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	Anne de Jong
Student number	4640845
Telephone number	
Private e-mail address	

Studio		
Name / Theme	Transitional territories	
Main mentor	Luisa Calabrese	Urbanism
Second mentor	Janneke van Bergen	Landscape architecture
Argumentation of choice of the studio	Related to territories in risk between land and water, the studio of transitional territories corresponds to both spatio-ecological, as well as socio-economic changes and vulnerabilities that are addressed in the project. Sea level rise is an uncertainty that can be approached through adaptive planning and systems thinking, which the studio applies. The studio offers an approach of research by design that can test different performances of the environment related to livability as well as biodiversity in areas that are challenged by natural processes (such as erosion, inundation etc.). Within the studio the project can relate to the inquiries of 'flux, erasure, terraforming', concerning inundation and erosion (tidal, Aeolian) of areas, and to a certain extend to the 'pervasive ecology of flows' and 'the dual nature of externalities'.	

Graduation project	
Title of the graduation project	Territories of eco-chance: Co-benefits of ecosystem based adaptation for future development of the Eastern Scheldt

Goal	
Location:	Eastern Scheldt, Schouwen-Duiveland, Noord Beveland (NL)
The posed problem,	General: It is not a question 'if', but a question of 'at which rate' sea level rise will occur. This uncertainty makes planning more difficult, since the static (human) environment is imposed on a dynamic surface. Currently the impact of flooding is perceived as an undesirable event that can negatively affect socio-economic processes (land use change, safety), as wel as ecological processes. However key constraints of current hard engineering is the relocation of existing infrastructures, and financial and technological barriers, as well as the availability of relocation space. Additional, the unforeseen environmental affects of 'hard' engineering approaches (such as dams, storm surge barriers, defensive coastal management) have been affecting biophysical as well as ecological systems, resulting in increased vulnerabilities of floods in the Rhine-Meuse-Scheldt delta as well as a loss of estuarine habitats. In the context of climate change it might not be a reliable long term approach for risk management. Specifically in Rhine-Meuse-Scheldt delta there appears to be competing socio-economic (agriculture, horticulture, industry, fishing) and as well as ecological claims, that will only be stressed more by a expected increasing population,intense land-use, and related human activities and needs. This questions the feasibility of (urban) developments in delta areas. Therefore there appears to be a need to rethink coastal (protection) strategies, questioning future relations between design, engineering, natural and social sciences, as well as governance. The problem field relates to temporal and spatial distributions of socio- economic as well as ecological vulnerabilities in delta areas under the influence of intensive human exploitation as well as increased flood risk under the influence of the natural variability of climate as well as Anthropogenic climate change. Eastern Scheldt: When looking at the Eastern Scheldt several issues can be perceived as drivers of change. The Eastern Scheldt barrier has affected sedimentation processes in the Eastern Scheldt leading to a loss of intertidal areas and related habitats. In order to sustain these

	habitats, as stated by Natura 2000 regulations, measures related to morphological processes are neccecary. Simultaniously processes of salinization of ground water (expected to increase due to sea level rise), and limited availibity of (future) fresh water supply (also affected by possible droughts) is affecting agricultural activities. This questions what type of spatial adjustment can support economic and ecological activities in the area.
research questions and	*The main research question:* *How can an ecosystem-based adaptation approach support the adaptive capacity of the Rhine-Meuse-scheldt delta and mitigation of altered future climate conditions, while meeting multiple environmental, ecological, social, and economic objectives to support its inhabitation?* Subquestions Analytical *1. What is the possible impact of floods in the Rhine-Meuse-scheldt delta? (in other words: which systems are affected?)* *2. What vulnerabilities were created by 'hard engineering' approaches, and which spatial layers and processes were affected?* *3. What are the social, economic and environmental drivers for change?* Theoretical *4. What constitutes the adaptive capacity of systems in the delta, and how can this be improved through behavioural, societal and (bio) physical adjustments?* *5. What do theories on climate/flood resilience imply for applied urban practices?* Applied *6. What are the ecosystem services of the delta related to flood phenomena and how can they be applied in order to contribute to (urban) flood resilience in the Rhine-Meuse-Scheldt delta (site specific)?* *7. What are criteria to measure the value of ecosystem based measures?*

design assignment in which these result.	The design assignment focuses on the synchronization of different subsystems alongside the Eastern Scheldt, specifically focusing on sites that are likely to be affected by altered climate conditions, such as sea level rise and salinization, and possible flooding (examination of dike trajectories). The project does not entail to offer a total integrated proposal, but proposes, and studies the effect of, different measures and when and where they can be applied (different adaptive pathways). The design is therefore not a singular proposal but an indication of possible changes. Simultaneously it questions which actors are involved in spatial modifications of the area, and how changes can be initiated.

Process

Method description

Creative methods (informed by social learning) can be combined with research to respond to socio-economic and ecological problems. In general, research by design is perceived as a helpful method to explore different outcomes. Different mediums can support this, namely: sketching, cartography, narration (through film or projections/models), scenario planning, etc.. A spatial Narrative approach might help in understanding the changing land-water interface, and the different forms of inhabitation/urbanization driven by specific economic, cultural and societal drivers over time.

Since adaptation demands dynamic, long term and transitional approaches to accommodate uncertainty (and avoid future maladaption) adaptive pathways are used as a method for designing with uncertainties. Example is the use of dynamic adaptive pathway development (Haasnoot, Kwakkel, Walker & Ter Maat, 2013). A list of possible actions and decisions needs to be defined related to the issues in the project area in order to establish different possible pathways. Example is actions related to the water supply or demand in an area. This approach is mainly qualitative, in the sense that it proposes different possible spatial actions.

Several tools will be used to accommodate the main methods, namely:

- Literature review
- Data analysis
- Field work
- Scenario planning
- Assessment tools
- Conversations with experts
- Stakeholder analysis
- Transcalar mapping

An elaboration on the tools is included in the P2 report.

Literature and general practical preference

Main theories that will be consulted in the project are related to:

- Complex social and adaptive systems
- Adaptive capacity of systems and resilience
- (Urban) Flood resilience
- Nature based design solutions: ecosystem based adaptation
- Ecosystem services (of flood phenomena)

These will be briefly explained in the following paragraphs.

Complex social and ecological systems: panarchy

Within these theories social and ecological systems can be perceived as complex integrated systems in which humans are part of nature (Berkes & Folke,1998). Addressing the multi scalarity of systems, and the different speeds through which they can operate or inform each other is related to the theory of panarchy. Gunderson and Holling refer to panarchy as, a 'interacting set of hierarchically structured scales' (Gunderson & Holling, 2002). The panarchy theory acknowledges that a system can not be understood or managed when focussed on at a single scale single time perspective (Resilience Alliance, n.k.). Systems are interlinked and can either be small and fast, or large and slow.

Adaptive capacity and resilience

The IPCC refers to the adaptive capacity (in relation to climate change impacts) as: 'The ability of a system to adjust to climate change (including climate variability and extremes) to moderate potential damages, to take advantage of opportunities, or to cope with the consequences.' (IPCC, 2007, p.869). According to the Resilience alliance, 'systems with high adaptive capacity are more able to re-configure without significant changes in crucial functions or declines in ecosystem services. A consequence of a loss of adaptive capacity, is loss of opportunity and constrained options during periods of reorganization and renewal.' (Resilience Alliance, n.k.)

Both Ecosystems, as well as social ecological systems are represented as an 'adaptive cycle' with four phases, namely: 1: Growth or exploitation; 2: Conservation; 3: Collapse or release; 4: Reorganisation. The moment a system is in distress there might occur a point of collapse or release after which reorganisation can take place. Systems perform a task and can learn through remembering, or can revolt.

Urban flood resilience

Future trajectories of Social-ecological systems are determined by three complementary attributes, namely: resilience, adaptability, transformability (Walker et al., 2004, p.1). The capacity of social-ecological systems to 'withstand perturbation and other stressors' whereas it remains the same regime (maintaining its structure and functions) is called resilience (Resilience alliance, 2019). It describes the degree to which the system is capable of self-organization, learning and adaptation, and is therefore capable to benefit from change (Gunderson & Holling, 2002, p.3). Building resilience can essentially be understood as a process of adaptation.

Resilience can be approached through different domains. Through Evolutionary resilience climate change adaptation is considered as 'a continuing process, which involves social and institutional learning and transformative potentials. As such, it discourages planners

from putting the emphasis on rigid and fixed plans and the attempt to command and control space and time' (Davoudi, 2012). According to Liao it can be argued that ''the adaptive capacity contributing to increasing urban resilience to floods" requires the ability to learn from each flood (Liao, 2012, p. 6/15). Through the learning process one can be ''making timely behavioral, physical, and institutional adjustments to be better prepared for the next flood" (Liao, 2012, p. 6/15). Three key properties to urban flood resilience are mentioned by Liao, namely: localized flood-response capacity, timely adjustments after a flood, and redundancy in subsystems (Liao, 2012, p. 6/15).

Nature based design solutions: ecosystem based adaptation

Different approaches try to tackle the adaptive capacity. Often mentioned are nature based solutions. These, as defined by the IUCN, are "actions to protect, sustainably manage, and restore natural or modified ecosystems, that address societal challenges effectively" (IUCN, 2007, p.1). Integrated are lessons learned from ecosystem services and natural phenomena. One example is Ecosystem-based adaptation that integrates the use of biodiversity and ecosysteem services in a overal strategy in order to help adapt to the impacts of climate change, induced by the current climate variability and climate change (IUCN, n.k, p.1), and therefore reduce risk. They also pose solutions to societal as well as ecological challenges, and can meet with multiple (environmental, social and economic) objectives.

Ecosystem services (of flood phenomena)

Ecosystem-based adaption is based on the use of ecosystem goods and services, which can be defined as 'the benefits human populations derive, directly or indirectly, from ecosystem functions" (Costanza et al., 1997, p. 253). And these ecosystem functions can refer variously to the habitat, biological or system properties or processes of ecosystems (Costanza et al., 1997, p. 253). Most often they are divided in four types of services, namely: provisioning services, regulating services, cultural services, and overall supporting services. Whereas regulating services are mainly related to the mitigation and regulation of climate related issues, additional services can arise as co-benefits from the conditions on the location. The project questions how ecosystem services related to the mitigation of flood phenomena can be used to support other services.

References:

Costanza, R., D'Arge, R., De Groot, R., Farber, S., Grasso, M., Hannon, B.,Van den Belt, M. (1998). *The value of the world's ecosystem services and natural capital.* Ecological Economics, 25(1), 3-15. doi:10.1016/S0921-8009(98)00020-2. Retrieved, 20-11-2019, from: https://www.researchgate.net/publication/229086194_The_Value_of_the_World's_Ecosystem_Services_and_Natural_Capital

Davoudi, S. (2012). *The legacy of positivism and the emergence of interpretive tradition in spatial planning.*

Regional Studies, 46(4), 429-441. doi:10.1080/00343404.2011.618120
Davoudi, S., Brooks, E., & Mehmood, A. (2013). *Evolutionary resilience and strategies for climate adaptation.* Planning Practice & Research, 28(3), 307-322. doi:10.1080/02697459.2013.787695

IPCC (2007) Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson, Eds., Cambridge University Press, Cambridge, UK, 976pp. Retrieved 26-10-2019, from: https://www.ipcc.ch/site/assets/uploads/2018/03/ar4_wg2_full_report.pdf

IUCN. (n.k.). Nature-based Solutions. Retrieved 10-10-19, from: https://www.iucn.org/commissions/commission-ecosystem-management/our-work/nature-based-solutions

Gunderson, L., & Holling, C. (2002). Panarchy : Understanding transformations in human and natural systems. Washington, DC: Island Press. (2002). Retrieved Oktober, 2019, from INSERT-MISSING-DATABASE-NAME.

Liao, K.-H. (2012). *A theory on urban resilience to floods—a basis for alternative planning practices.* Ecology and Society, 17(4), 48. Downloaded 20-11-2019, from: https://www.ecologyandsociety.org/vol17/iss4/art48/

Resilience Alliance. (n.k.). *Resilience.* Retrieved 01-10-2019, from: https://www.resalliance.org/resilience

Walker, B., Holling, C., Carpenter, S., & Kinzig, A. (2004). *Resilience, adaptability and transformability in social-ecological systems*. Ecology and Society, 9(2). doi:10.5751/ES-00650-090205

Reflection

1. What is the relation between your graduation (project) topic, the studio topic (if applicable), your master track (A,U,BT,LA,MBE), and your master programme (MSc AUBS)?

The graduation topic is concerned with adaptive planning practices and (urban) flood resilience in the Rhine-Meuse-Scheldt delta. It therefore relates to territories in risk between land and water (studio of transitional territories), and corresponds to both spatio-ecological, as well as socio-economic changes and vulnerabilities induced by natural and anthropogenic climate change. The graduation project addresses vulnerable farmers in areas with a relatively low population. The dependancy on fresh water supply and increased salt intrusion might require new adaptive (farming) management. It concerns the loss of intertidal areas (ecological vulnerability), affecting the shellfish industry (economy) and its regulating ecosystem functions (such as wave attenuation).

The master program of Urbanism is concerned with strategic spatial planning related to landscape functions and engineering, while integrating social, cultural (recreation, resistance to floods), economic (shellfish industry, large scale agriculture) and political climate related to (cross-border) water management.

2. What is the relevance of your graduation work in the larger social, professional and

scientific framework.

The Dutch government invests a great amount of money in the delta programme. The Deltafonds will invest around 20 billion euros in water safety, sweet water supply, maintenance, experiments, and water quality in the delta in the period of 2019 -2032 (Deltafonds, 2019). However main investments to ensure water safety go to the establishment of larger dikes, typical hard 'engineering' infrastructures. Will these investments be enough to support future resilience in the delta? What will be the costs after 2050 when sea level rise is more likely to accelerate? Are there enough resources, financial as well as material (such as sand), to support reinforcements? The project will contribute to the establishment of alternative pathways, through which expensive future investments might be reconsidered. It questions hard engineering approaches, reflects on (urban) resilience to floods, and opts for nature based approaches to overcome site specific issues (and possible future issues).

Deltaplanning: Eastern Scheldt case
The Sea and Delta department of the Directorate-General for Public Works and Water Management (in Dutch: Rijkswaterstaat, or the abreviation RWS), has a concern about the consequences of extreme sea level rise on the edges of the Oosterschelde and the still-waiting attitude of many stakeholders to act. Therefore the project aims to create awareness and to develop perspectives for adaptation of the area.
Initiated thought the OOZO is a collaborative network of students (different fields) and experts and stakeholders to think about future pathways of the Eastern Scheldt .The municipalities of Schouwen-Duiveland, Noord-Beveland, the water board and the province are involved, as well as the knowledge community Eastern Scheldt collaborate, in which various experts and local stakeholders work together to develop knowledge about the Eastern Scheldt. The project aims to contribute to knowlegde and planning development through the participation of this initiative (meetings, presentations, data sharing).

The following page shows the general planning schedule of the project.

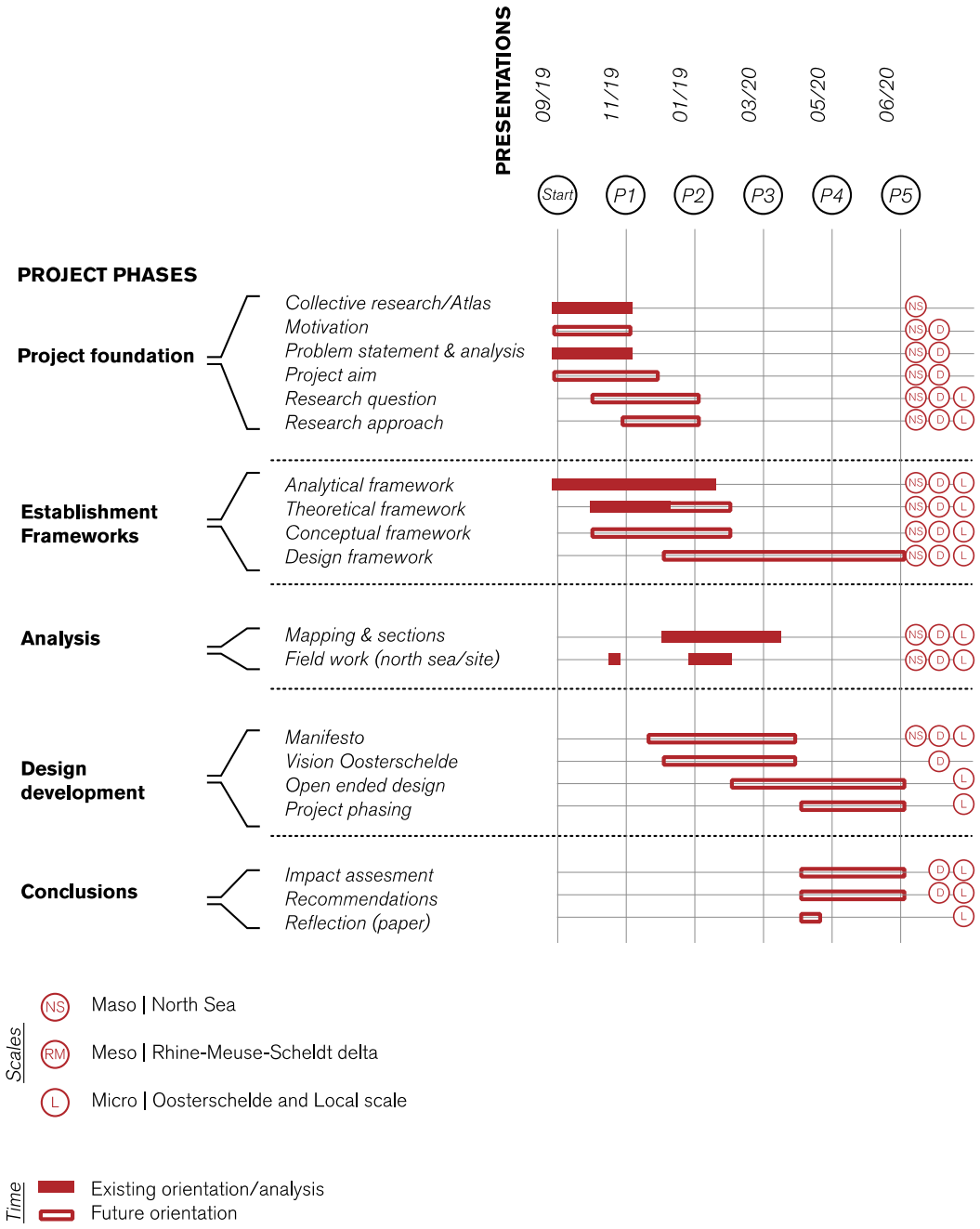

Image 3.9 | Overal timeline graduation project with main presentations