, as well as insight into other collaborative features that were not covered in the survey. After the quantitative and qualitative data collection, the data was analysed and the results and conclusion were written.

2. THEORETICAL FRAMEWORK

2.1 Collaborative governance

Bryson et al. (2015) define cross-sector collaboration as "the linking or sharing of information, resources, activities, and capabilities by organizations in two or more sectors to achieve jointly an outcome that could not be achieved by organizations in one sector separately" (Bryson et al., 2015, p. 648). Interesting in this definition is the need for organisations to work together, as the desired outcome could not be achieved by one organisation only. It reflects the complexity of issues, as well as the interdependence of stakeholders. Bryson et al. (2006) and Richardson (2012) both refer to the complexity of issues in today's society that causes an increased interdependence between organisations and spurs collaborative working. Richardson (2012) states that, "in a complex society with extending borders, central actors are unable to muster the knowledge required to shape effective instruments of intervention. They depend on the expertise and knowledge of private and local actors" (2012, p: 2). The complexity of modern society causes a dispersion of knowledge and an interdependence between stakeholders. The sharing of expertise and knowledge is thus necessary to overcome the complexity of society's public challenges (Bryson et al., 2006).

Cross-sector collaborations exist in the context of collaborative governance, a mode of governance studied by a full range of scholars proposing varies definitions, differing in understanding including informal cross-boundary arrangements (Emerson et al., 2011), towards more specific definitions focusing on the public policy (Ansell & Gash, 2007). Ansell and Gash's (2007) definition on collaborative governance seems fitting for the research and is as follows: "A governing arrangement where one or more public agencies directly engage non-state stakeholders in a collective decision-making process that is formal, consensus-oriented, and deliberative and that aims to make or implement public policy or manage public programs or assets" (Ansell & Gash, 2007, 544). Important here is (1) the involvement of public agencies as well as non-public stakeholders, (2) the collective decision-making process and (3) the focus on public policy or public management. In collaborative governance, knowledge, and responsibilities are being shared amongst actors from public and private sectors and are brought together to cooperative in decision-making processes (Ansell & Gash, 2007; Emerson et al., 2011; Yandle, 2002).

2.1.1 Integrative Framework for Collaborative Governance

Research has developed a broad set of models that conceptualises collaborative governance and defines conditions that determine the success of cross-sector collaboration (Bryson et al., 2015; Douglas et al, 2020). The most recent collaboration framework is developed by Emerson, Nabatchi and Balogh (2011); the Integrative Framework for Collaborative Governance. The framework is more extended in comparison to earlier developed models on collaborative governance (e.g., Ansell & Gash, 2008; Bryson et al., 2006), since it views collaboration as embedded in a broader context and acknowledges a certain effect from the external context on the collaborative process, called as the system context. Figure 1 displays the developed framework. Within the system context, a set of drivers serve as the incentive to collaborate. Once the collaboration is initiated, the framework's central element comes to front: the Collaborative Governance Regime (CGR). Within this regime, the success of the collaboration is determined by the three collaborative dynamics that interact as mobile components. The interaction of the three collaboration dynamics leads to action or the needed taken steps to implement the shared purpose of the CGR, which eventually, determines the impact of the collaboration. The framework's elements will now be discussed separately, while focussing especially on the three collaboration dynamics: principled engagement, shared motivation and capacity for joint action.

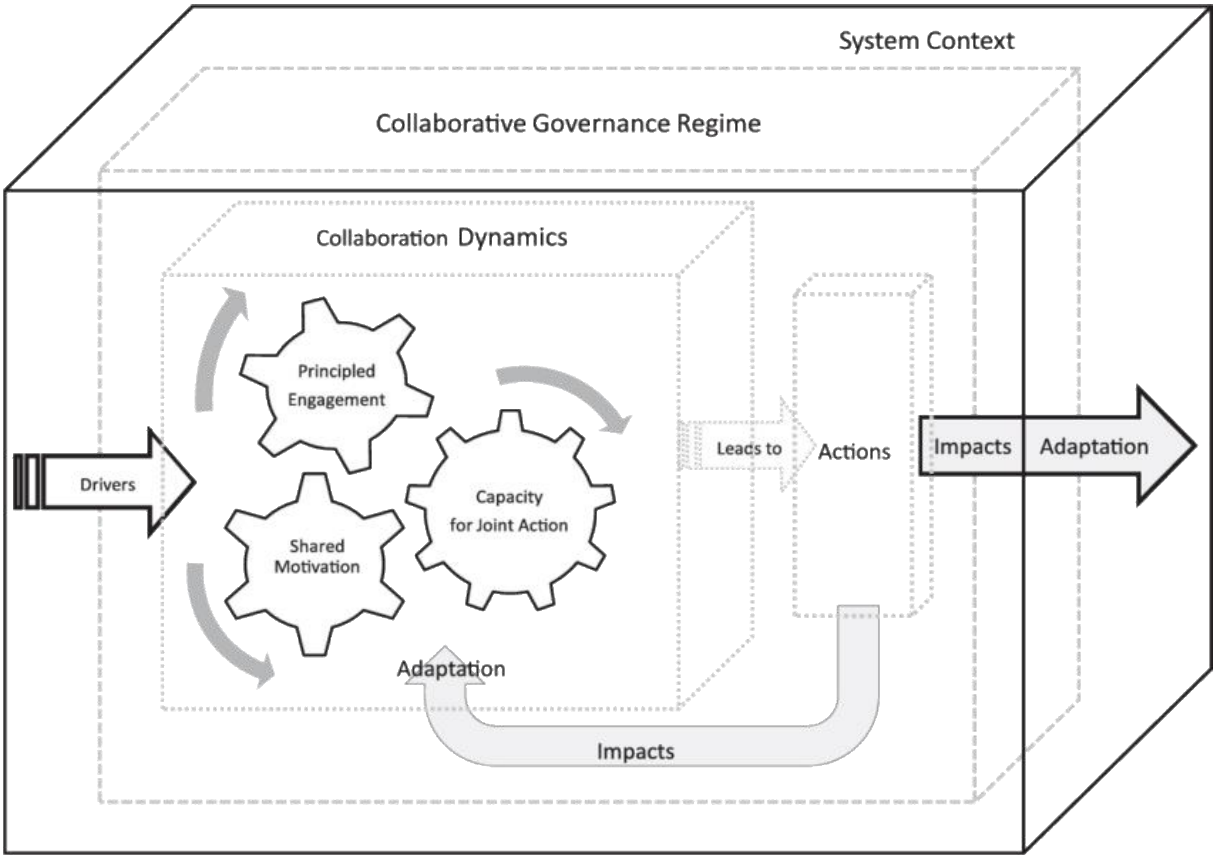

Figure 1: Integrative Framework for Collaborative Governance (Emerson et al., 2011).

System context

The system context represents the external influences from political, legal, socioeconomic and environmental spheres, that enable or constrain the functioning of the collaboration (Emerson et al., 2011). Important is that system context may influence the CGR at any time from any direction by outside elements, resulting Emerson et al. (2011) to refer to the system context as three-dimensional. The external elements could be distinguished by resource conditions, policy and legal frameworks, socioeconomic and cultural characteristics, political dynamics, network characteristics and prior failures or a history of conflicts (Emerson et al., 2011).

The former two are essential elements in this specific research because of their impact on collaborative governance in the dike reinforcement projects. Resource conditions refer to the condition of the studied unit – in this case the separate dike projects –, that calls for an improvement, increase or limit (Emerson et al., 2011). The condition of a dike, prior to when the project was set up, will affect the way the collaboration is shaped and thus, influence the functioning of the collaboration. The second external element, legal frameworks, as well impacts the collaboration. Legal regulations, such as current laws that block any intervention in the environment, could hinder the process of dike restructuring and therefore function as external influences that pressures the collaboration. At the same time, legal regulations could encourage collaboration and generate chances for dike reinforcement projects, for example, through policies that advocate for a flood risk reduction.

Drivers

While the system context affects the CGR externally, a set of drivers function as the catalyst for collaboration. Emerson et al. (2011) identify leadership, consequential incentives, interdependence, and uncertainty, as driving forces for collaborative action. Collaboration is mostly initiated by a substantial leader, with either internal or external incentives to tackle a certain issue. Here, stakeholders involved are unable to accomplish something on their own and therefore are interdependent from each other. Finally, a collective uncertainty of a wicked problem that cannot be resolved internally, drives stakeholders to collaborate. Douglas et al. (2020) argue that the presence of strong incentives for the participants to collaborate, is determining for the success of the collaboration. Identifying the participant's incentive to collaborate is therefore essential knowledge.

In the case of this research, an accumulation of several consequential incentives has driven the establishment of the collaboration between several stakeholders. Legislation, like the revised safety standards in 2017, has led to the introduction of the HWBP dike reinforcement projects. Driven by the bigger incentive of increased flood risk due to climate change. Moreover, the complex character of dike reinforcement forces multiple stakeholders to collaborate as the issue demands expertise from varies sectors and thus, stakeholders are interdependent from one another.

Dynamics

While a set of drivers function as input for setting the collaboration in motion, a threefold of dynamics operate in the collaborative process and constitute together the CGR. Emerson et al. (2011) view the three dynamics as interacting gears that move rather cyclical than linear. The three components work together and determine the success of the collaboration and thus, the desired action and outcome.

The first dynamic, principled engagement entails the quality of interactions between the involved participants. As each stakeholder brings its own set of values, knowledge, and ideas to the table, a shared sense of purpose or action must be established during within the collaboration (Ansell & Gash, 2008). Principled engagement can therefore be considered as the social learning process that concerns the synergy that is created over time (Daniels & Walker, 2001 in: Emerson et al., 2011). The happens by, for example, sharing individual interests and ideas, developing a shared purpose, using face-to-face dialogue to communicate, and reaching interim procedural and substantive decisions on innovations. Emerson et al. (2011) have recognised four process elements that determine the principled engagement: discovery, definition, deliberation, and determinations. Discovery refers to the identification of shared interests, concerns, and values that the participations reveal during the collaborative process. Definition concerns the process when the participants agree upon their (splintered) values, concepts, and terminology. By doing so, a common purpose and objective for the collaboration can be built. The quality of deliberation, the third element, is considered to be essential and requires effective communication, while listening to others and keeping other interests in mind. Determinations concern jointly agreements on procedural steps and actions to fulfil the common purpose. The quality of the interactive processes of discovery, definition, deliberation, and determination will mostly determine the performance of principled engagement (Emerson et al., 2011).

The second dynamic, shared motivation, entails the interpersonal dynamics between the collaborative partners, also referred to as social capital (Emerson et al., 2011). Once established, shared motivation accelerates the principled engagement. Shared motivation concerns, four aspects: trust, mutual understanding, legitimacy, and commitment. The former, trust, is a widely confirmed element in collaboration that evolves over time as parties work together and prove to each other to be dependable and reasonable partners. Trust enables people to go beyond their own frames of reference and is therefore an important element that motivates ongoing collaboration (Emerson et al., 2011). The second element, mutual understanding, involves the ability for the participants to understand and respect other's positions and interests even if that do not strike with their own interests (Ansell & Gash, 2008). Mutual understanding tends to generate a sense of legitimacy; the third element. Legitimacy concerns the validation and confirmation of the collaboration that stakeholders are involved in. It is valuable for the collaborative partner to validate that the cooperation is trustworthy and legitimate, as it reinforces the confidence in the collaboration. Legitimacy leads to a shared commitment, the fourth element. Commitment enables partners to commit to a shared process that crosses organisational and jurisdictional boundaries (Ansell & Gash, 2008.

Finally, capacity for joint action is a collaborative dynamic in Emerson's et al. (2011) framework that determines the Collaborative Governance Regime. The capacity for joint action characterizes the resources necessary to sustain the collaborative process and generate desired outcomes. Capacity building forms the basis for the group empowerment and serves "as the link between strategy and performance" (Saint-Onge and Armstrong, 2004, p. 19 in Emerson et al., 2011). The dynamics includes the following elements: procedural and institutional arrangements, leadership, knowledge, and resources. Procedural and institutional arrangements refer to the formal and informal supporting ground rules and regulation to make the collaboration work, as well as the organisational structure needed to manage interacting moments within the collaboration. Substantial leadership, functioning as the second element, is a highly appreciated aspect in collaborative governance that could fulfil multiple roles in different phases in the collaborative process. The third element, knowledge, tends to be in multiple ways an essential element in the collaborative processes. To start, as knowledge is becoming increasingly complex and distributed, the motivation to collaborate increases and thus, knowledge seems to be the catalyst of building a collaboration (Ansel and Gash, 2008). Also, within the collaboration, knowledge is expected to be shared as well as to be generated jointly. The final element of the capacity for joint action are the available resources, which is understanded in many ways. Adequate resources are considered to include budget, time, technical support administrative assistance, expertise, and power. Resource differences in-between stakeholders may affect the functioning of the collaboration (Emerson et al., 2011). As explained, the interaction and functioning of the three collaborative dynamics, principled engagement, shared motivation, and the capacity for joint action, determine the success of the Collaborative Governance Regime.

Action and outcome

The collaboration is meant to result in significant actions, that will eventually lead to a desired outcome (Douglas et al., 2020). Actions include narrow to broad goals that are set during the CGR by the collaborative partners. The goals are practical steps that should result in substantial outcome. In the HWBP program, the collaboration in the exploratory phase is expected to lead to the creation of a preferred alternative ('voorkeursalternatief') that entails a draft action plan for the reinforcement of the concerned dike. However, as the HWBP also aims to develop technical innovative solutions (HWBP, n.d.), this thesis studies how the collaborative process results in the generation of technical innovation. Thus, in this research, the desired outcome of the collaborative process is technical innovation.

2.2 Innovation

Since this research examines how collaborative conditions could influence technical innovation, the latter concept requires to be conceptualised. To indicate what technical innovation contains, a specification on innovation needs to be made first. The concept is complex and widespread discussed in literature; therefore, two important aspects will be discussed, partially proposed by Crossan and Apaydin (2009). First, innovation can either fulfil the role as a process or an outcome, or as Verwij et al. (2020) describe, a product. As outcome and product have the same meaning, both terminations will be used interchangeably. Crossan and Apaydin (2009) do mention that innovation as a process is not equally important as innovation as an outcome: “the role of innovation as an outcome is both necessary and sufficient for a successful exploitation of an idea, whereas that of innovation as a process is only necessary but not sufficient” (Crossan &Apaydin, 2009). As this research focusses on technical innovative solutions in FRM, the focus will probably be primarily on innovation as an outcome.

Second, other than the term might suggest at first instance, innovation contains more than the novelty aspect. Innovation can also be considered as added value to something already existing (Crossan & Apaydin, 2009). This characteristic of innovation entails a broad definition; yet, important is the distinction between ‘added value’ and ‘doing things differently’. The latter won’t be considered as innovation, since “it is practically impossible to do things identically” (Hansen and Wakonen, 1997 in Crossan & Apaydin, 2009, p. 1155). A process or an outcome needs to add value or contribute to something to be innovative (De Vries, Bekkers & Tummers, 2015). The Dutch Flood Protection Program (HWBP) uses the same terminology to define innovation in their Knowledge & Innovation Agenda (2019). The program considers not only the development of something new as innovation, but also the creation of added value. When the added value contributes to achieving the program’s objective, HWBP acknowledges it as innovation (Knowledge & Innovation Agenda, 2019).

Torfing (2019), nevertheless, emphasizes that innovation is more than a continuous improvement of existing practices: “innovation involves the development and implementation of new ideas that disrupt the common wisdom and habitual practices that hitherto dominated the solution context” (Torfing, 2019, p. 1). Given this definition, innovation disrupts and problematizes the established practices and changes how things usually were. This notion will be taken into account to a certain extent: by adding value, things will automatically change, but it does not necessarily need to problematize an earlier situation.

2.2.1 Technical innovation

As the concept of innovation is defined, a further clarification towards technical innovation can be drawn. Leiringer (2006) uses the definition by the OECD (1996), that illustrates technical innovation as “implemented technologically new products and processes and significant technological improvements in products and processes” (OECD, 1996 in: Leiringer, 2006, p. 303). Relevant in this definition is the specification on significant technological improvements. This ensues the characteristic of innovation being added value, whereas in technical innovation the added value refers to technological improvement. Verwij et al. (2020) as well make the specification on significant technological improvement and refer to technical innovation as technological product and process (TPP) innovations.

Crossan and Apayin (2009) distinguish technical innovation and administrative innovation, which reflect a general division between social structures and technology (Gopalakrishnan and Damanpour, 1997). Technical innovation includes “products, processes and technologies used to produce products or render services related to the basic of an activity of an organisation”

(Gopalakrishnan and Damanpour, 1997 in Crossan & Apaydin, 2009, p. 1168). Given this definition, Crossan & Apayin (2009) add that technology could also be the tool to produce innovation, as well as the final product.

Overall, technical innovation can be defined as: (1) a product or a process, (2) where technology refers either the added value itself, i.e., the significant technological improvement, (3) or the tool that creates it.

2.3 Collaborative governance and innovation

Literature seems to agree on the notion that cross-sector collaboration stimulates innovation (Roberts, 2000; Torfing et al., 2019; Torfing et al., 202020; Verweij et al., 2020). The involvement of multiple stakeholders tends to develop a more nuanced understanding of the problem, facilitates the exchange of knowledge and stimulates a diverse range of ideas, which will spur innovation (Torfing et al., 2020). Roberts (2000) compares hierarchal, competitive and collaborative strategies and concludes that multi-actor collaboration is the most effective governance mode considering the creation of innovative solutions (Torfing et al., 2019). The exchange of knowledge, competences and ideas in a collaborative process will influence the outcome of creative solutions. Furthermore, the collaborative process tends to disturb the established practices, a condition for innovation, according to Torfing et al. (2019). Collaborative working shows to increase efficiency and public-private partnerships (PPPs) seems to result in higher quality solutions in complex societal challenges (Verweij et al., 2020).

Verweij et al. (2020) add that the construction of a PPP drives creativity and innovation due to the less constrains that the private partner is normally restricted to, in comparison to the public partner. The involvement of a private partner tends to minimize risk in the PPP, which supposed to spur innovation. Lenferink et al. (2014) even argue that the involvement of the private sector in the early stage of projects is beneficial and strengthening for the project development. Because private sector parties are often bounded by cost savings and led by a business case incentive, private stakeholders tend to have a different perspective and possess an intrinsic motivation to use its creativity for the generation 'out of the box' solutions (Himmel & Siemiatycki, 2017; Lenferink, 2014). Therefore, early involvement of the private sector is more likely to generate innovation. However, Himmel and Siemiatycki (2017) specify that these innovations are rather clever ways of doing things than the creation of new technologies, as a result of the constant balance between affordability and return investments by the private sector.

Torfing et al. (2019) on the other hand, describe that the arguments on collaborative governance are often unfairly in favor of the private sector: "the public sector is much more innovative than its reputation" (2019, p. 2). Although diversity, disruption and tension between different views, generates creativity, it should not be overlooked that innovation is mostly the result of teamwork, based on a common ground. Communication, institutional design and good leadership are important drivers for the development of innovation, so do Torfing et al. (2019) argues. Douglas et al. (2020) built upon this notion and mention that the presence of a strong incentive for all partners to collaborate, is an essential aspect for the success and innovation of the partnership.

2.4 Dutch Flood Protection Programme (HWBP)

In 2017, the safety standards for flood protection in the Netherlands have been revised and incorporated in the Water Law (Avoyan & Meijerink, 2020; All-Risk, 2021a). The Dutch Flood Protection Programme (HWBP) therefore aims to reinforce the dike infrastructures across the Netherlands that do not meet the revised safety standards yet. Figure 2 illustrates the dike reinforcements projects. The HWBP is an alliance between regional water authorities and the Department of Public Works and Water Management (*Rijkswaterstaat*), based on shared responsibility and finance (Jorissen et al., 2016). The program functions as an umbrella program that coordinates and subsidises the different dike reinforcement projects, while the water authority is responsible for the reconstruction and maintenance of the dike (HWBP, 2019). A 'sober and functional' dike reconstruction is subsidised for 90% by the HWBP, the other 10% is covered by the water authority itself. The program's goal is to have reinforced among two-thirds of the current dike infrastructure to the new safety standards by 2050 but has also set additional goals: the program aims to enhance the cooperation between the water authorities and other stakeholders, and to initiate integrative solutions (Avoyan & Meijerink, 2020; Jorissen et al., 2016). The latter considers projects where flood protection is combined with other sectoral objectives, like spatial planning and nature development (Avoyan & Meijerink, 2020).

HWBP's aim to enhance its cross-sector collaboration process could be challenging, according to scholars (Avoyan & Meijerink, 2019). Dutch flood risk management (FRM) is historically a primary governmental task with only little interference from other sectors. Although the water sector aspires to engage other stakeholders, the Dutch FRM is still unisectoral and barely cooperative. In the cooperation that does exist, the water sector seems to be dominant, as water safety is treated to have priority (Avoyan & Meijerink, 2019). Since the HWBP contains large-scale infrastructure projects where flood protection is expected to be combined with other spatial objectives, a long-term collaboration between a diverse range of actors and organisations is inevitable. Given the size of the projects, stakeholders might be intensively working together for a couple of years, having to overcome different interests and stakes (All-Risk, 2021a).

The program is currently in an early phase of the development. After each project has been exploring potential solutions and designs, the projects have collaboratively agreed upon a preferred alternative with all involved stakeholders, that contains a probable plan on the restructuring of the concerned dike. Most projects are currently examining and elaborating the preferred alternative and developing a final design for the realisation of the dike reinforcement.

The HWBP is part of the Delta Programme, an overarching collaborative program between the national, water authorities and all regional and local governments across the Netherlands. Private sector parties such as businesses, NGOs and other organisations focus on water management are engaged in the program too (Rijkswaterstaat, 2021). The Delta Programme focusses on preventing the country from flooding, the providence of (future) fresh water and making the country more adaptative to climate change (Jorissen et al., 2016).

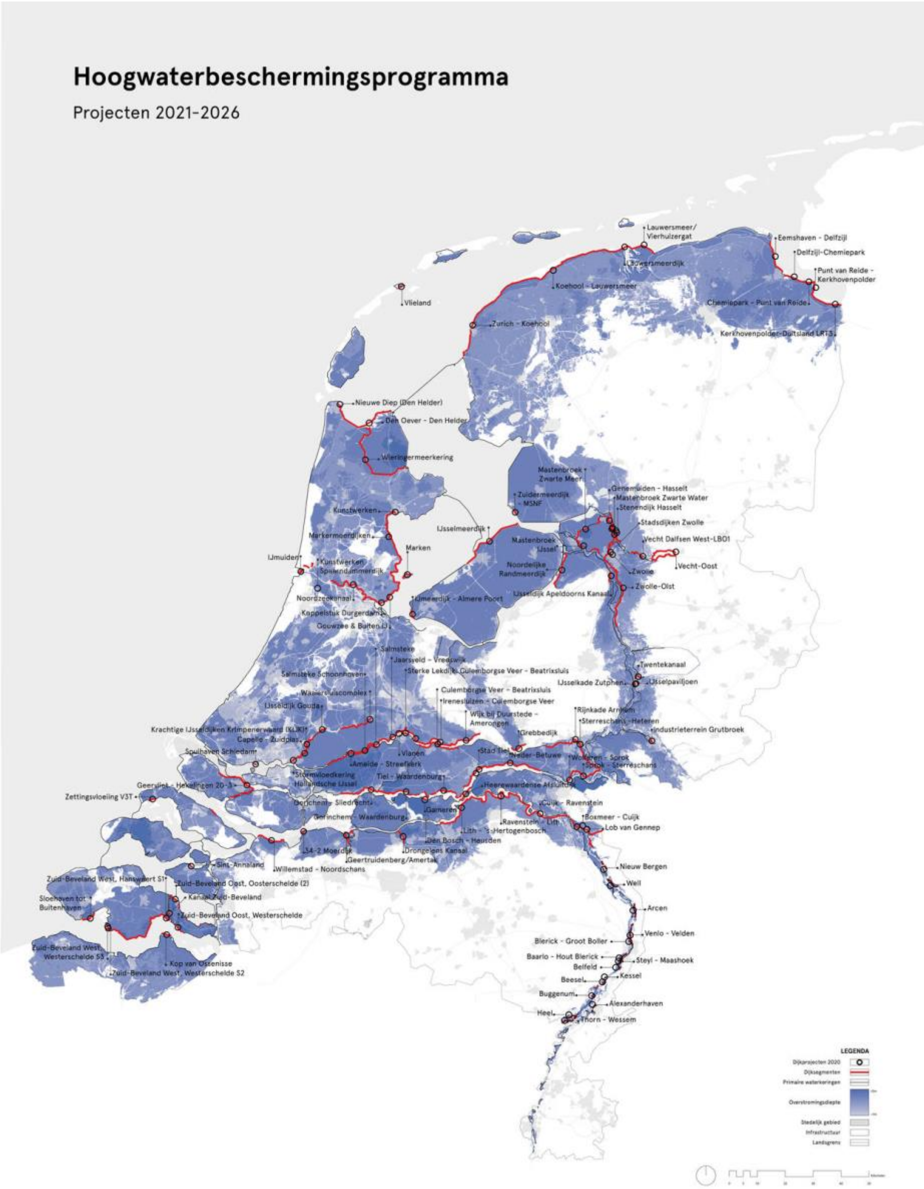

Figure 2: map of the HWBP dike reinforcement projects (HWBP, 2019).

2.5 Conceptual framework

The theories and concepts discussed in the theoretical chapter are visualised in the conceptual model in figure 3. The central of the model displays the three collaborative dynamics, which form the base of this research: principled engagement, shared motivation, and capacity for joint action. The three dynamics are, just as in the Integrative Framework for Collaborative Governance from Emerson, Nabatchi and Balogh (2011), illustrated as mobile interacting components. The collaborative dynamics situate within the Collaborative Governance Regime, that exists in the three-dimensional system context. The system context represents in this research the institutional setting of the Flood Protection Program (HWBP). As HWBP's institutional settings both initiate and regulate the dike reinforcement projects, it externally influences the functioning of the collaboration. Eventually, the CGR supposed to result in substantial actions which should, in this study, potentially lead to the creation of technical innovation. Here, technical innovation is referred to as either a process or a product.

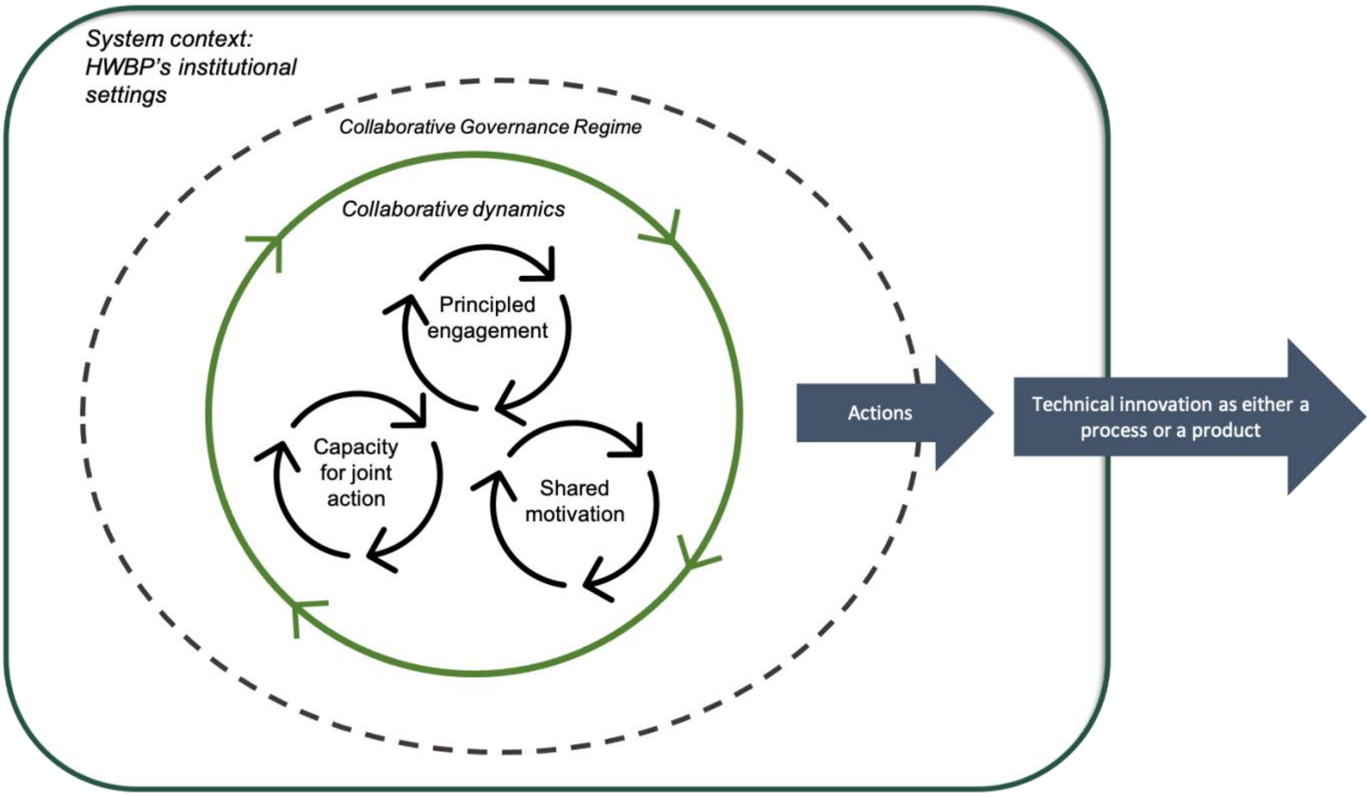

Figure 3: conceptual model.

3. METHODOLOGY

3. 1 Research strategy

This research employed a mixed methods research strategy, that used both quantitative and qualitative methods to answer the research question. Collecting and analysing quantitative and qualitative data within one study, provides an all-encompassing understanding of the researched issue (McKim, 2015). The mixed method approach is therefore an appropriate strategy for this study, as it aims to construct an inclusive insight of HWBP's collaborative process and the creation of technical innovation. The research was divided into two phases. First, the quantitative study was completed, that entailed a data analysis by running regression analyses in SPSS. The research contributed to answering the following sub-question:

- *Which collaborative dynamics and elements affect the development of technical innovative solutions in the HWBP projects?*

After analysing the collected data in SPSS, the qualitative research was performed, which entailed a single case study of the IJsselwerken Zwolle-Olst project. By analysing existing documents and conducting semi-structured interviews with involved stakeholders, the latter three sub-questions could be answered:

- *What is considered to be technical innovation and how was it developed in the IJsselwerken Zwolle-Olst project?*
- *Which collaborative conditions enabled or constrained the creation of technical innovations in the IJsselwerken Zwolle-Olst project?*
- *How did the institutional setting of the HWBP influence the process of generating and approving technical innovation?*

This chapter outlines a detailed understanding of the used methods, data collection and data analysis in the quantitative and qualitative studies. Both strategies will be described separately.

3.2 Quantitative study

3.2.1 Method and data collection

The first phase of this research contains a quantitative data analysis of an earlier conducted survey. The survey, composed by Avoyan (2020), is part of the All-Risk research projects and aims at improving the collaboration between water authorities, governmental organisations, NGOs, businesses, and citizens that are engaged in the HWBP dike reinforcement developments. By asking the respondents about their experiences in the collaborative process during the exploratory phase of the project, the survey investigates the effect of certain collaborative conditions. The respondents varying from involved employees at authorities or companies, to engaged citizens who participated in the projects. The survey addresses varying aspects of collaboration, such as the competences and behaviour of the involved participants, the available resources for the generation of collaboration, and further characteristics of the project. By doing so, the survey questions correspond to the collaborative dynamics and elements from Emerson's et al. (2011) Integrative Collaborative Governance Framework. Eventually, 98 respondents from 36 different HWBP projects have filled in the survey.

The gathered data was analysed in SPSS to run various linear regression analyses. Linear regression models are empirical models (Montgomery et al., 2021) that test whether the relation between a dependent and independent variable is linear (Van Thiel, 2014). In a positive linear regression, an increase of the independent variable will lead to an increase of the dependent variable. A linear regression analysis examines to which extent the independent variable is a relevant predictor for the dependent variable (Montgomery et al., 2021) and therefore shows which independent variables have significant effect (Van Thiel, 2014). By running regression analyses, it can thus be determined whether the collaborative conditions have influenced the development of technical innovation. By doing so, the following sub-question can be answered; *'Which collaborative conditions have effect on the generation of technical innovation in the HWBP projects?'*

3.2.2 Data analysis

According to the theoretical chapter, there is a wide variety of conditions within a collaborative process that might affect the performance of a proposed outcome (Douglas et al., 2020; Emerson et al., 2011). Which in this study is the generated technical innovation in the exploratory phase of the HWBP projects. As most survey questions match Emerson's et al. (2011) collaborative dynamics and conditions, the dynamics are used to analyse the data. Distributing fitting survey questions over all collaborative dynamics and elements, has allowed the researcher to operationalise collaboration within the dike projects and to examine which collaborative elements are determining factors in the process. This distribution has resulted in thirteen collaborative categories that are each indexed by related survey questions. The categorisation of questions according to the collaborative process elements is shown in table A in the appendix.

As previously stated, this study uses linear regression analyses to examine the effect of the independent variables, the collaborative conditions, on the dependent variable, technical innovation. The data from the dependent variable is extracted from one dichotomous question, that asks whether the respondent thinks technical innovative solutions are developed within the project. The two options, "yes" or "no", make the question binary in nature. Even though the data on the dependent variable is dichotomous, the data is not categorical, which is a requirement for using logistic regression analysis (Chao-Ying et al., 2002). In fact, answering "yes" to the question on whether technical innovation is generated in the project by one respondent, results in a higher average score on that project which makes the data continuous. Thus, despite of the dependent variable being binary, the variable is treated as continuous and therefore, a linear regression analysis is composed rather than a logistic regression analysis.

By generating a linear regression analysis, SPSS provides a R and R square value, both between 0 to 1. The R value indicates a simple correlation, meaning that the higher the value, the higher the degree of a correlation. R square illustrates how much of the total variation in the dependent variable, can be predicted by the independent variable (Montgomery et al., 2021). SPSS also produces a p-value, that tells us whether the measured analysis is significant. A p-value that is lower than alpha, when alpha is 0.050, is statistically significant (Chao-Ying et al., 2002). When the p-value indicates lower than 0.050, the null hypothesis – stating that there is no effect between the independent and dependent variable – is rejected, and it can thus be concluded that the stated correlation at R and R square is significant (Montgomery et al., 2021).

As discussed, the data is operationalised and analysed by using Emerson's et al. (2011). collaborative conditions: principled engagement, shared motivation, and capacity for joint action. Each condition contains four to five collaborative elements that exemplify the dynamic. The first two dynamics can be divided into the performance of both the authority officials and the project's participants that were involved in the project, as the survey asks its respondents to review both groups separately on the different collaborative elements. To build a more comprehensive understanding of the functioning of the latter collaborative dynamic, capacity for joint action, this dynamic is deconstructed into its separate collaborative elements and additionally, four extra elements are added: complexity, conflict management, manager, and spatial management. Complexity refers to the extent in which other spatial function apart from flood safety – such as recreation, nature, housing development – were at risk during the project. Conflict management applies to the way in which the collaborative parties were able to overcome conflicts and were provided with conflict resolution mechanisms. Manager concerns whether the assigned leader was both to connect different spatial functions and act independent and neutrally. Spatial management solely concerns whether the assigned leader was able to connect different spatial functions within the project. These four elements are studied additionally, as general literature suggests that through collaborations, parties are able to leverage various capacities such as knowledge, financial and human resources for common target goals (Bryson et al., 2015; Douglas et al., 2020). Moreover, during the quantitative analysis, the capacity for joint action turned out to be a substantial dynamic for the generation of technical innovation. Taking a deeper dive into the functioning of capacity for joint action's elements was thus a valuable and legitimate addition.

The following hypothesized statements are assessed by the quantitative data analysis:

- Hypothesis 1: Principled engagement is a substantial collaborative condition for the development of technical innovation in the exploratory phase of the HWBP dike reinforcement projects.
- Hypothesis 2: Shared motivation among collaborative parties is a substantial collaborative condition for the development of technical innovation in the exploratory phase of the HWBP dike reinforcement projects.
- Hypothesis 3: Capacity for joint action is a substantial collaborative condition for the development of technical innovation in the exploratory phase of the HWBP dike reinforcement projects.

3.2.3 Data presentation

Eventually, three different tables will be shown in the quantitative results chapter. For a better comprehension of the tables, the tables will briefly be elaborated.

The first table provides an overview of how each project's collaborative process and developed technical innovation was graded by their participants. As the projects being the units of analysis of this research, the overview gives insight in the functioning of the projects. Besides, the overview could be helpful for a case selection in the qualitative study. The overview consists of average scores for each collaborative condition and a percentage that represents the number of participants that think technical innovation was generated. For this table, the respondent's reactions were assigned to the HWBP projects they were involved in. Participants that were involved in the overall HWBP program, and thus did not belong to a certain project were left out, as well as respondents belonging to other than the 36 projects. Respondents from the 36 projects that have not answered the question on technical innovation, were automatically left out by SPSS as well.

An average score that a project acquired at a certain collaborative category was calculated for all 5-point Likert scale questions on collaboration, where *x* represents the number of answers given on that Likert scale and *y* represents the total answers given to that question by respondents from a certain project:

$$\text{Average score per process element per project} = \frac{1 * x + 2 * x + 3 * x + 4 * x + 5 * x}{y}$$

For the question concerning whether the respondent thinks the project has generated technical innovation, a similar formula is composed that calculates the average score that was given per project. *X* represents here the number of times participants answered "yes" to this question; *y* represents "no". The extent to which technical innovation was generated in each project, is regarded in percentages. Meaning that if all participants answered "yes" to the question the project scores a 100%, and equally, if all participants responded with "no", the total score will be 0%. The higher the average score, the more participants figured technical innovation was generated in their project.

$$\text{Average score on technical innovation per project} = \frac{\mathrm{x}}{\mathrm{x} + \mathrm{y}}$$

The second table demonstrated in the results chapter, presents overall regression analyses that considers all accumulated 36 HWBP projects. Here, the extent to which each specific collaborative condition effected the development of technical innovative solutions is examined. As a result, the table provides information on which collaborative conditions are significant for the generation of technical innovation in dike reinforcement projects. All collaborative dynamics and its elements, also the elements of principled engagement and shared motivation, are represented in this table to present an integral understanding of the working of all elements.

The third table displays a project-specific regression analysis. After gaining insight in the influence of the collaborative conditions on the generated technical innovation in all projects, it is interesting to understand the effect that the collaborative process had within each separate project. By providing information on the functioning of the different projects, this analysis could also be useful for the case selection in the qualitative study. In qualitative research, selecting a case is a considerate process that demands full information access (Van Thiel, 2014). Executing a project-specific regression analysis, enables the researcher to make an informed judgment based on the case's collaborative approach. In this project-specific analysis *N* is the number of respondents from the project that have filled in the survey. When only a limited number of respondents from a certain project answered the survey, the project's *N* is small. Running a regression analysis with a small *N*, could lead to an incorrect result where R, R square and the p-value are either 0.000 or 1.000, which is an impossible value. According to Darlington (1990) *N* should be at least 10, for the outcome to be correct. Therefore, projects with a respondent rate of lower than 10, will be excluded from the project-specific analysis. Thus, only cases with $N \geq 10$ are taken into consideration and presented in the table.

3.3 Qualitative study

3.3.1 Method and data collection

The second phase in this research entails a qualitative case study analysis. The case study contributes to this research by providing a comprehensive view on the collaborative process within one single HWBP dike reinforcement project: the IJsselwerken Zwolle-Olst project. A more in-depth approach allows to build a more detailed understanding of the collaborative governance and its potential effect on the generation of technical innovation. It therefore increases the confidence of the quantitative findings (O'Cathain, et al., 2007). The researcher reconstructed the collaborative process during the exploratory phase by (1) analysing documents and (2) conducting interviews. By doing so, a more detailed understanding can be composed of the functioning of collaborative conditions and its influence on the creation of technical innovation. Both the analysed documents and conducted interviews will systematically be evaluated by the method of process tracing. Process tracing is a fundamental method used in qualitative research, that inspects causal mechanisms in a process by 'backwards reasoning'. It systematically explores causal relationships between an independent variable and the outcome of the dependent variable. Process tracing is a with-in case methodology, appropriate to uncover the causal mechanism (George and Bennet, 2005 in: Tansey, 2007). Rather than identifying values of variables and measuring correlation, process tracing aims to understanding relevant influential factors that affect an outcome (Hall, 2013). By doing so, process tracing contributes to research objectives and can add leverage to quantitative research in small-*N* designs (Collier, 2011). Using this method for a reconstruction of the collaborative process is therefore a significant addition in this study.

By studying the causal mechanisms of the collaborative process, the qualitative study aims to determine which collaborative conditions played a significant role in the creation of technical innovative solutions within the IJsselwerken Zwolle-Olst case. It also intends to build a better understanding of how the project's participants define technical innovation, and to explore how HWBP's procedural setting enabled or constrained technical innovation.

Case study selection

After completing a quantitative data analysis, the research continues with a qualitative case study. Whereas the quantitative research analyses 36 projects, the qualitative study only explores one project. When selecting a case, several considerations must be made (Van Thiel, 2014). A first selection criteria was that the project should have a proper number of respondents who answered the survey. As discussed in the case study *N* should be at least ten, for a regression analysis to be valid (Darlington, 1990). Therefore, solely cases with ten or more reactions to the survey, were being considered for the case study. Taking that into account, only seven projects were left to consider for a case study analysis. Eventually, the IJsselwerken Zwolle-Olst dike project has been selected as a legitimate case for the case study analysis, for several reasons.

First, the collaborative process during the exploratory phase is reviewed quite well in the IJsselwerken Zwolle-Olst project. An average score of 4.1 was given by the twelve respondents on the overall collaborative process, which is a relatively high score. However, only 50% of the project's participants have expressed thinking that technical innovation was generated during the collaborative process. The other 50% has answered 'no' to the question on whether they think technical innovation was generated during the process. A rather contradictory result, given the stated correlation between cross-sector collaborative and innovation by several scholars (Roberts, 2000; Torfing et al., 2019; Torfing et al., 202020; Verweij et al., 2020).

Furthermore, such an evident discrepancy in opinions on the generated innovation is intriguing. What made that people think so different on whether technical innovation was generated in the project? Also, because of the high rated collaborative process and the segregated reviewed technical innovation, little correlation is detected in the quantitative data analysis. An in-depth case study is therefore an opportunity to gain insight in what other factors, other than the studied collaborative conditions, made that 50% of the participants think that innovation was generated? And what factors stood in the way of generating innovation?

Preliminary desk research on the project also reveals that the project had quite some obstacles in its way but that, enhancing water safety was the main and only goal (WDODelta, 2019). The outer dike is part of the Natura 2000 nature conservation area, where any spatial disturbance of the area is strictly restrained by European Law (Zisenis, 2017). Besides that, small settlements and 'objects with a protected status' are situated along the dike trajectory which were meant to not harm either (WDODelta, 2019). Logically thinking, these spatial implicated call for an urgency to develop innovative solutions to harm the surrounding areas as little as possible.

Moreover, the IJsselwerken Zwolle-Olst project is currently in farther stage than most other HWBP projects. Therefore, its participants might be better able to reflect on the collaborative process during the exploratory phase, than other projects who are currently still working on the preferred alternative. As the project is situated in a next phase, the information providence of the project is extensive, which is beneficial for the data collection as part of the document analysis. The project's website as well accommodates information on all its collaborative partners and project managers.

Additionally, there is specifically not chosen to use an extreme case for the case study analysis. Here, an extreme case would be a project where all participants thought that technical innovation either was or was not at all generated in the exploratory phase, thus scoring 100% or 0% on the survey analysis. Analysing an extreme case involves a risk of the analysis having straightforward results: when innovation was obviously or obviously not realised, nothing debatable can be found, which will both make the interviews and process reconstruction less compelling. The IJsselwerken Zwolle-Olst project possesses an evidential divide in opinions upon the generated technical innovation, which is an interesting starting point for further research.

Document analysis

To gain insight in the collaborative process prior to the drafting of the preferred alternative, all kinds of existing documents were examined. A document analysis is a form of empirical research, mostly used in combination with other qualitative methods to strengthen the knowledge base (Bowen, 2009; Van Thiel, 2014). A document analysis provides context and comprehension of a previous procedure (Bowen, 2009), assisting the researcher in developing a full understanding of the collaborative process. In this study, it identifies which parties were involved and which steps were taken along the collaborative process. The consulted documents were various reports of executed research and recaps of the process towards the drafting of the preferred alternative. The documents were either available on the water authority's website or were send to the researcher on request.

Interviews

As an addition to the document analysis, semi-structured interviews were conducted among the project's involved parties. The interviews are used to ascertain subjective responses on the interviewee's experiences of the collaborative process (Van Thiel, 2014). The research method of semi-structured interviewing is used because it both leaves room for flexibility, as well as it enables to compare the derived information since all respondents are asked more or less the same questions (McIntosh & Morse, 2015). As the quantitative study provided insight in the functioning the IJsselwerken Zwolle-Olst project, as well as the enabling and constraining collaborative conditions in all HWBP projects, the interview questions focused on specific topics that required additional information to answer the research question. An overview of the semi-structured questionnaire that was used during all interviews can be found in table B in the appendix.

The first interviewee, the project's stakeholder manager, was allocated by the WDODelta after the researcher contacted the water authority about this research. Subsequently, a snowball-sampling method was used (Weiss, 1995) as the researcher asked the stakeholder manager to recommend other potential interviewees. The method of snowball sampling is proven to promote and stimulate openness of the interviewees, as the researcher has been vouched for by a colleague (Small, 2009). Furthermore, the conducted surveys were consulted for additional interviewees to correct the risk of having solely interviewees that were proposed by the water authority itself, which might have led to a one-sided story. The gathered data from the conducted survey revealed whether the respondent judged that technical innovation was or was not generated during the project. Consulting this information allowed the researcher to interview participants with different perspectives on the topic of technical innovation. Additionally, the researcher aimed on interviewing participants from a diverse range of organisations to build an integral understanding of the collaborative process. Eventually, two representatives from three different collaborative partners and one program coordinator from the overarching HWBP were interviewed. Table 1 displays the interviewed respondents and their respondents' numbers which will be used in the quantitative results chapter.

Date of interview	**Collaborative position**	**Organisation**	**Function**	**Respondent nr.**
04/06/2021	Project team WDODelta	Drents Overijsselse Delta water authority (WDODelta)	Stakeholder manager	Interview 1
16/06/2021	Project team WDODelta	Drents Overijsselse Delta water authority (WDODelta)	Technical manager	Interview 2
24/06/2021	Omgevingsplatform	Institute for nature education (IVN)	Board member of IVN	Interview 3
09/06/2021	Omgevingsplatform	Landowner concerns	Chairman of the landowner concern	Interview 4
23/06/2021	Official advisory group	Department of Nature Reservations (Staatsbosbeheer)	Program manager delta nature	Interview 5
28/06/2021	Official advisory group	City of Zwolle	Program manager dike projects	Interview 6
25/06/2021	Flood Protection Program (HWBP)	Flood Protection Program (HWBP)	Program coordinator	Interview 7

Table 1: interviewed respondents

3.3.2 Data analysis

This research uses a theory-testing process tracing method. It studies the causal mechanisms of collaborative governance, specifically the causal mechanisms of collaborative dynamics, to understand whether the mechanism could explain the development of technical innovation in the exploratory phase of the dike project. Just like the quantitative part of this research, the process tracing analysis uses the collaborative dynamics and its corresponding elements of Emerson's et al. (2011) Integrative Framework for Collaborative Governance to examine the data. The supposed outcome of the process is, as the dependent variable, the generated technical innovation in the project.

The following hypothesized causal mechanisms are assessed:

- Hypothesis 1: Attaining functional principled engagement will lead to the development of technical innovation in the exploratory phase of the IJsselwerken Zwolle-Olst dike reinforcement.
- Hypothesis 2: Securing a shared motivation among collaborative parties will lead to the development of technical innovation in the exploratory phase of the IJsselwerken Zwolle-Olst dike reinforcement.
- Hypothesis 3: A sufficient range of capacities for joint action will lead to the development of technical innovation in the exploratory phase of the IJsselwerken Zwolle-Olst dike reinforcement.

The data extracted from the document analysis and conducted interviews were analysed to assess these causal mechanisms. Right after conducting the interview, the researcher jotted down the most important insights and transcribed the interview. After having transcribed all the interviews, the transcripts were re-read to get familiar with the data. Later, the data was coded and structured in Atlas.ti according to the collaborative conditions and additional essential information. The transcribed interviews are not included in the appendix but can be requested by the researcher. The results are presented by using active quotes of the interviewees (Moravcik, 2010), that either verify or reject the hypotheses.

To systematically assess whether, as hypothesized, the collaborative conditions led to the creation of technical innovation, the rules stated by Avoyan (2021) were used. Table 2, composed by Avoyan (2021), displays how the quality of each collaborative dynamic can be measured by the given rules.

Collaboration dynamics	**Elements**	**Qualities**	**Rule of assigning quality**
Principled engagement	1. Identification and examination of relevant to the collaboration information 2. Formation of shared meanings around the issues at hand and the collaboration 3. Open and inclusive deliberation over the issues at hand 4. Explicit agreements on common purpose and target goals procedures to be followed by the collaboration.	*Limited functionality* *Sufficient functionality* *High functionality*	One or two out of four elements observed Three out of four elements observed All four elements observed
Shared motivation	1. Building trust and mutual understanding 2. Developing sense of relational legitimacy as satisfaction with collaboration and beliefs about the worthiness of collaboration 3. Demonstrating commitment to the purpose of collaboration	*Limited shared motivation* *Sufficient shared motivation* *High shared motivation*	One out of three elements observed Two out of three elements observed All three elements observed
	1. Adopting procedural arrangements to govern the principled engagement and possible joint actions	*Limited range of CJAs*	One or two out of three elements observed

Capacity for joint action	2. Assigning leadership roles for the needs of collaboration 3. Generating knowledge for the collaboration 4. Acquire and share resources including logistical, human, financial to accomplish the collaboration's purpose	*Sufficient range of CJAs* *Wide range of CJAs*	Three out of four elements observed All four elements observed

Table 2. Rules of assigning the quality of the collaborative dynamics (Avoyan, 2021)

3.4 Reliability and validity

Two important criteria in research are the validity and reliability (Van Thiel, 2013). Validity concerns if the research measures what it is supposed to measure. Reliability questions whether a study and its results are repeatable (Bryman, 2012).

This research contains a mixed methods research strategy, which contributes to the overall validity (Bryman, 2012). Using both quantitative and qualitative methods will result in a deeper understanding of underlying dynamics of the causal relationship between collaborative conditions and the development of technical innovation, which favors the internal validity. Whether the results can be applied to other studies and thus contribute to the external validity, is questionable, due to potential external effects that influence the collaborative process in other ways than the conditions measured in the SPSS analysis. However, the qualitative case study gives the opportunity to also examine other collaborative conditions that are not studied in the quantitative analysis and will therefore increase the external validity.

As the first step in this research is a quantitative analysis using SPSS, it will enhance the reliability of the research if the analysis is well executed. Yet, since the second step contains a qualitative research method, the overall reliability could be challenging. Important is therefore to secure consistency in the interviews (Van Thiel, 2013).

4. QUANTITATIVE RESULTS

The quantitative analysis aims at exploring which collaborative conditions effect the creation of technical innovative solutions in the HWBP dike reinforcement projects. The conducted survey has provided data on several aspects of collaborative governance within the projects, as well as information on whether technical innovation was generated during the exploratory phases of the projects. This chapter will discuss three different tables that show the results of the SPSS analysis. The first table functions as an introductory overview of the data. The second two tables present the multiple executed regression analyses, that analyse the effect of the independent variables – the collaborative conditions – on the dependent variable: the generated technical innovation. Significant high R and R square values, represent an evidential correlation between the appointed collaborative condition and the generated technical innovation and thus, provide insight to answer the research question.

4.1 Overview

An overview of how the respondents have judged several aspects of the collaborative governance within their project, are displayed in table 3. On the scale between 1 to 5, where 5 reflects a positively rated collaborative process, the survey questions tick off different topics considering the collaborative conditions. The table also provides information on the percentage of the project's participants that think technical innovative solutions are generated within their project. Overall, most HWBP projects contain a relatively highly reviewed collaborative process. Within 15 of the 36 projects, all participants agreed on the notion that technical innovation was developed within their project.

Project	**Nr of participants**	**Principled Engagement**	**Shared motivation**	**Capacity for joint action**	**Innovation generated**
Grebbedijk	12	4,1	4,0	4,5	89%
Sterke Lekdijk	12	3,9	4,1	4,1	100%
IJsselwerken Zwolle-Olst	12	4,0	4,2	4,0	50%
Tiel-Waardenburg	14	3,6	3,7	3,9	50%
Meanderende Maas/ Ravenstein-Lith	13	4,5	4,5	4,5	67%
Markermeerdijken	13	4,1	4,1	4,3	75%
Stadsdijken Zwolle	7	4,0	4,3	3,9	0%
Veilige Vecht	3	3,5	3,6	4,1	0%
Noordelijke Randmeerdijk	7	3,7	3,7	3,7	67%
Dijkversterking Hansweert	4	3,5	3,6	3,2	67%
Krachtige IJsseldijken Krimpenerwaard	6	3,6	3,5	4,2	100%
Rijnkade Arnhem	5	4,3	4,1	4,3	33%
Houtribdijk	2	4,2	3,9	4,2	100%
Lauwersmeerdijk-Vierhuizergat	8	4,0	4,2	4,3	100%

IJsseldijk Apeldoorns Kanaal	4	4,1	3,6	3,9	33%
Arcen Well Nieuw Bergen	4	3,9	3,2	4,2	100%
Ringdijk Watergraafsmeer JLD ankers	2	4,4	3,7	4,5	100%
Koehool Lauwersmeer	9	3,7	4,1	4,2	67%
Stenendijk Hasselt	1	5,0	5,0	4,6	100%
Havendijk Den Oever	3	4,1	4,0	4,4	100%
NRD versterking kunstwerken	2	3,8	4,0	4,0	0%
Lob van Gennep	2	4,3	4,2	4,2	100%
IJsselmeerdijk	3	4,1	4,5	4,6	100%
Gestuurde kustverdediging	2	2,6	2,7	2,4	0%
Gestuurde kustverdediging	1	.	.	.	0%
Wolferen – Sprok	6	3,7	3,6	4,0	100%
Vlieland	2	4,7	5,0	.	0%
IJsselkade RfR	1	4,0	4,9	4,0	0%
Spijk-Westervoort	3	3,7	4,0	3,7	0%
Ooijen-Wanssum	1	4,3	4,7	3,7	100%
Dubbele Dijkproject	1	4,2	4,6	4,7	100%
Dubbele Dijkproject	1	1,4	1,1	.	100%
Durgerdam, Brede Groene dijk	2	3,1	3,5	3,9	50%
Neder-Betuwe	5	3,9	4,3	3,7	50%
Vianen	3	3,5	3,5	3,6	0%
Gorinchem - Waardenburg	12	3,9	3,9	4,2	100%

Table 3: overview survey results

4.2 Regression analyses

Table 4 illustrates the overall regression analyses for all collaborative conditions, crossing all 36 HWBP projects. As elaborated in the methodology chapter, this table considers all collaborative conditions by Emerson et al. (2011), including the collaborative elements from principled engagement and shared motivation, to present an integral understanding of all elements.

The table reveals that five collaborative conditions show significance: capacity for joint action, knowledge, internal leadership, external leadership, and spatial management. As discussed, if the p-value is lower than alpha, when alpha is 0.05, the stated correlation at R and R square is significant. The five collaborative conditions are all far below alpha, which reflects a strong correlation between the independent and dependent variable. The appointed significant collaborative conditions demonstrate relatively high R and R square values, meaning that an evident portion of the generated innovation, is predicted by these collaborative conditions.

Across all HWBP projects, the capacity for joint action, knowledge, internal and external leadership, and spatial management, were all substantial conditions for the creation of technical innovative solutions. It could thus be argued that an increased performance of one of these collaborative conditions will probably increase the development of technical innovation.

Collaborative conditions	**R**	**R square**	**Sig.**
Principled Engagement	0.121	0.015	0.488
Discovery	0.144	0.021	0.409
Definition	0.225	0.050	0.195
Deliberation	0.018	0.000	0.917
Determination	0.072	0.005	0.681
Shared motivation	0.048	0.002	0.784
Trust	0.058	0.003	0.742
Mutual understanding	0.012	0.000	0.946
Internal legitimacy	0.030	0.001	0.863
Commitment	0.150	0.023	0.388
Capacity for joint action	0.547	0.299	**0.001 *****
Procedural arrangements	0.264	0.070	0.131
Knowledge	0.551	0.303	**0.001 *****
Resource	0.157	0.025	0.367
Leadership: internal	0.551	0.304	**0.001 *****
Leadership: external	0.455	0.207	**0.006 ****
Manager	0.190	0.036	0.289
Spatial management	0.365	0.133	**0.037 ***
Complexity	0.066	0.004	0.715
Conflict management	0.014	0.000	0.937

N=36 *p <0.05. **p<0.01. ***p<0.001

Table 4: regression analyses across 36 HWBP projects.

4.3 Project-specific regression analyses

Table 5 displays the regression analyses executed for each HWBP project specifically. As scholars suggest that *N* should be at least ten for the regression analysis to be valid (Darlington, 1990), multiple projects are excluded from this table. Only from seven projects with more than ten participants have filled in the survey (Avoyan, 2020), are presented: Grebbendijk, Sterke Lekdijk, IJsselwerken Zwolle-Olst, Tiel-Waardenburg, Meanderende Maas/Ravenstein-Lith, Markermeerdijken, Gorichem-Waardenburg. Although the *N* at all projects is higher than ten, the *N* is still small, meaning that the chance on significance as well as the replicability and power of the analysis is limited. The following results will therefore not be used for the overall evaluation on collaborative conditions' effects but are rather an indication on the projects' functioning and are helpful to sample a project for the case study.

Again, a p-value lower than 0.05 illustrates that the appointed collaborative condition had a significant effect on the development of technical innovation within that project. This section will discuss the project-specific analysis results. First, neither the authorities' nor the participants' principled engagement show significance at any of the projects. Meaning that this collaborative condition was not a substantial element in the generation of technical innovation within each HWBP project. The collaborative dynamic of shared motivation for participants does contain a significant correlation at the Sterke Lekdijk project. A relatively strong correlation is detected too: a R square value of 0.756. The capacity for joint action collaborative dynamic shows no significance, although a high R and R square value is present at two projects. The procedural arrangements turned out to be meaningful for the creation of technical innovation within two projects; a significant correlation is detected in the Sterke Lekdijk and Meanderende Maas/Ravenstein-Lith project. Neither the collaborative conditions of knowledge or resources, present a significant relationship and thus did not turned out to be crucial in the creation of technical innovative solutions. The condition of internal leadership shows significance in the Sterke Lekdijk project. External leadership entails no significant relationship in any of the projects. The performance of management was compelling in the Meanderende Maas/ Ravenstein-Lith project and the manager's ability to connect different spatial functions was important for the generation of technical innovative solutions at the Sterke Lekdijk and Meanderende Maas/ Ravenstein-Lith. A significant correlation between the complexity and the created technical innovation is detected within the IJsselwerken Zwolle-Olst and the Meanderende Maas/Ravenstein-Lith. Complexity here reflects the number of functions that, apart from the water safety, were at stake within the project. The way conflicts were management turned out to be important for the development of technical innovation within one project, as significance is detected at the Markermeerdijken.

			Principled engagement participants			**Principled engagement authorities**		
Project ID	Project	*N*	R	R square	Sig	R	R square	Sig
1	Grebbedijk	12	0.410	0.0168	0.273	0.358	0.128	0.343
2	Sterke Lekdijk	12	0.400	0.160	0.432	0.303	0.092	0.560
3	IJsselwerken Zwolle-Olst	12	0.181	0.033	0.667	0.141	0.020	0.739
4	Tiel-Waardenburg	14	0.293	0.086	0.574	0.371	0.137	0.470
5	Meanderende Maas/ Ravenstein-Lith	13	0.387	0.149	0.304	0.240	0.058	0.533
6	Markermeerdijken	13	0.577	0.333	0.423	0.656	0.430	0.344
36	Gorinchem - Waardenburg	12	0.574	0.329	0.426	0.406	0.165	0.594

			Shared motivation participants			**Shared motivation authorities**		
Project ID	Project	*N*	R	R square	Sig	R	R square	Sig
1	Grebbedijk	12	0.217	0.047	0.574	0.468	0.219	0.204
2	Sterke Lekdijk	12	0.870	0.756	**0.024***	0.095	0.009	0.858
3	IJsselwerken Zwolle-Olst	12	0.105	0.011	0.805	0.069	0.005	0.871
4	Tiel-Waardenburg	14	0.170	0.029	0.748	0.303	0.092	0.560
5	Meanderende Maas/ Ravenstein-Lith	13	0.289	0.083	0.451	0.257	0.066	0.504
6	Markermeerdijken	13	0.522	0.273	0.478	0.422	0.178	0.578
36	Gorinchem - Waardenburg	12	0.889	0.791	0.111	0.440	0.194	0.560

			Capacity for joint action			Procedural arrangements		
Project ID	Project	*N*	R	R square	Sig	R	R square	Sig
1	Grebbedijk	12	0.449	0.202	0.225	0.575	0.331	0.105
2	Sterke Lekdijk	12	0.806	0.650	0.053	0.935	0.875	**0.006 ****
3	IJsselwerken Zwolle-Olst	12	0.374	0.140	0.361	0.452	0.205	0.261
4	Tiel-Waardenburg	14	0.629	0.395	0.256	0.738	0.545	0.094
5	Meanderende Maas/ Ravenstein-Lith	13	0.660	0.435	0.053	0.853	0.727	**0.003 ****
6	Markermeerdijken	13	0.135	0.018	0.865	0.562	0.316	0.438
36	Gorinchem - Waardenburg	12	0.525	0.275	0.475	0.683	0.467	0.317

			Knowledge			Resources		
Project ID	Project	*N*	R	R square	Sig	R	R square	Sig
1	Grebbedijk	12	0.184	0.034	0.635	0.354	0.125	0.351
2	Sterke Lekdijk	12	0.808	0.652	0.052	0.070	0.005	0.895
3	IJsselwerken Zwolle-Olst	12	0.229	0.053	0.585	0.425	0.181	0.294
4	Tiel-Waardenburg	14	0.447	0.200	0.374	0.421	0.178	0.480
5	Meanderende Maas/ Ravenstein-Lith	13	0.612	0.375	0.080	0.378	0.143	0.316
6	Markermeerdijken	13	0.333	0.111	0.667	0.333	0.111	0.667
36	Gorinchem - Waardenburg	12	0.577	0.333	0.423	0.333	0.111	0.667

			Internal leadership			External leadership		
Project ID	Project	*N*	R	R square	Sig	R	R square	Sig
1	Grebbedijk	12	0.607	0.369	0.083	0.335	0.113	0.378
2	Sterke Lekdijk	12	0.930	0.864	**0.007 ****	0.337	0.114	0.514
3	IJsselwerken Zwolle-Olst	12	0.068	0.005	0.873	0.141	0.020	0.740
4	Tiel-Waardenburg	14	0.196	0.038	0.710	0.083	0.007	0.876
5	Meanderende Maas/ Ravenstein-Lith	13	0.460	0.211	0.213	0.428	0.183	0.251
6	Markermeerdijken	13	0.566	0.320	0.434	0.192	0.037	0.808
36	Gorinchem - Waardenburg	12	0.420	0.176	0.580	0.309	0.095	0.691

			Manager			Spatial management		
Project ID	Project	*N*	R	R square	Sig	R	R square	Sig
1	Grebbedijk	12	0.316	0.100	0.407	0.661	0.437	0.052
2	Sterke Lekdijk	12	0.000	0.000	1.000	0.878	0.771	**0.021 ***
3	IJsselwerken Zwolle-Olst	12	0.378	0.143	0.356	0.516	0.267	0.190
4	Tiel-Waardenburg	14	0.522	0.273	0.288	0.560	0.314	0.326
5	Meanderende Maas/ Ravenstein-Lith	13	0.707	0.500	**0.033 ***	0.756	0.571	**0.018 ***
6	Markermeerdijken	13	0.683	0.467	0.317	0.522	0.273	0.478

36	Gorinchem - Waardenburg	12	0.471	0.222	0.529	0.333	0.111	0.667

			Complexity			**Conflict management**		
Project ID	Project	*N*	R	R square	Sig	R	R square	Sig
1	Grebbedijk	12	0.417	0.174	0.265	0.447	0.200	0.227
2	Sterke Lekdijk	12	0.217	0.047	0.680	0.387	0.150	0.448
3	IJsselwerken Zwolle-Olst	12	0.664	0.441	0.072	0.243	0.059	0.562
4	Tiel-Waardenburg	14	0.272	0.074	0.602	0.302	0.091	0.561
5	Meanderende Maas/ Ravenstein-Lith	13	0.742	0.550	**0.022 ***	0.455	0.207	0.219
6	Markermeerdijken	13	0.522	0.273	0.478	0.951	0.901	**0.049 ****
36	Gorinchem - Waardenburg	12	0.333	0.111	0.667	0.258	0.067	0.742

**p* <0.05. ***p*<0.01. ****p*<0.001

Table 5: regression analyses executed for the HWBP projects with a *N* larger than ten.

4.4 Evaluation

After having analysed the different collaborative conditions and their potential effect on the generation of technical innovation, a final evaluation should be made to answer the sub-question. To indicate which collaborative conditions, tend to be valuable conditions for the generation of technical innovation, the regression analysis that considers all HWBP projects will be used. The researcher has decided that a collaborative condition is effective for the development of technical innovation, when: a condition is significant and has a R value larger than 0.500. Looking at table 4, it turns out that three collaborative conditions are effective. The conditions, placed in order of a high R value, are: capacity for joint action, knowledge and internal leadership. It should be mentioned that the conditions spatial management and external leadership entail a significant correlation too. However, since both conditions contain a R value lower than 0.500 (0.455 and 0.365), the conditions cannot fully be considered as valuable indicators for the generation of technical innovation.

By this evaluation, the sub-questions can be answered: *'Which collaborative conditions have effect on the generation of technical innovation in the HWBP projects?'*. After having executed multiple regression analyses it can be concluded that capacity for joint action (including the elements of procedural arrangements, knowledge, resources, and leadership) is a significant collaborative dynamic for the creation of technical innovation. Looking further in the collaborative elements, the analysis reveals that knowledge and internal leadership appear to be more important for the generation of technical innovative solutions, than procedural arrangements and resources.

5. QUALITATIVE RESULTS

The qualitative study aims at constructing a deeper understanding of the collaborative governance during the exploratory phase of the IJsselwerken Zwolle-Olst project. An extensive document analysis and seven conducted interviews with different involved collaborative partners, have led to a reconstruction of the collaborative process. Using a process tracing method, has been helpful in uncovering causal mechanisms between the collaborative conditions and the creation technical innovation in the exploratory phase. As the quantitative study has discovered that the performance and availability of capacity for joint action, knowledge and internal leadership are significant conditions within the collaborative governance of the HWBP projects, an emphasis will be laid upon these conditions in this chapter. Furthermore, this chapter seeks to gain an encompassing understanding on how the project's participants define technical innovation, and to explore on how HWBP's institutional setting has enabled or constrained the generation of technical innovation.

5.1 Case introduction

The IJsselwerken is one of the many dikes in the Netherlands that protect the country from flooding. The IJsselwerken is a dike that stretches from Zwolle to Olst, a 29 kilometres long trajectory located in the Eastern part of The Netherlands. The dike protects Salland's inhabitants from water arising from the IJssel River (*IJsselrivier*) and the Lake IJssel (*IJsselmeer*). The trajectory alternates along rural areas and build environments, with a diverse range of ecological, environmental, and cultural-historical values. The IJsselwerken dike functions as the border between the outer dike riverine landscape and inner dike hinterlands and covers the N337 provincial road on the majority of the trajectory. The riverine landscape is featured with floodplains, that are now part of the nature conversation areas in the Netherlands under the European Natura 2000 policies (WDODelta, 2019). The dike protects its inner hinterlands from the IJssel River, which arises from the Rhine River (*Rijn)* and flows northwards and eventually, discharges in the Lake IJssel. The dike hinterland is characterized by rural areas, villages, smaller settlements, and nature estates.

The safety test executed in 2016, has demonstrated that the vast majority of the dike trajectory is not meeting the new safety requirements that were installed in 2017 according to the Water Law (WDODelta, 2016). The new safety standards do not only consider the risk of flooding but also take account of the consequences for the surrounding areas in case of flooding (Witteveen+Bos, 2018a). The extent of the consequences determines the safety norm for the appointed dike. Only 500 meters of the 28.9 kilometres dike trajectory of the IJsseldijk is solid enough, which means the other 28.4 kilometres need to be reinforced. The dike is therefore submitted to the national Flood Protection Program (HWBP) that aims to restore all dikes in the Netherlands that do not meet the revised safety standards. The IJsselwerken Zwolle-Ost reinforcement project is executed by the water authority of the Drents Overijssel Delta (WDODelta), which has the ambitions to strengthen the dike to meet current, as well as future safety standards.

The safety test demonstrated that the upper cover across the complete trajectory is not solid enough. The upper cover, that consists of mostly grass, has been damaged due to waves or storm that have partially eroded the construction. Other parts of the trajectory are dealing with piping, which occurs when water runs under or through the dike construction with high tide, instability of the construction and/or a height deficit of the dike. These four 'failing mechanisms' are situated on different parts of the dike trajectory, visualised in figure 4 on the map. As the replacement of the upper cover applies to the complete trajectory, this is not displayed on the map. Figure 5 is a visualisation of the four failing mechanisms.

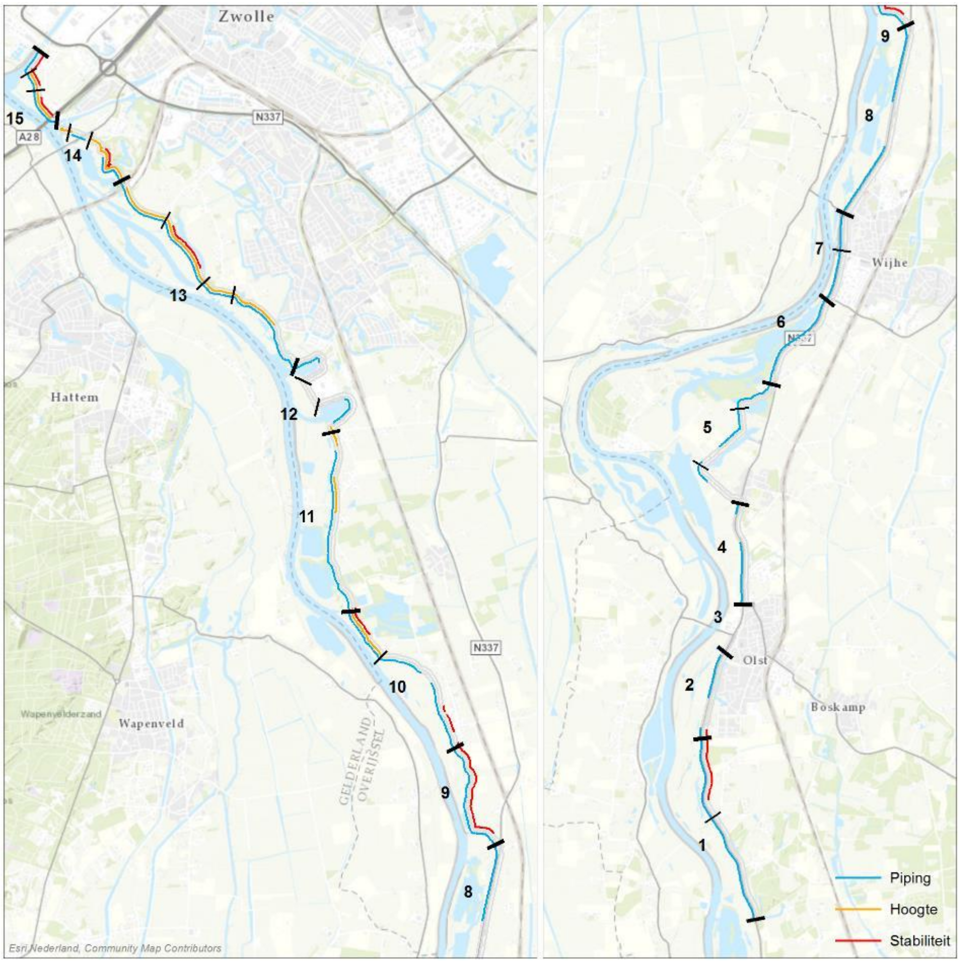

Figure 4: subprojects of the dike trajectory (WDODelta, 2019)

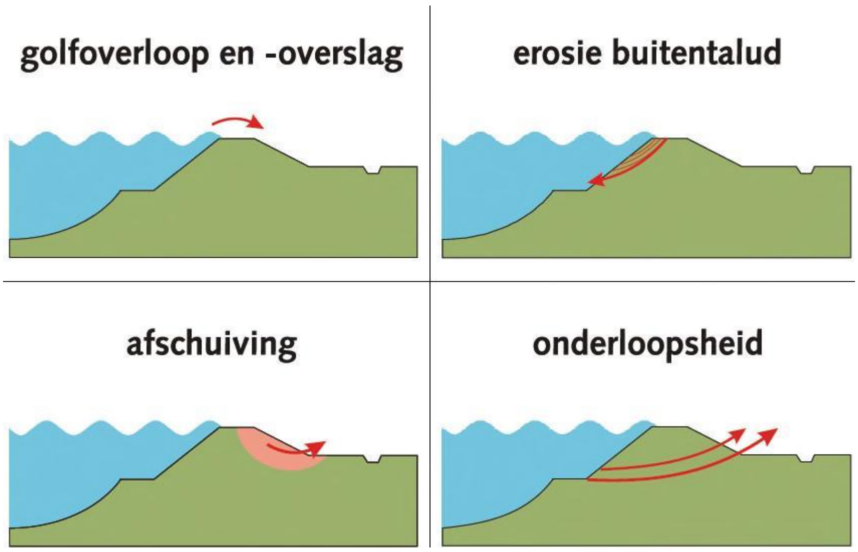

Figure 5: failing mechanisms of the IJsseldijk (WDODelta, 2019)

To secure that the dike will meet future safety standards, the IJsselwerken Zwolle-Ost project started off in 2017 with an exploration towards a solution for the flood safety challenge. All projects under the umbrella HWBP program are developing in three phases: an exploration phase, an elaboration phase and the execution of the final plan. The exploration phase examines different alternative solutions for the dike reinforcement. The alternatives are reviewed on the technique, impact on the surrounded areas and costs, and are discussed with involved stakeholders and surrounded residents. The exploration phase ends with the determination of one preferred alternative (*voorkeursalternatief*) that will further be research in the next phase. An elaborated reconstruction of the complete process towards the determination of the preferred alternative will be discussed in the next section.

The dike trajectory is divided into 15 components, in which a couple are additionally disentangled after the elaboration of potential alternatives. This leaves the projects into having 29 subprojects, that are demarcated by physical and environmental features, natural municipal borders and results from the safety test. Figure 6 is a map of the project area and its subprojects.

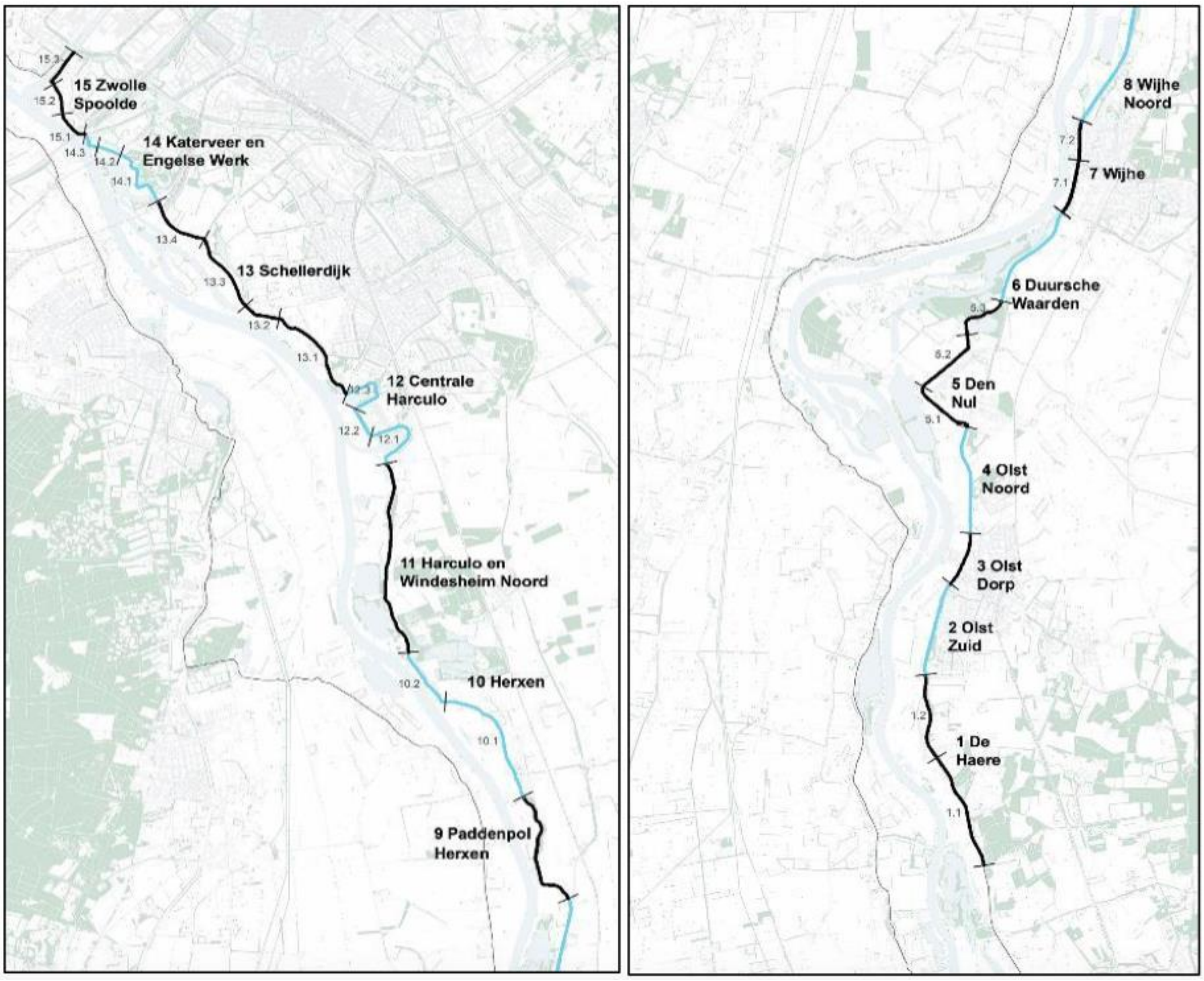

Figure 6: project area IJsselwerken Zwolle-Olst (WDODelta, 2019).

The composed preferred alternative, that was established by the end of 2019, is visualised in figure 7. Here, 23 of the 29 subprojects consist of an inner dike reinforcement with a vertical piping solution. By this, the reconstruction limits the consequences for the surrounded environment and other inner dike values and at the same time, prevents the river to propel. None of the surrounding homes are being harmed in this design. The other 6 subprojects will undergo an outer dike reconstruction in order to prevent damage to surrounded houses and cultural-historical heritage located at the inner landscape. Additionally, in the northern part of the trajectory, the dike will be heightened to protect the hinterlands from flooding.

Important is to mention that the preferred alternative is limited in harming its surrounded environments: the reinforcement is as much as possible kept outside the Nature 2000 areas and there is no propel of the river in order to prevent the current to change. Because of spatial measurements and the continue inner dike construction that is executed in the major part of the project, will the spatial quality and eventual look of the landscape not be reduced by the reinforcement.

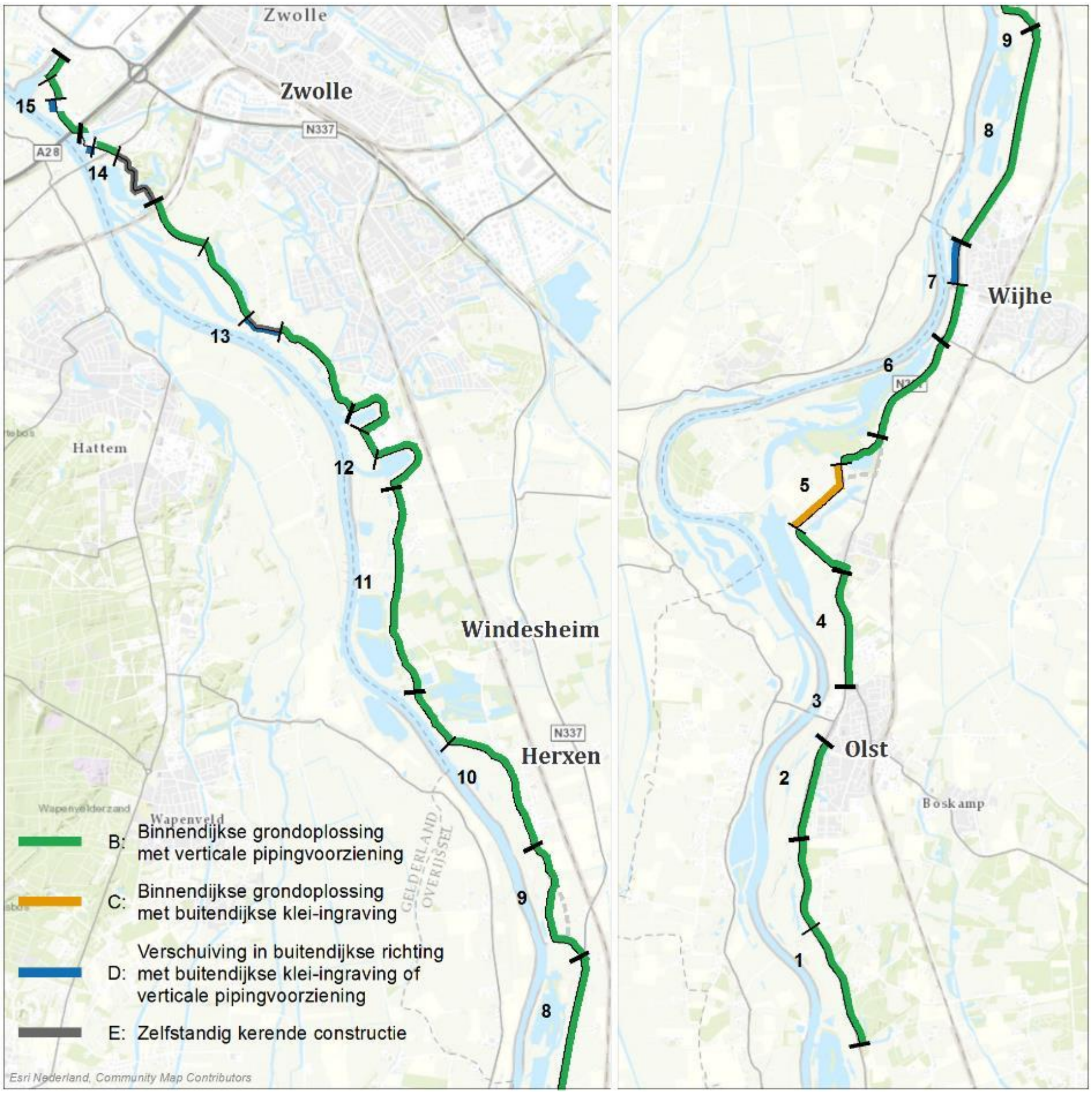

Figure 7: preferred alternatives for each subproject of the dike trajectory (WDODelta, 2019).

5.2 Collaborative process reconstruction

As discussed, the dike reinforcement project is divided into three phases, in which the first phase, the exploratory phase, will be studied in this research. The exploration phase started off in 2017 and ended by the end of 2019, when the goal of the phase was reached: the determination of the preferred alternative. In the two years that passed, the Drents Overijsselse Delta water authority (WDODelta) researched several optional dike reinforcements by their feasibility, according to a step-by-step procedure using a funnel method (figure 8). The exploration process could be divided into two stages: the first stage resulted in the proposal of several promising alternatives and by the end of the second stage, the draft preferred alternative was developed (WDODelta, 2019). A detailed reconstruction of the collaborative process will be discussed in this section, followed by an analysis on how the collaborative process affected the development of technical innovation

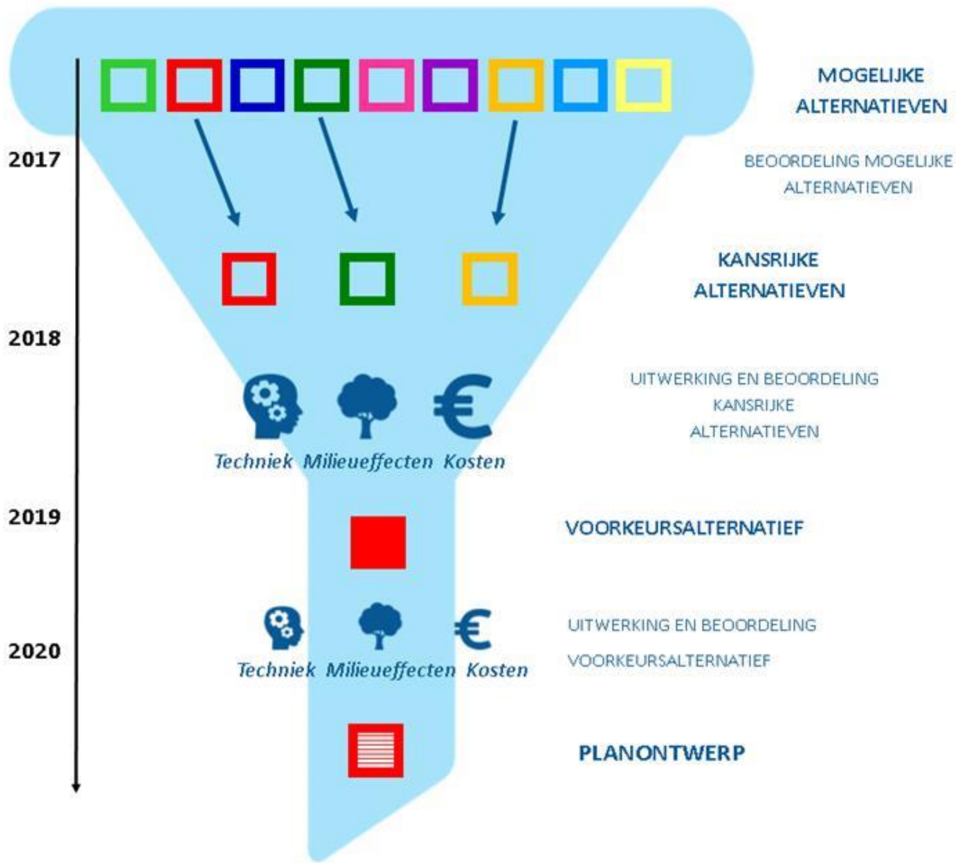

Figure 8: WDODelta's process towards the preferred alternative (WDODelta, 2019).

5.2.1 Governance

Multiple parties were involved in several meetings, design sessions and informal conservation along the exploratory process. Considering the new Dutch Environment and Planning Act, that highly values participation, the water authority established an engaged process that implicated several stakeholders (Gierveld, 2019; Delta Programme, 2018, p. 70). The water authority aspired to conduct a transparent process, to build a solid foundation for the preferred alternative. This was accomplished by demonstrating how all interests were being considered and increasing the amount of room for solutions by collaborating with partners (Govenance Dijkversterking IJsselijk Zwolle-Olst, n.d.).

A governance structure was determined by the start of the exploration phase, in which the different roles of parties and internal departments were established (interview 1 & 4; WDODelta, n.d.). The water authority's project team, which serves as the project's core, consisted of five managers with each their own field of expertise: a project manager, contract manager, technical manager, asset manager and stakeholder manager (IJsselwerken, 2021e). To increase the project's transparency and support base, the project team engages directly with the 'Dijkdenkers' and landowners, residents, and business located in the surrounding area. The Dijkdenkers is a group of residents, landowners and other people that are interested in the project and liked to actively be involved (IJsselwerken, 2021a). Here, the Dijkdenkers were asked to think along with certain issues and function as a sounding board for the project's process and matters. The landowners, residents and involved businesses were engaged during several participation meetings. When stakeholders desired, individual attention was offered (interview 1). Other than the Dijkdenkers who think along with the project team, the landowners, residents, and businesses were solely being informed by the water authority

The project team advises and reports the official advisory group, in which civil servants from several administrative partners were represented in. The administrative partners are: the municipality of Zwolle, the municipality of Olst-Wijne, the province of Overijssel, the Department of Public Works and Water Management (*Rijkswaterstaat*) and the Department of Nature Reserves (*Staatsbosbeheer*) (WDODelta, 2019). The official advisory group reports and prepares the administrative advisory group, where administers from the discussed administrative partners are assembled in (interview 5 & 6). The official advisory group is also advised by the 'Omgevingsplatform'. The Omgevingsplatform is a platform where different interests groups, such as nature, agriculture, recreation, and cultural-historical concerns, are represented in (WDODelta, n.d.). Representatives from the several villages located along the dike's trajectory were also involved in the Omgevingsplatform. The platform also advices the water authority's project team directly on their matters of interest.

Both the official advisory group and the project team advise the water authority's executive committee on the proposal for the promising alternatives and preferred alternative. Eventually, the executive committee determined the proposal of the promising alternatives at the end of the first stage, and the board of directors determined the preferred alternatives by the end of the exploratory phase.

Figure 9 visualises the governance structure of the project, in which the following parties were involved in the drafting of the preferred alternative, led by the water authority's project team: the Dijkdenkers, Omgevingsplatform, official advisory group, administrative advisory group, the water authority's executive committee and board of directors.

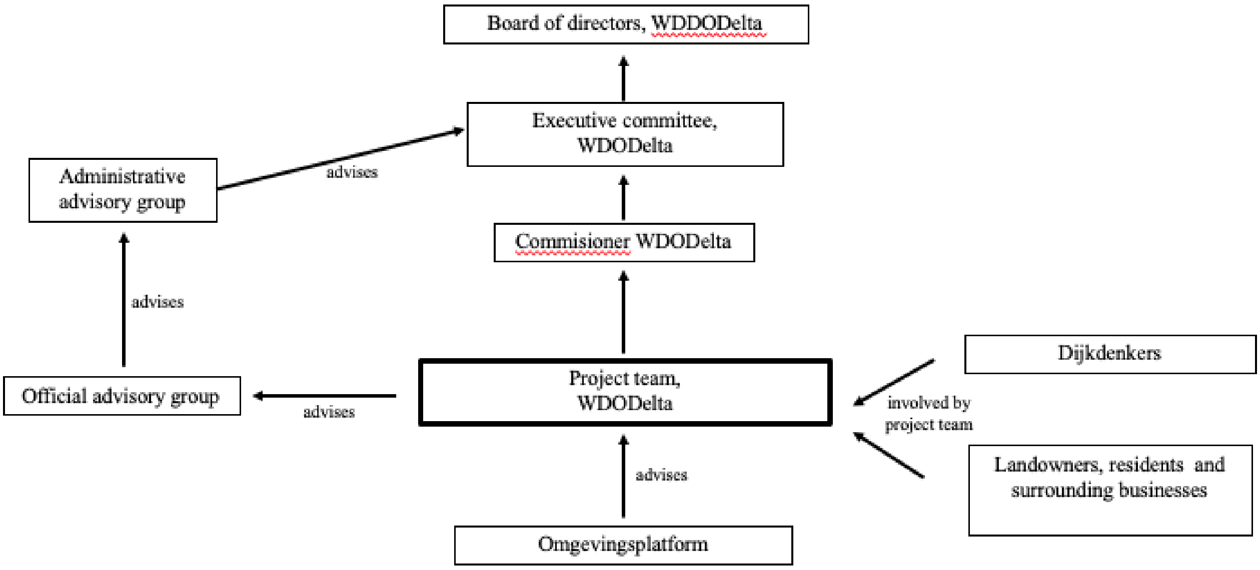

Figure 9: Governance structure dike reinforcement IJsselwerken Zwolle-Olst, WDODelta (own work)

5.2.2 Towards the promising alternatives

In the beginning of 2017, the first stage of the exploration phase starting off and the project team of WDODelta water authority began to work on the challenge ahead. A first informative participation meeting was organised in January 2017, were all residents, businesses and landowners situated in the broad surrounding areas were invited to (WDODelta, 2019). Here, the need for the dike reinforcement was elaborated and the attendees were given the opportunity to respond to the plan and were invited to join the Dijkdenkers as a possibility to be actively involved in the project (interview 1). Also the project's planning was explained during this event, and it was brought to the attention that the exploratory phase had to result in the drafting of a preferred alternative for the reconstruction. An agreement of a common purpose – the drafting of a preferred alternative – was thus already established in the first meeting. By utilizing the word "preferred alternative" to describe the exploratory phase's purpose, all attendees became familiar with the shared jargon right away.

For each segment of the trajectory, the 29 subprojects, a reconstruction scenario was drafted that encompassed the four failing mechanisms in the current dike system. The reconstruction scenarios were developed in several expert meetings that were organised in April 2017. Internal and external specialists and advisors from the water authority, as well as administrative partners were invited to different meeting (WDODelta, 2019). Together, they inventoried potential scenarios for each subproject and shared possible suggestions for improvement. In April 2017, the gathered group of Dijkdenkers had their first meeting to discuss the dike reconstruction and its possible challenges. In June 2017, the Dijkdenkers and administrative partners met up and shared their knowledge and experiences on the IJssel dike.

During the year of 2017, the project team aimed to have selected a couple of reconstruction scenarios that were promising. Together with specialists from the water authority and an external consultancy company, the scenarios were being assessed on four conditions: whether the reconstruction was (1) technical feasible, (2) affordable, (3) problem solving, and (4) legally permissible (interview 2; WDODelta, 2019). For each part of the dike trajectory, each subproject, the impact of the several reinforcement scenarios were examined. If a scenario did not meet one of the four conditions, the scenario was defined as ‘not realistic’ and got eliminated as potential scenario. Potential scenarios that were eliminated in phase 1 were, amongst others, the following:

- Widening the river, as part of the Room for the River program (Witteveen+Bos, 2018a). This scenario will lower the water level by 20 centimetres, while a one-meter elevation of the dike is needed. Besides, the piping and stability failing mechanisms detected at the dike, will not be solved by widening the river. This scenario did therefore not solve the problem.
- Temporary measures, such as emergency dikes that can quickly be constructed in case of flooding. Since the complete IJsseldijk trajectory is rejected on multiple failing mechanisms, a temporary measure was not an appropriate solution (WDODelta, 2019).
- Reinforcement of the western riverbanks: because of wind coming from a western direction during high tide, the eastern banks are much more obstructed and have a higher risk to be flooded. Reinforcing the eastern riverbanks was therefore more urgent. The reconstruction of the western banks was be postponed due to cost concerns (WDODetlta, 2019)

Eventually, six scenarios turned out to be meeting all four conditions (Witteveen+Bos, 2018a). These were labelled as the ‘promising alternatives’, that were left to be further researched. The proposal in which the six promising alternatives were presented, was drafted during the autumn of 2017 together with internal landscape architects and specialists from the water authority and was advised by the official advisory group and the Omgevingsplatform. The Dijkdenkers thought along and made suggestions on the impact assessment.

The proposal was discussed with the Dijkdenkers and the Omgevingsplatform in January 2018. In January and February 2018, four informative participation meetings were organised to present the promising alternatives to the surrounding residents, landowners, and businesses. Attendees were asked to express their thoughts on missing elements in the preferred alternative and propose recommendations. (WDODelta, 2019). In February 2018, the Omgevingsplatform gave a positive review on the promising alternatives. During the period of March and April 2018, the proposal for the promising alternatives was available for response from all interested residents, parties, and organisations. The surrounding area was asked specifically to respond to the proposal and to suggest potential solutions where needed. A reaction to all responses and suggestions was published in a document to assure the project’s accountability (interview 1; WDODelta, 2019).

Apart from the organised meetings, multiple informal kitchen-table meetings were initiated with involved residents or established businesses to discuss specific topics (interview 1). The water authority also distributed a news bulletin with information on the progress 3 to 4 times a year, to keep the surrounded area updated (WDODelta, 2019). Additionally, there were separate stakeholder meetings organised for each segment of the dike trajectory, the 29 subprojects, to deliberate project-specific matters (interview 1)

5.2.3 Towards the preferred alternative

In the second stage of the exploratory phase, the project aimed to select one of the promising alternatives as the preferred alternative (WDODelta, 2019). Therefore, the six promising alternatives were examined thoroughly. From the beginning till the end of 2018, several studies were completed that researched each promising alternative on the following criteria (interview 2):

1. Technical feasibility: the promising alternatives were being assessed on its technical risks, the degree of flood safety and whether the construction requires much maintenance. It was also being investigated if the reconstruction could be expanded in case of future rising water because of rapid climate change (WDODelta, 2019b).
2. Impact on the surrounding environment: it was important that the preferred alternative had as little impact as possible on environmental values and the surrounding (residential) areas. Therefore, two studies were executed by external consultancy companies: an Environmental Effect Report (*Milieueffectrapportage*) and a Spatial Quality Report (*Ruimtelijk Kwaliteitskader*). As almost the complete outer dike area is part is a Natura 2000 conservation area and households protected species, the preferred alternative needed to affect the surrounding nature as little as possible. It was also being researched if a reinforcement of the dike could influence the current of water negatively (Witteveen+Bos, 2019b). The Spatial Quality Report studied to extent to which the alternatives integrated in the residential areas (Bosch Slabbers, 2019). It was important that the reconstruction could be executed without demolishing any houses or companies located along the dike trajectory.
3. Affordability: for each promising alternative was calculated how much the investment for the reinforcement and the maintenance over the entire lifespan would approximately cost (Witteveen+Bos, 2019c). A final cost estimation will be constructed in the next phase.

Additionally, the promising alternatives were reconsidered on their spatial quality and base of support at the involved stakeholders (interview 1 &2). Both the water authority as the HBWP consider the spatial quality as an essential criterium: the spatial quality should be preserved, or even improved, during the reinforcement of the dike and the dike reconstruction should be properly integrated in the landscape (HWBP, n.d.; WDODelta, 2019). To secure a substantial support base among its surrounding residents, another priority for both the water authority and the HWBP, the project team discussed the potential alternatives with involved stakeholders and surrounding residents (interview 1). Bottlenecks and preferences from the surrounding area were being taken into consideration, however the support base was not a determining factor in the decision (interview 1).

Throughout 2018, several design sessions were organised by landscape architects. Representatives from the Dijkdenkers, administrative partners and the Omgevingsplatform were invited to join the design sessions. The design sessions were proposed to inquire to integrate the promising alternatives properly in its environment (WDODelta, 2019. The sessions could be divided into three design cycles.

- Design cycle 1: the aim of first design cycle was to create a basic technical design for all promising alternatives and to determine the effects on the surrounding environment. With the available knowledge on the area, substrate and current construction of the dike; information on the effects, bottlenecks and opportunities was mapped out in a draft design of the reconstruction (*voorlopig ontwerp*).
- Design cycle 2: with the overview and draft design created in design cycle 1, the promising alternatives were integrated on the map to further explore its potentials. The consequences on cultural heritages, infrastructure, housing and nature in the surrounding areas were investigated and finally, a final design (*definitief ontwerp*) was developed.
- Design cycle 3: in the third design cycle, information that was gathered from the earlier design loops, was being reviewed and if necessary, adjusted. It resulted in a spatially integrated design for each promising alternative.

During the process of researching the six promising alternatives, it turned out that the surrounding landowners as well as WDODelta Water authority, desired more reciprocal tuning. To accommodate this desire, two meeting were organised in May and October 2018 to discuss the integration of the promising alternatives and to evaluate the design sessions (WDODelta, 2019). Eventually, after a year of examining the six promising alternatives for the dike's subprojects, each part of the trajectory got appointed one alternative as the preferred alternative. A concept proposal was drafted by the project team in which the preferred alternatives were carefully demonstrated. The concept proposal also contains an overview of all executed studies and a description of the reconstruction for each separate subproject of the dike trajectory (WDODelta, 2019).

At last, an extensive consultation period was proceeded. From March 2019 till May 2020, the concept proposal for the preferred alternative was available for response. Several participation meetings were organised too, in which the preferred alternative was presented. Additionally, the Omgevingsplatform and the official advisory Group were asked for advice. Both groups reviewed the concept proposal positively and gave green light for the determination of the preferred alternative (interview 5; WDODelta, 2019). Finally, in September 2019, the preferred alternative was determined by WDODelta's the board of directors: the preferred alternative was approved to be further elaborated for reconstruction (IJsselwerken, 2021c).

5.3 Technical innovation

Innovation is either a process (Crossan & Apaydin, 2009) or a product (Verwij et al., 2020). In technical innovation, technology refers either to added value itself – the technological improvement – or the tool that creates it (Leiringer, 2006). However, this is how scholars define technical innovation. As previously stated, the earlier conducted survey revealed a discrepancy in how the IJsselwerken Zwolle-Olst project's collaborative partners view technical innovation: half of the respondents expressed that technical innovation was developed during the exploratory phase, while the other half thought there was not. To understand how the different parties view that the collaborative process enabled or constrained the generation of technical innovation, it is important to first comprehend how the parties define technical innovation.

During the interviews, two kinds of innovative matters were mostly brought to the attention: the 'grass on sand' research, and the relocation of the Paddenpol dike trajectory.
The grass on sand research is a research that was executed to examine how strong the current sandy dikes really are. As most dikes are made of clay, developed calculation models use the clay dikes to measure the size of the reinforcement. However, the dikes between Zwolle and Olst contain a sandy structure. Using the current calculation models, would mean that the 1,5-meter top layer of the complete dike trajectory would need to be replaced by clay. An expensive and demanding operation. The grass on sand research therefore investigates how strong the current grass on sand texture really is and explores the possibility to develop new calculation models for the sandy dikes. Waves of water were simulating by building large scaffolds on the dikes, allowing the technical team to assess the dikes' strength (interview 1). WDODelta's technical manager frames the research as a technical innovation: *"We were unable to use the existing calculating models, so we attempted to create our own by conducting several tests and developing alternative methods. As a result, we won't have to replace the entire top layer, and we will need less reinforcement than we anticipated on"*, (Interview 2). HWBP's project coordinator elaborates: *"technical innovation also entails using calculation methods in an alternative way, as most instruments are really generic. This research revealed that grass on sand is a much stronger texture than we thought before"*, (interview 7). Interviewee 6, member of the official advisory group, also agrees on the notion of the grass on sand research being innovative: *"they could have also just accepted the current calculation models and try to work with it, but they looked beyond that option: I think that is definitely innovative".* Interesting here is that the innovative way of thinking – the development of new calculation models – has led to a beneficial outcome. Although the result of the research is valuable, the inventive process is what made the research labelled as technical innovation.

The other frequently mentioned innovation is the relocation of the Paddenpol dike trajectory. Instead of reinforcing this part of the dike, the dike will be slightly relocated. By relocating the dike, more space will be created for nature development and recreation, which will make the delta area more resilient for future climate change effects. The project is a pilot in Integral River management: a program in which national and regional governments work together to enhance the Dutch delta areas (IJsselwerken, 2021d; interview 5). *"Even though it is on a small scale, the reconstruction is innovative. Besides, a relocation is technically a lot more complex than a reinforcement"*, (Interview 5), does the representative of the Department of Nature Reserves elaborate. The project manager from the municipality of Zwolle applauds the Paddenpol relocation: "*the relocation is innovative because the water authority didn't limit themselves by their primary job of securing water safety, but also considered other potential improvement opportunities"*, (interview 6). The WDODelta's technical manager explains why the Paddenpol project can be considered as technical innovation: *"technical innovation, in my opinion, also* *refers to the use of techniques that have not been fully developed yet"*, (interview 2). The project gives the technical team the opportunity to test and implement new dike relocation techniques.

The interviews have revealed that in practice, technical innovation is defined similar as suggested in the literature. In the case of the IJsselwerken Zwolle-Olst reinforcement, technical innovation refers to either a process or a product. Here, the development and use of new calculation models during the grass on sand research is a technical innovative process. The technically complex relocation of the Paddenpol dike is the technical improvement itself, the product. The reason for the disparity in opinions in the survey on whether technical innovation was or was not generated in the Zwolle-Olst project can be explained in a similar way: *"people often have certain images of innovation: groundbreaking techniques or methods that are used for the first time"*, (interview 2). However, as the grass on sand research shows, an alternative way of thinking that leads to cost-savings and nature preservation, can also be considered as technical innovation.

5.4 Collaborative conditions and technical innovation

An indication of which collaborative conditions enable or constrain the development of technical innovation in the IJsselwerken Zwolle-Olst project, can be gleaned from the conducted interviews and analysed documents. This section discusses the qualitative results and focusses on the collaborative dynamics by Emerson, Nabatchi and Balogh (2011). The dynamic of capacity for joint action will explicitly be highlighted, as the quantitative research has demonstrated it to be a significant dynamic for generating technical innovation.

5.4.1 Principled engagement

Principled engagement develops overtime when collaborative partners find a shared purpose to cooperate (Emerson et al., 2011). Through principled engagement, parties with different interests and concerns, find a way to understand each other and create value in working together. The created value in this research, is the development of technical innovation. In the IJsselwerken Zwolle-Olst project, technical innovation was generated within the 'grass on sand' research. The research was executed when multiple parties raised attention on the unique plants that grow due the sandy texture of the dikes on the grass top layer. The Institute for Nature Education (IVN) excessively inventoried the plants on the grass layer and handed that over to the WDODelta project team (interview 3). The Department of Nature Reserves also brought the rare plants under attention of the project team, *"due to constant pressure from our side on the vegetation of the grass mat, the project team became interested in researching it with the national HWBP organisation"*, (interview 5). The stakeholder manager of the water authority's project team confirms that the grass on sand research ensued from the surrounding area who questioned the necessity of replacing the turf for clay (interview 1). The municipality of Zwolle as well argued that the grass on sand research needed to be examined, because of ecological values and interests of Zwolle's residents (interview 6). Despite the insistence from the collaborative parties, the water authority itself was also interested in executing the research: replacing the top layer of the complete dike trajectory would have been extremely expensive and give a lot of nuisances for the surrounding area: "*Because of those three reasons – preserving the plants, cost reduction and less nuisances – we decided to execute the grass on sand research", (*interview 1). Although the collaborating partner have essentially unrelated interests, the parties crossed each other's concerns on this topic. From each of their own perspective, the partners shared their interest in executing the research, which eventually led to technical innovation: the research demonstrated that the grass is more resilient than prior calculation models reveal, allowing most of the dike's vegetation to survive.

5.4.1 Shared motivation

The interpersonal dynamics and relational elements between collaborating partners are referred to as shared motivation. A repeated quality of interaction will enhance the collaboration and its outcomes (Emerson et al., 2011). A solid foundation was built between the official advisory group and the water authority during the beginning of the exploratory phase (interview 1 &6). Because the water authority kept including its administrative partners, the parties' trust grew. The water authority listened carefully to the wishes that the municipality of Zwolle had for their part of the trajectory and took those in consideration for the drafting of the alternatives (interview 6). The Department of Nature Reserves received, due to their limited time and budget to cooperate in the project, a *"special treatment"* from the water authority (interview 5), which legitimised their relationship. Within the official advisory group, relationships were harmonious too. Administrative partners aligned their reaction on documents with each other (interview 5) and worked together when needed (interview 6). The latter resulted into pressure from the administrative parties to include a dike relocation as one of the promising alternatives (interview 1 & 5). The water authority was reluctant to consider a partial dike relocation in the first place, since it is a costly operation that produces additional nuisances in the surrounding area and poses more risks (interview 1 & 6). Besides, the proposal for the promising alternatives was almost finished and ready to be determined by the executive committee (interview 5). However, the dike relocation is an innovative solution that integrates water safety with room for nature and recreation (IJsselwerken, 2021d), which was important for most administrative partners. *"I remember a specific meeting with the official advisory group, when I specifically requested the water authority to consider the dike relocation as a promising alternative. Then, the representatives from the province of Overijssel and the Department of Public Works and Water Management backed me up and demanded to take this higher up in an administrative advisory group to seriously discuss that alternative"*, (interview 5). Due to reliable internal relations in the official advisory group, the group teamed up and pressured the water authority to look beyond standard dike reinforcement alternatives. In this sense, shared motivation within the official advisory group led to a form of technical innovation*: "It was the perfect example of collaborative river management"*, (interview 5).

Nevertheless, the interpersonal relations between the Omgevingsplatform and the water authority were not always as smooth. To sustain a cooperative alliance, the Omgevingsplatform suggested the use of a dialogue model (interview 4). This mostly entailed that parties interchanged each own's values to create an understanding of each other's positions and a circle of trust. During the beginning of the exploratory phase when the project, this dialogue model worked smoothly: *"we were in the honeymoon phase, willing to understand where both parties were coming from"*, (interview 4). However, later in the process, this became harder (interview 4). The stakeholder manager admits that participants from the Omgevingsplatform and other surrounding residents did have some difficulties trusting the project team, which she claims to be result of earlier conflicts with governmental organisations (interview 1). Talking to interviewee 4 clarifies this. In previous years, the dike area has dealt with three other projects concerning the area's water management: Room for the River, project Stroomlijn and research on water extraction (Delta Programme, 2018). The respondent claims that a lot has happened in the area and that not all collaborative processes have gone smoothly. *"At the Room for the River project, certain events in the process did not go well and emotions were running high. It caused a lot of frustration by some residents"*, (interview 4). The shortfall of trust that the stakeholder manager mentioned, can thus be explained by a history of conflicts. This might have also affected the development of technical innovation in project. Interviewee 4, member of the Omgevingsplatform, works for the Technical University in Delft and declares to have tried to connect the TU Delft with the water authority to explore innovative solution. *"After limited knowledge exchange with TU Delft, the water authority was reserved in working together on innovation and nothing really got off the ground"*, (interview 4).

5.4.3 Capacity for joint action

Capacity for joint action is a collection of elements, that form the basis for group empowerment, in order to achieve a common purpose. The joint capabilities arise in cooperative activities and serve "as the link between strategy and performance" (Saint-Onge and Armstrong, 2017, p. 17 in: Emerson et al., 2011). Like the other collaborative dynamics, capacity for joint action possesses multiple elements: procedural arrangements, leadership, knowledge, and resources. As the quantitative study demonstrated that these elements are significant for the generation of technical innovation, a detailed understanding of the elements' functioning in the Zwolle-Olst project is therefore required. The elements will therefore be discussed separately.

Procedural arrangements

Procedural arrangements include the range of process protocols and organisational structures necessary to manage repeated interactions over time (Emerson et al., 2011). A clear organisational structure of a project contributes to effective action (Bryson, Cosby and Stone, 2006). Within the IJsselwerken Zwolle-Olst, the functioning of the organisational structure was inherently connected to managing the collaboration expectations. As the collaborative partners solely advice the project team and do not possess the authorisation to decide, it was important that the parties all agreed upon the limitations of the power (interview 1). The project team was very transparent about this arrangement from the start of the process, according to all Omgevingsplatform- and formal advisory group members interviewed (interview 3, 4, 5, 6). The surrounding residents were briefed in the beginning of the participation process about what they could expect from the process: the participation trajectory was only to think along, not to co-decide (interview 1): *"It was important to explicitly mention this in the beginning of the process, to prevent that people would have other expectations and be disappointed"*, (interview 1).

For the Omgevingsplatform, it was important to also set the expectations at the start of every meeting. An arrangement that the platform practiced during every meeting with one of the managers from the WDODelta project team, was to immediately ask the manager's intentions for the meeting, as well as the authorisations and limitations that the he or she had. *"By doing so, we were aware of the meeting's objective and what we could expect would happen with the recommends and requests we would give during that meeting"*, (interview 4). The Omgevingsplatform decided to implement this procedure, because during earlier flood risk projects in the area it often happened that during meetings promises were made, which afterwards turned out it could not be promised. Implementing this custom helped to prevent this and manage expectations (interview 4).

Furthermore, procedural arrangements also concern the management of repeated interactions over time. The project team formed the base in this: the team would repeatedly meet every week (interview 1). Meetings with the collaborative partners were scheduled periodically, dependent of the stage of the process (interview 5 & 6). The project team was the initiator of these meetings and would take the lead in deciding the frequency of the meetings (interview 1, 2 & 5). The Omgevingsplatform did, as earlier agreed, occasionally request to meet to discuss certain topics of their concern (interview 1 & 4).

Overall, the project's procedural arrangements seem evident for both the project team as the collaborative partners. As stated, clear procedural arrangements assist in effective action (Bryson, Cosby and Stone, 2006). Since in this research, the effective action refers to the development of technical innovation, it can be argued that the organised arrangements as well as the ability to manage the collaboration expectations, contributed – or at least not constrained – the creation of technical innovative solutions.

Knowledge

Collaboration requires the aggregation of knowledge, as well as the generation of new, shared knowledge (Emerson et al., 2011). As an element of capacity for joint action, knowledge contributes to the accomplishment of a shared goal. Both knowledge exchange and in-house knowledge tend to be present in the IJsselwerken Zwolle-Olst project. The overarching HWBP program stimulates technical managers to exchange information in the initiated 'technical managers community' that meets every four months (Interview 2, Interview 7). The community assists technical manager to contact each other in case of technical issues, also outside the structured meetings: *"for example, when I wanted to learn more about how a project that had used a certain technique, I could easily get in touch with the technical manager from that project",* (interview 2). However, enough knowledge seemed to be in-house too: *"special about this water authority is, that our technical team had the knowledge and expertise to compose the first draft design themselves",* (interview 1). On topics that the technical team did not have the right expertise in, specialised knowledge was obtained externally. Consultancy companies got employed for quality assurance, to ask specific questions or to review technical reports (interview 2). For example, Deltares, an independent engineering institute (Deltares, 2021), was closely involved during the grass on sand research (WDOD, 2019). *"Eventually, you just need such parties to execute these innovative experiments, because they are much more experienced in doing such research",* (interview 2). According to the technical manager did the project team have, with the combination of internal and external hired knowledge, the needed expertise to generate the innovative projects (interview 2).

Although both the project team's managers confirm the available knowledge within the project team, interviewee 4 notes that substantial expertise was insufficient within the larger water authority organisation: *"Eventually, the board of directors supervises and decides about the project. The members of the board of directors mostly miss the needed substantive knowledge to ask critical questions, because the members are often guided by political objectives. This is a missed opportunity: by asking critical questions, the board could steer the project team in a more innovative direction and could encourage the project team to look beyond standard dike reinforcement option",* (interview 4). According to interviewee 4, the absence of specialised knowledge, has hindered the development of technical innovation within the project.

Resources

In collaboration, resources – such as time, money, expertise, assistance, and funding – are often shared (Emerson et al., 2011). The way these resources are distributed over the collaborative partners, can affect the achievement of common goal (Bryson, Crosby & Stone, 2006). All Dutch dike reinforcement projects are for 90% subsidised by the overarching HWBP. However, this subsidy is solely meant for a 'sober and functional' dike reinforcement. If a project team wants to expand the reach of their project and for example, include other spatial functions, HWBP cannot fund it (interview 1, 4, 6, 7; HWBP, 2019). The water authority's limited budget seems to have affected the collaboration. For example, both the municipality of Zwolle and the water authority would have liked to cooperate more frequent, but the water authority was not able to compensate the municipality for their spent hours. Therefore, the partners did decide to decrease the frequency of meetings (Interview 1 & 6). *"If the water authority had more money to distribute, we would be able to explore more opportunities together",* (interview 6). By 'exploring more opportunities together', the municipality's project manager means the way in which the dike reinforcement could be a harbinger to enhance its spatial quality, were innovative solutions can play an essential role to produce this. WDODelta's stakeholder manager also illustrates the unevenly distributed time to collaborative, over the partners: *"our project team works full-time on the dike. However, our collaborative partners have also a lot of other tasks to fulfil within their own organisation",* (interview 1). For example, the Department for Nature Reserves had very little time to participate in the project (Interview 1 & 5), which meant that the partners met each other less often and thus, had less time to explore innovative solutions for the dike and nature reservations.

Leadership

Substantial leadership is crucial in collaborative governance (Ansell and Gash, 2008; Emerson et al., 2011). Collaborative governance demands and fosters a variety of leadership opportunities and positions, and within this range of options, leadership can be fragmented too (Emerson et al., 2011; Meijerink et al., 2014). Pointing out one specific leader that has been meaningful in the innovative process is thus, also in the IJsselwerken Zwolle-Olst project, complex. Although the project team is led by a single project manager, the project team exists of multiple managers that each maintain their own field of expertise (interview 1 & 2; WDODelta, 2019). The project team is supervised by a water authority commissioner and the board of directors, in which the latter functions also as the final decision maker. Additionally, the board of directors is guided by the overarching Flood Protection Program and its funding requirements (interview 7; WDODelta n.d.). The fragmentation of supervision makes it hard to pinpoint where a force for action to innovate existed during the exploratory phase. However, one could argue that the fact that leadership was splintered over several layers within and outside the organisation, might have constrained technical innovation. Because each part of the organisation was supervised by another section of the organisation, it could have been complex for positioned leaders to push through.

However, as scholars argue, leadership is defined through action, rather than through the possession of a specific position (Meijerink, 2014). This allows us to look beyond the positioned leaders and explore how specific leadership actions influenced the innovations of the grass on sand research and the Paddenpol relocation. Interviews with the water authority's stakeholder manager and the Institute for Nature Education's (IVN) representative reveals that, both the IVN and ecologists from the Department of Nature Reservations insisted to research how the rare plants on the grass layer of the dike can be preserved. Members of the IVN inventoried the dike's flora and the Department of Nature Reservations's ecologists brought the seldom plants to the water authority's attention through the official advisory group (interview 3 & 5). This persistence eventually led to the grass on sand research (interview 1, 3, 5). The incentive to consider the Paddenpol relocation turned out to be the result of collaborative action within the official advisory group. Especially the representatives from the province of Overijssel and the Department of Public Works and Water Management played a key role in this process. During a meeting with the advisory group, the representatives insisted on examining the possibility for the dike relocation (interview 5), which led to a last-minute decision to include the Paddenpol relocation as a promising alternative (interview 1 & 5).

All in all, actions from the collaborative partners turned out to be playing a leading role in the generation of technical innovative solutions in the IJsselwerken Zwolle-Olst project. Logically, the stakeholder manager who stays in contact with the collaborative partners, has a significant position in this process too (interview 3 & 5). Although interviewee 4, representative of the property owners in the Omgevingsplatform, does mention that the person who positioned the function of stakeholder manager changed during the process. *"This was inconvenient: it takes some time to get to know each other, built trust and get used to each other's ways of working. When someone leaves you must start over"*, (interview 4). The representatives adds that not everything that was discussed during meetings, was written down. Therefore, this led to a loss of information (interview 4), and perhaps also to a loss of innovative ideas suggested by the Omgevingsplatform.

5.4.4 Evaluation

Overall, almost all discussed collaborative conditions seemed to be present within the IJsselwerken Zwolle-Olst project. Table 6 demonstrates the extent in which the collaborative conditions functioned sufficiently during the exploratory phase. The table is based on the stated rules outlined in the table 2 by Avoyan (2021). The principled engagement played a significant part when all collaborative parties found a common purpose in preserving the seldom plants on the grass dikes and so, urged to project team to execute the grass on sand research. The extent to which shared motivation was present during the collaborative process varied per collaborative partner. Whereas the distinct interpersonal dynamics within the official advisory group led to the proposal for the Paddenpol dike relocation, the shared motivation between the Omgevingsplatform and project team seemed limited. The 'score' of the capacities for joint action is an accumulation of the availability of procedural arrangements, knowledge, resources, and leadership. The procedural arrangements, knowledge, and leadership seemed sufficient, but the resources were limited due to HWBP's subsidy regulations. An encompassing discussion of the collaborative dynamics and its influence on developed technical innovative solutions within the project, as well as how this table relates to the quantitative results, will be discussed in the final conclusion.

Collaborative dynamics		
Quality of principled engagement	Limited functionality	
	Sufficient functionality	
	High functionality	X
Extent of shared motivation	Limited shared motivation	
	Sufficient shared motivation	X
	High shared motivation	
Availability of capacity for joint action	Limited range of CJAs	
	Sufficient range of CJAs	X
	Wide range of CJAs	

Table 6: functionality of the collaborative dynamics within the exploratory phase of the IJsselwerken Zwolle-Olst (Avoyan, 2021).

5.5 HWBP's institutional settings

As discussed, the IJsselwerken project is subsidised by the overarching Flood Protection Program (HWBP), which covers 90% over the dike reinforcement costs. The other 10% are for the account of the water authority and potentially, its collaborative partners (HWBP, 2019). A strict condition for HWBP's subsidy is that the program funds 90% of the 'sober and functional' dike. Meaning that the HWBP only vouches for the water safety issue, and that the reinforcement should be as sufficient and effective as possible (interview 7). Any other extra costs that do not contribute to a sober and functional dike, as well as costs that are not included in the previous determined proposal, should be paid by the water authority itself.

However, the HWBP does intent to stimulate its dike reinforcement projects to generate innovation (HWBP, n.d.; interview 7). In the first place by covering innovative projects with a 100% subsidy, to diminish the water authority's risk when generating innovation. HWBP also organises 'Innovation Days', assigns 'ambassadors of innovation' and connects technical managers with each other to spur the sharing of knowledge (HWBP, n.d.). Other than that, does HWBP assure publicity for the project when innovative solutions are applied (interview 7). HWBP's main reason to encourage projects to innovate is the reduction of costs: *"our current assignment cannot be reached if we don't generate innovative solutions: the prices are just too high"*, (interview 7). It is therefore a necessity that HWBP's projects look beyond standard constructions and explore innovative techniques that save costs.

The water authority's managers acknowledge HWBP's incentive to encourage innovation, while also pointing out the program's limitations. The stakeholder manager explains why innovation was not a goal in their project: *"Innovations can assist in making the reinforcement assignment more cost-effective. However, developing innovation comes with its own set of risks: if costs exceed those previously estimated, the water authority will be held liable for compensation, not the HWBP"*, (interview 1). The risks that come along with innovations made the project team decide to initially not actively intend on generating innovations (interview 1). The innovations within the project eventually naturally arose during the exploratory process. HWBP's proposal to fund 100% of innovative projects seemed not to be useful in the IJsselwerken Zwolle-Olst project: the grass on sand research was innovative but nevertheless paid by the water authority itself. The technical manager clarifies that, in order to receive a 100% compensation for the innovation, the project would need to disclose comprehensive reports and records of the research to be held accountable: *"the time, and thus money, that it would cost to develop all these reports would cost us the same amount as paying it ourselves. So, we did the latter"*, (interview 2). Moreover, the grass on sand research was developed later in the exploratory phase and was therefore not estimated in the project's proposal by the start of the project.

Aside from the way the Flood Protection Program is set up, the institutional setting of the water authority itself might have also affect the generation of technical innovation in the project. As interviewee 6 explains, *"the water authority solely exists to secure water safety and water quantity"*, (interview 6). This, together with HWBP's conditions to maintain 'sober and functional' projects, leaves little room for innovations that look beyond water safety. The bounded regulations of HWBP's subsidy, have constrained the water authority to expand their horizon: *"a missed shot: we would argue to pay attention to the spatial quality too, other than solely focussing a reasonable dike reinforcement"*, (interview 6). The municipality's project coordinator explains how some parts of the dike trajectory will protect citizens from flooding but are not always as spatially integrated in the surrounding area. More freedom in the subsidy will give the water authority more options to implement spatial quality in their program. As dikes are, especially in a dense country like the Netherlands, almost always part of a populated area. *"Innovating dikes in such a way that they integrate in the surrounding environment, produces opportunities. Unfortunately, this does not seem to be a priority at all at the water authority, because of the simple reason that it is not their task",* (interview 6).

6. CONCLUSION

Much has been written about collaborative governance and its importance to achieve demanded action. However, little is known about the causal mechanisms between collaborative governance and the creation of innovation. Since the Dutch dike reinforcements demand innovative solutions, as well as it requires collaboration between multiple stakeholders, this research has tried to fill in that gap. The study has provided insight in the influence that collaborative conditions have on the generation of technical innovations within the HWBP dike reinforcements projects. A mixed method research has allowed the researcher to uncover the significant collaborative dynamics for the development of technical innovations across all HWBP project, as well as explore the functioning of the causal mechanisms within one specific case study.

The conclusion briefly resumes the findings from the quantitative and qualitative study, which subsequently, leads to answering the research question and its corresponding sub-questions. The main question this study tried to answer is '*What are the enabling and constraining collaborative conditions for generating technical innovations within HWBP projects during the exploratory phase?'*

6.1 Quantitative conclusion

To answer the first sub-question – '*Which collaborative dynamics and elements affect the development of technical innovative solutions in the HWBP projects?'* a SPSS analysis was executed. An earlier composed survey among 98 participants from 36 different HWBP projects that was conducted as part of the All-Risk research project (Avoyan, 2020), allowed the researcher to analyse the extracted data. To operationalise collaboration, the Integrative Framework of Collaborative Governance by Emerson, Nabatchi and Balogh (2011) was used. Eventually, several linear regression analyses were run to examine the effect of the independent variables, the collaborative dynamics and elements, on the dependent variable: the generated technical innovation. The analysis led to the construction of table 4, that could be interpretated as follows: a collaborative condition is effective for the development of technical innovation, when a condition is significant and has a R value larger than 0.500. As a result, the conditions that have affected the creation of technical innovative solutions within the HWBP projects are: capacity for joint action, knowledge and internal leadership.

The quantitative findings enable the researcher to revisit the following hypothesized statements:

- Hypothesis 1: Principled engagement is a substantial collaborative condition for the development of technical innovation in the exploratory phase of the HWBP dike reinforcement projects.
- Hypothesis 2: Shared motivation among collaborative parties is a substantial collaborative condition for the development of technical innovation in the exploratory phase of the HWBP dike reinforcement projects.
- Hypothesis 3: Capacity for joint action is a substantial collaborative condition for the development of technical innovation in the exploratory phase of the HWBP dike reinforcement projects.

The SPSS analysis revealed that solely the last hypothesis can be confirmed. As the researcher decided that a collaborative condition is effective when the condition is significant and has a R value larger than 0.500, only hypothesis 3 meets this criterion. Hypotheses 1 and 2, referring to the effectiveness of principled engagement and shared motivation, are thus rejected by the quantitative research.

6.2 Qualitative conclusion

6.2.1 Technical innovation

To create a deeper understanding of the functioning of the collaborative conditions, especially of the capacity for joint action, knowledge and internal leadership, a case study analysis was carried out. The case study researches the exploratory phase of the IJsselwerken Zwolle-Olst dike reinforcement project. As the survey affirmed, 50% of the project's participants estimated that innovation was generated in the exploratory phase while the other 50% does not think so. Due to the disparity in opinions, it was important to initially gain insight on how the involved collaborative parties define technical innovation, which led to answering the sub-question: *'What is considered to be technical innovation and how was it developed in the IJsselwerken Zwolle-Olst project?'*. Eventually, the conducted interviews demonstrated that two different technical innovations were developed within the IJsselwerken Zwolle-Olst project: the grass on sand research, and the relocation of the Paddenpol dike trajectory. Considering those two innovations, interviewees understand technical innovation similar as literature suggests. Technical innovation refers not solely to the development of ground-breaking technical products, it could also consider an alternative way of thinking that leads to an innovative process.

6.2.2 Collaborative governance and technical innovation

A document analysis and multiple conducted interviews provided an encompassing reconstruction of the collaborative process of the project, which contributed to answering the following sub-question: *'Which collaborative conditions enabled or constrained the creation of technical innovations in the IJsselwerken Zwolle-Olst project?'.* The principled engagement between multiple collaborative partners who found their common purpose in persevering the rare plants on the grass top layer, led to the grass on sand research. A shared motivation between administrative partners was a harbinger for the Paddenpol dike relocation, which is considered to be an innovative solution. On the other hand, the rough interpersonal dynamics between the Omgevingsplatform and the water authority constrained the option to explore innovative opportunities as partners. As the quantitative analysis demonstrated, the availability of capacities for joint action seemed, also in the IJsselwerken Zwolle-Olst project, significant for the development of technical innovations. The periodically procedural arrangements and clear organisational structures that were agreed upon, contributed to an overall smooth collaborative process. The abundance of (the exchange of) knowledge that was either internally available or externally obtained, enabled the execution of the grass on sand research. Nevertheless, the limited resources of time and budget, tended to reduce the collaboration with some partners, which seemed to have left a few opportunities to innovate untouched. Leadership on the other hand, was fragmentedly present during the exploratory phase. Along the process, leading roles alternated among the involved partners which enabled the Paddenpol dike relocation to be considered as a promising alterative. However, the alternating roles and fragmentated positioned leaders within the water authority might have also increased the complexity of the process, and therefore hindered the creation of technical innovations.

All in all, the results assist in validating the hypothesized causal mechanisms of the collaborative dynamics on the generation technical innovation.

- Hypothesis 1: Attaining functional principled engagement will lead to the development of technical innovation in the exploratory phase of the IJsselwerken Zwolle-Olst dike reinforcement.
- Hypothesis 2: Securing a shared motivation among collaborative parties will lead to the development of technical innovation in the exploratory phase of the IJsselwerken Zwolle-Olst dike reinforcement.

- Hypothesis 3: A sufficient range of capacities for joint action will lead to the development of technical innovation in the exploratory phase of the IJsselwerken Zwolle-Olst dike reinforcement.

Based on the analysed documents and conducted interviews, all three hypothesises can be confirmed. Meaning that, the performance and availability of all three collaborative dynamics – principled engagement, shared motivation, and capacity for joint action –, contributed to the creation of technical innovations within the IJsselwerken Zwolle-Olst project.

The qualitative results differ somewhat with the quantitative results. The quantitative study examined that solely the latter hypothesis, referring to the effectiveness of capacity for joint action, is valid. Principled engagement and shared motivation tended to be less substantial for the creation of technical innovative solutions when all HWBP projects were assessed in the quantitative analysis. However, although the principled engagement and shared motivation dynamics showed no significant correlation to creation of technical innovation, it does not mean they were not meaningful for the development of technical innovation in any of the projects. The regression analysis covers all projects and systematically examines the overall correlation, whereas the qualitative case study dives deep into a collaborative process. Moreover, in the IJsselwerken Zwolle-Olst project, the capacity for joint action was a substantial collaborative condition, notwithstanding that the limited capacity of resources and budget may have withheld some further innovative inventions. The slight shortfall of resources may even partially explain why 50% of the project's participants estimated in the survey that technical innovation was not developed within the project's exploratory phase. Meaning that, especially an increase of capacities for joint action might have been determinative for the creation of technical innovative solutions within the project.

6.2.3 HWBP's institutional settings

At last, the qualitative research examined how the institutional setting of the HWBP influenced the creation of technical innovation, in order to answer the last sub-question: *'how did the institutional setting of the Flood Protection Program (HWBP) influence the process of generating and approving technical innovations?'*. The document analysis and conducted interviews uncovered the relatively strong influence that the HWBP has on the dike reinforcement projects. HWBP's subsidy regulations that solely cover the costs of a 'sober and functional' dike, seemed to have constrained the water authority to actively include innovations within the project. Especially the financial risks that emerge when creation innovations due to HWBP's limited safety net, had initially retained the project team. Also, the institutional setting of the water authority itself, which solely secures water safety and water quantity, might have constrained the project team to expand their horizon and include innovative spatial functions within their dike reinforcement.

6.2.4. Final evaluation

Concluding, this research has contributed to uncovering the 'black box' that exists between the functioning of collaborative governance and the generation of technical innovation, within Flood Risk Management (FRM). A quantitative and qualitative study enabled the researcher to eventually answer the research question; '*What are the enabling and constraining collaborative conditions for generating technical innovations within the Dutch HWBP projects during the exploratory phase?'*. The quality and availability of the three collaborative dynamics – principled engagement, shared motivation, and capacity for joint action –, all contribute to the creation of technical innovative solutions. The latter dynamic, including the elements of knowledge and internal leadership, are particularly meaningful conditions in the process towards developing innovations. The Flood Protection Program's (HWBP) subsidy regulations seemed more to constrain than enable technical innovations. However, HWBP's Knowledge & Innovation Agenda (n.d.) that encourages collaboration within the dike reinforcement projects, tends to be essential, as the collaborative process itself turned out to be the main harbinger for the creation of technical innovations within the case study project.

6.3 Discussion

Within the discussion, the researcher reflects on the executed study, its limitations and will discuss some recommendations for further research.

6.3.1. Theoretical limitations

To begin, this research uses the Integrative Framework for Collaborative Governance from Emerson, Nabatchi and Balogh (2011) as the foundation of the study. The framework is widespread admitted amongst scholars, which is why this research uses it predominantly. However, it is important to remember that the framework is merely a systematic way of explaining the concept of collaborative governance and that the collaborative dynamics are a way of operationalising the collaboration itself. A different collaborative framework that uses slightly other definitions and concepts will most likely lead to a similar conclusion, but certain details might differ.

Executing this study, the researcher notified some limitations within the Integrative Framework for Collaborative Governance (Emerson et al., 2011). First, the Integrative Framework misses a collaborative condition that refers to the importance of consistency within a collaboration. During the exploratory phase of the IJsselwerken Zwolle-Olst project, the stakeholder manager alternated twice. Most interviewees briefly touched upon this topic, although not everyone specifically mentioned the inconvenience of this staff turnover. However, interviewee's 4 comment is substantial: *"it takes some time to get to know each other, build trust and get used to each other's ways of working. When someone leaves you must start over"* (interview 4). Attention to the consistency of collaborative partners could be a meaningful addition to the Integrative Framework as an element of shared motivation. Furthermore, the IJsselwerken Zwolle-Olst demonstrated that leadership is often fragmented within collaborations. Specific leadership studies have highlighted the prospect of fragmentated leadership (Meijerink et al., 2014), but Emerson's et al. (2011) Integrative Framework pays inadequate attention to this topic. Which, in this research, made it difficult to pinpoint crucial leadership for the creation of technical innovation. A more comprehensive understanding of leadership that concerns not only positioned leaders but also the fragmentated characteristics of leadership, would be a considerable extension of the Integrative Framework.

6.3.2. Methodological limitations and recommendations

Limitations in research are inevitable. Primarily, as collaborative governance entails interpersonal dynamics, ways of deliberation, and communication aspects, it is unjust to ignore the cultural(-historical) dimension in the collaboration. The Netherlands, with decades of 'polder model' traditions (Van Dyk, 2006) will inevitably embody a different collaborative process, than countries with other deliberative traditions. Therefore, this research is foremost useful for Dutch collaborative settings. Further research that demands to receive a broader understanding of collaborations within international spheres, could potentially research the effect of the cultural-historical components by comparing collaborations within different countries. The recent flooding in parts of the Netherlands, Belgium and Germany offers, as awful as the situation is, an interesting starting point for further research. So far, the water damage tends to be worse in Belgium and Germany (Mudde, 2021). Studying to which extent the collaborative settings in the Netherlands might have led to other flood defense mechanisms and potentially, extensive innovative solutions, could provide valuable insight.

The quantitative study has used an earlier produced survey that was conducted among participants involved in the different HWBP project. Although the sample size was high enough to execute a validate regression analysis (Darlington, 1990), the *N* is still relatively small. This means that the analysis possesses less powers, which makes it more complex to verify a significant correlation (Dupont, 1998). In further research that entails a larger *N*, other collaborative conditions might be uncovered to have a significant effect on the creation of technical innovative solutions too, other than the capacity for joint action, knowledge and internal leadership that were measured in this research. Furthermore, as the survey and its extracted data is based on the collaborative dynamics and elements by Emerson et al., (2011), a different collaborative framework that uses other definitions, will logically lead to different significant collaborative conditions.

The qualitative study also has its methodological limitations. First and foremost, case study results are often difficult to generalise as the research only examines one single case (Van Thiel, 2014). Especially in collaborative processes within spatial planning, cases are often identified by spatial-specific elements that might (unintentionally) influence the collaboration. Time constraints impeded the researcher to include more cases in the qualitative study. Therefore, additional studies might consider investigating more HWBP project to create an encompassing understanding of the causal mechanisms between collaborative governance and technical innovation.

Furthermore, conducting interviews with stakeholders from different organisations will inevitably lead to varying views, experiences, and opinions on the collaborative process. In research that entails collaborative governance it is therefore important to acknowledge these different narratives. Rather than forcing all viewpoints into one storyline, the researcher should embrace the varying assumptions and involve all different views, to prevent a one-sided narrative. Continuing this topic, dike reinforcements are spatial implications that, especially in a dense country as the Netherlands, often occur in built environments. The dike reinforcement therefore produces nuisances and causes big impacts on the surrounding environments. Interviewing stakeholders that live around the dike reinforcement will potentially have strong feelings about the reconstruction. In conducting interviews, it is the researcher's job to interpret these emotions and carefully consider the narrative.

Seven interviews were conducted, divided over three different collaborative parties and the HWBP overarching program. The fact that from each collaborative partner, two persons were interviewed provided a natural factcheck on the interview which strengthens the reliable of the research. However, no Dijkdenkers nor residents, landowners or businesses in the dike area were interviewed. This was decided because both groups were merely being informed or invited to think along as part of the participation procedure, and therefore did not have an active advisory role in the collaborative process. Further research that aims at building an all-encompassing collaborative reconstruction of the IJsselwerken Zwolle-Olst project, interviewing the participation groups could potentially provide useful insights.

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Appendix

Table A: survey questions for SPSS analysis

Collaborative dynamics	**Process elements**	**Survey questions**
Principled engagement	Discovery	1a: Participants have / had regular contact with each other. 1b: Participants have / had the opportunity to express their views, goals and concerns. 1c: Participants are / were aware of each other's ambitions with regard to the area and the VKA. 1d: The arguments of participants about their objectives with regard to the VKA were substantively understandable.
	Definition	2a: Participants can agree on what exactly is meant by concepts used (e.g., agreement on terms used, clarification of integration concepts, area ambitions, etc.). 2b: Participants are / were able to identify shared goals and common needs and build a shared view of the VKA.
	Deliberation	3a: The chairman (s) of the meetings acted independently and neutrally. 3b: The chair (s) of the meetings provides deliberation mechanisms through which everyone can participate in discussions (e.g., Working groups, brainstorming etc.). 3c: The collaborative process in your project offered/ offers many opportunities for debate and discussion.
	Determination	4a: Participants have reached agreement on a plan of action to draw up a VKA together. 4b: Participants were able to manage any conflicts during the meetings. 4c: Participants are/ were they provided with conflict resolution/ conflict management mechanisms? 4d: The decision-making process about your project is characterized by a high degree of transparency (insight into how concrete decisions are made).
Shared motivation	Trust	1a. Participants in your project usually honor agreements made. 1b. Participants in your project trust each other.
	Mutual understanding	2a. Participants appreciate and respect differences, such as the different area ambitions that are brought into the project. 2b. Participants in this project may assume that the intentions of the other participants are in principle good.

	Internal legitimacy	3a. The VKA development organization meets your expectations. 3b. Participants within your project take into account the intentions of other participants.
	Commitment	4a. Participants in your project were generally committed to the process (uninterrupted participation, except exceptional circumstances such as elections).
Capacity for joint action	Procedural and institutional arrangement	1. To what extent does / has your project used the following procedural/organizational arrangements to support the collaboration? a. Various types of meetings (workshops, information sessions, regular meetings, kitchen table discussions, etc.). b. Platform (s) for stakeholder participation. c. Collaboration agreements, participation and communication plans to organize internal communication. d. Basic rules and procedures specifically designed to produce an innovative and integral VKA.
	Knowledge	2a. To what extent does / has your project used scientific information, results of different studies to support the collaboration? 2b. Your project has / had attention for knowledge management.
	Resources	3.To what extent does / has your project used resources (a. money; b. expertise/experience; c. other, please specify) by project participants/authorities to support the collaboration?
	Leadership: internal	4a. To what extent does / has your project used internally assigned (e.g., project manager, Environment manager from water authoritys) to support the collaboration? 4b. Internally assigned experts contributed to a transparent process of VKA development. 4c. Internally assigned experts have / had a substantial impact on the development of the VKA. 4d. The manager of your project aims to connect different spatial functions during the exploration of the project.
	Leadership: external	5a. To what extent does / has your project used recruited externally (e.g., external facilitators, hired experts such as landscape architects) to support the collaboration? 5b. Externally hired experts have contributed to a transparent process of VKA development. 5c. Externally hired experts have / had a substantial impact on the development of the VKA.

	Manager	6a. The manager of your project aims to connect different spatial functions during the exploration of the project 6b. The manager acted independently and neutrally
	Spatial management	7. The manager of your project aims to connect different spatial functions during the exploration of the project
	Complexity	8. Which functions, apart from water safety are at stake within your project? - recreation, housing developments, commercial developments, mobility developments, water management, nature, other.
	Conflict	9a. Participants were able to manage any conflicts during the meetings 9b. Participants are / were they provided with conflict resolution / conflict management mechanisms?) Authorities were able to manage any conflicts during the meetings 9c. Authorities are / were they provided with conflict resolution / conflict management mechanisms?

Table B: interview questionnaire

Topic	Question
Actor	1. Wie bent u en wat is uw functie? 2. Wat is uw relatie met betrekking tot het project? 3. Waarom was het belangrijk dat uw organisatie betrokken was bij het project? - Wie vertegenwoordigt u? 4. Welke rol vervult u binnen het project?
Defining technical innovation and technical innovation in practice	1. Wat beschouwt u als technische innovatie in dijkversterking? 2. In hoeverre was het implementeren van technische innovatie (naar uw mening) een doel op zich binnen de verkenningsfase? 3. Waarom wel? - Op welke manier is dat doel bereikt? Kunt u voorbeelden noemen van technische innovaties die zijn ontwikkeld? - Welke aspecten van samenwerking waren belangrijk voor het ontwikkelen van technische innovatie? - Welke partijen of personen speelden een belangrijke rol? 4. Waarom niet? - Wat waren de obstakels? - Welke partijen waren terughoudend? - In hoeverre stonden ruimtelijke elementen op het spel?
Technical innovation and the survey	1. Uitleggen survey resultaten. Hoe zou u het grote verschil in meningen verklaren rondom de vraag of er technische innovatie is ontwikkeld binnen het project? - Hoe zou dat kunnen? 2. In hoeverre is (naar uw mening) technische innovatie ontwikkeld in het project?
Collaboration in general	1. Kunt u mij meer vertellen over de samenwerking binnen het team/platform/adviesgroep waarin u betrokken was? 2. Kunt u mij meer vertellen over de samenwerking tussen andere partijen?
Principled engagement	1. Waren er tegengestelde belangen en hoe werd daarmee om gegaan? 2. Was er tijd om die tegengestelde belangen vooraf te bespreken? 3. Begrepen partijen elkaars belangen?
Shared motivation	1. Hoe waren de verhoudingen? 2. Vertrouwden partijen elkaar? Waarom wel/niet?
Capacity for joint action	1. Hoe werd het contact binnen uw team/platform/adviesgroep onderhouden? - Wie initieerde dat? - Hoe vaak vergaderde u met het projectteam van het waterschap?

	2. Was van tevoren duidelijke welke functie uw team/platform/adviesgroep precies had? 3. Waren er genoeg middelen beschikbaar binnen het project? - Geld - Tijd - Kennis 4. In hoeverre was er sprake van een duidelijke leider binnen het waterschap en/of uw team/platform/adviesgroep? - Hoe beoordeelt u dat leiderschap?
Preferred alternative	1. In de verkenningsfase werd het voorkeursalternatief opgesteld. Wat waren de voornaamste reden dat bepaalde alternatieven afvielen?