Graduation Plan

Master of Science Architecture, Urbanism & Building Sciences

Graduation Plan: All tracks

Submit your Graduation Plan to the Board of Examiners (Examencommissie-BK@tudelft.nl), Mentors and Delegate of the Board of Examiners one week before P2 at the latest.

The graduation plan consists of at least the following data/segments:

Personal information	
Name	Lisa (Elisabeth) Lieftink
Student number	4418441

Studio		
Name / Theme	Urban Metabolism & Climate	
Main mentor	Kristel Aalbers	Environmental Technology and Design - Expertise in urban metabolism, especially in water (& climate adaptation) - Expertise in sustainable urban planning and design - Spatial design orientation
Second mentor	Verena Balz	Spatial Planning & Strategy - Expertise in regional planning, governance and design - Experience with adaptive planning and the Dutch spatial planning context - Spatial planning orientation
Argumentation of choice of the studio	I feel most connected to the subjects and methods of Urban Metabolism & Climate. As I knew that **climate adaptation** would be the main subject of my graduation project, I found that Urban Metabolism & Climate was the right studio, as it (the mentors) has the most attention, knowledge and passion for this subject. The **combination of analysis, design and engineering**, which is typical for the studio, is also of importance in my project. In addition, **(water) systems and flows** are the focus point of the thesis, which connects to system thinking, as used in the studio. Understanding the (water)systems and the **interplay between Urbanism and Water Management** is the basis for my project.	
Mentors Civil Engineering	Main = Martine Rutten (CEG), Second = Erik Mostert (CEG)	

Remark: Double Degree
This graduation project is a combined project for my **double degree programme** (Urbanism and Water Management (CEG, TU Delft)). This means that my graduation project needs to be 60 ECTS (73 including the supporting courses). This includes 30 ECTS overlap (Urbanism + Water Management), 20 ECTS specific for Urbanism, and 10 ECTS specific for Water Management. My plan is to **graduate in November 2021**.

Graduation project	
Title of the graduation project	Boosting Climate Adaptive Haven-Stad *Spatial Adaptive Policy Pathways for Climate Adaptation Planning in the Development of Haven-Stad*
Goal	
Location:	Haven-Stad, Amsterdam
The posed problem	**Problem Field Summary** *Climate Change + Higher Densities = Livability Risk* **>** Over the past years the **effects of climate change in urban areas** have become increasingly apparent. The future is uncertain, but there is great certainty that climate change will intensify in the coming years. **>** Due to population growth, a growing housing shortage, and a space shortage, it is expected that urban developments in the Netherlands will mainly (or firstly) take place inside existing city boundaries and in **high densities**. **>** The consequence of the two trends discussed is a **liveability risk**. Risk is determined by the interaction of hazard, exposure, and vulnerability. Due to climate change, it is expected that the hazard will increase (more extreme weather events). Due to high-density developments, the exposure will increase, as more people will be present in the same area. The result is an increased risk for liveability. To reduce this risk, the vulnerability of the system should be reduced. **> Climate adaptation** is the most important way to achieve a vulnerability reduction **Problem Focus Summary** *Traditional Spatial Planning does not match with the Climate Adaptation Task* **> Static planning VS Dynamic climate** Climate change is a dynamic problem. Both climate change itself and the effects of climate change are changing continuously. However, traditional spatial planning is often static. A plan is fixated and is often only changed when problems occur (re-active). **> Short-term planning VS Long-term climate change** In urban development processes, the time horizon is often short. The year 2050 (30 years from now) is a common time-horizon if climate change is taken into account. But this time horizon is not far enough, considering the expected lifetime of an urban development of at least 50 years and the climate projections which show an increased acceleration of change after 2050. **> Fixed paths and goals in planning VS Climate uncertainty** Climate change is uncertain; it is not fully clear how the climate will be in the future. And looking further into the future, the uncertainties of climate projections only get bigger. In traditional spatial planning these climate uncertainties are not enough considered. A plan is usually made for the 'most likely' scenario, instead of considering multiple futures. **> Importance of water VS Lack of integration with spatial planning** Water is crucial to consider for the climate adaptation task, but it does not yet have enough say in urban developments. Climate adaptation is still mainly the task of the water sector and climate adaptation has a limited role in spatial developments.

	There is a lack of integration between spatial planning and water & climate adaptation. In addition, water has mainly a facilitating role, but it is probably needed to give water a more directing role, as the importance of water will grow due to climate change. **Problem Statement** Due to population growth, a growing housing shortage, and a space shortage, it is expected that urban developments in the Netherlands will mainly take place inside existing city boundaries and in high densities. At the same time, it is projected that the effects of climate change will increase, as climate change is expected to accelerate and intensify. These two trends cause an increased risk for the liveability of these new urban areas. To reduce this risk, climate adaptation is key. However, traditional spatial planning does not match with the climate adaptation task. Climate change is dynamic and uncertain and extends over a long timescale. Traditional spatial plans, however, are often static, short-term plans, which do not enough take into account uncertainties. In addition, climate adaption is not yet fully integrated into spatial planning and is often still the task of the water sector. This makes that water, which is crucial for climate adaptation, does not have enough say in decisions about urban developments. Climate adaptation planning is crucial to ensure the development of sustainable urban areas with high liveability standards for future and far-future inhabitants. If spatial planning fails to act now for climate adaptation, the problems are passed on to future generations. **Hence, there is a need for a different way of working**. Climate adaptation asks for **more pro-active and flexible planning, for consideration of a longer timescale, and for working with uncertainties**. In addition, **urbanism and water management should be integrated to fulfill the climate adaptation task**. As the liveability of urban areas for future and far-future inhabitants will depend on the success of climate change adaptation planning, it is key to find new working methods.
Knowledge gap & Research aim	**Theory: Adaptive spatial planning & Adaptive pathways methods** In my academic theory paper, I described why climate adaptation planning needs an adaptive planning approach (and how traditional planning is not matching with the climate adaptation task). I also introduced **adaptive pathways as a promising planning method** which connects to more pro-active and flexible planning, consideration of a longer timescale, and working with uncertainties. However, **the spatial translation of adaptation pathways is far understudied** (Zandvoort et al., 2019). In theoretical literature, two relevant methods are found, which translate the idea of adaptive spatial planning into a working approach: **> Dynamic Adaptive Policy Pathways, Haasnoot et al. (2013)** The dynamic adaptive policy pathways method is proposed in the study of Haasnoot et al. (2013). The method is a combination of two existing theories: Adaptive pathways and Adaptive policymaking. The paper shows how the method could be applied for a water management case study of the Rhine Delta. It shows different

policy trajectories that could be followed, depending on the development of climate change (Haasnoot et al., 2013).

Spatial Adaptive Pathways - Zandvoort et al. (2019)

In their paper, Zandvoort et al. (2019) use spatial adaptive pathways to make a sustainable and adaptive landscape design. The authors created a spatial translation of the pathways to improve both the design and the pathways in an iterative research-by-design process. They showed different ways how the physical landscape could evolve, depending on the increase of sea-level rise (Zandvoort et al., 2019).

Spatial Adaptive Policy Pathways – this thesis

In this thesis, a combination of the methods above is made; it is called Spatial Adaptive Policy Pathways. As in both theoretical methods, it uses adaptive pathways to give place to uncertainty and to plan for different trajectories in the future. It combines the spatial translation of the pathways (Zandvoort et al., 2019), and the dynamic trajectories of policies (Haasnoot et al., 2013).

Knowledge Gap

As the combination of these two methods is not studied before, there is a **knowledge gap about the usability of this combined method**. In addition, the two methods are tested for landscape architecture and large-scale water management, but not yet for climate adaptation in high-density urban areas (connecting to urbanism and urban water management). The research aim is therefore to test the usability of Spatial Adaptive Policy Pathways for climate adaptation in high-density urban areas.

Research Aim

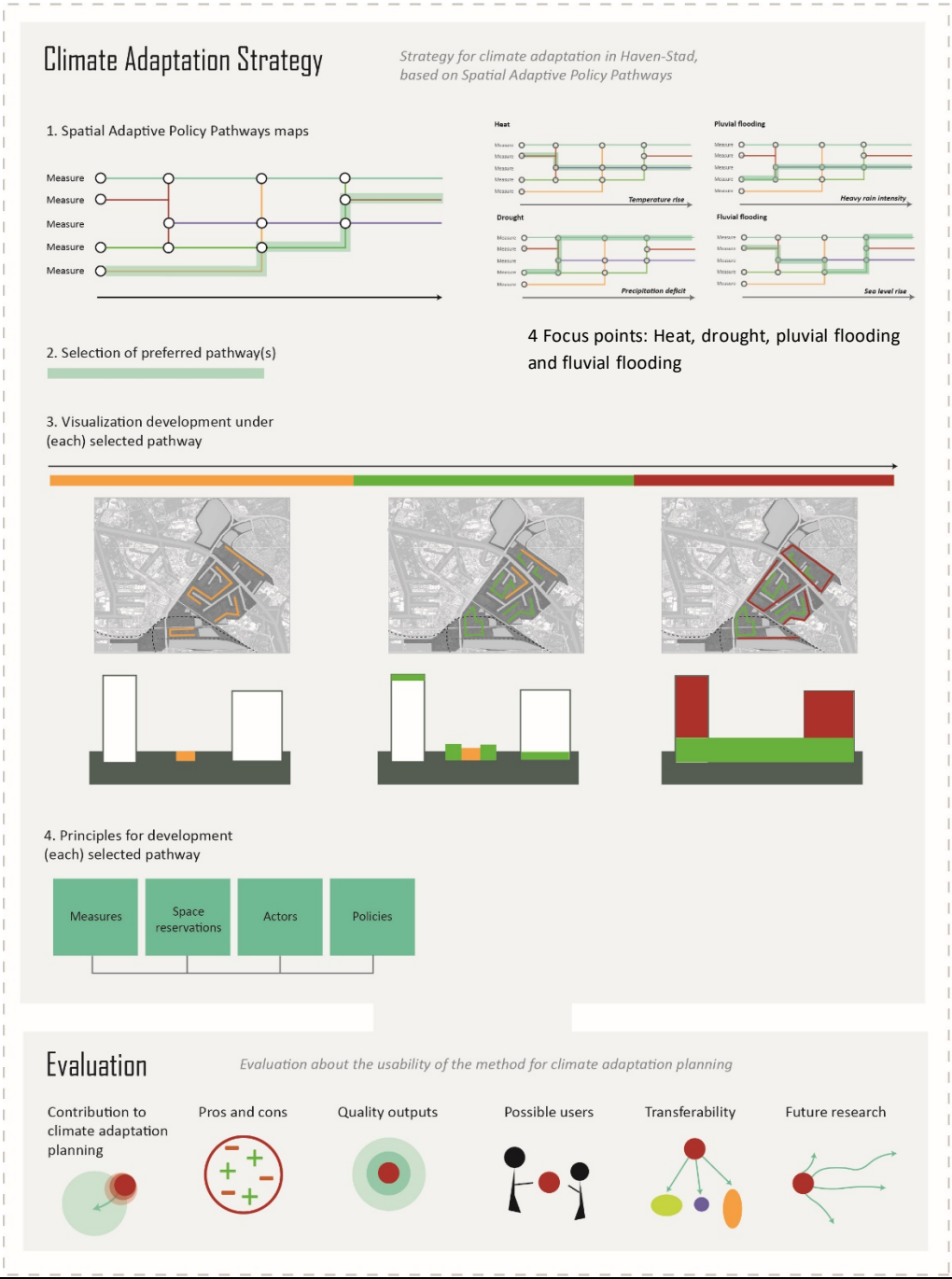
This research aims to **investigate the usability of a spatial version of the Adaptive Policy Pathways Approach for climate adaptation planning** in the development of Haven-Stad. The project tries to generate new insights about the usability of the method and possible adjustments needed. The research will contribute to the on-going learning process and exploration of planning methods that address climate change uncertainties and the implementation of climate change adaptation in urban developments. The final goal of this exploration is to find suitable working methods that support decision-making, planning, and design related to climate change adaptation. To boost the implementation of climate adaptation in urban developments and to ensure the development of sustainable living environments with high livability standards for future and far-future inhabitants.

Research questions	**Main Research Question** How can the method of Spatial Adaptive Policy Pathways be used for the development of a Climate Adaptive Strategy for Haven-Stad? **Sub-Research Questions** Sub-question 1 - Explore: What is the knowledge gap to be addressed in this research? Sub-question 2 - Analyse: What is the current and future situation of Haven-Stad? Sub-question 3 - Identify: What are the key elements for a climate-adaptive urban development? Sub-question 4 - Develop: How can Spatial Adaptive Policy Pathways be developed for climate adaptation planning in Haven-Stad? Sub-question 5 - Propose: How can a climate-adaptive strategy for Haven-Stad be proposed, based on the Spatial Adaptive Policy Pathways? Sub-question 6 - Evaluate: What can be learned from the process and outputs? *Each sub-question connects to a research objective (1. Explore, 2. Analyse, 3. Identify, 4. Develop, 5. Propose, 6. Evaluate). These objectives come back in the diagrams for the method description.*
Design assignment	**Design Assignment:** Spatial Adaptive Policy Pathways for Climate Adaptation Planning in the Development of Haven-Stad (Haven-Stad = Case study area) **Haven-Stad**, a redevelopment area (district) in Amsterdam, will be used as case study, because it is a typical case of a high-density urban development which will be confronted with climate change effects. This district will be the main scale of the project, and when needed I will zoom in (for instance street/neighbourhood design for heat and pluvial flooding) or zoom out (look into the regional context for fluvial flooding and drought). The design assignment consists out of two main aspects: **A working 'design' of the tested method**; I have to study how the Spatial Adaptive Policy Pathways method can work and how it can be applied. And a **climate adaptive strategy** (based on the Spatial Adaptive Policy Pathways) for Haven-Stad; I want to produce a strategy for climate adaptation planning, with the focus on heat, drought, pluvial flooding, and fluvial flooding). This strategy shows at which moments decisions need to be made, which decisions can be made (which climate adaptation options), and how the urban spaces could develop over time, depending on the decisions made. The spatial adaptive policy pathways show the possible trajectories over time for climate adaptation in Haven-Stad. These pathways/trajectories are spatially translated and research-by-design is used to shape the pathways. In addition, policy is integrated in these

pathways; I want to find out what is needed to realize the pathways (with a focus on the integration of water in spatial planning).

Intended outputs:

The intended final research outputs are two intertwined products, namely a **climate adaptation strategy for Haven-Stad based on Spatial Adaptive Policy Pathways (SAPP)** and an **evaluation of the method**. The SAPP strategy shows different ways of how climate adaptation can be implemented and developed over time in Haven-Stad. The evaluation elaborates on the usability of the method for climate adaptation planning and the lessons learned.



Process

Method description

Overall approach:

Integration of disciplines & Mixed methods

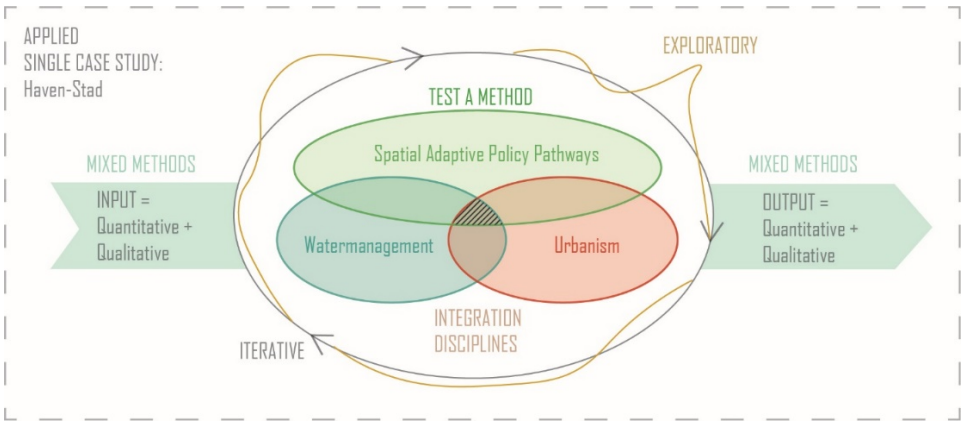
This graduation project is a combined project for the track Urbanism (Architecture, Urbanism and Building Sciences) and the track Water Management (Civil Engineering). The project, therefore, integrates the two disciplines. Due to the integration of the disciplines and the nature of the problem, this research combines qualitative and quantitative data, methods, and outputs. Qualitative data, methods, and outputs are for instance spatial configurations, research by design, and a design. Quantitative data, methods, and outputs are for instance rainfall data, modelling, and effectivity ratings.

Testing a method: Iterative & Exploratory

Testing a method is the overall objective of the research and does also define an important part of the overall approach. The tested method (explained on page 10) is a combination of two existing methods and is not studied before. The research is therefore exploratory, as an important part contains exploring how the method itself could work. The research is also iterative, which connects to both the exploratory nature, and to the tested method itself.

Applied: Case study

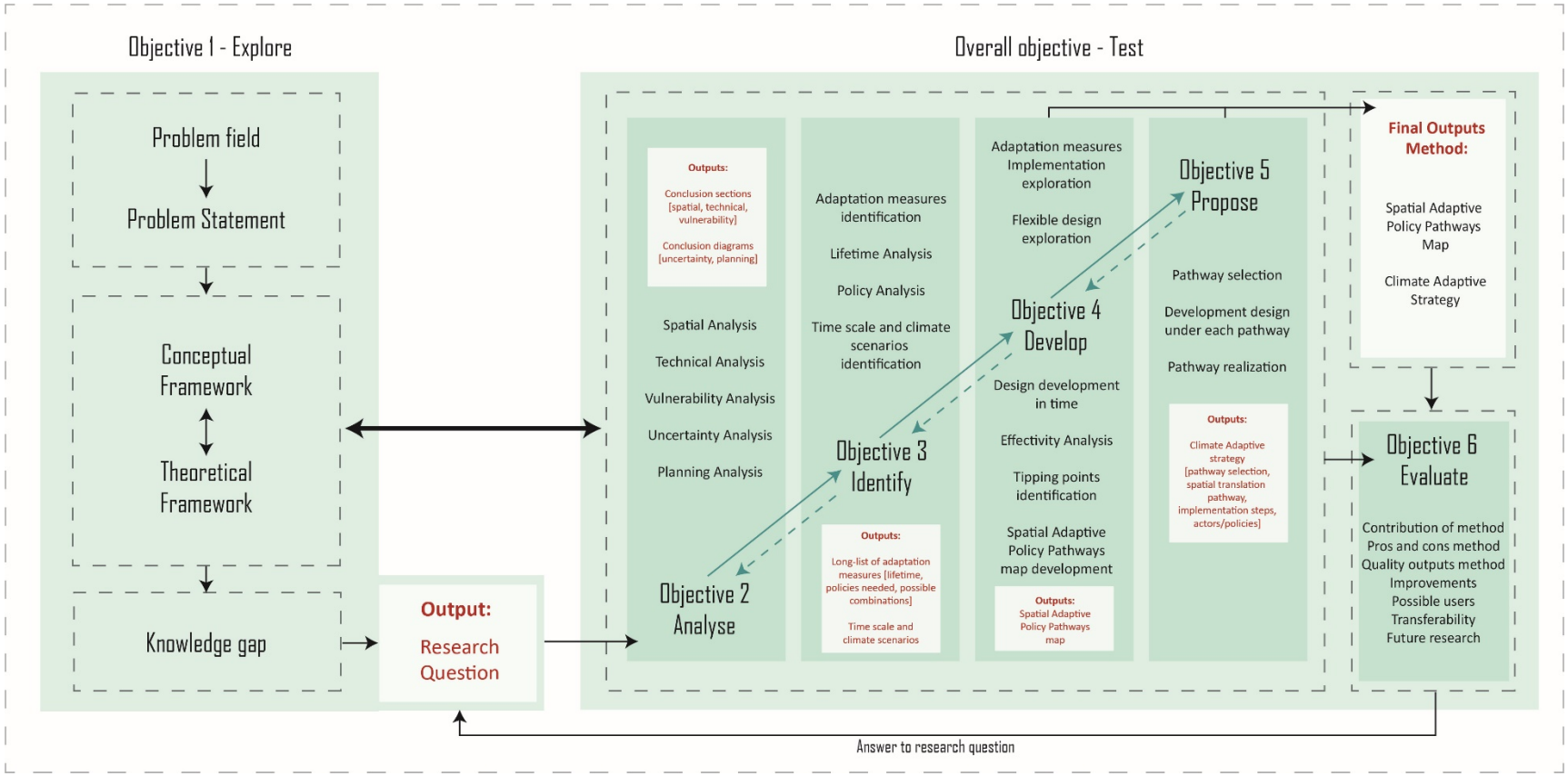
This research is an applied research, as it aims to solve a practical, real-life problem. A single case study (Haven-Stad, Amsterdam) is used to test the method for a real-life situation. Due to time limitations and the need to go in-depth, a single case study is conducted.



Research framework:

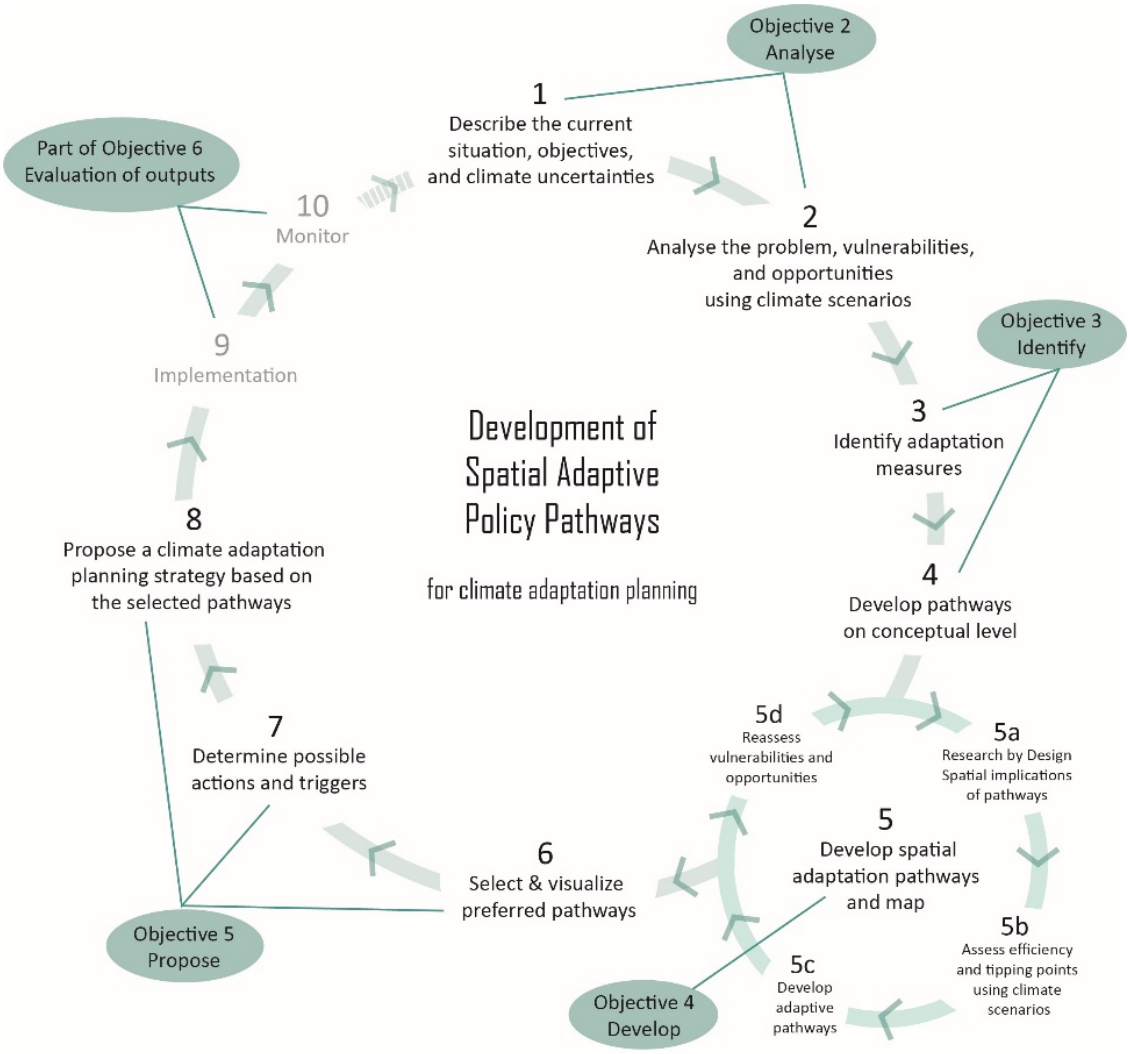
The research framework shows the flow in the methodology (page 9). The flow starts from the first research objective, Explore. To fulfill this objective, first, the problem is defined through the problem field and problem statement. From the problem definition, important concepts and theories are explored and selected. In the end, the knowledge gap is defined and the research question is formulated.

The overall objective, Test, is the core of answering the research question. To test the Spatial Adaptive Pathways method, multiple steps need to be followed. Objectives 2 until 5 represent the steps in the method, which will be carried out iteratively. In the end, the process of the method and the outputs of the method are evaluated (objective 6) to give an answer to the research question.


Objective 1 - Explore
Problem field
Problem Statement
Conceptual Framework
Theoretical Framework
Knowledge gap
Output:
Research Question
Overall objective - Test
Outputs:
Conclusion sections [spatial, technical, vulnerability]
Conclusion diagrams [uncertainty, planning]
Spatial Analysis
Technical Analysis
Vulnerability Analysis
Uncertainty Analysis
Planning Analysis
Objective 2 Analyse
Adaptation measures identification
Lifetime Analysis
Policy Analysis
Time scale and climate scenarios identification
Objective 3 Identify
Outputs:
Long-list of adaptation measures [lifetime, policies needed, possible combinations]
Time scale and climate scenarios
Adaptation measures Implementation exploration
Flexible design exploration
Objective 4 Develop
Design development in time
Effectivity Analysis
Tipping points identification
Spatial Adaptive Policy Pathways map development
Outputs:
Spatial Adaptive Policy Pathways map
Objective 5 Propose
Pathway selection
Development design under each pathway
Pathway realization
Outputs:
Climate Adaptive strategy [pathway selection, spatial translation pathway, implementation steps, actors/policies]
Final Outputs Method:
Spatial Adaptive Policy Pathways Map
Climate Adaptive Strategy
Objective 6 Evaluate
Contribution of method
Pros and cons method
Quality outputs method
Improvements
Possible users
Transferability
Future research
Answer to research question

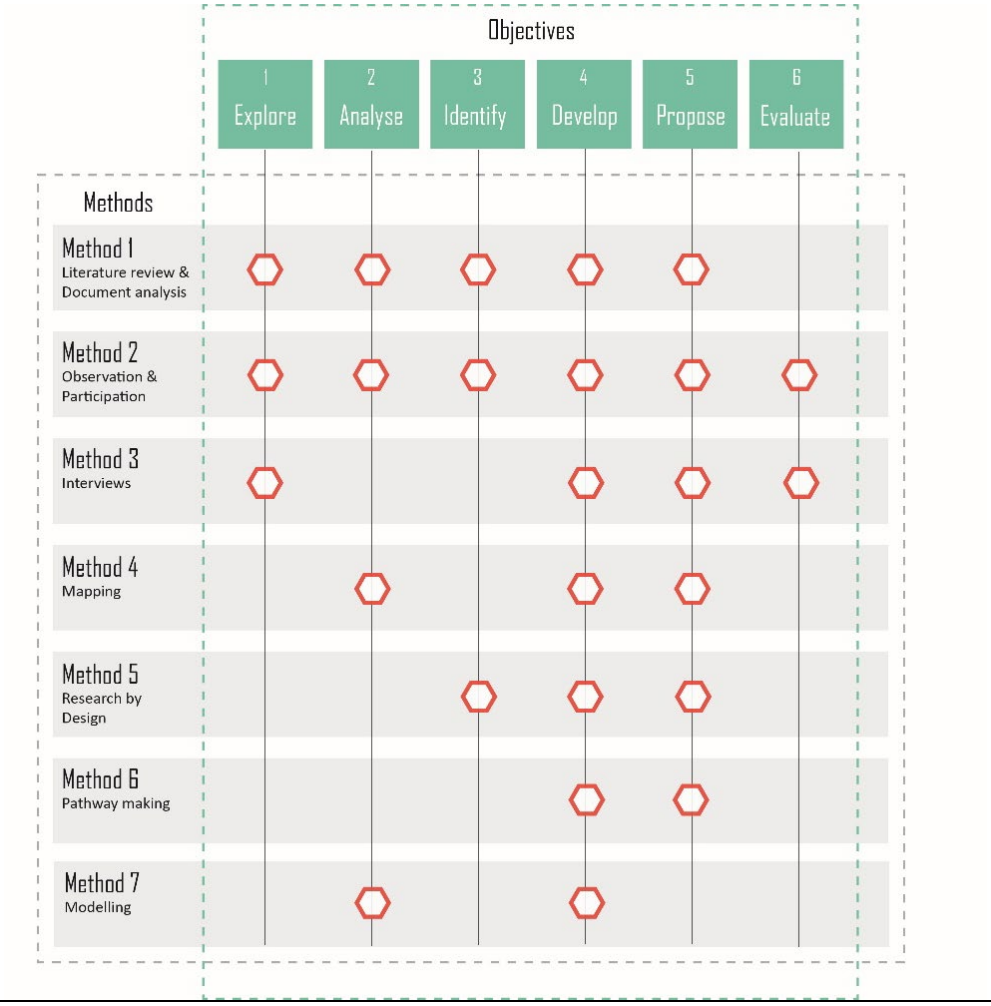
Proposed method:

The method of Spatial Adaptive Policy Pathways (SAPP) is a combination of two existing methods in literature: Dynamic Adaptive Policy Pathways (Haasnoot et al., 2013) and Spatial Adaptive Pathways (Zandvoort et al., 2019). This combination is interesting for climate adaptation planning, as it **brings together water management perspectives and spatial design and planning**. The figure below shows the steps of the SAPP method for climate adaptation planning. The steps are adapted from the study of Haasnoot et al. (2013), by adding steps or actions from the study of Zandvoort et al. (2019). Step 9 and 10 would be followed in practice, but are in this research replaced by an evaluation of the outputs.



Analytical Framework:
The analytical framework presents the connections between the research objectives (connected to the sub-research questions) and the methods. Seven methods are selected to fulfill the research objectives and to answer the research questions:

- Literature review & Document analysis
- Observation & Participation
- Interviews
- Mapping
- Research by Design
- Pathway making
- Modelling



Literature and general practical preference

Expert knowledge
- Interviews with employees of Waternet
- Interviews with employees of the municipality of Amsterdam
- Interviews with (TU Delft) researchers

Research data
- Climate Scenarios (KNMI)
- Vulnerability data (heat, drought, pluvial flooding, fluvial flooding)
- Weather data (KNMI)
- Water system data (Waternet, Dinoloket)
- Norms (STOWA)
- Governmental reports (Municipality of Amsterdam, Waternet)

Literature
- Urban Water Metabolism
- Urban Resilience
- Climate adaptation (planning, adaptation measures, design)
- Adaptive (spatial) planning
- Adaptive Pathways: Spatial Adaptive Pathways, Dynamic Adaptive Policy Pathways

Balducci, A., Boelens, L., Hillier, J., Nyseth, T., & Wilkinson, C. (2011). Introduction: Strategic spatial planning in uncertainty: theory and exploratory practice. *The Town Planning Review, 82*(5), 481-501. doi:10.3828/tpr.2011.29

Biesbroek, G., Termeer, C., Kabat, P., & Klostermann, J. (n.d.). Institutional governance barriers for the development and implementation of climate adaptation strategies. Working paper for the International Human Dimensions Programme (IHDP) conference "Earth System Governance: People, Places, and the Planet'. Amsterdam: Theoretical and Methodological Foundations, Panel 1: Adaptation and Resilience.

Biesbroek, R., Klostermann, J., Termeer, C., & Kabat, P. (2011). Barriers to climate change adaptation in the Netherlands. *Climate Law 2*, 181-199. doi:10.3233/CL-2011-033

Biesbroek, R., Klostermann, J., Termeer, C., & Kabat, P. (2013). On the nature of barriers to climate change adaptation. *Regional Environmental Change*, 1119-1129. doi:10.1007/s10113-013-0421-y

Deser, C., Philips, A., Bourdette, V., & Teng, H. (2012). Uncertainty in climate change projections: the role of internal variability. *Climate Dynamics* (38), 527-546. doi:10.1007/s00382-010-0977-x

Dujardin, S. (2019). Planning with Climate Change? A Poststructuralist Approach to Climate Change Adaptation. *Annals of the American Association of Geographers*, 0(0), 1-16. doi:10.1080/24694452 2019.1664888

Eisenack, K., Moser, S. C., Hoffmann, E., Klein, R. J., Oberlack, C., Pechan, A., . . .Termeer, C. J. (2014, October). Explaining and overcoming barriers to climate change adaptation. *Nature Climate Change, 4*. doi:10.1038/NCLIMATE2350

Haasnoot, M., Kwakkel, J., Walker, W., & Ter Maat, J. (2013). Dynamic adaptive policy pathways: A method for crafting robust decisions for a deeply uncertain world. *Global Environmental Change*, 485-498. doi:http://dx.doi.org/10.1016/j.gloenvcha.2012.12.006

Haasnoot, M., Middelkoop, H., Offermans, A., Van Beek, E., & Van Deursen, W. (2012). Exploring pathways for sustainable water management in river deltas in a changing environment. *Climatic Change, 115*, 795-819. doi:10.1007/s10584-012-0444-2

Hallegatte, S. (2009). Strategies to adapt to an uncertain climate change. *Global Environmental Change, 19*, 240-247. doi:10.1016/j.gloenvcha.2008.12.003

IPCC, 2014. *Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* [Core Writing Team, R.K. Pachauri and L.A. Meyer (eds.)]. IPCC, Geneva, Switzerland, 151 pp.

One Architecture; Arcadis; Smartland; Climate Adaptation Partners; Over Morgen; University of Pennsylvania; DRIFT of Erasmus University. (2020). *Resilience by Design Metropoolregio Amsterdam.*

Pot, D. W. (2020). Deciding for tomorrow, today: what makes governmental decisions about water infrastructure forward looking? Wageningen: Wageningen University. doi:10.18174/520563

Rauws, W. (2017). Embracing Uncertainty Without Abandoning Planning. Exploring an Adaptive Planning Approach for Guiding Urban Transformations. *disP - The Planning Review, 53*(1), 32-45. doi:10.10 0/02513625.2017.1316539

Runhaar, H., Wilk, B., Persson, A., Uittenbroek, C., & Wamsler, C. (2018). Mainstreaming climate adaptation: taking stock about "what works" from empirical research worldwide. *Regional Environmental Change*, 1201-1210. doi:https://doi.org/10.1007/s10113-017-1259-5

Stults, M., & Larsen, L. (2018). Tackling Uncertainty in US Local Climate Adaptation Planning. *Journal of Planning Education and Research*, 1-16. doi:10.1177/0739456X18769134

Van Buuren, A., Driessen, P. P., Van Rijswick, M., Rietveld, P., Salet, W., Spit, T., & Teisman, G. (2013). Towards Adaptive Spatial Planning for Climate Change: Balancing Between Robustness and Flexibility. *Journal for European Environmental & Planning Law (JEEPL), 10*(1), 29-53. doi:10.1163/18760104 01001003

Van Veelen, P., Stone, K., & Jeuken, A. (2015). Planning resilient urban waterfronts using adaptive pathways. *Water Management, 168*(WM2), 49-56. doi:http://dx.doi.org/10.1680/wama.14.00062

Viner, D., Ekstrom, M., Hulbert, M., Warner, N. K., Wreford, A., & Zommers, Z. (2020). Understanding the dynamic nature of risk in climate change assessments—A new starting point for discussion. A mospheric Science Letters, 21(e958). doi:10.1002/asl.958

Weyrich, P. (2016). *Barriers to Climate Change Adaptation in Urban Areas in Germany. Report 26.* Hamburg: Climate Service Center Germany.

Whitney, C. K., & Ban, N. C. (2019). Barriers and opportunities for social-ecological adaptation to climate change in coastal Britisch Columbia. *Ocean and Coastal Management, 179*. doi:10.1016/j ocecoaman.2019.05.010

Wise, R., Fazey, I., Stafford Smith, M., Park, S., Eakin, H., Archer Van Garderen, E., & Campbell, B. (2014). Reconceptualising adaptation to climate change as part of pathways of change and response. *Global Environmental Change*, 325-336. doi:http://dx.doi.org/10.1016/j.gloenvcha.2013.12.002

Woodruff, S. C. (2016). Planning for an unknowable future: uncertainty in climate change adaptation planning. *Climatic Change*(139), 445-459. doi:10.1007/s10584-016-1822-y

Zandvoort, M., Campos, I., Vizinho, A., Penha-Lopes, G., Krkoska Lorencova, E., Van der Brugge, R., . . . Jeuken, A. (2017). Adaptation pathways in planning for uncertain climate change: Applications in Portugal, the Czech Republic and the Netherlands. *Environmental Science and Policy,* 18-26. doi:http://dx.doi org/10.1016/j.envsci.2017.08.017

Zandvoort, M., Kooijmans, N., Kirshen, P., & Van den Brink, A. (2019). Designing with Pathways: A Spatial Design Approach for Adaptive and Sustainable Landscapes. *Sustainability, 11*(565). doi:10.3390 su11030565

Reflection

Project & Master Architecture, Urbanism and Building Sciences - Track Urbanism
The project is also embedded in the track Urbanism, which inherently connects it to **spatial design and planning**. In the project spatial quality will be one of the main focus points, together with integrative design. Methods learned in the urbanism track will define the research approach, such as thorough **analysis, research by design, evidence-based design, and working through the scales**. For the project, both the research into the problem, as the design of a solution are important aspects. The final aim of the proposed solution is always an improvement in spatial quality (in this project mainly liveability), and with that an improvement in the lifes of people. Another important aspect of the project is that it is **future-oriented**, which also connects to the Urbanism track. Trends are observed and researched, and plans are made to adapt the urban developments to this new future.

The project suits the studios of **Urban Metabolism & Climate (UMC) and Planning Complex Cities (PCC)** best. It connects to PCC due to the strategic focus and the investigation into water governance and policy making. The project also uses notions from the studio **Urban Ecology**, as green and water are important measures and structures for climate adaptation. The studio **Transitional Territories** would fit with this project as well, due to the focus on the delta environment, climate change, and adaptation. The link with the studio **Urban Fabrics** is a bit harder to find, but both the project and the studio deal with densification and the implications of it.

Project & Urbanism Studio - Urban Metabolism & Climate
The research will take place within the Urbanism studio Urban Metabolism & Climate. In the base it connects to the studio by the **problem to be tackled: Climate change**. Both the studio and the project focus on the **urban metabolism**, and how it can be designed to adapt to current and future climate changes. **Flows and systems thinking** are important perspectives used in the studio and the project. The project also fits the studio through the methods used, by making the combination of **analysis, design and engineering**.

Scientific Relevance
This project is of scientific relevance, as it **tests a new combination (Spatial Adaptive Policy Pathways) of two existing methods described in academic literature** (Spatial Adaptive Pathways & Dynamic Adaptive Policy Pathways). This research explores the usability of this combined method and contributes to the wide exploration of methods for climate adaptation planning. Thus, the evaluation of the method is the most important research outcome and gives insights in adjustments and future research needed.

Societal Relevance
This project tries to **make a contribution to the exploration of methods which support climate adaptation planning**. New urban developments are made to ensure the societal need for more housing, as the population is growing. **Climate adaptation is needed to ensure sustainable developments in which the liveability standards are high for the future and far-future inhabitants**. As densities are getting higher and climate change is getting more intense, the societal need for climate adaptive living environments is growing. So far, the implementation of climate adaptation in developments is not yet self-evident. This threatens the current society and future societies, on a social level (more inequality and livability treats), but also on an economic level (losses and damages). This project shows what the societal risks are if climate adaptation is not considered in

urban developments, and it shows how climate adaptation planning should and could be considered and implemented in urban developments.

Ethical Considerations

This project touches on the notion of **environmental justice**. The hazard (incident) x the exposure (people/assets) x the vulnerability (weakness) = the risk (loss or damage). As the effects of climate change are not evenly distributed in space, different areas are confronted with different levels of threat. The effect of this is that some people are at higher risk than others (higher hazard = higher risk). Moreover, due to different socio-economic statuses, some people will be more vulnerable than others to the same hazard (if you have money to buy preventive measures, you lower your vulnerability). Again, people which cannot afford measures to lower their own vulnerability, are at higher risk (higher vulnerability = higher risk).

Besides spatial environmental justice (intragenerational justice), **intergenerational justice** is also important to consider. This has to do with the fact that next generations will be born in the world this generation will leave behind. Maybe the consequences of climate change are not that severe for this generation, hampering the urge for working on climate adaptation. However, the future generations should also be considered, as they will most likely be confronted with even more severe climate changes. If this generation does not adapt in time, future generations will bear the consequences. And as climate change adaptation is a long-term process, it is important to start in time to protect the future.

Another important consideration comes with the implementation of climate adaptation itself. It is the **question of responsibility**. At this point, public parties still carry a big part of the responsibility, but it is unsure if their capacity is enough to keep up with the fast-changing climate. More and more attention is given to the importance of including inhabitants and private parties in climate change adaptation. But if some of the responsibility is shifted to inhabitants or private parties, it should be considered if these people are also capable to carry this responsibility. And if responsibility is given to for instance inhabitants, this will probably not be the same amount of responsibility for each inhabitant. Can we expect the inhabitants of vulnerable areas to carry more responsibility than inhabitants of safe areas? This is probably only fair if the inhabitants also get something in return for this responsibility, for instance more say and control about the area developments.

Time planning