FROM STRATEGY TO IMPLEMENTATION

UNCOVERING BARRIERS AND ENABLERS TO THE DEVELOPMENT OF THE REBUILD BY DESIGN HUDSON RIVER PROJECT IN HOBOKEN, USA

N.S. ten Brinke
Bachelor of Science – Civil Engineering
s1531956

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Department of Construction Management & Engineering
University of Twente, Enschede, The Netherlands

Supervisor University of Twente: dr. ir. J. (Joanne) Vinke – de Kruijf
Supervisor Royal HaskoningDHV: ir. N. (Nanco) Dolman

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PREFACE

This research project marks the end of my career as a bachelor student in Civil Engineering at the University of Twente. Writing this preface makes me think back on the past years at the UT and everything I have learned during the course of my study. I think back to a vibrant student life, during which I have been able to develop myself at an academic as well as, and even more important, a personal level. Not only did going to university mark the next step in my educational career, it also marked the start of getting independent. Living on campus, making new friends, participating in extracurricular activities, studying abroad, doing a year of fulltime board membership; it all contributed to making me look back at a fascinating period of time. All these activities together make that the past years were by far the most exciting time in my life so far. They have all contributed to shaping me to the person I am today, and I am very proud of that.

I conducted this research in collaboration with Royal HaskoningDHV, the University of Twente and Stevens Institute of Technology. I am grateful for having been given the opportunity to complete this last step of my bachelor in the New York City area at Stevens Institute of Technology. I look back at an intensive yet exciting nine weeks of doing research in the US. First of all, I would like to thank my supervisors from the University of Twente and Royal HaskoningDHV, dr. ir. Joanne Vinke – de Kruijf and ir. Nanco Dolman. Joanne, thank you for your continuous support, provided feedback and sharing your knowledge with me. Nanco, thank you for your enthusiasm, feedback and sharing your experiences from the Civil Engineering field with me. I would also like to thank Sonja Möbius and Justus Baumann for their support and most of all for making the time in New York truly amazing. I would like to thank the people at Stevens, Gregg Vesonder, Jose Ramirez-Marquez, Gaby Gongora and Andy Garcia Tapia for offering me the opportunity to study at their university and for supporting me through the process. Also, I want to thank Bart Treurniet for peer-reviewing my work and providing useful feedback. And last but not least, a big thanks to my family and friends for their unconditional and continuous support.

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MANAGEMENT SUMMARY

Introduction
In a world with historically high amounts of urbanisation, one of today's key challenges is how to make urban areas more resilient towards shocks and stresses. The effects of climate change are imminent: natural disaster will continue to become more severe and occur more often (Melillo, Richmond, & Yohe, 2014). Preparing cities for these threats is therefore of high importance. One of the pressing issues concerns water safety: how do we protect our cities to (an increase in) storms, hurricanes, and heavy rainfall? Hurricane Sandy presents an example of what goes wrong when these issues remain unattended. The 2012 hurricane caused enormous devastation to large parts of the US East coast, leaving billions of damage, hundreds of deaths and hundreds of thousands of destroyed properties (Hurricane Sandy Rebuilding Task Force, 2013).

Hoboken is one of the areas which was severely hit by Hurricane Sandy. The small town located opposite of Manhattan on the Hudson River experienced severe flooding during and after Hurricane Sandy. A combination of unfavourable topographical characteristics, the absolute absence of flood protection measures and a lack of drainage capacity showed that the town was in no way prepared to deal with the consequences of severe weather events (City of Hoboken, 2018). Even though some of these problems have long been known, it was not until after Hurricane Sandy that the need for extensive resilience-enhancement efforts was recognised. This led to the start of the Rebuild by Design Hudson River Project. The beginning of this project is marked by the creation of a strategic plan for the Hoboken area called 'Resist, Delay, Store, Discharge: A Comprehensive Urban Water Strategy'. Over a period of three years, this plan was subsequently converted into a final implementation plan which constitutes the basis for the actual implementation of the project.

Research shows that complex adaptation processes are at the basis of these resilience enhancement projects and that barriers impeding these adaptation processes often occur (Leichenko, 2011). Stakeholders involved in the Rebuild by Design Hudson River (RbDHR) project expected barriers in the process to have caused significant deviations from the original strategic plan. This study analysed the course of the RbDHR project in order to verify these expectations.

Research approach
This research presents a qualitative single case-study of the Rebuild by Design Hudson River project. The objective is twofold, consisting of a comparative and an explanatory element:

- to analyse the differences and assess their significance by comparing the RbDHR strategic plan and implementation plan;
- to uncover and explain the factors impeding and promoting the RbDHR project in terms of barriers and enablers;

First of all, the research started with exploring theoretical frameworks to form the basis for studying the RbDHR project. Secondly, a qualitative comparison of the strategic plan and implementation plan was conducted alongside the four key elements of the strategic plan: Resist – Delay – Store – Discharge. Variations between the strategic plan and implementation plan were identified and their significance was subsequently assessed. Thirdly, a qualitative analysis was done to identify barriers and enablers in the RbDHR project. The primary data consisted of 10 interviews with key stakeholders as well as additional newspapers articles and public hearing notes. Secondary data comprised an additional 14 interviews from previous similar studies. A framework, deductively derived and inductively improved, was used to identify and categorise the discovered barriers and enablers. The framework consists of 7 clusters of barriers and enablers: 1) Alignment of Values & Interests, 2)

Community Involvement & Support, 3) Cooperation & Institutional Constraints in Governance, 4) Knowledge & Expertise, 5) Leadership, 6) Politics, and 7) Resources.

Research findings

The comparative study showed significant differences between the strategic plan and implementation plan. During the RbDHR project, attention had been shifted towards the Resist aspects of the plan. The Delay – Store – Discharge elements gained less attention as there was no funding available, implying that the intended integrality of the RbDHR project was therefore lost. Moreover, concrete measures proposed under Resist, Delay and Store were changed during the conversion from the strategic plan to the implementation plan. The most noticeable difference was the repositioning of the Resist infrastructure.

The explanatory part of this study uncovered that barriers concerning Community Involvement & Support occurred most in RbDHR, followed by respectively Cooperation & Institutional Constraints in Governance, Resources, Politics, and Knowledge & Expertise. Alignment of Values & Interest and Leadership clearly showed to be enablers rather than barriers to the RbDHR process. The most noteworthy barrier concerns Politics. The findings indicate that a lack of state-level endorsement seriously impeded the progress of RbDHR and could have even caused the project not to be funded at all. Fortunately, the consequences of this lack of endorsement were compensated by the political will and strong leadership presented on a local level by Hoboken's mayor. This shows to be the most critical enabler in the process of RbDHR.

Implications of findings

Hoboken has set itself an ambitious task in the RbDHR project. The novelty of the RbDHR approach, being one that has never been applied before in the US (Ovink & Boeijenga, 2018), posed several inescapable barriers. However, some enablers heavily promoting the process of RbDHR were also in place. The findings presented in this research illustrate the dynamics of complex resilience adaptation processes and can be used in future resilience planning to possibly prevent similar barriers from arising or to facilitate the existence of enablers.

Recommendations

In future research, combining several or all cases within the Rebuild by Design programme in a multi caste study approach could provide interesting results. Combining the insights from all 7 Rebuild by Design projects allows for verification of the findings presented in this study and would allow for drawing more general conclusions on this approach. Also, further research could focus on uncovering sources of barriers and enablers, as well as assessing ways to overcome barriers and promote the existence of enablers.

ABBREVIATIONS, TABLES AND FIGURES

List of abbreviations

DEP – New Jersey Department of Environmental Protection
GI – Green Infrastructure
RbD – Rebuild by Design
RbDHR – Rebuild by Design Hudson River (project)
RDSD – Resist-Delay-Store-Discharge
RHDHV – Royal HaskoningDHV
UT – University of Twente

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1. INTRODUCTION

In times where the world is facing the consequences of climate change and ongoing urbanisation, one of the key challenges has become how to make urban areas more resilient towards shocks and stresses they are experiencing now and will encounter in the future.

Urbanisation – the gradual increase in the proportion of people living in urban areas – has been ongoing steadily over the last decades (United Nations Department of Economic and Social Affairs, 2014). Dense urban areas attract people by offering a broad variety of activities, job opportunities, and services in close proximity. Where only 10 percent of the global population lived in urban areas in 1990, this percentage had increased to 50 percent by 2010 and is expected to continue growing in the future (Meerow, Newell, & Stults, 2015). With this growth in population density, the dependence on the urban systems such as healthcare, transportation and water supply also rises. Increasingly more people depend on these systems, meaning that the consequences of disruptive events such as natural disasters increase in magnitude as well. Moreover, the increasing vulnerability of these cities is strengthened by the effects of climate change. An increase in occurrence and severity of natural disasters is evident, posing an additional threat to urban areas (Melillo, Richmond, & Yohe, 2014).

Preparing cities for these threats is essential. In order to thrive in the future, cities will have to become more resilient towards shocks and stresses. The necessity for increased attention towards urban resilience is recognised by the United Nations in its Sustainable Development Goals, the follow-up of the well-known Millennium Goals (United Nations, 2017). The United Nations herewith emphasize the importance of resilience on a global scale, showing that large cities ask for extensive resilience measures in order to prevent societal disruption and enable quick recovery from natural disasters (Leichenko, 2011).

1.1 Problem context and definition

Driven by examples of what goes wrong when urban resiliency is disregarded, many cities are taking extensive measures to protect their citizens and assets from harm. One can see the consequences of a lack of resilience when examining the societal disruption in the case of Hurricane Sandy. Hurricane Sandy hit the New York and New Jersey coast on October 29, 2012, causing vast devastation: 65 billion USD in damage and economic loss, 159 deaths, 650,000 homes destroyed, and its infrastructure heavily damaged (Hurricane Sandy Rebuilding Task Force, 2013). These numbers indicate the magnitude of the consequences of such inescapable events like hurricanes on dense urban areas. These natural events cannot be prevented from happening, yet something can be done to mitigate their impact. This is exactly where urban resilience comes in, creating urban societies that are better able to withstand the consequences of disruptive events.

Following the great momentum for better water protection in the aftermath of Sandy, an extensive period of recovery was started by President Obama in 2012. This led to the foundation of the Rebuild by Design (RbD) programme, managed by the Dutch special envoy for water affairs Henk Ovink. An innovative approach was chosen by the Rebuild by Design team, namely a competition with an open call for resilience experts to lead the way in creating flood resilient urban areas from a design perspective. Instead of the authorities dictating how to rebuild, a bottom-up approach was chosen to allow participants in the competition to come up with their own solutions. This approach was inspired by the rebuilding efforts in the aftermath of Hurricane Katrina which hit New Orleans in 2005 (Nemes, n.d.), showing that merely building back the way it was would not provide a safe solution for the future.

One of the projects within Rebuild by Design is the Hudson River project (RbDHR), involving the cities of Hoboken and small parts Weehawken and Jersey City (hereafter referred to as just Hoboken), all located opposite of Manhattan on the Hudson River. The RbDHR project, aiming to improve the flood resilience of these cities, started in 2013 and is continuing up to at least 2022 (see Figure 1). One could describe the RbDHR process as a lengthy one, requiring devotion from the authorities, citizens, engineers and many more stakeholders in the process. During this period of multiple years, plans and choices were made, citizens were involved, and plans were altered again. In the early stages of RbDHR, a strategic plan was created and subsequently selected by the federal authorities to be implemented in the foreseeable future. This plan was created by the Team OMA consortium, a collaboration between several international consulting companies, amongst which the Dutch Royal HaskoningDHV for the water engineering and management part. The strategic plan reflects four key areas to address in order to achieve a more flood resilient Hoboken. Storm surge defence measures (Resist) are combined with measures to limit the effects of heavy rainfall flooding (Delay, Store, Discharge) (Team OMA, 2014). During the process of RbDHR, the visionary strategic plan for Hoboken was converted into an implementation plan, the latter being the starting point for the actual construction process.

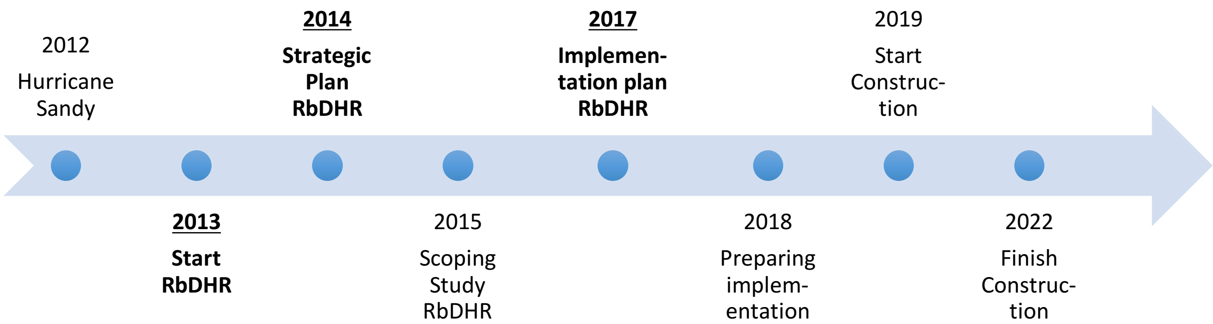

Figure 1: Timeline of the Rebuild by Design Hudson River project

Complex adaptation processes are at the basis of these resilience enhancement projects and barriers impeding these adaptation processes often occur here, sometimes leaving cities weakly prepared for shocks and stresses (Moser & Ekstrom, 2010; Leichenko, 2011). One of the consultants involved in the early stages of the RbDHR project, Royal HaskoningDHV (RHDHV), expects that the resulting implementation plan significantly deviates from the strategic plan. Possible changes with respect to the strategic plan arose during the project, affecting the final resiliency outcomes of RbDHR.

But to what extent are these changes significant? And how can one explain the emergence of changes upon facing contextual influences and events? This research will analyse the RbDHR project by studying this conversion process from strategic plan to implementation plan and uncovering the impediments and promotive factors that occurred during the process.

1.2 Research objective and questions

Following the problem context and problem definition, the research objectives and research questions for this study are established. Answering each of the research questions contributes towards achieving the research objectives. In general, this study aims to create a better understanding of the factors impeding and promoting resilience-enhancing processes in urban areas by analysing barriers and enablers to resilience adaptation in the case of the Rebuild by Design Hudson River project. The objective of this research is twofold, consisting of a comparative and an explanatory part:

- to analyse the differences and assess their significance by comparing the RbDHR strategic plan and implementation plan;
- to uncover and explain the factors impeding and promoting the RbDHR project in terms of barriers and enablers;

The following questions will be addressed in the process of achieving the research objectives:

1. *What can be learned from existing literature regarding frameworks for analysing barriers and enablers towards improved urban resilience in the context of climate change adaptation? And which framework is most suitable for application in the RbDHR case?*

2. *What are the differences between the strategic plan and the implementation plan in terms of its key philosophy and proposed concrete measures?*

3. *Which barriers and enablers were present in the Rebuild by Design Hudson River project and how are these interrelated?*

The first question allows for examining frameworks from existing literature for barriers and enablers in resilience-enhancement projects. Based on this examination a suitable framework for the RbDHR case will be selected. The second question involves comparing the strategic plan and the implementation plan to analyse the existence of possible deviations arising in the resilience-enhancing process. This analysis will follow the recurring key-philosophy of Resist – Delay – Store – Discharge (RDSD) to systematically compare the process from its beginning to the ready-for-implementation phase. Lastly, the third question concerns uncovering the barriers and enablers to adaptation that were present during the process of RbDHR. Uncovering and analysing these barriers and enablers will ultimately provide insights into the process of achieving a more flood resilient Hoboken.

1.3 Boundaries to research

Following from the establishment of the research objectives and questions, the following limitations apply to this study:

- The conversion process under investigation is limited to ranging from strategic plan up to and including the implementation plan, thus not including the physical implementation process that follows the implementation plan. At the moment of conducting this study, the implementation phase of RbDHR has not started yet, it is therefore impossible to collect data about this stage in the process other than based on expectations expressed in the data.
- This research will not include an assessment of the effectiveness of the proposed resilience measures of the strategic plan nor the implementation plan. This research will therefore not conclude on whether the possible deviations from the strategic plan can be justified in terms of resilience. Instead, it will provide a critical analysis on the RbDHR project involving barriers and enablers to the adaptation process.
- This research on RbDHR confines to flood resilience only, being highly relevant to the city of Hoboken. Nonetheless, other types of resilience also exist and apply to the area of Hoboken, but these are not part of the RbDHR project's scope.

1.4 Research relevance

Uncovering impediments in the RbDHR project is of profound interest to its stakeholders, amongst others Royal HaskoningDHV (RHDHV). Having worked extensively on the strategic plan for Hoboken, RHDHV suspects that not all of the elements from the strategic plan have been taken over in the implementation plan. Assumptions regarding barriers were made about reasons behind this incomplete conversion. Uncovering these reasons provides an opportunity to critically examine the course of the RbDHR project. The reasons behind the deviation can subsequently provide information on how to better structure such a process in other resilience-enhancement projects.

2. LITERATURE REVIEW

This chapter explores key theoretical aspects from literature which are relevant in the context of this research. The term urban resilience is first defined, after which the principle of knowledge transfer in face of this study is explained. Next, literature analyses on adaptation processes, adaptation frameworks and adaptation barriers are provided. Analysing the available literature enables the research to be placed into a bigger picture. Moreover, the literature review provides frameworks to guide this research and thus allows working towards a research methodology.

A study for available literature was conducted using Scopus, Google Scholar and the University of Twente library. The search was carried out using the following keywords: urban resilience; paradigm shift, transition, climate change adaptation, system innovation, implementation barriers, barriers to adaptation, resilience implementation. In the process of searching, literature was selected based on title and abstract. Potentially relevant literature, consisting of journal articles and digitally accessible books, was then examined by scanning its contents. The remaining literature that was found to be relevant was then stored and grouped into clusters matching with the keywords mentioned before. Following this literature review, a theoretical background for this study was formed.

2.1 Defining urban resilience

At the basis of this research lies the term 'resilience', specifically 'urban resilience'. Seen that the term resilience has taken a course similar to 'sustainable' in becoming a 'buzzword' in itself, its definition will have to be established first.

Several definitions for urban resilience are used, both from academia as well as from the resilience industry. One prevalent definition of resilience is provided by the 100 Resilient Cities (100RC) organisation. 100RC defines urban resilience as:

> "*the capacity of individuals, communities, institutions, businesses, and systems within a city to survive, adapt, and grow no matter what kinds of chronic stresses and acute shocks they experience*" (100 Resilient Cities, 2018)

Another definition is used by the United Nations Office for Disaster Risk Reduction, namely:

> *"the ability of a system, community or society exposed to hazards to resist, absorb, accommodate, adapt to, transform and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions through risk management."* (United Nations Office for Disaster Risk Reduction, 2018)

Also in academia, a wide range of definitions of urban resilience exist. Meerow et al. (2015) combined 25 influential research articles on urban resilience from different perspectives, ranging from engineering to social sciences, to constitute a definition. Meerow et al. (2015) ranked the 25 most popular definitions found across these papers based number of citations as a means for indicating its importance within the scientific community. Based on this review, a new definition was created:

> *"Urban resilience refers to the ability of an urban system-and all its constituent socio-ecological and socio-technical networks across temporal and spatial scales-to maintain or rapidly return to desired functions in the face of a disturbance, to adapt to change, and to quickly transform systems that limit current or future adaptive capacity."* (Meerow, Newell, & Stults, 2015)

The definition of Meerow et al. (2015) was found to be most inclusive and clearly formulated, stressing the return to desired function in the face of disturbances. Also, its definition fits well within the (influential) literature on urban resilience. Hence, this definition will be used in the continuation of this research.

2.2 Knowledge transfer

The RbD project introduced with its design competition an entirely novel way of solving resilience problems. RbD offered a chance to think outside of the box, allowing international design teams to come up with innovative solutions. In RbDHR, large parts of the strategic plan were designed by international consultants operating from their respective fields of expertise. Inherent to this approach is that, following from their expertise, each team member brings in best practices which they aim to apply to the RbDHR project. However, the transferability of these conducts to dissimilar environments is being questioned.

The leading design principles in the RbDHR strategic plan concerning water management and engineering were created by RHDHV, largely from their Dutch perspective on how to effectively manage water. However, there are vast differences between how The Netherlands and the United States deal with water (Wesselink, 2007; Bijker, 2007). Both countries share a comparable history regarding disasters involving flooding, but the way it shaped the general perception on water management is different. The ruling paradigm in the US is that of hazard mitigation: early warning systems, evacuation plans and federal flood damage insurances (Bijker, 2007). Whereas in The Netherlands the paradigm is one of flood prevention, resulting in a technological culture of having extremely fail-safe water defence structures. The US has long been focussing on cure rather than prevention, but recent events such as Hurricane Sandy show that more focus on preventive measures is needed.

Seen the fact that the US and The Netherlands operate within such different water management paradigms, the transferability of water management practices requires particular attention. International knowledge transfer considers the extent to which knowledge and practices can be successfully transferred from one environment to another. Where methods, techniques, and know-how are well-transferable, philosophy, ideas and principles show not to transfer very well between disparate environments (Stead, 2012). Factors impeding the transferability of specific practices are for example political and administrative cultures. In the case of RbDHR, the transferability of knowledge and practices is highly relevant seen its international design team. Based on research, it is expected that the techniques and methods behind proposed resilience-enhancing measures transfer well, but the underlying philosophy will be hard to transfer due to the differences in the ruling water management paradigm (Stead, 2012). It is argued that if the underlying philosophy is not taken over by the authorities and citizens in the RbDHR project area, the feasibility of implementation will be significantly reduced.

2.3 Adaptation processes

In academic research, resilience and climate change adaptation are closely related terms. The RbDHR project can be seen as an adaptation process as it involves adjusting the natural and physical systems to increase the flood resilience of the project area. However, the definition of adaptation varies across academic literature as the term is applied to many fields of research. Amongst the most cited research papers on climate change adaption is that of Moser & Ekstrom (2010), introducing a framework for studying these adaptation processes and the barriers that arise within. Pahl-Wostl (2009) uses a different approach which is less related to climate change adaptation but instead focusses on changes in governance regimes (adaptive capacity) to cater for successful adaptation. Both studies, however, connect to resilience, mentioning resilience as part of the climate change adaptation process. The intertwinement of these concepts explains why urban resilience itself has not been extensively studied as a stand-alone subject but instead as a part of academic literature on climate change adaptation. Climate change adaptation has been studied frequently in the past and its definition varies across several scientific articles (Weyrich, 2016). One of the most widely accepted definitions is that of the Intergovernmental Panel on Climate Change (IPCC), yet this study on RbDHR deviates from this definition. Moser & Ekstrom (2010) chose a broader perspective on adaptation in light of climate change, following a modification in the definition of the IPCC. Other authors in the field use stricter definitions, such as Pahl-Wostl (2009) who only confines to climate change adaptation regarding governance regimes. Moser & Ekstrom recognise that adaptation in face of climate change is not by definition justified by climate change alone. Moreover, the outcomes of these adaptation processes are not necessarily effective (Moser & Ekstrom, 2010). This leads to the following alternative definition of adaptation:

> *"Adaptation involves changes in social-ecological systems in response to actual and expected impacts of climate change in the context of interacting nonclimatic changes."* (Moser & Ekstrom, 2010)

In this research, adaptation is considered in the sense of adjusting the natural and human systems to reduce the impact of shocks and stresses as a means to increase urban resilience. In this definition of adaptation, barriers in the RbDHR process constitute reasons for not succeeding in moderating harm or exploiting beneficial opportunities due to the impediments they impose.

2.4 Adaptation frameworks

Academic literature provides many perspectives and tools for analysing barriers to adaptation in resilience enhancement processes. Before choosing a framework to be used in this research, two potentially relevant frameworks were identified from the literature and were subsequently assessed on their applicability.

System innovation approach

One perspective on barriers impeding the RbDHR process is provided by system innovation literature. System innovation concerns innovation as a process based on interaction between people, enterprises and institutions. This complex process of interaction determines the success of innovation (Woolthuis, Lankhuizen, & Gilsing, 2005). Following this perspective, one sees the failure for a system to innovate as a barrier to accommodating true change. Woolthuis et al. proposed a policy framework for addressing these failures in system innovation, building upon existing system failure frameworks from literature as to provide a clearer, better applicable framework to assess failures in system innovation. (Woolthuis, Lankhuizen, & Gilsing, 2005) The framework consists of an overview of different types of system failure clusters, namely market failures and structural system failures, and can be used as a tool for analysing where, which and why system innovation failures occur.

Due to the framework's broad scope and limited level of detail, other authors have further operationalised this framework for specific fields of adaptation research (Weber & Rohracher, 2012; Kuokkanen, Mikkilä, Kahiluoto, Kuisma, & Linnanen, 2016). The framework was for example further developed for use in sustainability transition (Weber & Rohracher, 2012) and food system innovation (Kuokkanen, Mikkilä, Kahiluoto, Kuisma, & Linnanen, 2016). Weber & Rohracher (2010) further extended and improved the framework with a new category of system failures, as they found the framework of Woolthuis et al. too limited. Kuokkanen et al. (2016) have subsequently adapted the framework of Weber & Rohracher (2012) by rearranging system failures into new categories, forming a new framework specifically for the food industry. The framework by Kuokkanen et al. (2016) was particularly adapted to the food industry and was therefore found not to be applicable to the case of RbDHR. The framework by Weber & Rohracher, however, seems to align more with the case topic as it concerns sustainability transitions in general.

The framework of Weber & Rohracher provides a clearer structure than the preceding one by Woolthuis et al. as it directly links failure mechanisms with corresponding failure types instead of solely naming general failure types. Weber & Rohracher have combined the framework of Woolthuis et al. with a multi-level perspective to better describe long-term transformation processes (Weber & Rohracher, 2012). In short, the multi-level perspective considers three hierarchical layers in which transition processes take place, leading towards long-term transformation. These regimes are technological niches, socio-technical regimes and socio-technical landscape. Regimes are embedded within landscapes and niches are embedded within regimes (Geels & Schot, 2010). Innovation processes take place within all three levels to accommodate true system innovation (Weber & Rohracher, 2012). Resulting from combining the system innovation framework of Woolthuis et al. (2005) with the multi-level perspective as explained by Geels & Schot (2010), an improved framework was created adding a third category – transformational system failures – to the framework.

Planned adaptation approach

Another perspective on barriers to adaptation is offered by Moser & Ekstrom (2010), introducing a framework based on the three common phases in the process of planned adaptation: understanding, planning, and managing. This definition of the process of adaptation, drawing upon common phases in rational decision-making processes, provides the basis for this framework. The framework resembles the entire adaptation process, from detecting the problem in the understanding phase up to the evaluation of the adaptation process in the final managing phase (Moser & Ekstrom, 2010).

The outcome of the research by Moser & Ekstrom is a diagnostic framework on barriers to climate change adaptation, being applicable to a wide range of adaptation cases. The construction of the framework is guided by four principles: (1) socially focused but ecologically constrained; (2) actor-centred but context-aware; (3) outcome-oriented; and (4) structured for convenience (Moser & Ekstrom, 2010). First of all, the framework focusses on social interactions between actors who are not autonomously reacting to a changing environment but who are constantly thinking, acting and feeling about the process. Yet, actors are ecologically constrained. Secondly, the framework is actor-centred, acknowledging the crucial role of a variety of actors in adaptation processes. Many barriers to adaptation are linked to the actions of actors themselves (Weyrich, 2016). Awareness of contextual factors is however required, since these factors (unconsciously) influence the actors' thinking and constrain the freedom to act in certain ways (Ekstrom, Moser, & Torn, Barriers to Climate Change Adaptation: A Diagnostic Framework, 2011). Thirdly, the framework balances between a focus on process and on action outcomes. By nature, the interaction between actors in adaptation processes is dynamic and ongoing, still what counts in the end are the (un)conscious decisions made by the actors (Ekstrom, Moser, & Torn, Barriers to Climate Change Adaptation: A Diagnostic Framework, 2011). Lastly, Moser & Ekstrom acknowledge that these adaptation processes rarely follow a well-structured sequence of steps but are in fact messy and iterative. However, the structured approach in this framework enables a more straightforward and more convenient analysis of barriers to adaptation, although these processes in reality are less structured than the framework shows (Ekstrom, Moser, & Torn, Barriers to Climate Change Adaptation: A Diagnostic Framework, 2011; Weyrich, 2016).

The framework contains three phases and nine stages, each phase having three stages (Figure 2). The four guiding principles which Moser & Ekstrom implemented for the sake of convenience allows a systematic identification of barriers using their framework. Every one of the nine stages leads to another stage, and barriers within each stage can impede the process of moving towards the next stage in the adaptation process (Moser & Ekstrom, 2010; Ekstrom, Moser, & Torn, Barriers to Climate Change Adaptation: A Diagnostic Framework, 2011).

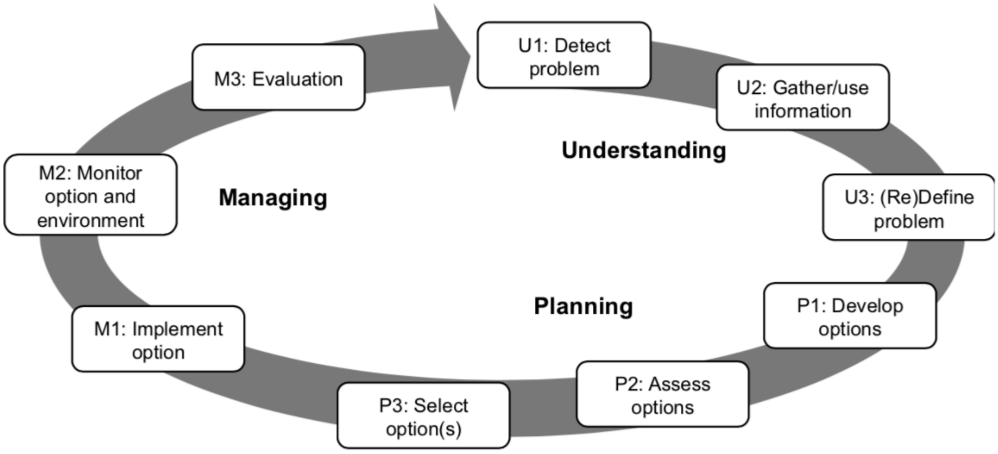

Figure 2: Components of the adaptation barrier framework: phases and stages throughout the adaptation decision-making process. Reprinted from "A framework to diagnose barriers to climate change adaptation", by S.C. Moser and J.A. Ekstrom, 2010, PNAS, 107, p. 22027.

For every one of the nine stages, Moser & Ekstrom identified barriers. The entire framework consists of 50+ barriers to adaptation, sorted per phase and stage. This framework thus allows for a detailed barrier analysis based on the principle of three phases in the adaptation process. Additionally, Moser & Ekstrom developed a set of diagnostic questions for each phase of the adaptation process to aid in identifying barriers.

Conclusion

Evidently, there are more frameworks to be found, also outside of academic literature. Several organisations such as the United Nations, 100 Resilient Cities organisation and the World Bank have created frameworks for resilience as well. These are however broadly defined and do not provide a structured approach towards uncovering barriers to adaptation in resilience projects, but rather show what constitutes resilient societies. Therefore, these frameworks are not suitable for guiding this research along. There are also more frameworks to be found in academic literature than those identified in this chapter. For the purpose of this study, frameworks were solely distilled from the most influential papers on climate change adaptation, resilience enhancement and system innovation, based on the article's respective number of citations.

The frameworks of Woolthuis et al. (2005) and Weber & Rohracher (2012) on system innovation provide an approach that has not yet been widely applied on resilience enhancement processes; its applicability is thus unknown. A system innovation approach to adaptation processes appears to be interesting due to its novelty in the resilience field. However, it has to be concluded that neither of these framework provides a well-structured approach towards analysing the barriers in the RbDHR process. Moreover, the failure mechanisms within the frameworks are only briefly introduced. Since adapting this framework to the field of resilience enhancement is beyond the scope of this study, it will not be used as a guiding framework.

The framework by Moser & Ekstrom (2010) provides a solid basis towards uncovering barriers to adaptation following its three-phase model, since it has already been successfully applied to the field of climate change adaptation. For example, Weyrich (2016) has used this framework for analysing barriers to climate change adaptation in urban areas in Germany. Given the similarities between this case and RbDHR, this provides a good indication for the applicability of the framework in this study. Also, the framework provides a structured approach along the three stages and nine phases for systematically identifying barriers. Since the framework of Moser & Ekstrom (2010) is regarded most compatible with the scope of this study, it will therefore be used in the continuation of this research to streamline the process of uncovering impediments/barriers to RbDHR.

2.5 Framework for identifying barriers and enablers

Having chosen a suitable framework for addressing barriers the in RbDHR process, the next step is to apply this framework to the case of RbDHR. In order to do so, it will first have to be further operationalised to include enablers and provide a solid basis for the research methodology.

In uncovering barriers and enablers in RbDHR, a proper representation of the different types of barriers and enablers is needed for systematically extracting these from the data. The framework of Moser & Ekstrom however identifies over 50 different types of adaptation barriers, making it infeasible to match data to all of these possible barriers. In order to do so, aggregation of these barriers into clusters is required. Several researchers have identified clusters of barriers to adaptation (Ekstrom & Moser, 2014; Moser & Ekstrom, 2010; Biesbroek, Klostermann, Termeer, & Kabat, 2011; Trogrlić, 2015). Ekstrom & Moser (2014) built upon their own framework in a case study on urban climate adaptation in San Francisco's Bay Area, introducing as many as 12 clusters of barriers to adaptation. Trogrlić (2015) introduced five broadly defined clusters for categorising Green Infrastructure barriers to adaptation: financial, technical, physical, institutional and legal. Moreover, Biesbroek et al. (2011) introduced seven categories derived from a literature review. As there are many more attempts to cluster barriers to adaptation, one has to conclude that there is no universal set of clusters for adaptation processes because barriers (and enablers) to adaptation are highly context-specific (Weyrich, 2016).

Following an extensive literature review, Weyrich (2016) combined different adaptation barrier classifications, including the ones mentioned earlier, into nine clusters of barriers to adaptation applying specifically to climate change adaptation in urban areas, and matching the framework of Moser & Ekstrom (2010). This categorisation was found to have a well-noted basis in climate change adaptation literature. The clusters of Weyrich (2016), with the exclusion of one cluster, have therefore been used as a basis for identifying barriers and enablers in this study. The cluster 'adaptation processes' was left out as, in contrary to the other clusters, no proper references for the existence of this cluster were provided. The clusters as derived from Weyrich (2016) are shown in Table 1.

Table 1: clusters and description of barriers and enablers derived from the literature

Cluster	Description
Conflicting timescales and conflicts of interest	Divergent objectives, needs, scope and priorities
Leadership	Availability and capabilities of leadership
Resources	Financial means, technical resources, technology, staff expertise and time
Science	Availability and accessibility of information, scientific understanding
Governance and institutional constraints	Institutional governance issues, laws and regulations, structural and operational constraints
Lack of communication and awareness	Communication, information, understanding and awareness about the problem, solutions and their implications
Attitudes, values and motivations	Behavioural obstructions and personalities of individuals in critical positions, cultural values
Politics	Political influences

Table 1 shows the basis of clusters for categorising barriers and enablers. During the research, changes were made in this composition of this list through inductive reasoning. The methodology chapter of this study (chapter 4.3) covers this modification based on observations.

3. CASE DESCRIPTION

This study concerns the case of the Rebuild by Design Hudson River project in New Jersey, USA. This chapter describes the case selection process and introduces the project from multiple perspectives, providing insights into the history, topography, status regarding flood resilience and participation in the RbD competition.

3.1 CASE SELECTION

For the purpose of this research, the RbDHR project was chosen because of its relevance in the resilience field and the representativeness for other urban areas facing flood resilience challenges in the US.

Hoboken has a long history of flooding events which have long been unattended to, seen the city's past efforts on flood resilience. In the recent history this changed after Hurricane Sandy caused massive devastation in the New York and New Jersey area, including Hoboken. Similar to Manhattan, Hoboken is among the most severely hit cities in the area affected by Hurricane Sandy. Hoboken's vital role in public transport caused even more disruption outside of the impact on the city itself. The necessity for the city of Hoboken to take action to improve its flood resilience became apparent in the immediate aftermath of Hurricane Sandy. Its great vulnerability had been shown to the authorities and inhabitants, leading to the demand for extensive operations to improve its resilience. Being named a role model city by the United Nations for its resilience efforts, including its effective response to Hurricane Sandy, it shows that the case of Hoboken is highly relevant to the resilience field (United Nations Office for Disaster Risk Reduction, 2015).

Besides its relevance in the resilience field, Hoboken's representativeness makes it a valuable case for studying barriers in resilience-enhancement processes as well. Hoboken is a relatively small area ($3,3 km^2$), yet it is the 4^{th} densest city in the US (United States Census Bureau, 2010). These characteristics make Hoboken highly vulnerable to the consequences of disruptive events, e.g. social, infrastructural and economic losses caused by flooding. Like many cities in the US (New York, Miami, etc.) and worldwide, Hoboken shares a high population density, high population growth and limited space to build. Moreover, Hoboken's infrastructural characteristics resemble that of many other (dense) US cities: impervious surfaces and a deficit of parks and green areas that aggravate the likelihood and effects of flash floods occurring due to heavy rainfall (Nowak & Greenfield, 2012).

The relevance of RbDHR in the resiliency field and the representativeness of Hoboken in relation to other (US) urban areas makes it a good case for uncovering the governing barriers and enablers to adaptation in flood resilience enhancement. General recommendations on improving resilience-enhancing projects can be drawn from this research to inspire other urban areas facing similar problems. It is however to be noted that context differs in every city, thus uncovered barriers and enablers in RbDHR cannot be generalised to apply in the same composition to other urban areas.

3.2 THE CITY OF HOBOKEN

The city of Hoboken is situated in the east of New Jersey, alongside the Hudson River separating the state of New Jersey and the state and city of New York (Figure 3). Situated right across the Hudson River from Manhattan, Hoboken resides about 55.000 citizens of which many commute to New York City on a daily basis (United States Census Bureau, 2010). Hoboken, being part of the New York Metropolitan area, serves as an important transportation hub between New Jersey and New York. An estimated 56% of its inhabitants use its public transportation facilities to travel to and from the 'Big Apple', making Hoboken the city with the highest use of public transportation in the US (Vardi, 2011). Partly because of its favourable location relative to New York City, being relatively quiet yet close to the city, Hoboken is a popular place to live for young and higher educated people who often work in Manhattan (United States Census Bureau, 2010).

Hoboken used to be an island, surrounded by wetlands and marshes, in the Hudson River until it was impoldered in the 19th century to create more land to build on. The majority of the city used to be marshes, still visible in its topography. The former island part is called Castle Point (Terrace) and nowadays accommodates the Stevens Institute of Technology, founded by the original inhabitants of the island. Hoboken has been a major transportation hub since the end of the 19th century, serving as a port for international freight and passenger ships. The first direct connection to Manhattan opened in 1908 with the start of the Hoboken-Manhattan subway line. Its transportation hub opened in the same year (City of Hoboken, 2018).

Figure 3: Location of the city of Hoboken. Reprinted from Google Maps (Google, 2018).

3.3 Flood resilience in Hoboken

Due to its topography, Hoboken is very vulnerable to both coastal flooding and stormwater flooding (City of Hoboken, 2018). As shown in Figure 4, Hoboken's topography clearly reveals significant differences in elevation between Castle Point and parts of the waterfront areas, constituting the former island of Hoboken (indicated in red), and the low elevation areas which used to be wetlands and marshes (indicated in yellow and grey). Hoboken's inland borders, also showing red on the elevation chart, indicate what used to be the beginning of the actual land before the marshes and wetlands were impoldered. The former wetlands show a 'bathtub' effect in retaining water once it flows over Hoboken's quays or pours down in an excessive amount from its sky. Once water gets in, it will not runoff to the river by itself.

Figure 4: Elevation chart of Hoboken. Reprinted from "Rebuild by Design Action Plan Detailing" (p.18), by AECOM, 2018

This topography constitutes the basis of the flooding issue in Hoboken. Its flooding vulnerability is twofold. First of all, the city often deals with stormwater flooding. Hoboken relies on an old sewer system with a limited discharge capacity, combining wastewater and stormwater. The discharge capacity is limited by the wastewater treatment plant in the North of Hoboken. In events of heavy rainfall and depending on the pollution of the runoff water, the treatment plant can quickly reach its capacity as it does not separate stormwater (which does not need treatment) from the sewer system. In these events, the excessive amount of water (wastewater combined with stormwater) is discharged into the Hudson River. Discharge is however not always possible, seen that various outfalls in the Hudson River are located below high tide level. Not all of these outfalls are equipped with 'wet weather' discharge pumps allowing for discharge during high tide. Heavy rainfall and high tide combined thus often causes parts of Hoboken to face stormwater flooding (City of Hoboken, 2018; State of New Jersey, 2015). Secondly, Hoboken is also vulnerable to coastal flooding caused by surges from the Atlantic Ocean/Hudson River. Seen its proximity of just 2km to the New York's Upper Bay (Atlantic Ocean), natural disasters such as hurricanes can easily cause surges to reach the Hoboken quays. The absence of water defence structures allows water to flow over Hoboken's quays during such surge events. Subsequently, water will not be able to flow out anymore due to its topographical 'bathtub' effect.

Both these problems demonstrate the lack of flood resilience, also having been acknowledged by the authorities (Federal Emergency Management Agency, 2006). These flooding problems have been known by the authorities for a long time, and some projects addressing the issues of stormwater flooding were already completed before Hurricane Sandy hit Hoboken in 2012 (City of Hoboken, 2018). Nonetheless, the aftermath of Hurricane Sandy showed that Hoboken was not well-prepared to withstand the high water level that came with the hurricane. Considering the effects of climate change, showing an increase in hurricanes and heavy rainfall events, the problem with Hoboken's flood resilience is evident (Melillo, Richmond, & Yohe, 2014).

The absence of (adequate) flood defence measures meant that most parts of Hoboken were flooded during Hurricane Sandy. The devastation of Sandy to the Hoboken community was extensive: 250 million USD in direct damage. Most severely hit was its public transportation infrastructure, taking up half of the costs in direct damage. The PATH train, connecting Hoboken and New Jersey with New York, suspended its service for three months after Sandy due to extensive repair work. In 2018, repairs to the infrastructure of PATH are still ongoing. The aftermath of Sandy created significant momentum for taking action to increase its flood resilience, allowing for a complete re-evaluation of the current state of flood protection in Hoboken. One of the preliminary outcomes of the reassessment was a flood map of the Hoboken area portraying different coastal flooding scenarios. In Figure 5, the blue area shows the parts that flood at a certain surge height of 3 respectively 1 meter above normal sea level. Surges like the one during Hurricane Sandy, 4m above sea level (City of Hoboken, 2018), are extreme events. However, Figure 5 shows that even a 1m surges already cause flooding in Hoboken, indicating its overall high vulnerability.

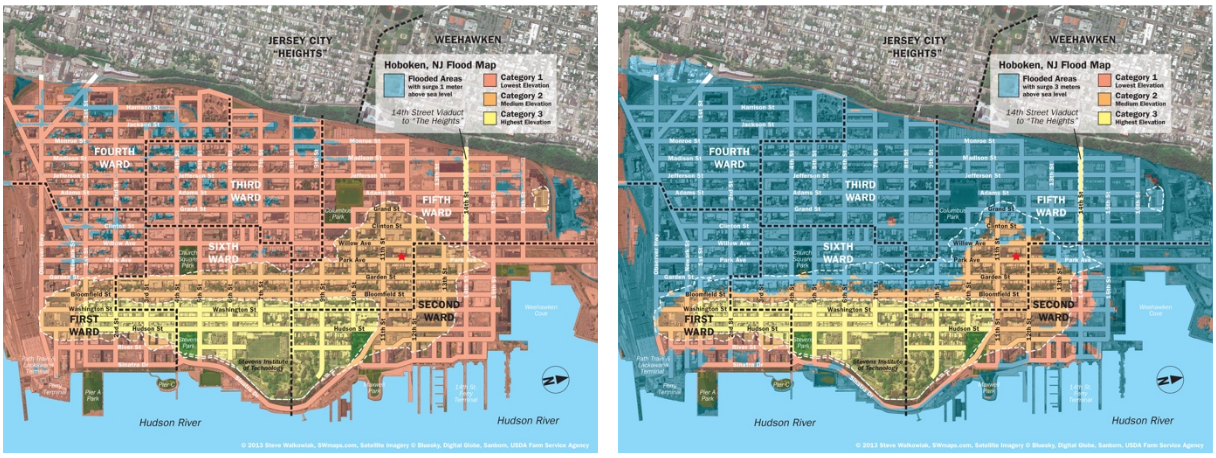

Figure 5: Inundation maps of Hoboken showing respectively 1m (left) and 3m surges (right). Reprinted from "New Hoboken Flood Map with Water Levels, Post Hurricane Sandy", by Walkowiak, 2013

3.4 Rebuild by Design in Hoboken

In the aftermath of Hurricane Sandy in 2012, the US federal government started its elaborate rebuilding works. Following the lessons learned from Hurricane Katrina in New Orleans, the aftermath of Sandy led to an extensive process of building for a more resilient city, instead of solely rebuilding to pre-Sandy conditions. This led to the creation of the Rebuild by Design campaign, uniting internationally respected water engineers. The Rebuild by Design campaign led to the creation of several separate projects in the Sandy-affected area. A bottom-up approach was chosen in which international teams could apply and propose solutions for enabling increased flood resilience (Ovink & Boeijenga, 2018).

The authorities in New Jersey started a lengthy process focussing on flood resilience enhancement for the city of Hoboken under the name of the Rebuild by Design Hudson River project. The project area concerns the entire municipality of Hoboken including the north-eastern tip of Jersey City surrounding the Long Slip Canal and the southern part of Weehawken surrounding the Weehawken Cove. The project area is shown in Appendix 4. Team OMA created a strategic plan to set the desired future state of Hoboken's water protection, encompassing protective measures for both storm surges and rain-based flash floods. The proposal by Team OMA called 'Resist, Delay, Store, Discharge: A Comprehensive Urban Water Strategy' ended up being one of the winning projects in the RbD competition. Team OMA united multiple companies and their expertise, Royal HaskoningDHV for water management and engineering, Balmori for land-use planning, HR&A for economic consulting and OMA architectural design (Office for Metropolitan Architecture, 2018).

In 2014, Team OMA completed their integral strategic plan for flood resilience enhancement in Hoboken, showing how to prevent damage and minimise societal disruption in case of future water-related shocks and stresses. Team OMA presented an integral approach to achieving a more flood resilient Hoboken, focussing on four key components of *Resist – Delay – Store – Discharge* as shown in Figure 6. After the completion of Hoboken's strategic plan for resilient water management by team OMA, the implementation cycle started. This involved converting the visionary strategic plan into a detailed implementation plan. From the conversion onwards, RHDHV had not been involved in the project anymore. Other parties kept working on the project, doing a re-evaluation of the strategic plan from Team OMA in 2014 and 2015 and converting this re-evaluated plan into an implementation plan by August 2017. At the moment of writing, Hoboken is in the phase of preparing construction and acquiring building permits to turn the implementation plan into reality (AECOM, 2018). The project is scheduled to be completed by 2022. The project's timeline is visualised by Figure 1 in Chapter 1 of this study.

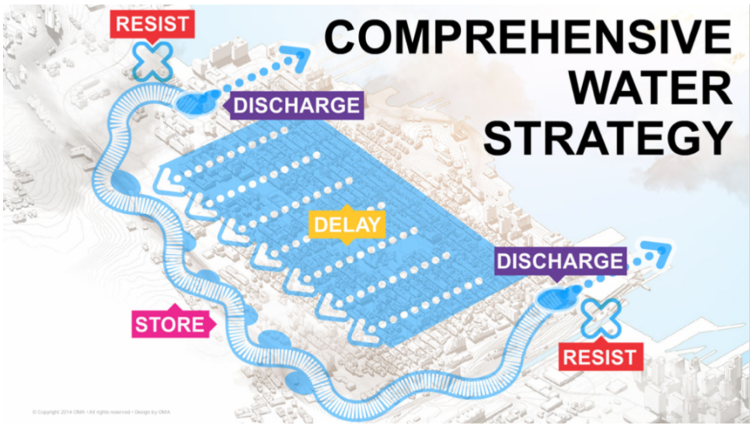

Figure 6: Strategic plan proposed by Team OMA. Reprinted from "Resist, Delay, Store, Discharge: A Comprehensive Urban Water Strategy" (p. 64), by Team OMA, 2014

4. METHODOLOGY

This chapter provides information on the methodology applied in this study. It contains information on the research design, data collection, and methodology for data analysis through the different stages of research. The chapter concludes by describing limits and threats to this study and showing how these were addressed.

4.1 Research design

This study concerns a qualitative approach in uncovering barriers and enablers to adaptation in a single-case study on the Rebuild by Design Hudson River project. A case study approach was chosen as it enables in-depth analysis of the phenomenon within its real-life context, being of substantial importance in complex cases such as resilience adaptation processes (Yin, 2003). Case study research enables using a variety of techniques, amongst which observations and personal accounts, which cannot be easily captured by quantitative analysis. Using such an approach allows for deeper understanding of the (causal) mechanisms that are apparent in processes such as the one under investigation in this research (Gerring, 2009). The ability to generalise outcomes from a single-case study outcome is often debated, depending on e.g. the representativeness of the case, as cases can be very context-dependent. Nevertheless, selecting a critical case can greatly add to generalisability (Zainal, 2007; Steinberg, 2015). Case study research respects the complexity of social interaction and human behaviour (Gerring, 2009). It is therefore found to be a good approach for analysing the complex structures that influence adaptation in the resilience-enhancement process of the Rebuild by Design Hudson River project.

The research consists of multiple phases matching with the research objectives (RO) and research questions (RQ) of this study. First, desk research and a literature analysis were done to acquire sufficient information about the RbDHR project and its environment and to constitute the basis for the methodology being described in this chapter (RQ1). Chapter 2 shows the results of this analysis. The second phase is a comparative analysis between the RbDHR strategic plan and implementation plan to analyse the course of RbDHR process over the years (RQ2, RO1). The third and final phase consists of the identification and analysis of barriers and enablers in the RbDHR process (RQ3, RO2).

4.2 Comparative analysis

This chapter elaborates on the data collection and methodology for the comparative analysis. This phase of the research concerns analysing the extent to which the RbDHR project has undergone changes by uncovering whether there are differences between the strategic plan and implementation plan.

4.2.1 Data collection

An analysis of available documentation about the RbDHR project was conducted, allowing for a good understanding of the data coverage for RbDHR. First of all, data was collected about the city of Hoboken and its surroundings, providing insights into the status quo of its flooding background and context. Next, the strategic plan and implementation plan, as well as other reports relevant to the conversion from the strategic plan to the implementation plan, were collected. The 'strategic plan' refers to 'Resist, Delay, Store, Discharge: A Comprehensive Urban Water Strategy' which was created by Team OMA in 2014. The 'implementation plan' refers to the document 'Action Plan Amendment Number 20 - Substantial Amendment for The Final Design of Rebuild by Design Hudson River Project' composed by the State of New Jersey Department of Environmental Protection – Bureau of Flood Resilience in 2017. Table 2 shows an overview of the collected data for this phase of the research.

Table 2: collected data for comparative analysis

Data	Type	Source
City of Hoboken information	Website	City of Hoboken website
RbDHR Strategic Plan	Report, 180 pages	Royal HaskoningDHV
RbDHR Scoping Document	Report, 226 pages	RbDHR website
RbDHR Feasibility Study	Report, 310 pages	RbDHR website
RbDHR Implementation Plan	Report, 71 pages	RbDHR website

The RbDHR scoping document, a feasibility study, and the implementation plan were collected from the official RbDHR website of the State of New Jersey. An extended version of the RbDHR strategic plan, including water engineering details, was obtained from Royal HaskoningDHV as this version was not publicly available.

4.2.2 *Methodology for data analysis*

Based on the consultation of experts from Royal HaskoningDHV, it was expected that the implementation plan deviates from its originating strategic plan in terms of its resilience measures, because of the existence of barriers in the RbDHR project impeding the process and altering its outcomes. This assumption, although based on knowledgeable and involved actors, is subject to bias and will have to be proven. The purpose of this stage of the research is therefore to identify possible differences in resilience measures between the strategic plan and implementation plan and assess whether these are significant. Evaluating the consequences of these differences in terms of achieved resilience is not within the scope of this research.

Assuming that the assumption about the existence of differences is correct, this could cause the researcher to solely look for evidence supporting this claim. To eliminate this researcher bias, it is first concluded that there are no significant differences until proven otherwise. To guide this process, the following hypotheses were formally established:

> H_0: There are no substantial differences between the strategic plan and the implementation plan in the RbDHR project.
>
> H_1: There are substantial differences between the strategic plan and the implementation plan in the RbDHR project.

As the null-hypothesis indicates that there is no significant difference, evidence to reject the null-hypothesis is required to be able to accept the alternative hypothesis. In order to do so, it needs to be stated under what conditions (or: which evidence is required) the null-hypothesis is to be rejected.

The null hypothesis is to be rejected if one of the following applies:

- The integral key philosophy of *Resist – Delay – Store – Discharge from* the strategic plan is not present in the implementation plan (some or all of the four elements are missing);
- The ratio between the *Resist – Delay – Store – Discharge* elements in the implementation plan differs from the strategic plan (e.g. all the focus has been put on *Resist*);
- Concrete measures proposed under one or more of the *Resist – Delay – Store – Discharge* elements in the strategic plan are not present in the implementation.

This process involves an in-depth qualitative comparison of the contents of the strategic plan and implementation plan. Following from the criteria for null-hypothesis rejection, the plans are compared on the main elements only: Resist – Delay – Store – Discharge. For each of these elements, the proposed measures were extracted from both plans and subsequently compared. The comparison was based on visuals of the proposed measures from both plans, using provided maps depicting the location, size and the type of measures. The findings are supported by in-text explanation from both plans. The other collected data as described in the previous section was used in this comparison for supporting specific claims or providing further details which were not necessarily always provided by the two main documents.

4.3 Analysis of barriers and enablers in RbDHR

Having identified the differences in resilience measures between the strategic and implementation plan, this second phase in the research aims to uncover the impeding and promoting factors in the process of RbDHR, possibly leading to changes in its outcome. This chapter elaborates on the data collection and data analysis for this phase of the research.

4.3.1 Data collection

Different types of quantitative data were collected for this phase of the research through several sources. Data is divided into primary and secondary data, based on how it was collected. Primary data concerns all data that was collected by the author for this specific study. Secondary data was gathered by others for different (research) purposes but was found to be applicable/useful to this study as well. Table 3 displays an overview of the collected data for this phase of the research.

Table 3: collected data for analysis of barriers and enablers

Data	Type	Source
Primary		
Stakeholder interviews	Transcripts	10 interviews – conducted by author
Public hearing notes	Transcripts	RbDHR website
Newspaper articles	Articles	Websites Hudson Reporter, New York Times
Secondary		
Stakeholder Interviews	Transcripts	14 interviews – conducted by others (Trogrlić, 2015; Staas, 2017)

The principal data is provided by the interviews with stakeholders. All interviews, concerning both the primary and secondary data, were conducted in English, had a duration of between 30 and 75 minutes, and were fully audio-recorded. After each interview, the audio-recording was transcribed. The interview transcripts were subsequently used for data analysis. All interview data presented in this report was anonymised as to protect the privacy of the interviewees. Appendix 3 presents detailed information about the data sources.

Primary data

Primary data were collected through in-depth semi-structured interviews. Moreover, public hearing reports from RbDHR's Community Advisory Group as well as newspaper articles covering RbDHR, both describing a community-centred perspective on RbDHR, were collected to further complement the interview data.

A total of 10 interviews were carried out in Hoboken in June and July 2018. The primary interview data concerns a variety of actors from different backgrounds, ranging from government officials to resilience consultants and from citizens to academics. All interviews took place in-person or through Skype/phone when meeting in-person was not possible. The interviewees were principally selected based upon advice from RHDHV, aiding in the constitution of a list of key actors in the RbDHR process. Furthermore, more possible interviewees were contacted based on the advice from actors and gathered insights during the process of conducting interviews ('snowball effect'). All interviewees were contacted via email using a uniform invitation letter (Appendix 1). To prevent conducting interviews providing similar results, actors that had already been interviewed in the past and whose interviews were thus present as secondary data, were not interviewed again. In a few occasions however, interviewees from the secondary data set were approached again for the new series of interviews, depending on their relative importance in the Rebuild by Design project and the usefulness of the information from previous interview transcripts. Before starting the interview, each interviewee was presented a consent form describing the use and confidentiality of the interview data. The semi-structured interviews consisted of mainly open questions. To allow for comparability, all interviews followed the same interview script, shown in Appendix 2. This script was based on the three phases in planned adaptation (section 2.4) and the framework of clusters for barriers and enablers (section 2.5) The questions focussed on the stakeholder's involvement in RbDHR, views on resilience, and mainly on the barriers and enablers in different parts of the RbDHR process. A detailed list of the primary interview data is provided in Table 8 in Appendix 3.

To complement the data from interviews, reports from 21 public hearings of the RbDHR Community Advisory Group (CAG), a group of involved citizens, were collected from the state of New Jersey RbDHR website. The CAG consists of a few dozen citizens from different backgrounds representing the community of Hoboken. These members are very knowledgeable about RbDHR and provided input on contents as well as the process during the entire RbDHR project. Furthermore, local and regional newspapers articles about RbDHR were collected. These articles were selected based on title and were quickly scanned to assess the contents. Articles just providing factual data on e.g. meeting times were filtered out. The final selection consists of ten newspaper articles, of which nine from the Hudson Reporter and one from the New York Times. A detailed list of this data is provided in Table 9 in Appendix 3.

Secondary data

Secondary data consists of interviews conducted during two past research projects on barriers to adaptation in the same case study (RbDHR) but with a different focus.

A total of 26 interview transcripts from two different studies dating from 2015 and 2017 were collected. Both studies concern implementation barriers in the RbDHR project but focus more specifically on Green Infrastructure implementation (Delay element), covering most of the key actors in the process (Trogrlić, 2015; Staas, 2017). In his research on making cities flood resilient by implementing Green Infrastructure, Trogrlić (2015) conducted a series of 18 interviews with a variety of stakeholders involved in RbDHR. Moreover, Staas (2017) conducted eight interviews in 2017 for a study on governance context for green infrastructure implementation.

All interviews were examined after which a selection was made of interviews relevant to this research. Not all interviews were found to be useful to this research depending on the organisation and job title of each of the interviewees. Interviews solely concerning Green Infrastructure organisations were therefore left out in the continuation of this research. A total of 14 interview transcripts remained, of which eight from Trogrlić (2015) and six from Staas (2017). Table 10 in Appendix 3 shows the respective backgrounds of the remaining 14 interviewees. Before analysing these, all questions and answers solely concerning Green Infrastructure were excluded from the dataset as to make sure that data which does not resemble the entire RbDHR process was not used in the data analysis phase.

4.3.2 Methodology for data analysis

All collected data were examined in order to identify barriers and enablers in the RbDHR process. First of all, a formal definition of barriers and enablers had to be established. The following definitions of barriers and enablers are used in this research:

A barrier is an event or contextual factor that impedes the development of the RbDHR project.
An enabler is an event or contextual factor that promotes the development of the RbDHR project.

Following the definition of enablers, it is to be noted that disagreeing with an event or contextual factor being a barrier does not imply that this is in fact an enabler. For an event or contextual factors to be marked as an enabler, it has to have a significant positive influence on the (development of the) RbDHR project.

Atlas.ti software was used as a tool for data analysis in this phase of the research. Atlas.ti provides comprehensive tools for analysing qualitative data based on the principle of data-coding. A database was created in Atlas.ti containing all collected primary and secondary data. The data analysis process involved the author analysing the documents and labelling, referred to as 'coding', specific parts of text showing barriers or enablers in RbDHR.

A categorisation into clusters is applied, using the deductively derived framework presented in chapter 2.5. This grouping into a limited amount of understandable clusters allows for a comprehensive data analysis. This list of clusters was inductively modified based on gathered insights and findings from the interview data analysis. Based on these insights, 'Conflicting Timescales and Conflicts of Interest' was merged with 'Attitudes, Values and Motivations' to constitute a new cluster called 'Alignment of Values and Interests'. Also, 'Science' was renamed to 'Knowledge & Expertise', 'Lack of Communication and Awareness' to 'Community Involvement & Support' and 'Governance and Institutional Constraints' to 'Cooperation & Institutional Constraints in Governance'. To allow for easier recognition of barriers and enablers, keywords were matched with the different clusters. The keywords were initially gathered from Weyrich's[1] (2016) barriers to climate change adaptation clusters and were then subsequently updated with findings resulting from this data analysis. Table 4 thus shows the result of an iterative process of identifying clusters and keywords, which were both deductively and inductively derived.

Table 4: clusters and keywords for barriers and enablers

Cluster	Keywords
Alignment of Values & Interests	Will, motivation, attitude, values, beliefs, priorities, objectives, scope, commitment, agreement
Community Involvement & Support	Public support, communication, informing, involvement, understanding, awareness, urgency, importance, mistrust in authorities
Cooperation & Institutional Constraints in Governance	administrative structure, cooperation, interaction, partnership, legislation, legal, law, policy, regulation, constraints, jurisdiction,
Knowledge & Expertise	Knowledge, expertise, experience, know-how, information, understanding, training, skills, education
Leadership	Leadership, leader, ambassador, advocate, promotor, champion, endorse
Politics	Politics, political commitment, political priorities, political agenda
Resources	Money, funding, funds, budget, financial resources, time, timeframe, human resources, manpower, natural resources

The first step in the analysis process involved the researcher identifying barriers and enablers from the data. Barriers and enablers were subsequently coded based on the clusters identified in Table 4. Apart from solely identifying specific keywords in the (interview) data and subsequently coding them, their relevance was also taken into account. This means that when certain keywords occurred in the data but were not explicitly mentioned as being a barrier or enabler, these were then not considered as such. Moreover, exclusivity of coding was applied, meaning that a barrier or enabler can only be matched to one cluster. This requires having clearly identified clusters, incentivising inductively

[1] Derived from Biesbroek, Klostermann, Termeer & Kabat (2011), and Ekstrom & Moser (2014)

improving these in the process. The coding stage involved two iterations of the author coding the data. Moreover, cross-validation was applied to allow for increased objectivity in interpreting the data. An independent reviewer who was familiar with but not involved in RbDHR, examined the same dataset and identified and coded barriers and enablers as well. The cross-validation showed a ±70% match with the author's coding. A discussion between the author and the reviewer on the differences in coding followed, providing input for merging and renaming clusters as was described before in this section.

It has to be noted that the goal of this analysis is not to indicate 'favourite' barriers or enablers based on the frequency of occurrence throughout the analysed data. The frequency of occurrence does not provide information on how hard it is to overcome barriers. Also, it does not necessarily indicate its importance. The goal of this analysis is therefore to identify barriers and enablers in general that impede or promote the RbDHR process, explain how these come into effect and describe their interconnectedness.

4.4 Threats to validity of research

This section briefly discusses the threats to validity that apply to this study, also showing how these threats were subsequently addressed.

One of the threats to this research is posed by researcher bias. An assumption was made by experts that significant differences between the strategic plan and implementation plan exist. Although it was noted that this is merely a hypothesis, this could still lead to the researcher (unconsciously) only looking for specific evidence that aligns with this hypothesis. To reduce this risk of researcher bias, a null-hypothesis was introduced.

Moreover, subjectivity in interview coding also posed a threat to this research. Cross-validation by an independent reviewer took place in order to prevent the researcher from (unconsciously) looking for certain barriers or enablers in coding, allowed for increased objectivity in the data analysis. Also, this contributed to the reduction of human error in analysing the data.

The interview set-up and the way in which questions were formulated is of great significance to the outcome of interviews. For example, suggestive questioning can trick interviewees into giving particular desirable or undesirable answers. Every interview was therefore guided along a fixed script. Also, this script was checked by several reviewers to eliminate e.g. suggestive questions. In order to ensure validity in the interview data, triangulation of data was applied. Interviews were not only conducted by the author, but also interviews from other previously conducted studies and newspaper articles and community hearing reports were used. Using a variety of data sources in this research allowed for a higher validity in this study's results.

5. RESULTS

5.1 From Strategic plan to implementation plan – comparative study

This chapter shows the results of a qualitative comparison between the RbDHR strategic plan and implementation plan.

5.1.1 The core principles of the strategic plan

The strategic plan portrays a vision for Hoboken's resilience enhancement directed towards flood risk mitigation specifically. This concerns threats from the Hudson River/North Atlantic Ocean in the form of storm surges and threats from the sky in the form of flash floods due to excessive precipitation. The strategic plan shows awareness of the complexity and connectedness of dense urban areas like the study area, therefore stressing the necessity for integral planning as a key aspect in the making and the implementation of this resilience strategy. The integral approach in the strategic plan appears in the introduction of four fundamental elements by RHDHV which together constitute the basis for the strategic plan: Resist – Delay – Store – Discharge. These elements originate from the Dutch multi-layer safety approach proposed in its 2009 National Water Plan and the Three Stages of quantitative water management proposed in the Dutch 21st Century Water Management report. The multi-layer safety approach introduces three layers in the process of water protection: 1) prevention of flooding (Resist), 2) spatial organisation and 3) disaster management (Ministerie van Verkeer en Waterstaat, 2009). The Delay – Store – Discharge approach originates from the three stages of quantitative water management which were proposed by the Committee 21st Century Water Management in 2000 (Commissie Waterbeheer 21e eeuw, 2000). Also, the Delay – Store – Discharge elements resemble the hydrological cycle, where water faces run-off resistance on the surface (delay), infiltrates in the soil (store) and discharges into water bodies (discharge). According to Team OMA, combining these elements will provide the best outcome in achieving a flood-resilient Hoboken area.

5.1.2 KEY COMPONENT COMPARISON

Table 5 provides an overview of the results of the comparison between the strategic plan and the implementation plan.

Table 5: overview of resilience measure comparison

Element	Measure	Strategic plan	Implementation plan
RESIST	Surge barriers	Waterfront: retaining walls, terraced edges and deployable walls.	Inland: retaining walls, closable gates on streets.
	Storm sewage system	No	Yes
	Closing the long-slip canal	Yes	No (completion outside of RbDHR)
	Area protected by surge barriers	Hoboken Weehawken Jersey City Hoboken Transit Terminal	Hoboken Weehawken
DELAY	Resiliency Parks	4 Additional green areas in Hoboken and at waterfront.	0 (2 resiliency parks have already been implemented outside RbDHR)
	Green roofs	Yes, throughout Hoboken	No
	Bioswales	Yes	No
STORE	Green corridor	Yes Retention basins Artificial wetlands	No
	Storage tanks	Dozens of cisterns in the green corridor and in town	61 'DSD' tanks in town 3 large stormwater tanks (NW and SW parts of Hoboken)
DISCHARGE	Wet weather pump	1	3
	Storm drain	1	2

Resist

The Resist element concerns hard infrastructure and soft landscape measures for coastal defence (Team OMA, 2014). The core of this key element of the strategic plan lies with creating infrastructure to prevent surges from overflowing quays and water from the Hudson River entering the towns of Hoboken, Weehawken and Jersey City. Multiple measures were therefore proposed as part of the Resist element in the strategic plan by Team OMA. All Resist infrastructure is directly situated at the waterfront. The measures consist of a combination of terraced edges, retaining walls in the form of elevated waterfront walkways and deployable flood walls closing off the protective Resist infrastructure by connecting to Castle Point Hill. Additionally, the strategic plan proposes to close off and fill Hoboken's long slip canal, situated at Hoboken transit terminal, to further protect Hoboken and Jersey City from storm surges.

Upon inspecting the implementation plan, it became evident that the same guiding principle of flood protective infrastructure recurs in this plan. The necessity of protection against surges has settled well in the foundation of the implementation plan. The design and placement of the protective measures have however undergone significant changes. First of all, the location was changed. The Resist measures were initially placed on the waterfront in the strategic plan, ensuring maximum protection (Team OMA, 2014). The implementation plan shows that the protective measures will be placed inland to reduce costs but mostly to minimise the impact on the waterfront visibility and access. This change was unavoidable due to the strong opposition of the community towards options that would disturb the view of the waterfront. Consequences of this choice include affecting traffic circulation and most of all reducing the flood protection (Dewberry, 2017; State of New Jersey Department of Community Affairs, 2017). This new location involves mainly retaining walls with closable gates on street level. To compensate for the loss of protection, the proposed measures in the implementation plan contain a newly introduced storm sewage system as part of the Resist infrastructure. This sewage system is disconnected from the sanitary sewage system and should prevent water from entering Hoboken through unsealed inlets (Dewberry, 2017). Lastly, a difference was found in the exclusion of protective measures for both the city of Weehawken and Jersey City. The strategic plan includes respectively the southern and northern part of these cities in the Resist strategy. Due to re-alignment of the surge barrier in the implementation plan, Jersey City no longer co-benefits from the Resist measures in the RbDHR project. Also, the Hoboken Transit Terminal is no longer protected by Resist measures. Measures to protect this property will have to be taken separately by its owner, NJ Transit.

Delay
The Delay element concerns city-wide policy recommendations, guidelines and urban infrastructure to slow down rainwater runoff (Team OMA, 2014). It consists of both policy action as well as physical modifications of the built environment. Whereas Resist measures concern the waterfront area of Hoboken, one can find the Delay measures mainly in the town itself. The Delay measures aim to slow down water run-off in Hoboken as to unburden the process Store and Discharge. The proposed Delay measures in the strategic plan of Team OMA concern Green Infrastructure measures. These include parks and green areas in Hoboken and at the waterfront, green roofs, and bioswales at designated areas. All of these measures shortly retain and therefore delay water run-off.

Two of the proposed Delay measures have already been (partially) implemented in the period between the strategic plan and the implementation plan and therefore do not recur in the implementation plan. This concerns the North-West Resiliency Park and the Pier A park near Hoboken terminal, being two out of four proposed parklands to be created. The other two areas designated for the creation of parks do not show in the implementation plan either and have also not been realised at the moment of writing. It is unknown what happened to these plans. Furthermore, the implementation plan does not indicate any detailing for green roofs nor bioswales to be constructed in Hoboken. A combination of unfamiliarity with these concepts and a lack of resources (most would have to be implemented on private property) meant that this option is relatively hard to realise. While some proposed Delay measures of the strategic plan have been already implemented (outside of RbDHR), the implementation plan does not follow up on the other proposed measures. Neither policy guidelines nor the physical implementation of the Delay element are addressed in the implementation plan.

Store
The Store element concerns large-scale circuits of interconnected green infrastructure measures to store excessive amounts of (rain)water (Team OMA, 2014). By assigning designated places for storing water resulting from flash floods, water can be directed towards areas that can easily cope with it. The strategic plan proposes three kinds of water storage measures, namely cisterns, retention basins and artificially constructed wetlands. These were to be predominantly created in the green corridor on the edges of town, following the Hudson-Bergen light rail track and the municipal boundary. Since this green corridor is situated at the lowest elevation in Hoboken it shows to be an ideal place for water storage as Hoboken’s topography enables natural water runoff to these areas. Cisterns will also be located in the town itself, as they are buried beneath the surface. The measures embodied in the Store element all serve the purpose of unburdening the discharge process, allowing the pumps an extended period of time to discharge the excessive amounts of water.

There are numerous differences between the strategic plan and implementation plan. First of all, the strategic plan proposes a set of three measures (retention basins, wetlands and cisterns) addressing the storage of water. The implementation plan however only proposes the installation of 61 so-called small 'DSD tanks' within the city of Hoboken and three large stormwater tanks near the north-west and south-west edges of town. These proposed locations differ slightly from the locations in the strategic plan, but this is not considered as a significant difference. Secondly, and more striking, is the fact that the implementation plan does not include the proposed green corridor of storage measures. Following the strategic plan, this corridor was proposed to be a combination of mainly artificially constructed wetlands and retention basins along the topographically lowest area of Hoboken. This green corridor is considered an essential element in the RbDHR strategic plan; it does however not recur in the implementation plan in any (similar) form.

Discharge

The final element, Discharge, concerns pumps and drainage modifications to increase the discharge capacity (Team OMA, 2014). The strategic plan proposes installing one additional wet weather pump in Hoboken to ensure enough drainage capacity in the event of heavy rainfall to prevent flooding, since the current capacity is insufficient. With its current capacity, Hoboken faces flooding about twice a year (Team OMA, 2014). Moreover, one additional storm drain was proposed for the northern part of Hoboken. Together, these measures should strengthen the discharge capacity of the project area to handle excessive amounts of water.

Different choices have been made in the implementation plan with regards to the proposed Discharge measures in the strategic plan. The use of both drainage pipes (outfalls) and wet weather pumps is evidently present in both plans. The exact location and numbers do however differ. Where the strategic plan focusses on strengthening the discharge infrastructure with merely one additional pump and storm drain, the implementation plan proposes the instalment of two extra outfalls in combination with two pump stations in the north of Hoboken (near Weehawken cove) and one pump station at the Hoboken Transit Terminal.

5.1.3 SUMMARY

The results of the comparative study of the strategic plan and implementation plan show that differences are present between both plans. The following expressions were found to be true:

- The ratio between the *Resist – Delay – Store – Discharge* elements in the implementation plan differs from the strategic plan (e.g. all the focus has been put on *resist*);
- Concrete (resilience-enhancing) measures proposed under one or more of the *Resist – Delay – Store – Discharge* elements in the implementation plan differ from those displayed in the strategic plan;

The ratio between RDSD has been changed in the implementation plan as significantly more emphasis was put on the Resist part following political choices on where to spend the RbDHR budget on. Although the Delay – Store – Discharge elements are being addressed by the City of Hoboken mostly outside of RbDHR, funding for the Delay – Store – Discharge elements was shown to be extremely limited. This gives rise to the question to what extent and in what timeframe these measures will eventually be realised, implying that the aimed integrality of the RbDHR strategic plan will not be achieved. Also, concrete measures proposed under Resist, Delay and Store show differences in between the strategic plan and implementation plan. Although differences are also evident in the Discharge element, these are of smaller proportion as the basis of the proposed measures remains the same.

Based on the aforementioned findings the null-hypothesis is formally rejected, leading to the acceptance of the alternative hypothesis:

> H_1: There are substantial differences between the strategic plan and the implementation plan in the RbDHR project.

Following the comparative analysis and the rejection of the null-hypothesis, it can be stated that the assumption made about the existence of substantial differences between the RbDHR strategic plan and implementation plan was correct. The data clearly shows on which of the key elements and on what specific elements the implementation plan deviates from the strategic plan. The research question on the differences between the strategic plan and implementation plan has therefore been answered.

5.2 Barriers and enablers in RbDHR

This section shows the barriers and enablers that are/were present in the RbDHR project, impeding or promoting the course of the process. Figure 7 shows the revealed occurrence of barriers and enablers in the RbDHR project. The frequency of occurrence concerns how often barriers/enablers were mentioned by stakeholders during the interviews.

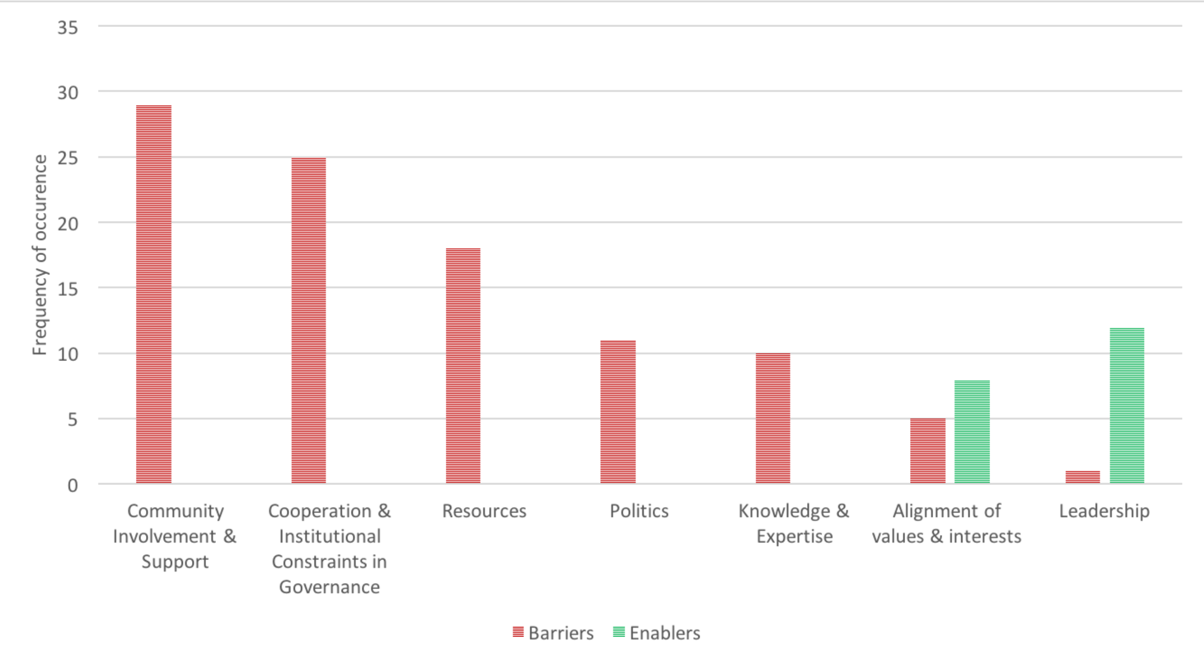

Figure 7: Clusters of barriers and enablers encountered within RbDHR, ordered by frequency of occurrence

The most frequently encountered barriers in RbDHR belong to the cluster Community Involvement & Support addressing a lack of understanding of the project, a lack of communication and mistrust in the executive authorities. The second most occurring barrier cluster is that of Cooperation & Institutional Constraints in Governance which is about a lack of cooperation within involved organisations, inefficient administrative structures, lack of clarity about jurisdiction and restrictive laws/regulations. The third most mentioned barriers are concern Resources, related to limited funding, time constraints and unavailability of sufficient human resources. The other clusters of barriers that occur less frequently are those of Politics (e.g. political priorities and agendas), Knowledge & Expertise (e.g. lack of experience in handling such projects, lack of education and training, lack of knowledge), and Alignment of Values & Interests (e.g. lack of shared values, lack of commitment and diverging objectives). The least present cluster of barriers is that of Leadership, addressing a lack of a strong advocate, ambassadorship or a leader in endorsing the project. Leadership instead shows as an enabler in the RbDHR project. Moreover, Alignment of Values & Interests comes forwards as an enabler in the RbDHR process as well.

Table 6 and 7 provide an overview of all unique barriers and enablers that were identified from the data.

Table 6: overview of barriers per cluster

Cluster	Barriers
Community Involvement & Support	Misunderstanding of the plans and concepts Lack of citizen education Unawareness about the necessity Mistrust in authorities Lack of support for chosen options
Cooperation & Institutional Constraints in Governance	Inflexibility of existing regulations Scatteredness and overlap of jurisdiction Lack of collaboration between authorities Too many agencies involved
Resources	Limited funding Lack of time Lack of human resources Lack of space for implementation
Politics	Political disagreement between governor and mayor Lack of state-level resilience endorsement Existence of prematurely made high-level political decisions
Knowledge & Expertise	Lack of experience with similar (sized) projects Inexperience with community involvement Lack of expertise on social resilience planning Lack of technical understanding within agencies
Alignment of Values & Interests	Lack of shared priorities between mayors Internal disagreement within engineering team Lack of shared vision on project's importance and outcome
Leadership	Lack of leadership at a regional level

Table 7: overview of enablers per cluster

Cluster	Enablers
Alignment of Values & Interests	Commitment and devotion across involved authorities Existence of shared values amongst citizens concerning the importance of resilience
Leadership	Political will and strong leadership at a local level

5.2.1 EXPLANATION OF BARRIERS AND ENABLERS

The next section discusses the main findings per cluster, further explaining the barriers and enablers within their respective context and their connectedness to one another. References to interviewees are made in parentheses. Each interviewee was randomly assigned a referencing number. To protect the privacy of individual interviewees, the list connecting reference numbers to individual interviewees will remain confidential.

Community Involvement & Support
Community Involvement & Support is the most often occurring barrier cluster in RbDHR. The importance of community involvement and support has essentially to do with the strong influence of citizens on RbDHR. The City Council has a formal role in decision-making, also concerning projects like RbDHR. The City Council is accountable to its constituents and defends their interests, so without citizen support, the City Council's would not let RbDHR advance (4, 18). As became apparent, 'the challenge in RbDHR is less about the physical ability to do things, but much more about the social capacity to do so' (21). A frequently mentioned barrier in this cluster is the lack of effort to educate the citizens, leading to misunderstanding the "why", "what" and "how" concerning RbDHR. For example, for many citizens it was not clear what abstract terms as '100-year flood event' meant in the context of RbDHR or that 'flood barriers' did not refer to high concrete walls blocking the view on the waterfront. This misunderstanding lead to unawareness of the need for RbDHR (6, 12) and general mistrust in the authorities as the reasoning behind specific choices was not understood fully (18). Another barrier concerns the lack of awareness amongst citizens about the existence of RbDHR, in turn leading to small community engagement.

Cooperation & Institutional Constraints in Governance
"The shift from a program that was endorsed by a federal agency, but very much born outside of the traditional government channels, to a state driven process was very foreign", illustrating the existence of barriers concerning governance (19). The existence of overlapping jurisdictions, making the RbDHR process more complex as several authorities have control over different parts of the project, is frequently mentioned as a barrier to the RbDHR process. Although the New Jersey Department of Environmental Protection (DEP) is formally in charge of RbDHR, the municipalities of Hoboken, Weehawken and Jersey City as well as the North Hudson Sewage Authority (NHSA) have a say in these plans as well. Having many 'cooks in the kitchen' was seen to slow down the process of resiliency planning (8, 11, 15). In particular, the cooperation with NHSA was found to impede the process. NHSA is a multi-municipal authority also being accountable to municipalities not included in RbDHR, such as (West) New York. Having to rely on NHSA for cooperation in mostly the Discharge element of RbDHR, this multi-municipal structure was found to pose a problem as other municipalities were not in favour of spending money on fixing local water problems (14, 16). Moreover, although Hoboken benefits most from RbDHR, cooperation between with the cities of Weehawken and Jersey was of vital importance as resiliency measures crossed municipal borders. However, several accounts show that active participation of Jersey City was lacking in RbDHR, instead Jersey City had been taking its own separate steps in resiliency (4, 13, 17). As interviewee 13 mentioned, "Jersey City chose politics over partnership and thus missed an opportunity to co-benefit from RbDHR. This resulted in allowing the Resist barriers to shift to Hoboken, not protecting Jersey City anymore but at the same time also leaving the NJ Transit hub unprotected. One can see the close link to politics in this cluster of barriers. Moreover, the inflexibility of existing law and regulations for a novel approach as RbDHR was found to significantly slow down the process, as many existing regulations were not up to speed with current practice (3, 8, 9, 10, 15).

Resources
Often mentioned barriers in the cluster Resources concern the lack of funding, available time and human resources. These barriers are often interrelated, e.g. money influences the availability of human resources which in turn influences time consumption. Having been mentioned in nearly all interviews, limited funding is the direct cause for only partial implementation of the RDSD strategy. Only the Resist part was federally funded, covering just half of the required budget for the total RDSD strategy. Combined with the lack of dedicated funding for resiliency projects by the State of New Jersey (18), this meant that the City of Hoboken had to finance the Delay – Store – Discharge parts by itself. Since acquiring funding has proven to be difficult, the project was significantly slowed down on these aspects and the feasibility of implementing these parts of the project was reduced. Politics has a large influence on this process, as the allocation of resources concerns a political decision. Moreover,

time poses a barrier in RbDHR. With a timeframe "that is always bordering of madness" (4), decision-making and exploration of options had to be rushed in order to finish the project on time (4, 9). Due to shifting priorities on a federal level, fear exists that extending the timeframe to allow for a better preparation and decision-making process will cause the federal government to take back the allocated budget of 230M USD.

Politics

Politics is an important driver behind the RbDHR project, influencing for example Resources. Inherent to the lack of widespread understanding of the necessity for flood resilience in the US is the constant need for maintaining urgency for the planning and implementation of resiliency-enhancing measures (18). Political support is of high importance to a project like RbDHR, making these very politically dependent. RbDHR has sustained a change in mayor (Hoboken), governor and president and is still continuing, showing that its necessity was upheld. One important barrier was the lack of support of Governor Chris Christie in RbDHR, following an accusation made by former Hoboken mayor Dawn Zimmer towards high officials in the state (13, 22). Hoboken's democratic mayor accused Chris Christie's republican administration of strong-arming her into proceeding with certain development projects related to one specific organisation in order to get support for the funding for RbDHR. The (federal) ministry of HUD allocated the funding to individual projects, but the governor had an influential role in this decision-making process. Although the case was dismissed due to lack of evidence, the accusations spread to national television creating a huge impact on the image of governor Christie's who was at the time a contender for the 2016 Republican nomination for president (Little, 2014; Frates, 2014). Also, the allocation of money in New Jersey's two RbD projects, RbDHR and Meadowlands, is debated as it is presumed that the governor did not want all the money to be awarded to RbDHR as a means of getting back at mayor Zimmer. The exact truth about these accusations and assumptions cannot be objectively uncovered, but following the limited interest and support from the mayors in the Meadowlands project one could wonder why RbD funding was still awarded to this project (17, 18) Also, the witnessed lack of support of the governor in past climate change related issues gives an indication of the (absence of) political will to support such initiatives as RbDHR (11, 14) The aforementioned barriers illustrate the lack of political will, profoundly impacting resource allocation in its turn.

Knowledge & Expertise

Knowledge and Expertise posed a barrier to the RbDHR process in the sense that not enough experience was available to effectively guide the process. The DEP, being in charge of the project, was found not to be up to speed with resilience planning due to limited access to high-level training (12, 20). The size and novelty of RbDHR meant that "DEP staff is overseeing a project that they have never built before" (18). There was plenty of technical experience in water defence structures available at specialised consultants. However, the real barriers confine to the integration of such measures in the urban landscape and leading a long process of extensive community-involvement. In other words, the social part of resiliency planning is what really mattered (9, 18, 19). The lack of expertise on this element was found to be primarily reflected in the cluster of Community Involvement & Support as well. Mistakes were made in proper community involvement, leading to a lack of knowledge and awareness amongst citizens, in turn leading to impediments in the RbDHR process.

Alignment of Values & Interests

This cluster contains both barriers as well as enablers applying to the RbDHR project. First of all, a lack of shared priorities between mayors was found to pose an impediment to RbDHR. Mayor Zimmer's (Hoboken) strong involvement in RbDHR was not shared to the same extent by the mayors of Weehawken and Jersey City. Weehawken's included area in RbDHR is significantly smaller than Hoboken's portion, therefore explaining a difference in the involvement of Weehawken's mayor. The case for Jersey City is different, as during the process of RbDHR a mayoral switch took place. In the process of this mayoral shift, RbDHR was not given priority by the newly appointed mayor (13).

Consequences of this difference in prioritisation meant that in the time between the strategic plan and implementation plan Jersey City would gradually get more excluded. One could call this a lost opportunity for Jersey City to co-benefit from the RbDHR funding. Moreover, changes had to be made with respect to the original plan, leading to re-alignment of the protective barrier inland, in turn leaving the Hoboken Transit Terminal unprotected against surges (13, 19). A second barrier impeding the RbDHR process concerns internal disagreement within the engineering team in the making of the RbDHR strategic plan. It appears that the engineers were of two minds regarding the importance of the Resist element in the strategic plan. At this point in the RbDHR process, the competition phase was still ongoing, meaning that the proposal from Team OMA had not been selected as a winning RbD project yet. Some engineers preferred stressing the Resist element above Delay, Store and Discharge as this would increase the likelihood of winning the RbD competition, while others defended the equal importance of all four elements (12). Eventually, the Resist part was put to the forefront of the strategic plan. However, following this disagreement, choices were made which have been guiding the RbDHR process ever since.

The shared commitment of staff from the City of Hoboken and the DEP is a strong driver (enabler) in the RbDHR process. A strong sense of the necessity for increasing flooding resilience through RbD was reported to be present within different levels of the administration. On the basis of this commitment are shared values, clear objectives and agreements on the approach (2, 10, 19). This commitment facilitates a streamlined process with highly motivated and involved people, all working towards a shared goal of achieving a more resilient society. Another influential enabler concerns the shared community values towards sustainability, climate change and resilience. This refers to the willingness of Hoboken's citizens to address these issues. Although Community Involvement & Support was found to pose barriers to RbDHR, Hoboken's general population shows many signs of valuing the efforts that DEP and the City of Hoboken are taking to create a more resilient Hoboken. One interviewee (17) claims that shared values towards sustainability are caused by a unique set of demographical aspects in the area: young people (between age 25-54: Hoboken 65%, USA average 39%), high income (Hoboken 118k USD annual, USA average 55k USD) and a high level of education (Hoboken 78% bachelor's degree, USA average 42%) (United States Census Bureau, 2017). The validity of this claim is however unknown.

Leadership

This cluster concerns barriers as well as enablers. A barrier was found in the lack of political will from Jersey City as has been described before (13). The most evident enabler concerns the existence of strong leadership in the RbDHR project from Hoboken's mayor Zimmer (1, 4, 9, 13, 16, 17, 19, 22). According to many accounts, the political will of mayor Zimmer to address the issues of Hoboken's flood resilience and take on the opportunity of joining the RbD competition was crucial. Mayor Zimmer's standpoint as a strong advocate was at the basis in her vocal championship towards RbDHR. As Hoboken has a 'strong mayor-council' government, the mayor being the executive branch and the city council being the legislative branch, this leadership was crucial in the RbDHR process. Hoboken's Mayor kept RbDHR as a political priority throughout her term as a mayor, leaving behind a legacy of continuous awareness and dedication even after she left in 2018 (19). This illustrates the effects of strong leadership on people, both citizens as well as government officials. It is often argued that without the strong leadership from Hoboken's mayor, RbDHR wouldn't have been funded because "mayor Zimmer shepherded RbDHR through its most fragile and delicate time" (19), referring to the early stages of Hoboken participating in the RbD competition.

6. DISCUSSION

This chapter covers further discussion on the results and research set-up, explaining the implications of the findings and evaluating the process of research.

6.1 COMPARATIVE ANALYSIS

Comparing the strategic plan with the implementation plan shed new light on the RbDHR process. Using a structured approach, both plans were compared on each of the RDSD elements. The results of this comparison were as expected, namely that significant differences between the strategic plan and implementation plan did arise. The identification of differences in specific measures provides information about the course of the RbDHR process.

By definition a strategic plan is a document that envisions a desired state of being following broadly identified objectives and goals (Business Dictionary, 2018). A strategic plan needs to be converted into an implementation plan, for it is not detailed enough to allow for direct implementation. In the process of converting strategy into implementation planning, the strategic plan is translated into concrete measures and objectives aligning with the 'bigger picture' as set in the strategic plan. The question then arises to what extent the existence of these differences is part of a normal design process, or whether these are the consequence of a poor quality strategic plan. This comparison does not identify good nor bad decisions/choices in either one of the plans as this is beyond the scope of this study. It is thus not possible to assess the quality of resilience measures chosen or the effects of deviating from the strategic plan on specific elements. The comparison thus solely provides general insights into the similarities and differences between both documents having been created three years apart and following a long process of iterations and modifications.

6.2 OCCURRENCE OF BARRIERS AND ENABLERS IN RBDHR

The results of the research show the existence of a variety of barriers and enablers in RbDHR. The findings are to some extent consistent with expectations based on previous research on urban climate adaptation in similar studies (Ekstrom & Moser, 2014; Biesbroek, Klostermann, Termeer, & Kabat, 2011; Measham, et al., 2011; Weyrich, 2016).

The high occurrence of barriers in the cluster of Community Involvement & Support shows in other research as well, although the dominance over all other clusters was not expected based on the findings in the literature (Ekstrom & Moser, 2014; Weyrich, 2016). This cluster includes barriers related to awareness and communication. Communication is important to increase public consciousness about the impacts of climate change, the levels of vulnerability, and the need to start addressing these issues. Without communication, the public remains uninformed about the necessity and the collective efforts on adaptation (Biesbroek, Klostermann, Termeer, & Kabat, 2011). The results indicate the importance of citizen support in the process of RbDHR, which can be explained in two ways. First of all, the political system in Hoboken means that the city council, representing all of Hoboken's citizens, has a large power within the local administration. Full cooperation of the city council is therefore required in cases like RbDHR, or else a project cannot go through. Secondly, the novelty of the approach of RbD requires particular attention since a widespread understanding concerning the necessity and implementation methods for integral water defence structures is generally absent. As explained in chapter 2.3, the ruling US paradigm does not currently accommodate for these approaches towards water management (Bijker, 2007). A combination of lack of knowledge and lack of community engagement caused a lot of community feedback to arise only after the strategic plan was already created. This could be considered as a missed opportunity for creating a strategic plan with more community support, which could have led to fewer modifications and delays during the continuation of the RbDHR process.

Institutional constraints and inflexible governance structures are mentioned in the literature as one of the most prevailing barriers (Ekstrom & Moser, 2014; Measham, et al., 2011) in climate change adaptation processes. The high frequency of occurrence in RbDHR is therefore not surprising. Moser & Ekstrom (2014) explain the inflexibility of public institutions by pointing out that they aim to stabilise societal procedures, thereby inevitably hindering change. Moreover, the results show that a large amount of involved agencies leads to scatteredness and overlap in jurisdiction. Small cities such as Hoboken, having a limited political power on a state or federal level, were primarily found to face restraints regarding a lack of influence on these adaptation processes (Weyrich, 2016). Furthermore, Biesbroek et al. (2011) refer to the term 'institutional void' to describe the lack of formal legislation that obliges actors to address climate change adaptation. The absence of shared rules and principles makes communication and cooperation between actors more difficult (Biesbroek, Klostermann, Termeer, & Kabat, 2011).

Barriers connected to resources are often encountered in literature and are the most frequently mentioned barrier in climate change adaptation processes (Ekstrom & Moser, 2014; Biesbroek, Klostermann, Termeer, & Kabat, 2011; Measham, et al., 2011; Weyrich, 2016). The results of this research deviate from the findings in the literature, although it still shows a high frequency in being the third most encountered cluster of barriers. Based on the findings in literature, one would expect resources to be the most frequently mentioned barrier. The absence of legislation in face of resilience-enhancement processes also leads to the absence of dedicated federal funding. The RbD competition provided a unique chance for funding resilience-increasing efforts, but outside of this competition there is no funding available. The absence of funding can also lead to a lack of manpower, in turn leading to a lack of time to conduct a thorough decision-making and design process. Although a lack of resources poses serious impediments to RbDHR, it is argued that resources are in fact never infinite and thus always limit a project. One could therefore argue to regard limited resources as a constraint rather than a barrier. Moreover, the roots of problems in resources often lie in institutional behaviour, in which politics plays an important role (Ekstrom & Moser, 2014). Most of the barriers belonging to Resources were the direct consequence of political choices made by officials on a state and federal level.

A substantial number of barriers related to politics were found in this study, however barriers concerning politics are not frequently mentioned in the literature (Biesbroek, Klostermann, Termeer, & Kabat, 2011; Weyrich, 2016). The findings align with the research of Moser & Ekstrom (2014), showing that, in terms of frequency of occurrence, political barriers are of moderate importance. Detailed explanation of this cluster in literature is however absent. Political barriers in RbDHR mostly confine to the lack of political will on a state level and an incident between the governor of New Jersey and the mayor of Hoboken. Smaller municipalities such as Hoboken tend to be less strongly connected to the central level of government, making it harder to access research programmes and funding. The reliance on good political relationships is therefore of importance to communities such as Hoboken (Dannevig, Rauken, & Hovelsrud, 2012). The existence of these barriers concerning politics had a large influence on the RbDHR process, as it could have led to RbDHR being awarded no funding. The presence of these barriers however seems to be case-dependent.

The relatively low occurrence of barriers concerning Knowledge & Expertise is in line with the literature (Ekstrom & Moser, 2014; Weyrich, 2016). It was reported that the Department of Environmental Protection, which is formally responsible for RbDHR, did not have enough experience in managing such a project so extensive and innovative as RbDHR. This gap of knowledge was however compensated by external consultants being involved in RbDHR.

The occurrence of barriers concerning Alignment of Values & Interests is lower than shows in the literature (Ekstrom & Moser, 2014; Moser & Ekstrom, 2010; Weyrich, 2016). In fact, the results show more enablers than barriers belonging to this cluster. Federal endorsement combined with advocacy on a local level was found to create a shared set of values towards the need for addressing Hoboken's flood resilience problems. The necessity for addressing resilience through RbDHR was reported to be well-settled within the authorities, promoting cooperation and dedication towards implementing the resilience-enhancing measures.

Leadership was found to be the most important enabler in RbDHR. This finding aligns with the research of Weyrich (2016) in showing absence of barriers connected to Leadership. Ekstrom & Moser (2014) present different findings as they show a moderate occurrence of barriers concerning Leadership. Leadership, in particular when presented by officials in high ranks, was found to be a key resource in the process of adaptation. Missing leadership from higher levels of government often lead to a lack of local leadership (Measham, et al., 2011). Although a lack of leadership in climate change adaptation at the regional and state level was detected, this claim appeared not to apply to RbDHR as strong leadership at the local level was present. It is argued that the set-up of the RbD competition allowed that, even though state endorsement for RbD(HR) was absent, the leadership presented by Hoboken's mayor highly contributed to promoting the course of RbDHR. It is therefore considered a unique factor to the case of RbDHR.

6.3 Implications of research

The uncovered barriers and enablers in RbDHR provide a general explanation for the existence of differences between the RbDHR strategic plan and implementation plan. For example, the lack of resources and political priorities explain the focus on just the Resist element. However, to connect specific differences to individual barriers was found to be infeasible. First of all, because the existence of differences between the strategic plan and implementation is inevitable seen that a strategic plan is solely the basis for a more detailed implementation plan. This indicates a reduced comparability of the plans as they differ in purpose. Secondly, because of the complexity of adaptation processes and the long period of time in between the strategic plan and implementation plan, it was not possible to reconstruct the process in enough detail to link specific choices to individual barriers or enablers.

The results of this case study show both similarities and differences with existing literature. As explained before, barriers (and enablers) are highly context-specific and can therefore show vast differences in between specific cases. Nevertheless, it is argued that these findings can be applied to similar cases as RbDHR, but one should be aware of possible differences in context. On the short term, barriers that are present in the process can be individually addressed. However, in the long term the governing system concerning water management needs to truly innovate to cater for moving towards achieving resilience (Ovink & Boeijenga, 2018). Achieving a more flood resilient Hoboken following of the RbDHR project involves a change in way of thinking about water management, both for the citizens and authorities of Hoboken as well as its surroundings (Ovink & Boeijenga, 2018). Complex processes of change involving various actors, interests and values lead to decisions being made on the resilience measures to be implemented in RbDHR. It is argued that a paradigm change will eventually have to take place to constitute this new way of thinking about the new world of water management and water protection. This paradigm shift involves moving away from technocratic approach of infrastructural measures and is led by a new way of thinking, as one can see in the innovative approach in RbD (Bijker, 2007).

6.4 Reflection on research

Overall, the design of this study showed a good fit for its purpose. The qualitative approach offered the opportunity to capture the stakeholders' personal thoughts and perspectives and provided flexibility in changing the interview script based on recent findings. Unfortunately, not all key actors in the RbDHR process were interviewed due to unwillingness to participate. Also, some stakeholders were not given permission by their client to take part in this research, limiting the sample size of this study. This led to the primary data excluding the perspective of engineering companies in the RbDHR project. Although the secondary data complements the primary data with perspectives from different stakeholders, including that of engineering companies, these interviews could not be structured to precisely fit to the purpose of this study. Lastly, the findings were compared with available literature, but due to time constraints it was not possible to validate the results with the stakeholders from the RbDHR project.

7. CONCLUSION AND RECOMMENDATIONS

This chapter summarises the general results of this study, presenting answers to the research questions and providing recommendations for future research.

7.1 Conclusion

This study analysed the differences between the RbDHR strategic plan and implementation plan and uncovered the barriers and enablers that were present during the RbDHR project. The research addressed three research questions, of which the answers will be presented here.

What can be learned from existing literature regarding frameworks for analysing barriers and enablers towards improved resilience? And which framework is most suitable for application in RbDHR?
Two frameworks connected to the field of resilience and climate change adaptation were explored, of which the planned adaptation approach by Moser & Ekstrom (2010) was found most suitable. This approach was subsequently used to constitute the basis for a new framework for uncovering barriers and enablers, which was used in the continuation of this research.

What are the differences between the strategic plan and the implementation plan in terms of its key philosophy and proposed concrete measures?
A qualitative study was done, comparing the implementation plan of RbDHR with its preceding strategic plan. It was found that during the conversion from strategic plan to implementation plan, significant changes were made. The key strategy Resist – Delay – Store – Discharge (RDSD) from the strategic plan has well-survived the conversion into the implementation plan, however the ratio between the four key elements presented in the plan as well as the concrete proposed resilience measures have significantly changed. Where the strategic plan presented an equal distribution between the four elements, the implementation plan shows decreased focus on Delay – Store – Discharge. Also, most of the concrete measures under each of the RDSD elements deviate from the proposed measures in the strategic plan.

Which barriers and enablers were present in the RbDHR project and how are these interrelated?
Most barriers concern Community Involvement & Support, addressing a lack of awareness and misunderstanding amongst citizens. Cooperation & Institutional Constraints in Governance and Resources also pose significant impediments to the RbDHR process. Moreover, Politics showed to be a significant barrier since a supportive regime on state-level was absent. Factors significantly promoting the course of the RbDHR project were found to be the existence of shared values amongst stakeholders, promoting cooperation between authorities, and most of all the strong local leadership presented by Hoboken's mayor. Furthermore, many barriers and enablers show a high degree of interrelatedness, for example seen in the influence of Politics on (the allocation of) Resources.

This study presents insights into the course of the RbDHR project and aids in understanding resilience-enhancement processes. Since the (academic) field of resilience adaptation is still in an early stage, this research contributes to the establishment of this emerging scientific field. The results of this study can be used in the resilience industry as it provides insightful information on barriers and enablers that can occur in similar projects. Using this knowledge, impediments could be prevented or diminished and enabling factors could be promoted. The existence of barriers impeding certain parts of such complex resilience adaptation processes is inevitable; it should therefore not be the goal to prevent any barrier from occurring but rather to use the findings in this research to avert avoidable impediments in future projects.

7.2 Recommendations for further research

In future research, it would be interesting to combine all cases within the Rebuild by Design programme in a multi caste study approach. Combining the insights from all 7 Rebuild by Design projects allows for the creation of more general conclusions on the entire RbD set-up. This would enable a higher degree of generalisation of the results and enables interviewing more stakeholders, especially those active on the state and federal level. Using this approach, the effectiveness of the entire RbD process can subsequently be examined. Moreover, further research could include uncovering the sources of barriers, their importance in terms of effects on adaptation processes, and ways to overcome these barriers, continuing on Moser & Ekstrom's (2010) framework. This extension of the research will strengthen its usability in the resilience engineering field as it leads to identifying specific actions required to allow for a better adaptation process.

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APPENDICES

APPENDIX 1 – Interview cover letter

Subject: Interview inquiry for research project on Rebuild by Design

Dear Mr. / Ms. [Surname]

My name is Niek ten Brinke and I am currently writing my final BSc thesis in Civil Engineering and Management at Stevens Institute of Technology in Hoboken, NJ, and in close collaboration with Royal HaskoningDHV and the University of Twente, both located in The Netherlands.

Nanco Dolman from Royal HaskoningDHV advised me to contact you concerning an interview for my BSc thesis research, titled 'From strategic plan to implementation: uncovering adaptation barriers in the Rebuild by Design resilience project in Hoboken, USA'. The thesis research concerns a case study on the Rebuild by Design Hudson River project in Hoboken, uncovering barriers to adaptation/implementation in this resilience project. The research will be largely based on the insights of key actors in the Rebuild by Design project and/or Hoboken resilience domain.

Following your involvement and affinity with the Rebuild by Design project, I would very much like to interview you. The interview will take place in-person or by phone and will take 30-60 minutes. Are you willing to take part in this interview? Your input is highly appreciated. If you are willing to participate, could you suggest a date and time that suits you best? If you are unable to take part in an interview in-person or by phone but you would still like to participate, I could also send you the questions so that you can answer in written form.

Needless to say, all interview data will remain anonymous and strictly confidential. If you have any questions or require more information on my research project, please do not hesitate to contact me.

Thank you for your consideration.

Kind regards,

Niek ten Brinke
Graduate intern at Royal HaskoningDHV
Visiting student at Stevens Institute of Technology
Student in Civil Engineering and Management at University of Twente
Email: n.s.tenbrinke@student.utwente.nl // Phone: +1 (551) 283-4979 // LinkedIn

APPENDIX 2 – INTERVIEW GUIDELINE

Interview – set-up

Structure

- Semi-structured interview
- Mainly open questions, but:
    - possibly verify known information using closed questions to save time
    - avoid suggestive questioning
- Main body consisting of 15 questions. Additional questions to choose from are marked in grey
- Required time: ±60 minutes

Equipment needed

- Audio recorder (preferably not a phone)
- Notebook and pen
- Laptop (in case of refusal to audio recording)
- Interview questions/guide

Process

- Before interview:
    - Gather information about interviewee
- During interview:
    - Record audio and take notes where desirable
- After interview:
    - Write down key elements of the interview
    - Write down feedback from the interviewee
    - Transcribe audio data
    - Write interview report
    - Analyse data

Interview – contents

Start: 10 minutes

- Word of appreciation
- Introduction of interviewer (study, nationality, …)
- Introduction of research project and topic
- Interview set-up: structure and recording
- Confidentiality: anonymity in report
- Form of consent: explaining and signing
- Any questions and/or comments before starting?

Main: 45 minutes

1. Interviewee information
    - Can you tell me something about your current occupation? What do you do within your organisation and for how long have you been doing this?
    - What is the connection of you and your organisation to the Rebuild by Design Hudson River project or Rebuild by Design project in particular?

Barriers in the adaptation process:
I will now go through the different phases of the adaptation process to further explore barriers to adaptation in the Rebuild by Design Hudson River process. Please answer these questions from your own experience and observations.

2. Understanding phase
    - Can you indicate any specific point in time in which the necessity for flood resilience in the Hoboken area became apparent?
    - How well is the necessity for flood resilience adaptation settled within
        - the responsible authorities?
        - the community?
    - Is there consensus on the problem and who needs to address this?
    - Was there in the past and is there now enough information and expertise available to address the problem?

3. Planning/designing phase
    - Are there enough resources (time, money, people) to facilitate the process of resilience planning?
    - Is there enough freedom for designing optimal solutions or are we facing a lot of boundaries (lock-in, political) in this process?
    - To what extent is the community actively being involved in the designing and selection process? Does the community generally support the resilience planning?
    - (Do you think sufficient time is given to assess/explore different options?)

4. Managing phase: implementation
    - Seen that Sandy happened 6 years ago, how large is the remaining momentum? Do you think it is still large enough?
    - How do you think the commitment in resources towards implementation has changed during the process? How does this affect the implementation?
    - Are you aware of any legal or institutional boundaries or thresholds undermining or slowing the implementation process, now or in the future?

General remarks:

5. General perception on Rebuild by Design Hudson River
    - What obstructions/barriers in the process do you see currently or do you anticipate?
    - How do you think Urban Resilience, specifically flood resilience, applies to the Hoboken area?
    - What is your opinion on the Rebuild by Design Hudson River project in terms of process and progress?
    - (What does the term Urban Resilience mean to you?)
    - (How important do you personally perceive the implementation of flood resilience measures in Hoboken specifically or in general for the NJ/NY area?)

Wrap-up: 5 minutes

- Do you have any remaining questions and/or comments?
- Do you have any recommendations on people whom I should speak to for this research?
- Explain the next steps in this research
- Word of thanks

APPENDIX 3 – LIST OF DATA SOURCES

Table 8: List of interviews in primary dataset

Organisation	Position	Involvement
City of Hoboken	Mayor	Mayor
City of Hoboken	Business Administrator	Overseeing the RbDHR process from a management perspective
City of Hoboken	Chief Resiliency Officer[2]	Responsible for the implementation of RbDHR
Fund for a Better Waterfront	Executive Director	Non-profit community organisation, community advisory group RbDHR
New Jersey Department for Environmental Protection	Manager Bureau of Flood Resilience	Official project manager for RbDHR
New Jersey Department for Environmental Protection	Community Outreach Specialist	Community Outreach specialist for RbDHR
Rebuild by Design	Managing Director	Overseeing and coordinating all RbD projects
Resiliént City	CEO[2]	Urban resilience consulting expert in Hoboken area
Stevens Institute of Technology	Vice President Community Relations[1]	Stakeholder in RbDHR
Hoboken Strategy Group	President[1]	Community Consultant
n/a	Citizen	Involved citizen in RbDHR

[1] Combined interview, more than 1 interviewee
[2] Interviewee was interviewed more than once

Table 9: List of additional primary data

Date	Title	Subtitle/Description	Source	Author
November 7, 2014	What Henk Ovink Thinks	The Dutch idea-guy ponders Hoboken's flooding problem	Hudson Reporter	Amanda Staab
September 27, 2015	Turning back the tide	Public speaks out at first meeting for $230 million flood project	Hudson Reporter	Steven Rodas
December 20, 2015	Residents 'flood' city with criticism over seawalls	Mayor says she won't support any plan that blocks waterfront access	Hudson Reporter	Steven Rodas
December 27, 2015	Rebuild by Design options	Editorial note	Hudson Reporter	Deborah Meyer
December 27, 2015	The wall	Editorial note	Hudson Reporter	Greg Ribot
February 7, 2016	Plan to Flood-Proof Hoboken Runs Into a Wall	-	The New York Times	Patrick McGeehan
February 21, 2016	Goodbye floodwalls, hello barriers?	Hoboken could see renderings for flood-protection plan by June	Hudson Reporter	Steven Rodas
July 17, 2016	How flood walls would work in Hoboken	Residents express concerns, get answers about federal anti-flood plans	Hudson Reporter	Marilyn Baer
September 2016	Community Advisory Group Meeting Summaries and Memos	21 public hearing summaries from between August 6, 2015 to September 13, 2016	New Jersey Department of Environmental Protection	n/a
October 29, 2017	How Hoboken has changed 5 years after Sandy	City gets $230M for flood prevention, local museum looks back	Hudson Reporter	Marilyn Baer
June 3, 2018	River, stay away from our door	Public discusses the aesthetics and amenities of Rebuild by Design	Hudson Reporter	Marilyn Baer

Table 10: List of interviews in secondary dataset

Organisation	Position	Involvement	Source
City of Hoboken	Chief Resiliency Officer[2]	Responsible for the implementation of RbDHR	(Trogrlić, 2015)
City of Hoboken	Chief Resiliency Officer[1,2] Sustainability Officer[1]	Responsible for the implementation of RbDHR	(Staas, 2017)
New Jersey Department for Environmental Protection	Chief Environmental Review Team	State financing of RbDHR and similar projects	(Trogrlić, 2015)
New Jersey Future	Director of State Policy	Non-profit community organisation promoting smart urban growth	(Trogrlić, 2015)
New Jersey Future	Local Development Officer[1] Green Infrastructure Officer[1]	Non-profit community organisation promoting smart urban growth	(Staas, 2017)
NY/NJ Baykeeper	Executive Director	Non-profit community organisation protecting the NY/NJ bay area	(Trogrlić, 2015)
LANGAN Engineering	Senior Project Manager[1] Project Manager[1]	Engineering company involved in resiliency parks design in Hoboken	(Staas, 2017)
Louis Berger Group	Green Infrastructure (GI) Experts	Hoboken GI strategic plan, process preceding RbDHR	(Trogrlić, 2015)
PrincetonHydro	Water Resources Engineer	Engineering company consulting in resilience planning for Hoboken	(Trogrlić, 2015)
Resiliént City	CEO[2]	Urban resilience consulting expert in Hoboken area	(Staas, 2017)
Rutgers University	Professor Water, Society & Environment	Water infrastructure management researcher	(Trogrlić, 2015)
SCAPE Landscape Architecture	Urban Designer	Involved in designing process of RbDHR during feasibility study	(Staas, 2017)
Stevens Institute of Technology	Assistant Professor GI	Technical advisor on GI in RbDHR, GI researcher	(Trogrlić, 2015)
n/a	Community Advisory Group RbDHR	Involved in advising on the design of the RbDHR project	(Staas, 2017)

[1] Combined interview, more than 1 interviewee
[2] Interviewee was interviewed more than once

APPENDIX 4 – VISUALISATIONS OF THE STRATEGIC PLAN AND IMPLEMENTATION PLAN

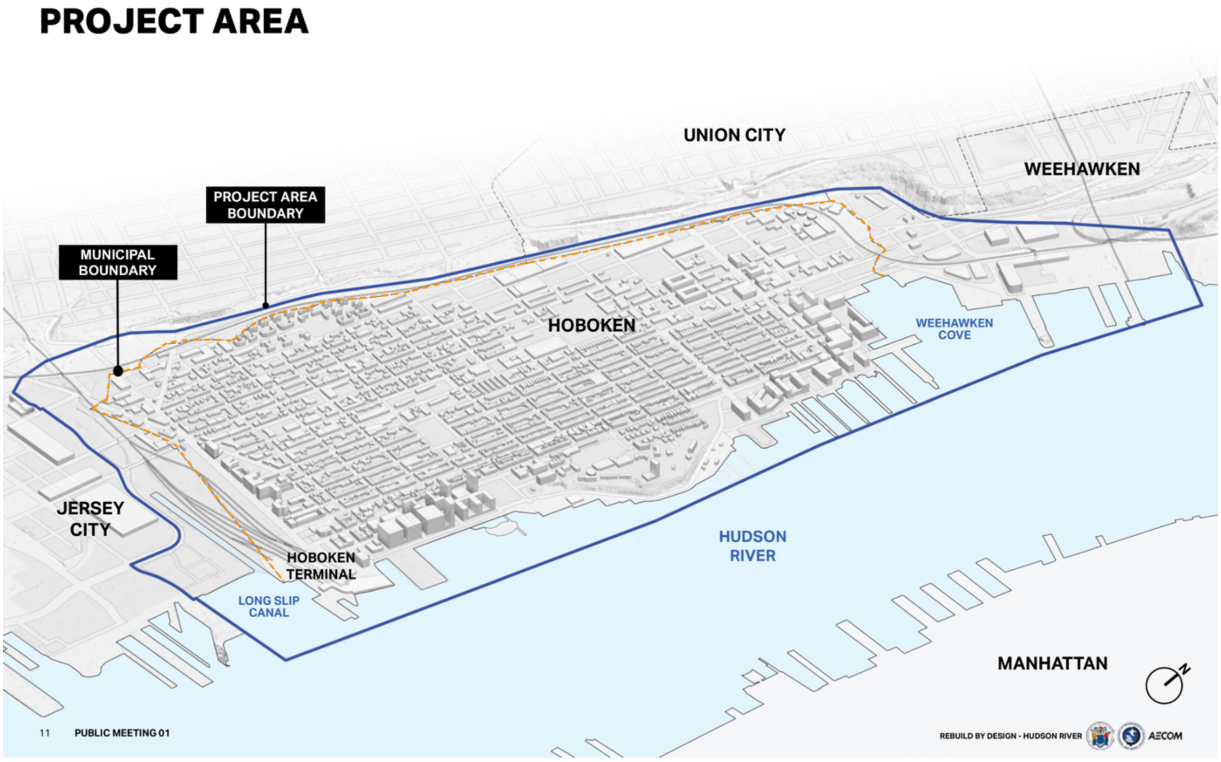

Figure 8: Rebuild by Design Project Area. Adapted from "Rebuild by Design Action Plan Detailing" (p.11), by AECOM, 2018.

Figure 9: Proposed resilience-enhancing measures per key element in the strategic plan. Reprinted from "Resist, Delay, Store, Discharge: A Comprehensive Urban Water Strategy" (p. 66, 74, 80, 85), by Team OMA, 2014.

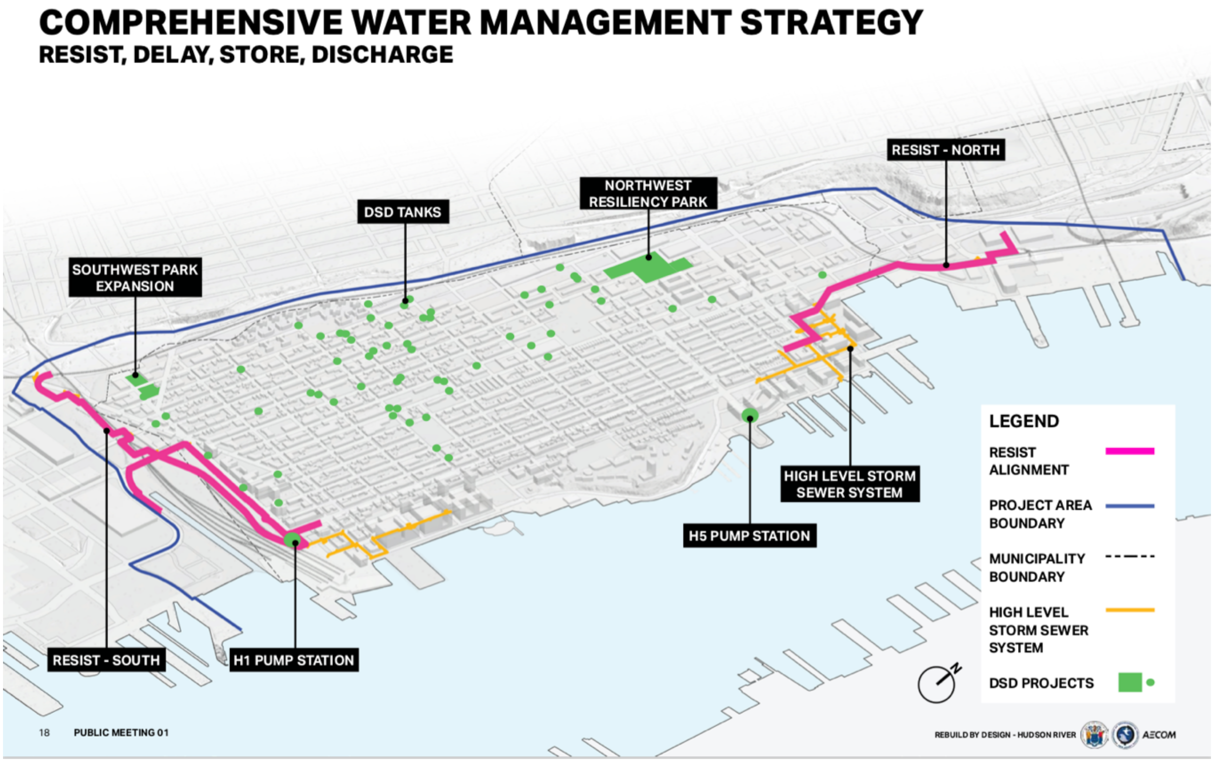

Figure 10: Proposed resilience-enhancing measures per key element in the implementation plan. Reprinted from "Rebuild by Design Action Plan Detailing" (p.18), by AECOM, 2018.