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:

<table>
<thead>
<tr>
<th>Personal information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
</tr>
<tr>
<td>Student number</td>
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<tr>
<td>Telephone number</td>
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<tr>
<td>Private e-mail address</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Studio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name / Theme</td>
</tr>
<tr>
<td>Teachers / tutors</td>
</tr>
<tr>
<td>Argumentation of choice of the studio</td>
</tr>
</tbody>
</table>
# Graduation project

<table>
<thead>
<tr>
<th>Title of the graduation project</th>
<th>Crossing the line for nature. Cross-border planning coordination as a mean to implement ecosystem-based adaptation.</th>
</tr>
</thead>
</table>

## Goal

<table>
<thead>
<tr>
<th>Location:</th>
<th>Western Scheldt / Netherlands, Belgium</th>
</tr>
</thead>
<tbody>
<tr>
<td>The posed problem,</td>
<td>[Problem Statement]</td>
</tr>
<tr>
<td>research questions and</td>
<td>[Research Question]</td>
</tr>
<tr>
<td>design assignment in which these result.</td>
<td>[Design Assignment]</td>
</tr>
</tbody>
</table>

## CASE STUDY SELECTION

The Western Scheldt was chosen as the site of the project because:

a) It presents high vulnerability to climate change effects (Particularly flood risks)
b) As the remaining open arm of the Rhine-Meuse-Scheldt delta it has higher natural value that needs to be preserved
c) There is potential to use Ecosystem-based adaptation to increase resiliency of the built environment
d) The Western Scheldt is also located between the southern part of the Netherlands (In the region of Zeeland) and the Northern part of Belgium (in the region of Flanders), which will address the main point of discussion about the potentialities of cross-border coordination to best manage Ecosystem-based adaptation strategies. In this case, one territorial unity is divided administratively by two countries (Therefore 2 different planning systems and different goals that need to be coordinated to implement effective and efficient EbA across scales)

## PROBLEM STATEMENT

In a context where climate change poses a threat to many parts of the world, our built environment needs to improve its adaptive capacity to these changes. This is particularly relevant for low coastal areas. They are vulnerable to increasing flood risks due to sea level rise and more frequent storm events. Not only cities are affected by climate change, but also natural environments. In addition to climate change, natural environments are also disturbed by human activity.

The concentration of urban settlements near the coast has caused severe environmental consequences and has intensified the already altered state of the coastal ecosystems. (McGranahan et al. 2007). By prioritizing economic activities for short-term benefits, urban systems have significantly altered water, energy and other resources flows in existing ecosystems, which results in a decreasing capacity to operate properly (Rakodi et al, 1997). Damaged ecosystems face biodiversity loss, fail to provide the necessary ecosystem services and finally are not able to mitigate the hazards related to climate change.
Even if actions are taken globally to mitigate the effects of climate change (like reducing Co2 emissions and by that reducing temperature rise), cities still need to adapt to climate change. For this reason, we have to aim for plans and implementations that can be more adaptable to the changing conditions. In the past, we have relied strongly on hard engineered solutions to deal with risks, which have a very limited adaptive capacity and result in high costs and constant intervention. Approaches like seawalls, building dams, levees and channels to control flooding and even relocating infrastructure and settlements may help to some extent, but do not address integrally the climate change impacts. They can contribute to the destruction of fragile ecosystems and even reduce their adaptive capacity. (Hale et al., 2009)

Recently we have rediscovered the potentialities of working with nature to increase our resilience against climate change. Integrating “soft” and “hard” approaches have more potential to achieve adaptation, where structural measures can even aim to protect the ecosystems so they can continue providing their services. (Hale et al., 2009)

Ecosystem-based adaptation has been recently introduced in planning as an approach to build with nature and face climate change.

Ecosystem-based adaptation (EbA) proves to be a more efficient, cost-effective and sustainable approach to respond to climate change (Munang et al. 2013) and the concept is recently being introduced in spatial planning as an approach for to face climate change work towards a sustainable development. (Wamsler, 2014).

The main challenge in strategic planning to take EbA from a goal to operations is to acknowledge the territorial scale of ecosystems and its dynamics, which is usually not confined by traditional political and administrative boundaries. This means that traditional planning structures do not align with the territorial dimensions of ecosystems and cannot manage them properly. (Andrade et al. 2011, p.8). Ecosystems can cross cities, regions and even countries and therefore be subject to many different and conflictive planning structures.

This means that planning systems not only need to coordinate ecosystem management with all the other functions and activities of urban areas, but they also need to coordinate their strategies with the other planning systems involved in the same natural system. Ecosystems are complex and any intervention to improve something can create new problems in other areas. That needs to be taken in consideration in the process of decision making.

EbA requires long term vision, more complex planning and a custom governance system to be implemented.

Researchers, decision makers, economic forces and society need to come together and contribute to an integral approach, which means that new forms of governance need to emerge according to the specificity of the context.
This issue is very apparent in the case of the Western Scheldt, a river delta that has to satisfy the needs of the Dutch and Belgian development. An increasing port activity, multiple risks associated to flood and the deterioration of very valuable ecosystems in this tidal estuary are today’s main goals that both countries need to address (Outline 2030 Western Scheldt, 2005). Cross-border coordinating planning is a key factor to combine these goals in an optimal way and allow for more creative solutions for the development of this region. Some cross-border initiatives have already been put forward to manage the Western Scheldt as a natural system. However, port activity still has a dominating autonomous development model (Eker and Houtum, 2013).

If new forms of governance encouraged a higher level of cooperation among the ports of the area, new opportunities could emerge to combine the port development with measures to increase safety and preserve environmental quality of the Western Scheldt. To explore these possibilities, the project will answer this following research question:

RESEARCH QUESTION:

“How can cross-border planning coordination in relation to the regional port system of the Rhine-Meuse-Scheldt Delta play a role in implementing local ecosystem-based adaptation strategies to increase the ecologic, economic and safety performance of the Western Scheldt?”

SUBQUESTIONS:

SQ1: What are the potentials and limitations of ecosystems in the Western Scheldt area to facilitate adaptation to climate change?

SQ2: What are the main limitations to operationalize EbA in the Western Scheldt area?

SQ3: How do ecologic, economic and safety dynamics influence morphologic and infrastructural change in the Western Scheldt area?

SQ4: What are the main alignments and conflicts related to climate change adaptation goals in the planning systems that affect the Western Scheldt area?

SQ5: How can an increasing sand demand influence the development of the Western Scheldt area?

SQ6: How can the degree of coordination of the ports in the Western Scheldt influence the development of the area?

SQ7: How does the degree of planning coordination influence the capacity of local projects in the Western Scheldt to change to the overall performance of the ecosystem?

SQ8: How can the Outline2030 for the Western Scheldt facilitate cross-border port coordination and the implementation of adaptive responses like EbA?
The main goal of the project is to create a more coordinated, comprehensive and flexible governance structure, which can adapt to the requirements of a specific ecosystem-based project to facilitate its implementation.

This will be on the basis of higher level of coordination among the different plans, specially regarding port development on the Western Scheldt.

The project is also framed under the Long-term vision for Western Scheldt (Outline for 2030), which has defined goals. The project aims to use Ecosystem-based adaptation to contribute to these goals as well.

- Safety by reducing the risks of flooding: Projects will reinforce the capacity of mud flats, dunes and other sand formations to dissipate waves and maintain coastal defenses
- Good accessibility to the different ports along the Scheldt: Port development and new port infrastructure should not only have a reduced impact on the ecosystem, but contribute to its resturation.
- Preserving the natural systems: In combination with the other goals, the surface of valuable natural areas should increase and provide new economic opportunities.

After different possibilities of the projects are tested, they will be compared based on how effectively they can contribute to these goals. The most successful alternatives will then be studied in terms of governance and what kind of arrangements would be required to implement these projects. The study will result in a set of policies, governance arrangements and investment recommendations to revise the Outline for 2030 of the Western Scheldt and related planning systems of Belgium and the Netherlands.

**Process**

**Method description**

**PROCESS – ANALYTICAL FRAMEWORK**

1a- Group analysis – North Sea

In the scope of the studio, the research is centered around the North Sea and how dynamics in this area could be influenced by the effects of climate change.

This analysis of the geomorphological, economic, politic and biological conditions served as a common base of the studio to identify potential risks and challenges.

At the same time, a theoretical research was developed individually to identify key concepts and gaps in the theoretical discourse.
1b- Individual research

For my personal research, identifying EbA as a valuable approach to respond to climate change and challenges in planning to put it to practice led me to define the Western Scheldt as the case study.

Map analysis and data collection of the North Sea revealed that this river delta concentrates high risks related to climate change, high pressure to protect due to the importance of port activity and many governance overlaps resulting in conflictive interests.

2a- Site spatial analysis – Western Scheldt

On the case study, a more detailed analysis will be elaborated. First, by mapping the natural dynamics of the delta’s ecosystems I will be able to define what is the optimal frame to propose an adequate governance structure for it. Then, the layer approach (developed by De Hoog, Sijmons en Verschuuren for spatial planning, 1998)(Schaick and Klaasen, 2011) will be used to first identify how the functions of economy, ecology and safety take place in the Western Scheldt and then how these uses influence the infrastructural development and morphological transformations of the river. The focus of this analysis will be to identify sediment dynamics (flows, supply, demands) related with these activities and project how could they be in the future when sea level rises. The elaboration of these layers will be based on research and other collected data as well as information gathered on a site visit.

2b- Site governance analysis – Western Scheldt

In addition to the traditional layers, a governance layer will be included to identify the spatial presence of planning systems in different scales over the area, where overlaps occur and how they relate to the spatial development of the other functions. Mapping this layer requires a review over the different Dutch and Belgian spatial plans and strategies that affect the Western Scheldt, with particular attention to climate change responses and port development plans. A cohesion assessment will be elaborated and then used to systematically compare all of these plans in relation to their priorities, goals, timeframes, and responsibilities and determine where the major alignments and conflicts. This analysis phase aims to provide information about a) sand dynamics and b) port development opportunities which will then be used as the axis for projecting future scenarios.
These scenarios will explore the possibilities that can arise when planning encourages the ports of the area to make strategic alliances or when it continues to promote competitiveness between them. In both cases, it will be necessary to propose new planning arrangements, policies and governance structures to influence port development. Also, designing these possible scenarios will inform until what extent ports are able to grow while still maintaining the ecological conditions of the river and estuary in both a moderate and an accelerated projection for climate change (Adaptive capacity).

To further develop how the scenarios can unfold, the use of sediment transport models will be used. These models can provide and approximated reference on how morphological changes in the area can affect the sediment flows in the system. It can be used to strategically ensure that sediments are deposited in needed areas and define optimal places for possible erosion. This modelling approach is useful to decide where local interventions can or should happen to manage sediment flows in a favorable way for the large-scale system. In other words, it will guide the development of projects that implement EbA.

4- Evaluation

Finally, the outcomes of these scenarios will allow me to compare how different levels of coordination in governance (particularly among the ports of the delta) can have an effect on facilitating the implementation of EBA to deal with port accessibility, ecological preservation and flood protection of the Western Scheldt. These 3 variables have been set as the common goals for the Outline 2030 of the Western Scheldt and will be used to measure performance in the scenarios. This will respond the main research question and serve as the outcome to make policy and investment recommendations for the Outline 2030.
LITERATURE REVIEW:

It provides theoretical input of the concepts that will be analyzed throughout the research and how they relate to each other. For example, in order to define that a certain area is under flood risk, it is necessary to clarify first what constitutes risk, what are the direct and indirect attributes, how are they valued in urban contexts to then use this knowledge and establish under which parameters the flood risk of an area will be measured. Another example involves using literature to understand cross-border dynamics and use them to propose how can it operate in the specificity of the case study.

Limitations: In literature, there can be multiple versions of a concept, sometimes the definitions can even be contradictory. This means that I have to be explicit about which definitions and arguments I stand by and why some would not be appropriate for my research.

DATA COLLECTION:

Some historical records about the sea level rise and what are future projections on the North Sea will provide a realistic starting point to develop scenarios on the case study area and what would be required for strategies to adapt as time passes. Other useful data sources include population (Growth, decrease, distribution in space), port growth projections based on size, transported volumes, jobs and sediment volumes, flows and uses.

Limitations: Because I’m dealing with a cross-border issue, data from the Netherlands and Belgium will be required. Each country has their own organizations and researchers that will produce the data. For example, it could happen that one country produces content in relation to sand flows and the other doesn’t. I can also happen that both countries study the same topic, but measure with different parameters or different timeframes.

These limitations reinforce one of my arguments of the research the point of the research; fragmented knowledge defined by administrative borders is less useful than an integrated ecosystem analysis.

LAYER APPROACH:

To understand the dynamics of an area, especially on a territorial scale, the layer approach can be a good starting point. In its basic form, it analyses the spatial organization in 3 layers, which change at very different paste. The first layer is centered on the underground, encompassing the soil conditions, topography, river flows and how land has transformed. The second layer is mostly related with infrastructure, which in this case is important as it includes the implementations that have been used to respond to flood risk and sea level rise such as dikes, dams and shipping routes. The last layer focus on occupation, land use and how human activities develop, which is required to identify the variety of roles that case study area serves. For the special conditions of the project, an additional layer will be added, which considers the governance structure, how different planning systems spatially recognize climate change adaptation, the alignments and conflicts of their goals and strategies, the role of small scale plans within larger scale frameworks, etc.
Limitations: While this layer division may be very convenient for some types of analysis, it is not optimal for morphological analysis. There are functional, infrastructural and territorial components that influence the way that spatial morphology changes over time. Layers need to be combined to understand where pressures concentrate and how can it affects the river’s form and sediment flows.

MAPPING:

In addition to the maps to develop a layer approach, additional maps for ecological dynamics, urban expansion patterns, transformation of landscape through time and other historical changes will be elaborated, which will be useful to make more accurate projection of how the area will evolve and used to propose possible scenarios.

Limitations: Mapping itself is a process of abstraction and synthesis. On every map, the attention is guided to a specific topic, but can selectively ignore other relations and influences.

SITE VISIT:

By visiting the area of study is possible to gain more insight of the operational aspect of the current flood risk management, how the biophysical environment reacts to the flood risk implementations and how urban activities relate to the flood risk functions. It is also an opportunity to go to the different planning departments and interview people involved in the decision-making process to have a better understanding on how are current relations when it comes to defining a combined multi-level strategy.

Limitations: Knowledge gathered on a site visit is influenced by temporary conditions like weather, traffic, events, etc. The visit is like a picture, it captures a fixed moment in time, but is very limited to capture change. In relation to the project, it still provides partial understanding of short span cycles like tidal variation or the intensity of port activity through the day.

TRANSECT:

As part of the understanding process of the biophysical conditions of the area of study, the use of transects to see the variations of profiles along the coast, including topography, bathymetry soil composition and occupation of both ecosystems and urban environments will provide useful information about the potential risks that these areas are exposed due to sea level rise and what could be the consequences of this.

Limitations: Nature is a complex system. There can be thousands of variations of river sections and transects will require to make a very limited selection. Species that inhabit the area may not be visible at the time that the transect was produced.

PLANNING COHESION ASSESSMENT:

One of the fundamental actions to understand how the current planning system works in a certain area, what scales are considered, who are the groups involved, what are their goals and ambitions and how they relate with the other planning entities. The planning analysis will particularly focused on the issues related to responses to climate change and port development strategies.
As a conclusion of the planning analysis, an assessment tool will be elaborated to evaluate how well aligned are the goals, strategies, implementation, phases and resources between the different planning entities. This will set the basis to adjust the governance structure for the specific needs of the territory of the case study.

The planning cohesion assessments tool could be used not only to evaluate the alignment of goals related climate change and port development, but also for other types of goals in order to create customized and optimal governance systems to reach them.

Limitations: All the planning structures define goals, but in order to assess how they relate to each other, some level of interpretation is required. Objectives may be explained differently, but aim to the same goal. Milestones and vision can be defined on different timeframes.

SCENARIO PLANNING:

The purpose of this method is to understand how would the current planning system perform in the coming decades to deal with the effects of climate change, particularly related with sea level rise. In order to increase its capacity to respond and be more resilient, the scenarios proposed in the research will explore the opportunities that can arise if planning facilitates and encourages port coordination and how to combine the development of the ports with the preservation of the environmental qualities of the river and estuary. Imagining multiple futures allows to think of multiple solutions and that contributes to increase the adaptable capacity of a strategy.

Limitations: Scenarios as the name indicates are based on assumptions and not necessarily represent the real future. There are infinite scenario possibilities and scenario planning normally explores very few of them.

SEDIMENT TRANSPORT MODELLING:

With a scaled model of the case study area it is possible to see how morphological alterations on the edges between land and water can influence sediment flows. It shows an approximation of where sand erodes and where is deposited. It informs the impacts of some design proposals and can be used to guide sediments to where is needed.

Limitations: Currents, as any natural dynamic are very complex. It is difficult to reproduce the real water flows, therefore simulations in the model will probably not show the real sediment transport.

**Literature and general practical preference**

As part of the theoretical foundation of the project, a research paper was elaborated. The following conceptual framework diagram explains the relation between the key concepts that was explored in the paper and the related theories. Basically, it highlights the importance of planning coordination to operationalize Ecosystem-based adaptation and that way contribute to a more resilient and sustainable built environment. Then the relations are explained through a concrete case study on the Western Scheldt.
Abstract

Sea-level rise, coastal erosion and destruction of natural habitats are some of the effects of climate change that are now affecting many parts of the world, particularly near coastal areas, where about 23% of the population is currently living. In the past, we have generally relied on hard engineered solutions to deal with the risks, but they have high costs and a limited adaptive capacity. Ecosystem-based adaptation (EbA) is a concept that has recently been introduced in planning to respond to the effects of climate change. Wide range of studies show that EbA solutions are more sustainable, cost-effective and can provide many additional co-benefits. However, not much has been said about how to incorporate EbA in urban conditions where more land use conflicts are present. In most cases, EbA is presented as a goal, but frequently is not translated into practical actions.

This paper will first reexamine the roles of coordinated planning in relation to the concept of EbA to explain why this is a key factor to properly manage the territorial dimension of ecosystems and why planning structures need to adapt to site-specific conditions and normally cross their administrative borders. The discussion will then be developed in the case study of the Western Scheldt, which deals with the extreme of cross border planning coordination. The Western Scheldt is influenced by two different planning systems (Dutch and Belgian) and is an example of how planning coordination is used in the development of cross border EbA solutions.
For the development of the paper, the following literature was referenced

SOURCES:


**Reflection**

**Relevance**

What is the relation between your graduation (project) topic, the studio topic (if applicable), your master track (Urbanism), and your master programme (MSc)?

The project explores the evolution of a territory, the mutual influence of natural and urban dynamics and how can we create better synergies between them. These are very relevant topics for the transitional territories studio, specially this year that the theme is centered on the North Sea and the idea of coexistence. The project will be developed around the Western Scheldt, which is part of the Rhine-Meuse-Scheldt delta that is directly connected and influenced by the North Sea. With the project, I will test alternatives of regional strategies and the capacity of small scale projects to contribute to large scale dynamics. It will also deal with the issue of governance and policy that could facilitate the implementation of these strategies. More importantly, the project studies the relation between site-specific, project-specific governance and the capacity to properly manage the territorial scale at which ecosystems operate.

**SOCIETAL RELEVANCE:**

The projects highlight the value of working with and not against nature to become more resilient towards the effects of climate change. It increases environmental consciousness of society so they can be more involved in the process of support and maintain the conditions of their local ecosystems. Well preserved ecosystems can then operate and provide the wide range of products and services needed by society. This societal engagement with Ecosystem-based adaptation is also part of the local level management strategies.
In the case of the Western Scheldt, the quality of the ecosystems plays a vital role in the intensity of risks related to climate change and if human intervention continues to deteriorate them, they increase the problem in the future. Part of the value of the project is coordinating the need to maintain ecological quality with the need to keep land safe and aligned with the ambitions of port economic development to optimize resources and increase stakeholder’s engagement with nature conservation.

As the project proposes a more site-based, project-based, inclusive and coordinated governance, it is possible that some groups of society may be important to consider in the process of decision-making. That way society is better informed about what is at stake for them and for everyone, how are they influencing natural dynamics and what can they contribute to find an optimal solution.

SCIENTIFIC RELEVANCE:

Planning coordination is fundamental to develop effective plans to manage ecosystems, including Ecosystem-based adaptation strategies.

The main reason is that the extension of ecosystems frequently does not align with the traditional administrative divisions of governance. Large scales and time frames of natural processes require new arrangements of governance that recognize the site-specific conditions, defines the optimal scales to operate and includes the corresponding stakeholders in the process of decision-making.

This flexibility should also facilitate the exchange of perspectives, knowledge and resources within the scope of each project in order to make well-informed decisions and reduce trade-offs.

Planning coordination can then facilitate operatizing ecosystem management via small-scale projects and interventions that can also contribute to a long-term vision and the improvement of the natural systems at their territorial dimension.

Natural dynamics change at a slow pace, but can provide many benefits and be cost-effective. For this reason, we have to find ways to incorporate them in planning not only as a goal, but how to make it possible. When properly managed, Ecosystem-based adaptation can increase the resiliency of the built environment against climate change, which is major threat that will become more problematic in the future.

Time planning