Bachelor Thesis

Building Flood Resilience in Harbour Cities

Research on the integration of flood risk management and urban planning in harbour cities in the light of European regulation.

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Bachelor thesis Geography, Planning and the Environment
Nijmegen School of Management
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List of Abbreviations

FRM:	flood risk management
FRMD:	European Flood Risk Management Directive
FRMP:	Flood Risk Management Plan
PAA:	Policy Arrangement Approach
PA:	Policy Arrangement
MSL:	Mean Sea Level
p.c.:	personal communication
WLH:	Water Law Hamburg (Hamburgisches Wassergesetz)
PPH:	planning permission hearings pph
UDP:	urban development plan
BUE:	Behörde für Umwelt und Energie
LSBG:	Landesbetrieb für Straßen, Brücken und Gewässer
BIS:	Behörde für Inneres und Sport
BSW:	Behörde für Stadtentwicklung und Wohnen
HPA:	Hamburg Port Authority
RAS:	Rotterdam Adaptation Strategy
SPA:	Spatial Planning Act (Wet ruimtelijke ordening)
EIA:	Environmental Impact Assessment
SEA:	Strategic Environmental Assessment

Summary

This bachelor thesis is the report of a research on the integration of flood risk management (FRM) and urban planning in European harbour cities. The discussion around this topic started with the emergence of the global warming problem. The main challenge climate change will pose on society is the increase in extreme weather events such as floods and storms. Climate adaptation, thus, is of crucial importance in order to deal with the unavoidable changes in the climate which impact on the global society. In addressing flood risk management in an urban context, this thesis links climate change to one of the most important issues of the 21st century: Urbanisation.

Cities increasingly face the challenge of adapting to the specific water related climate impacts. In order to cope with the rising sea level, storm surges and extreme precipitation, especially harbour cities recognise the need to implement FRM measures. Flooding, as one of the water related climate impacts, belongs to the costliest and most damaging hazards that will challenge city authorities as they become more frequent and more severe. Especially harbour cities face increased risk since the IPCC (2007) concludes that the most likely effects of climate change are the sea level rise in coastal cities and extreme events damaging the built infrastructure. That is why coastal cities located in low-lying coastal plains, islands and deltas are the most threatened areas.

UN-Habitat (2011) and the World-Bank (2010) recognise cities as crucial in the response to these changes. They are of special interest when it comes to climate change as they contribute a large part of the national GDP which means that they are hubs of economic activity for every nation. Moreover, they accommodate important social and political activities, environmental and cultural services, and a huge concentration of population. But the local level is not only vulnerable, it also brings the potential to design and implement effective adaptation responses, since the climate risks in cities are more relevant and directly influencing private and public actors who feel the sense of urgency themselves.

In the past, flood risk policies have been based on the prevention of disasters, only. Flood disasters such as the flooding of Elbe in 1962 have shown that the traditional approaches are not effective anymore and a more integrative approach is needed for flood protection. In this context, the EU Flood Risk Management Directive (FRMPD) was developed which requires member states of the EU to create Flood Risk Management Plans (FRMP) for areas they identified as potentially vulnerable. In order to do so, the FRMPs need to take relevant environment-related aspects into account which refers to land-use, water conservancy, spatial planning, nature protection and harbour infrastructure.

An important progress in the literature was the development of the concept of integration. For years, scholars have advocated the integration of climate adaptation and spatial planning as the key factor in the development of effective policies. The knowledge of the role of urban planning in FRM, however, remains scarce. As Wamsler, Brink, & Rivera (2013, p. 76) state: "Urban planning is, in practice, only of marginal interest. Most national adaptation strategies are not yet translated into planning practice, and other countries do not have such strategies. Hence, whilst it is generally recognized that the role of spatial planning for adaptation should be strengthened, the practice is still not well developed." In order to deal with this lack of knowledge, this thesis aims at acquiring a better understanding of the practices of integrating flood risk management and urban planning in harbour cities with regards to their European context in order to help in making recommendations for the improvement of future policy making. In order to do so the following research question will be answered:

What are the prospects and barriers in the integration of flood risk management and urban planning in harbour cities with regards to their European context?

Therefore, this research is meant to be practically-oriented as it aims to improve the existing practices of FRM in harbour cities. (Verschuren & Doorewaard, 2010, p. 33*)* Drawn from the definitions of the main terms, concepts and the research questions, the Policy Arrangement Approach appears to be an appropriate tool for examining the process of the integration. By applying the Policy Arrangement Approach to two harbour cities from different national contexts as case studies, insights are obtained in the institutional framework, relevant actors and coalitions, resources and power relations, and discourses. Due to the assessment of these aspects for the current situation of two successful cases, it is possible to identify prospects and barriers which can be used in order to improve future practices and governance processes in the field of urban FRM.

This thesis applies a multiple-case study as research method. The European harbour cities Hamburg and Rotterdam are used as units of analysis in terms of instrumental cases. By means of the case studies, the issue of integration FRM and urban planning will be explored in-depth. In order to show different solutions and perspectives, two cases will be compared. In doing so, the principle of replication is applied, meaning that both cases are explored and analysed in the same way. Therewith, information will be obtained on how the process of integrating FRM and urban planning is precisely taking place and which factors are influencing this process.

Hamburg and Rotterdam are both harbour cities, similar in size, facing similar flood risks, mainly in terms of storm surges and sea-level rise, due to their location in river basins next to the North Sea. In addition, both areas are low-lying with polders in their hinterlands. Both harbour cities contain a huge concentration of population which puts pressure on the available space. Also, both cities have large parts lying outside of the line of protection. Moreover, the cities are both having a similar social and cultural background when it comes to their population and they are both subject to European regulation. That they are located in different countries is on purpose as that might enable insights over the influence of nation specific aspects, such as national regulations, discourses and path-dependency.

Chapter 4 and 5 represent the empirical part of the thesis, by providing and descriptive elaboration of the cases Hamburg and Rotterdam and a subsequent analysis of the policy fields flood risk management and urban planning. In the end of each chapter both PAs for each case are compared in order to identify existing prospects and barriers in the integration of FRM and urban planning. The comparison is based on the four dimensions of the PAA and accordingly structured in the same way. Each dimension addresses both prospects and barriers.

Comparing the cases of Hamburg and Rotterdam, it gets obvious that the FRMD had no direct impact on their flood protection systems. The reason for that is that the directive addresses countries in which no flood protection system exists. Moreover, it is limited to formal instruments and therewith does not provide any material objectives or measures. In Rotterdam neither directive nor FRMPs had any impact at all because of their general character. They were regarded as necessary tool only, not as additional value. The EU directive can, support the integration of FRM and urban planning by organising the tasks of the planner in FRM, tough. The impact of the directive on the integration is enhanced by the strategic environmental assessment that was carried out for the FRMP of the Elbe in that is assessed FRM measures in relation to spatially relevant aspects, and because it was used as a spatial instrument for the purpose of FRM.

Regarding the prospects in the integration of FRM and urban planning in harbour cities, it gets obvious that endogenous changes as a consequence of the interplay between policy domains, societal developments, or shock events can, when addressed properly, support the integration of FRM and urban planning. Additionally, spatial instruments are necessary for the implementation of FRM measures as the legal power of water managers is limited. Therefore, urban planners represent a crucial contribution to FRM with respect to land-use and building-regulations. Moreover, the interaction of cross-sectoral departments, as well as cooperation with stakeholders and research institutions appears to be essential for the creation of knowledge and for developing innovative solutions for the integration of FRM and urban planning on city level. Furthermore, integrating both field is crucial in order to adapt related

actions to each other and to use the available space as efficient as possible. The related strategy is multi-functional use of spaces and objects which can provide several functions or services at the same time. The co-benefits arising from the integration of FRM and urban planning secure long-term political and social support.

Despite the above listed prospects, there remain barriers, too, hindering the further integration of both fields. One is the technological path-dependency which leads to a lack of experience with facilitating integrated management processes and to a persistent focus on the protection part of FRM. Moreover, institutional fragmentation hinders an efficient integration since the responsibilities of the several actors are not clearly defined. Also there is a lack of a common vision amongst FRM and urban planning field which leads to different problem perceptions and priorities.

In the end, FRM and urban planning are, despite some remaining barriers, already integrated with each other. In some cases, the integration is only being practiced in particular urban areas and particular aspects of FRM, in other cases urban planning is involved during the whole FRM-process. However, urban planning represents a necessary and valuable contribution to measures FRM could not take on its own.

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1. Introduction

1.1 Project Framework

Currently, climate change is one of the main issues the world society has to deal with. Today's climate change related activities mainly focus on mitigation which refers to the reduction of greenhouse gas emissions and their storage or capture, aiming at limiting global warming. (Bulkeley, 2010) Although mitigation is necessary to slow down changes in the global climate, it is not sufficient as not all impacts of climate change can be prevented any more. (van Buuren et al., 2013; Wilson, 2006) World-wide greenhouse gas emissions will double by mid of the century resulting in an increase in temperature between 4 and 6° degrees Celsius above pre-industrial levels. The main challenge climate change will pose on society is the increase in extreme weather events such as floods and droughts, storms, heatwaves, and conflicts over food and water resources. (OECD, 2010) Climate adaptation, thus, is of crucial importance in order to deal with the unavoidable changes in the climate which impact on the global society. Although there remain huge uncertainties regarding the costs of a business as usual scenario, it is generally recognised that this will have negative implications on the global economy.

In addressing flood risk management in an urban context, this thesis links climate change to one of the most important issues of the 21st century: Urbanisation. De Moel (2014, p. 7) emphasises the importance of urbanisation by stating: "Urban areas are more and more becoming the nexus of where man and environment meet, putting pressure on both the environment and the communities who live there." This is the reason why urban planning is an important process which continuously needs to be adjusted to new circumstances, insights and requirements.

1.1.1 Harbour cities and climate change

Cities increasingly face the challenge of adapting to the specific water related climate impacts. In order to cope with the rising sea level, storm surges and extreme precipitation, especially harbour cities recognise the need to implement flood risk management (FRM) measures. Flooding, as one of the water related climate impacts, belongs to the costliest and most damaging hazards that will challenge city authorities as they become more frequent and more severe. Flooding has the power to take lives, to disrupt energy transmission and distribution, cripple transportation systems and comprise water treatment systems and water supplies. "Recent OECD work demonstrates that a 50 cm sea level rise, factoring in socio-economic development, could result by 2070 in a tripling of the population at risk of coastal flooding and a tenfold increase in the amount of assets exposed, or from 5% of 2008 GDP to 9% of 2070's GDP." (OECD, 2010, p. 68) As 70% of the big cities in Europe have areas lying less than ten meters above sea level (OECD, 2010), the importance of urban water and FRM is undisputed. In terms of storm surges, climate change can stress the capacity of drainage infrastructure, water treatment facilities and sewage systems. Extreme precipitation may wash pollutants into lakes and rivers and in doing so might reduce the water quality in reservoirs. Flooding has hidden costs as well, which can be related to lost productivity, rerouting traffic, lost heritage and damage to urban ecosystems.

UN-Habitat (2011) and the World-Bank (2010) recognise cities as crucial in the response to these changes. They are of special interest when it comes to climate change as they contribute a large part of the national GDP which means that they are hubs of economic activity for every nation. Moreover, they accommodate important social and political activities, environmental and cultural services, and a huge concentration of population. But the local level is not only vulnerable, it also brings the potential to design and implement effective adaptation responses, since the climate risks

in cities are more relevant and directly influencing private and public actors who feel the sense of urgency themselves.

The IPCC (2007) concludes that the most likely effects of climate change are the sea level rise in coastal cities (also due to storm surges) and extreme events damaging the built infrastructure. That is why coastal cities located in low-lying coastal plains, islands and deltas are the most threatened areas. (Hunt & Watkiss, 2011) Especially harbour cities face increased risk, such as Rotterdam or Amsterdam in the low-lying Netherlands. As Hanson et al. (2011) state, 13 out of 20 of the world's most populated cities are at the same time harbour cities which are extremely exposed to changes in coastal water levels. One example of possible consequences is Hurricane Katrina which caused significant damage to the important harbour city New Orleans in 2005, where the long-term disruption in the economy even global impact. (Hanson, et al., 2011)

Harbours are important as they play a significant role in the international economy through the creation of employment, generation of wealth, contribution to national GDP, and promotion of related-industries and cities. Ports carry out 80% of the world trade and therewith catalyse economic growth and development. (Becker et al., 2013) Their location in coastal zones, low-lying areas or deltas makes them highly vulnerable to rising sea level and related permanent or temporal flooding. Current climate scenarios predict a sea-level rise up to 1.9 meters by 2100 which would cause damages in many regions if no adaptation to the changing condition occurs. (Becker, et al., 2013) The position of harbours at the heart of the global economy points to the importance of adequate adaptation measures as damages to the port system may have significant impact on the local, national as well as the global economy. (Hanson, et al., 2011) Just small service disruptions bear the potential of causing losses that exceed billions of euros. Becker et al. (2013) find that the contemporary approaches in harbour cities are not adequate in dealing with the changing climatic conditions since they are based on a short-term objective (usually 5-10 years) which does not go along with the long-term frame of climate change. (Becker, Newell, Fischer, & Schwegler, 2011) According to them, "new institutional approaches are required to improve the long-run quality of their decisions for harbour resilience." (Becker et al., 2013, p. 384) The problem is that the infrastructure of ports is designed with a long lifespan which means that ports will largely be under-designed in future when the climate changes.

There are hard and cost-intensive measures that can be taken in response to climate change, such as the relocation of ports, elevating the whole infrastructure or building coastal defences. These measures are very difficult to implement and bring their own problems. (Becker, et al., 2013) Another possibility that is based on soft measures are adaptive planning responses. Such responses include land-use planning and the integration of planners and designers in the early stages of new development plans. Although there appears to be a variety of possible adaptation measures and a recognised importance of taking action, only few port authorities have been starting to respond to climatic changes so far. (Becker, et al., 2013) One explanation could be that harbours are mainly concerned with generating short-term profit only and rely on their insurance to cover disaster risk. Climate adaption measures only pay off in the long run, which however might be beyond the time horizon of harbour managers and other officials responsible today. (Becker, et al., 2013) On the other hand, there is the public good factor. Many actors are affected by damages to the harbour systems which means that making the harbour resilient will benefit a variety of stakeholders. All those factors lead to structural and organisational barriers which need to be overcome in order to address a complex issue such as climate adaptation in terms of FRM in harbour cities. In the following, adaptation and resilience building will be used as synonyms for FRM.

1.1.2 Flood risk management and urban planning

Urban planning in harbour cities is the starting point for decreasing vulnerability by modifying infrastructure and the built environment. Wilson (2006) identifies land-use and strategic sectoral planning by local authorities as key instruments for adapting to climate change. The problem is that such structural changes need 50-100 years to fully realise. (OECD, 2010, p. 23) Similarly, urban planning authorities can be identified as helpful tool in coping with floods. (Wilson, 2006) Greiving and Fleischhauer (2012) add on this insight by arguing that planners play a crucial role in building urban resilience to flooding, but they also mention that their specific roles and responsibilities are not clear, yet. In order to implement effective policies, however, urban governments and urban planners need to know the different options they have for minimising risks, and how flood management can be integrated into urban planning in practice.

The knowledge of the latter, however, remains scarce. As Wamsler, Brink, & Rivera (2013, p. 76) state:

"Urban planning is, in practice, only of marginal interest. Most national adaptation strategies are not yet translated into planning practice, and other countries do not have such strategies. Hence, whilst it is generally recognized that the role of spatial planning for adaptation should be strengthened, the practice is still not well developed."

Their paper strongly advocates the integration of FRM as part of climate adaptation into urban planning as this would have the advantage that adaption actions were not perceived as additional investment areas and thus in competition with other government objectives. Van Buuren et al. (2013) focus on three points relevant to integrate FRM and urban planning: the institutional context of adaptive spatial planning, the organisation of concrete planning processes and principles for allocating responsibilities.

An important progress in the literature was the development of the concept of integration, also called mainstreaming. While for years, scholars have advocated the integration of climate adaptation and spatial planning as the key factor in the development of effective policies. (van der Brugge, Rotmans, & Loorbach, 2005; van Buuren, Klijn, & Edelenbos, 2012; Hartmann & Albrecht, 2014, White, 2008) Zevenbergen, Veerbeek, Gersonius, & van Herk (2008) emphasise the need for an integrated approach to also be used in coping with urban flood risk as different spatial scales and sector are affected. A variety of papers additionally point to the importance of recognising the cross-sectoral character of flood safety and related adaptation linkages. (Hunt & Watkiss, 2011; Smit & Wandel, 2006; Wamsler et al., 2013)

Wamsler et al. (2013), specifically call for mainstreaming FRM into urban planning in order to build resilient cities. "As regards the prevailing mainstreaming strategies, most studies explicitly or implicitly stipulate that adaptation should be communicated as a mainstreaming or cross-cutting issue for urban planning, and not as an additional and separate aspect which should overrule other planning issues." (Wamsler et al., 2013, p. 78) In this regard, the integration of FRM into urban planning can be an opportunity for multi-functional strategies, which means that the vulnerability to urban flooding can be reduced by taking advantage of redevelopment opportunities. In order to make that happen, FRM and urban planning need to be better integrated. In that context, an integrated approach is viewed as an effective way of minimising risks.

However, empirical guidance on the actual process of integration does not exist, yet. (Carter, Kreutswizer, & de Loe, 2005) One reason are the various challenges posed on the integration. Urban planning for instance needs to take different scales and timeframes into consideration which leads to the fact flood management is often not tackled with a sufficient sense of urgency by the decision

makers. Moreover, urban planning mainly focuses on contemporary issues, but FRM is in most cases just a long-term goal. The challenge in multi-objective decision-making in urban planning therefore lies in the implementation of actions that bring short term-benefits as well as structural changes that make cities in future more flood resilient. (White, 2010) Other more nested problems are institutional structures, traditional approaches in FRM and urban planning, and inflexible regimes. (van der Brugge et al., 2005) Even though pilot projects have introduced different approaches on how to integrate FRM and urban planning, the cooperation in practice still seems to be very difficult and none of these pilots have been carried out in the context of harbour cities yet. (Biswas, 2004)

1.1.3 Flood risk management and the EU Flood Risk Management Directive

In the past, flood risk policies have been based on the prevention of disasters, only. Flood disasters such as the flooding of Elbe, Danube and Rhine in 2002 and 2013 have shown that the traditional approaches are not effective anymore and a more integrative approach is needed for flood protection. (van der Schrier, et al., n.y.) The new strategy recognises that prevention alone is not sufficient in coping with flooding as existing defences bear the risk of being overtopped or breached. (Hanson, et al., 2011) Therefore, the approach of living with the water has been introduced, combining prevention with adaptive spatial planning and disaster preparedness. (Raadgever, Hegger, Wiering, & Gersonius, 2013) This institutional shift is visible in Germany and the Netherlands since 1990, when both countries moved away from the mere focus on technological measures for the management of flood risks. (Hartmann & Albrecht, 2014; van Herk, Rijke, Zevenbergen, & Ashley, 2013) The European Commission followed with similar suggestions for all member countries in the beginning of the 21st century.

In this context, the EU Flood Risk Management Directive (FRMD) was developed which requires member states of the EU to create Flood Risk Management Plans (FRMP) for areas they identified as potentially vulnerable, by the end of 2015. (FRMD, 2007, § 7(1)) In the context of these FRMPs, the EU asks member states to establish objectives and measures that are meant to reduce negative impacts of flooding on health, environment, cultural heritage and economic activity by following a working with nature approach. Such plans are meant to address the prevention of flooding and the reduction of potential consequences in order to minimise physical and social damage. In order to do so, the FRMPs need to take relevant environment-related aspects into account which refers to land-use, water conservancy, spatial planning, nature protection and harbour infrastructure. The plans are developed for whole river basins and coastal zones, but can also be complemented by local and regional policy documents. (Europäische Gemeinschaft, 2007) The FRMPs are developed by district governments in cooperation with other relevant actors such as waterboards, municipalities, citizen initiatives etc. This is why multiple sectors and scales have to be involved in the planning process to achieve effective long-term adaptation strategies. The literature, focusing on this topic, seems to be limited to a theoretical basis. (Hartmann & Albrecht, 2014; Hartmann & Juepner, 2014; Woltjer & Al, 2007)

Research in terms of the development and implementation of the EU FRMD is carried out by means of several EU funded projects. To name a few, the "FLOODsite" project is aimed at developing a decision support system for flood risk assessment and management. In the context of the "CORFU" project adequate measures for the improvement of urban flood management have been developed by European and Asian cities and stakeholders. Furthermore, "THESEUS" looked at how to make Europe's coasts safer. It gets obvious that most initiative look at river basins, only few on coastal areas. None of these programmes focuses on flood risk in cities with specific characteristics, such as having a harbour attached. (Quevauviller, 2011)

The development of the FRMD is the only EU-led action putting emphasis on the need to explore the relation between FRM and spatial planning. Such explorations are still in its infancy compared to, e.g., like engineering or environmental sciences. It might not be obvious that the FRMD could have actual implications for the integration of spatial planning as it focuses on ecological and environmental issues. But spatial planning will somehow bear the responsibility for incorporating and enforcing related legislation. (White & Howe, 2003) The specific role of spatial planning in FRM is to protect the environment (which can be natural, built and social) from flooding.

1.2 Relevance

1.2.1 Scientific

Although it is generally recognised that climate related effects such as flooding will have significant impacts on harbour cities, the literature reveals a knowledge gap on the consequences of climate change for harbour cities, especially when it comes to building flood resilience and multi-stakeholder decision-making in that context. There is hardly any research done in the context of harbour cities, only on coastal or delta cities and sea ports as an entity on its on. Since flood-proofing harbours is closely related to other urban risk management measures, it is important to recognise harbour cities as an entity on its own. The existing research focuses on the drivers and impacts of climate change and sea-level rise as well as its measurement and prediction, but not the responses harbour cities take in order to make themselves flood-resilient. Thus, the urban planning response to flooding and the constraints for these responses remain hardly addressed. (Becker, Newell, Fischer, & Schwegler, 2011; Vermeer & Rahmstorf, 2009; Brooks, Nicholls, & Hall, 2006)

Moreover, the actual integration of FRM and urban planning remains a new phenomenon, certainly when it comes to harbour cities. Also the integration process and related arrangements remain unexplored to date, although many researchers do advocate to mainstream climate adaptation actions. The exploration of successful harbour cities as cases is meant to provide more insight into those processes and arrangements. Moreover, information can be obtained on barriers in the integration and how these can be treated. Therefore, this thesis aims at contributing knowledge to these fields of study with focus on the harbour city context.

The theoretical knowledge related to the FRMD, also remains limited to several pilot projects, none of which focuses on the integration of FRM and urban planning or flood risk management in harbour cities more generally. Therefore, this thesis aims to investigate which influence the directive has on FRM and urban planning in harbour cities.

In addition, research is necessary that estimates the driving forces in facilitating and constraining flood risk strategies and the integration with urban planning. (Smit & Wandel, 2006) In order to respond to that knowledge gap, this thesis will analyse the FRM and urban planning approaches of two similar case studies. In doing so, empirical findings might contribute to the identification of prospects and barriers in the integration and therewith contribute to the development of a theory in the field of urban FRM in the context of harbour cities. Generally said, the results of this research might provide empirical guidance on the implementation of an integrated approach to FRM and urban planning in the context of harbour cities in order to ensure the local safety and to remain the harbour infrastructure functioning.

1.2.2 Societal

If not managed properly, flooding bears the potential to take lives, destroy the built infrastructure, and to damage property by means of which they pose challenges of people's livelihoods. Even though a lot of innovation is taking place in the field of flood prevention, adaptation, and disaster preparedness, it remains difficult to actually implement these measures effectively. Therefore, the importance of FRM and urban planning is undisputed. Although adaptation actions are costly and need time for being developed, failing in adapting in time only increases the costs of climate related damage and the costs for future adaptation actions. (OECD, 2010) Coastal areas, including harbour cities, will be among the first sinking into the sea if the sea level continues to rise and adaptation measures are not taken in a sufficient way.

Especially harbour cities are an important object to flood adaptation as they are an example of infrastructure which has to be located at waterfronts and thus in flood sensitive areas. Their economic importance and the nature of their existing infrastructure require special treatment in terms of adaptation. (Becker et al., 2011) Harbours cannot be located in safer spots such that the related cities will sooner or later be forced to take FRM into account in order to remain both efficient and resilient. Integrating FRM and urban planning can be valuable as harbours are steadily expanding which means that taking flood resilience in new developments into consideration decreases future reconstruction expenses. As many ports might face similar problems, generating knowledge on that topic might be valuable for future policy making.

1.3 Research aim

From the literature review it got obvious that the actual process of integrating FRM into urban planning remains problematic in reality. Therefore, this research is meant to be practically-oriented as it aims to improve the existing practices of FRM in harbour cities. (Verschuren & Doorewaard, 2010, p. 33*)* By applying the Policy Arrangement Approach to two harbour cities from different national contexts as case studies, insights will be obtained in the institutional framework, relevant actors and coalitions, resources and power relations, and discourses. Due to the assessment of these aspects for the current situation of two successful cases, it is possible to identify prospects and barriers which can be used in order to improve future practices and governance processes in the field of urban FRM.

The aim of this research is to acquire a better understanding of the practices of integrating flood risk management and urban planning in harbour cities with regards to their European context in order to help in making recommendations for the improvement of future policy making.

1.4 Research model

This research will be carried out in six steps, which are illustrated in figure 1 below. As a first step, a literature review has been carried out on the issue of climate change and harbour cities. During the reviewing process of academic literature, the topic was narrowed down to FRM and urban planning and the role of the EU FRMD in that. In order to structure the empirical data collection and enable to answer the research question, the Policy Arrangement Approach was identified as an adequate theory. The second step now refers to the the selection of fitting cases and related information. The chosen theory from stage A is then applied to the two cases chosen (step C). This is done through data collection from documents, observation and in-depth interviews. In step D, this data is firstly analysed for each case separately and afterwards compared to each other (E). The last step (F) aims at analysing and evaluating the findings in terms of the European context of FRM, the integration of

FRM and urban planning, and the related prospects and barriers, all in the context of harbour cities. The ultimate goal is to come to practical suggestions for the future improvement of FRM in harbour cities.

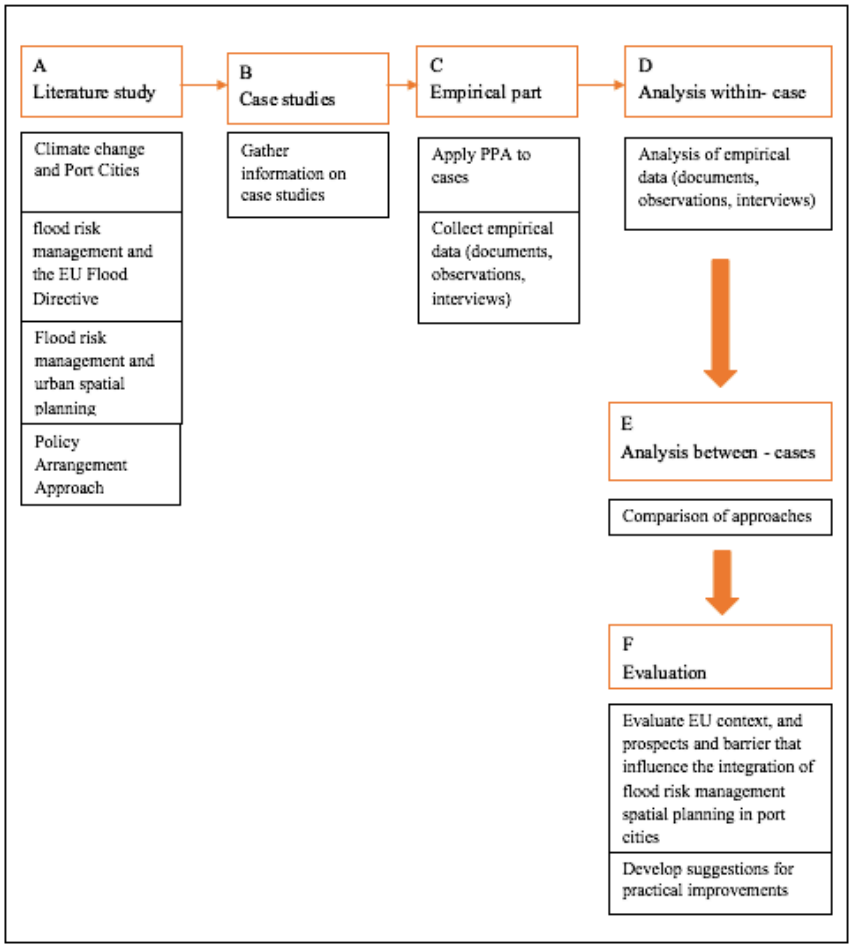

Figure 1: Research Model (author, 2016)

1.5 Research questions

1.5.1 Main research question

What are the prospects and barriers in the integration of flood risk management and urban planning in harbour cities with regards to their European context?

1.5.2 Sub-questions

1) How is flood risk management in harbour cities organised?
2) How is urban planning in harbour cities organised?
3) How does the EU Flood Risk Management Directive impact on the integration of flood risk management and urban planning in different member states?
4) What are the prospects in the integration of flood risk management and urban planning in harbour cities?
5) What are the barriers in the integration of flood risk management and urban planning in harbour cities?

2. Theoretical Framework

The theoretical framework provides clarification and a definition of the two main terms FRM and urban planning, which is important for the theoretical choices made afterwards. The concept of integration is not further explained at this point since this has already been done in the context of the project framework. Drawn from the definitions of the main terms and concepts and the research questions, the Policy Arrangement Approach appears to be an appropriate tool for examining the process of the integration of FRM and urban planning with the related prospects and barriers.

2.1 Terms and definitions

2.1.1 Flood risk management

There are different types of flooding with the potential to affect urban spaces. Firstly, there are river floods which occur when extreme rainfall leads to an exceeding run-off capacity of rivers. Secondly, flash floods are the rapid accumulation and release of run-off waters from heavy rainfall or cloud bursts. Thirdly, coastal floods occur due do storm surges and the rising sea level. Such floods have the potential to last long in case a city is not capable of draining the excess flood water. Fourthly, urban drainage flooding appears when the capacity of the piped system is exceeded at times of extreme precipitation. As the water is not able to infiltrate into the ground due to built infrastructure such as roads, the excess water travels down roads and paths of least resistance. Fifthly, ground water flooding is caused by extreme precipitation as well which occurs over several periods. In that case, the ground water is moving to low-lying areas. (OECD, 2010)

According to the EU, "Floods have the potential to cause fatalities, displacement of people and damage to the environment, to severely compromise economic development and to undermine the economic activities of the community" (FRMD, 2007) which underlines the importance of taking action in the form of FRM. In this thesis the term FRM is defined as all measures taken in relation to water quantity issues that bear the potential to damage the urban system. The term disaster risk or flood risk is defined as "the potential for consequences where something of value is at stake and where the outcome is uncertain, recognizing the diversity of values. Risk is often represented as probability of occurrence of hazardous events or trends multiplied by the impacts if these events or trends occur." (Field et al., 2014, p. 5) Risks are related to vulnerability which refers to the degree of sensitivity of a community or society to the effects of a flood disaster. "It describes the existing conditions, characteristics and circumstances of an area exposed to one or several hazards, where a highly vulnerable area is understood as being incapable of resisting their impacts." (Wamsler et al., p. 69) There exists a variety of terms which are related to or similar to FRM. In the following, the terms adaptation, resilience, risk management and flood management are used as synonyms.

2.1.2 Urban planning

Urban planning emerged in the beginning of the 20th century as response to changing social, economic and also sanitary circumstances, based on the attempt to manage the rapidly growing industrial cities. Contemporary, urban planning can be regarded as political and technical process concerned with the use of land, use and protection of the environment, welfare issues, as well as the design of the urban environment in terms of aspects like air, water and infrastructure. Its main objective, however, is and was the orderly development of settlements. Urban planning is an interdisciplinary field covering aspects such as design, architecture, research and analysis, strategic thinking, policy recommendations and management. In the context of this thesis, urban planning as

well as urban development refers to spatial planning on the local level. Since Hamburg is federal state and city in one, land-use plans, which are actually part of regional planning, are applied to the urban context.

2.2 The Policy Arrangement Approach

According to Healey (2007), understanding urban resilience depends on understanding urban governance due to the relation between resilience and measures of quality of life, the spatial organisation of places, justice, and economic development. Urban policies are therefore crucial in climate-proof cities. Governance is also regarded as remaining challenge in the integration of FRM and urban planning. "The traditional model of government setting the framework for private decision has been replaced by a flexible system of communication and adjustment between public and private actors, called governance". (Wegener, 2012, p. 157)

In order to take this aspect of governance into account, the Policy Arrangement Approach (PAA) seems to be a useful tool for the examination of FRM in harbour cities, the integration of FRM and urban planning, and the influence of the European Union on these factors. "Policy arrangements develop when governance emerges around a certain theme that is placed on the political and social agenda." (Van Eerd, Weiring & Dieperink, 2014, p. 94) In this case, governance is related to FRM as an emerging concern for harbour cities. Different scholars already used this method in combination with water- as well as crisis management. (e.g. see Raadgever et al., 2013; Hegger et al., 2014) The concept of a Policy Arrangement (PA) can be defined as "the way in which a certain policy domain – such as climate change – is shaped in terms of organization and substance. Therefore, it is seen as a 'temporary stabilization of the content and organization of a particular policy domain'." (van Eerd et al., 2014, p. 93) This thesis will use the definition by Hegger et al. (2014) as it contains all of the relevant aspects which can be derived from the project framework. They define a PA in the light of FRM as "The constellation resulting from a dynamic interplay between actors and actor coalitions involved in all policy domains relevant for flood risk (…); their dominant discourses; formal and informal rules of the game; and the power and resource base of the actors involved." The four dimension of a PA are depending on each other in that changes in one dimension may lead to changes in another dimension as well.

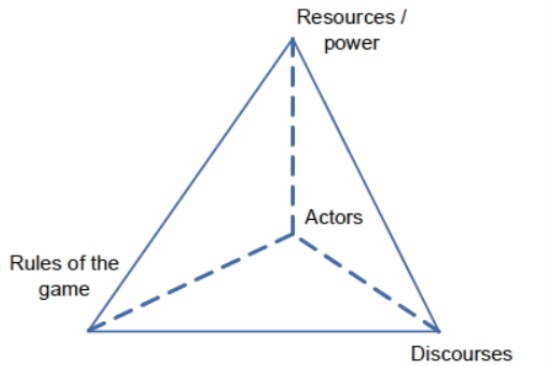

Figure 2: Relation between the four dimensions (van Eerd et al., 2014, p. 95)

In the first dimension rules of the game refers to the institutional framework of FRM and urban planning in harbour cities, and therefore will be called accordingly in the following. Related indicators are legislative history (which could be interesting in terms of path-dependency), policy instruments, as well as formal and informal legislations which impact on the way stakeholders can

act. Furthermore, this dimension requires a huge degree of cross-sectoral coordination and cooperation as the different regulations need to be adapted to each other.

The second dimension is actors and coalitions. Those refer to all stakeholders, organisations and institutions which are involved in FRM and urban planning in harbour cities. The actors can be public, private or from civil society and they can interact in terms of coalitions and oppositions. In that it refers to the roles of the different actors, their interests and objectives, their influence on the policy process, the relations between actors, coalitions and their position in the process and the context they operate in. (van Eerd et al., 2014)

The third dimension of a PA refers to resources and power. Resources can give certain actors the power to operate. That also means that actors are dependent on each other due to a limited amount of a certain type of resource. Such resources do not only refer to financial capital, but also to the availability of knowledge and expertise. Power "refers to mobilization, division and deployment of resources that will in turn influence policy outcomes of the policy arrangement. It is important to take into consideration that the division of resources, their usefulness, power and relations of influence will be dynamic and may vary depending on the setting and time span." (Van Eerd et al., 2014, p. 94)

The fourth and last dimension is the discourses of the policy field. The term discourse has not a single definition, but always has to be regarded in its wider context. Generally, "a discourse is defined as a set of ideas, concepts and narratives which give meaning to certain phenomena in the real world." (Van Eerd et al., 2014, p. 94) Common definitions contain values, vision, policy objectives and aims, and approaches to solutions. (Contestabile, 2014). Other definitions more related to FRM include awareness, the framing and perception of the problem (sense of urgency for instance), and strategies. (Verwijmeren & Wiering, 2007) Similar discourses are necessary for the cooperation with other fields. In this thesis, discourses are understood as problem framing, mind-set and problem solving.

2.3 Conceptual model

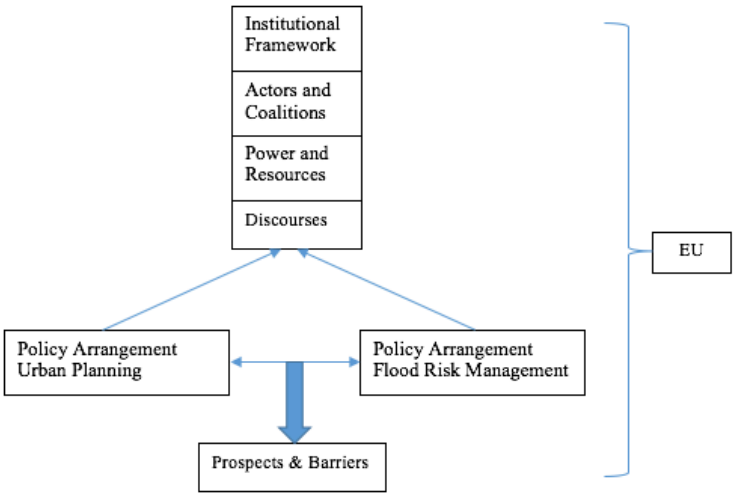

Figure 3: Conceptual Model (author, 2016)

This conceptual model illustrates the information derived from the research objectives and the theoretical framework. The theory is applied with regards to the European context the cases are set in. Integration is defined in terms of overlapping institutional frameworks, coalition building, sharing resources and issue linking. (Bouwer & Biermann, 2011) Legislation, regulations and policy instruments are examined as institutional framework for the decision-making in both countries that works as a legal basis for the whole arrangement. Coalition building is seen as the process of selective activation or exclusion, in other words, with which actors one cooperates. Issue linking means that objectives, issues and strategies are combined or adapted to each other in order to take action in which both FRM and urban planning are contained. The related discourses are not set out for every actor individually but for the whole policy arrangement in terms of FRM and urban planning.

Firstly, the PAA will be applied separately for each case to FRM and urban planning. On the basis of the resulting PA, the integration will be analysed with regards to existing prospects and barriers in each dimension. In this thesis the four dimensions are operationalised as indicated in the following table:

Institutional framework	Legislative history Legislation and regulation (EU, national, regional, local) Policy instruments
Actors and Coalitions	Actors (public, private) Responsibilities Interaction
Power and Resources	Power relations (decision-making procedure, power in decision-making) Financial resources Knowledge and expertise
Discourses	Problem framing (awareness, sense of urgency) Mind-set (values, visions) Problem solving (aims and objectives, strategies)

Figure 4: Indicators of the PA (author, 2016)

Regarding the first dimension, the question is in how far objectives from both sites are integrated in the institutional framework and whether there exist contradictory or complementary legislations. Looking at actors and coalition it is necessary do analyse the existing relations between the actors and their actions in terms of coalition building. In terms of resources and power, the power relations, decision-making structures and use of resources will be examined. Assessing the discourses of FRM and urban planning will indicate whether there is accordance or frictions which lead to prospects or barriers in the integration.

3. Methodology

The previous chapters provided information on the research aim, main questions and the theoretical framework. Building upon these paragraphs, this chapter will explain which research strategy is applied and why, how the necessary empirical data is gathered and how this data is analysed in order to retrieve the information necessary to identify prospects and barriers in the integration of FRM and urban planning in European harbour cities.

3.1 Research strategy

A qualitative approach seems to be appropriate for this research as it aims to expand the understanding of how things are taking place in terms of actors and their interactions in the light of FRM. A qualitative method makes it possible to get an insight in who the main relevant actors in both cases are, why they are important, how and with whom they interact exactly, and how they are influenced by and make use of regulations, resources and different discourses. Therefore, a qualitative approach is useful as it is the study of reasons, meanings and the sense behind actions. (Kamstra & Ernste, 2015) This is important as this thesis aims at exploring how the integration of FRM and urban planning in harbour cities with regards to their European context is taking place at the moment in order to provide practical information on how to enhance this process in future. Therefore, this research needs to investigate what the relevant governance mechanisms are, how they are working and how they are influencing the integration. A quantitative design is not appropriate as it is not able to measure reasons. It could only provide information on whether there exist interconnections between certain aspects, but it cannot tell anything about why and which influences they have on the whole process. (Vennix, 2011)

This thesis will apply a multiple-case study as research method. The European harbour cities Hamburg and Rotterdam are used as units of analysis in terms of instrumental cases, which means that they are both means to understand one specific issue. (Creswell, 2012) In the light of this thesis this is related to the challenge of integrating FRM and urban planning. By means of a case study, this issue will be explored in-depth. In order to show different solutions and perspectives, two cases will be compared. In doing so, the principle of replication is applied, meaning that both cases are explored and analysed in the same way. Therewith, information will be obtained on how the process of integrating FRM and urban planning is precisely taking place and which factors are influencing this process. One disadvantage that derives from a multiple case study, is the difficulty to generalise the findings as the contexts of the cases might differ. In order to deal with that, two very similar cases are chosen.

Hamburg and Rotterdam are both harbour cities, similar in size, facing similar flood risks, mainly in terms of storm surges and sea-level rise, due to their location in river basins next to the North Sea. In addition, both areas are low-lying with polders in their hinterlands. Both harbour cities contain a huge concentration of population which puts pressure on the available space. Also, both cities have large parts lying outside of the line of protection. Moreover, the cities are both having a similar social and cultural background when it comes to their population and they are both subject to European regulation. That they are located in different countries is on purpose as that might enable insights over the influence of nation specific aspects, such as national regulations, discourses and path-dependency.

A detailed description of both cases will further enable the reader to decide by himself/herself and judge the validity of the analysis. There is chosen for only two cases in order ensure that each of the cases can be explored in-depth. The method of within-case analysis as well as cross-case analysis

will be used in order to explore the case specific aspects first and to compare the results afterwards with each other. The units of analysis will be a mixture of descriptive and explanatory cases. Firstly, they are used to describe the phenomenon FRM in harbour cities in general. Secondly, the interviews related to the two cases will enable to elaborate the interconnection of the four aspects related to the PAA. (Kamstra & Ernste, 2015) Therefore, the comparative case-study will provide detailed information and will also be explored from different perspectives. (Vennix, 2011)

One important rule for scientific research is that its results need to be valid. One way for enriching the quality of the research is the combination of different research methods. Creswell (2012) lists eight different strategies which can be used to enhance the validity of a research: triangulation, observation, peer-reviewing, negative case-analysis, rich and thick description, clarifying, member checking, and external audits. Due to a limited amount of time and money available for this research, some of those strategies, such as member checking or external audits, are not realistic to apply. Others such as negative case-analysis are not applicable to the topic. This research, however, will be based on two validation strategies, because Creswell (2012) recommends the use of at least two procedures in any given study. Firstly, rich and thick description is used. By providing detailed information on the cases the reader can determine whether the outcomes are suitable to be transferred to another case. (Creswell, 2012) Secondly, triangulation is adopted whereby different sources provide corroborating evidence aiming at lighting FRM in different perspectives. (Vennix, 2011) The data collection material consists of a literature study, interview- and document analysis. One disadvantage is that interview findings are dependent on individuals' generalization and therefore might be difficult to evaluate properly. By combining interviews, documents and theory to corroborate the verbal and cognitive information of the main data source, the research findings remain valid, anyway. (Swedlund, 2015)

3.2 Data collection and analysis

3.2.1 Data collection

As said before, this thesis makes use of triangulation as research method. The first step was based on a critical literature study. In the context of this literature study, a variety of book chapters, scientific articles, reports and websites have been reviewed in order to gain a general understanding on FRM and to define the remaining knowledge gap in relation to that topic which is FRM especially in harbour cities and the integration of spatial planning with regards to European legislation. The literature review, thus, does not provide any new empirical data, it rather provides an overview on the topic that is to be studied. This gathered information forms the theoretical basis for the development and operationalisation of research aim, questions and interview guides.

Afterwards, relevant policy documents, reports and digital information were analysed in order to examine the institutional framework for decision-making in Germany and the Netherlands. The information gained from documents will be combined with the data obtained through personal communication.

This leads to the third step of triangulation, gathering information through interviews. It is important that only interviewees are contacted who are personally involved in the FRM in Hamburg and Rotterdam so that the data remains valid. Possible interviewees will be contacted via mail and phone calls in order to achieve as much response as possible. The interviewees will be selected with regards to their expertise and function in the light of the FRM and urban planning (see appendix for the list of interviewees). Interviews with concerned stakeholders and decision-makers from both case studies provide information on the on the aspects that were outlined in the theory: relevant regulations, the specific roles of the different actors, their interaction, resources and power relations

as well as discourses. The advantage of interviews with experts and involved actors is their greater focus on the subject. However, it might be difficult to identify experts or to differentiate between professional opinions and personal bias. (Ernste, 2015) In order to deal with this disadvantage, information will be gathered on the theoretical and interviewees' background, before the interview takes place. This makes it possible to distinguish between what is objective and what influenced by personal circumstances. Even though it can still not be guaranteed that the interviewees are telling the truth, the internal validity of the gathered information is increased. (Swedlund, 2015)

The interview data collection will be based on in-depth interviews. Recording and note-taking during the interview makes it possible to reconstruct the whole interview and provide all important data to the readers. The interviews aim at providing focused knowledge on FRM in harbour cities. They are based on a semi-structured interview guide with space for an open communication that bears the benefit of flexibility and further explanations as it ensures a deep insight into the topic. On the other hand, it ensures that all topics from the theory are covered during the interview and it helps to stick to key words and give further explanations where necessary. (Swedlund, 2015) In other words, a semi-structured interview ensures that the interview is suitable for analyses and at the same time enabling the interviewee to add additional aspects. (Brantlinger, Jimenez, Klinger, Pugach, & Richardson, 2005)

3.2.2 Data analysis

The following passage will examine the methods for data analysis applied in this thesis. For a comparative case study, it is most appropriate to analyse the data by means of describing the context of both cases separately before going into the cross-case themes. During the analysis, the interviews related to either Hamburg or Rotterdam were treated separately in order to retrieve information on the specific factors related to the specific case, so that those can be compared afterwards.

The analysis of the data derived from interviews is based on a coding process. In order to do so, the interviews are recorded and typed out afterwards. (Creswell, 2012) This coding process is divided into several steps in the computer programme Atlas.ti in order to assure that the research meets important quality criteria. (Kamstra, 2015) First of all, the transcripts are coded by initial coding, attaching codes to quotes which answer general questions such as which actors are involved, which coalitions can be found, what resources and discourses are used and which regulation are relevant. According to this, family codes are created by means of focussed coding that divide the codes and memos into different categories. This requires decision about which initial codes categorize the data and which make most analytical sense. (Vennix, 2011) By following the several steps of the coding process, it is possible to obtain insights into the factors that influence the integration of FRM and urban planning in harbour cities in a European context. The interactions and influences of certain aspects of the PAA are proved when codes or families occur in different interviews. Creswell (2012) calls this 'intercode agreement'.

This thesis is going to use a mix of documents which can be policy documents, reports or digital information, as additional data source next to interviews and observations. In order to assure their quality, they will be checked according to the criteria listed by Brantlinger et al. (2005, p. 202):

- Meaningful documents are found and their relevance is established
- Documents are obtained and stored in a careful manner
- Documents are sufficiently described and cited

In addition to this checklist, the validity and reliability of the chosen documents is taken into account. In case a documents contains lots of personal judgements, this one will not be used as a means to provide empirical data.

4. Case Study Hamburg

The German city Hamburg, generally referred to as "green metropolis by the water" is the first case study of this research. The economic and spatial development of the city is induced by the proximity to the water which is also an important feature for the related harbour. That the city is crossed by waters bears the risk to endanger infrastructure, property, people and livelihoods at times of floodings. That is the reason Hamburg has a long tradition of FRM in which dikes, barrages and other protection measures need to be constantly planned, built and improved. The city is mainly threatened in terms of storm surges since the harbour is located in the river basin Elbe that connects Hamburg with the North Sea. Another flood factor in the city are inland floods coming from the various rivers and streams running through the city. (BSU, n.y.)

4.1 Background

This chapter provides a descriptive elaboration of the case Hamburg. This aims at putting the case into a context in order to better understand the subsequent policy analysis. For this purpose, this section firstly looks into the geographical, spatial and organisational characteristics of Hamburg which are sub-divided into the following aspects: geography, demography, political organisation, economy and port. Secondly, information is provided on the city's vulnerability to floods, and thirdly, a first draft of Hamburg's FRM system is given.

4.1.1 Geographical, spatial and organisational characteristics

Geography

Hamburg, officially called Free Hanseatic City of Hamburg, is located in the North of Germany and represents the centre of the metropolitan region, with an area of 755.22 square kilometres. (Regionaldatenbank Deutschland, n.y.) Hamburg is located in the mouth of *Bille* and *Alster* into the Elbe, approximately 100km north-east of the North Sea. The Alster runs into the city centre where it is dammed as an artificial lake, separated into the *Binnenalster* and *Außenalster*.

Demography

Hamburg is the second largest German city with a total population of 1.78 million citizens. (Statistikamt Nord, 2016) The population of Hamburg is diverse with respect to culture, age, and income. This has lead to the formation of social clusters spread over the city. Whilst most high-income people located around the *Außenalster,* in the outskirts of the Elbe and north-eastern parts of the city, the lower-income-groups typically settle in the eastern parts of the inner-city, *Wilhelmsburg, Veddel* and *Harburg*. The city's economy, educational institutions, cultural live and other leisure activities attract many young people, which is why its population is expected to continue to grow until 2030. (BSU, 2014) This population growth led and still leads to a spatial expansion of Hamburg which, despite sub-urban expansion, is concentrated along water ways.

Political organisation

Hamburg is a federal city state, that is a municipality and a federal state at the same time. The federal state power comes from Hamburg's parliament, the so-called *Bürgerschaft*. The federal state government is the senate whose president is also mayor of the city. Every senator manages one city department which is similar to the ministries in other federal states. Hamburg is further divided into seven districts, whose representatives come together in regular district assemblies.

Economy and harbour

Hamburg is a centre of trade, traffic and the service provider industry. An important economic motor is the port of Hamburg. It ranks ranks first in Germany and second in Europe and therefore is often referred to as "*Deutschlands Tor zur Welt*". In relation to the growing importance of the harbour activities, the expansion and redevelopment of the harbour area is inevitable. One of the biggest redevelopment projects in Europe started in 2003: The HafenCity. The project includes the creation of a new liveable neighbourhood for working, living, retail, culture, recreation and tourism with maritime flair in the inner-city until 2025. (Hafen Hamburg Marketing e.V., n.y.)

4.1.2 Vulnerability of Hamburg

Due to its location within the marshlands in the catchment area of the Elbe, Hamburg is affected by storm surges from the North Sea. (LSBG, 2012) Storm surges are strong winds which press the water against the dikes or lead it into the city. The marshlands are lying at, or even under the mean sea level (MSL) causing about 45% of the city area to lie below the rated water levels. Meanwhile, 325.0001 people (approximately 20% of Hamburg's population) have settled in these vulnerable areas. (Drucksache 20/5561, 2012) In particular the 55.000 inhabitants of the Elbe-islands *Veddel* and *Wilhelmsburg* are strongly exposed to potential flooding. (Drucksache 20/5561, 2012) Besides the human lives at risk, there are about 165.000 jobs located in these vulnerable areas as well as assets which have an estimated value of 30 billions of euros. (Drucksache 20/5561, 2012) Figure 5 shows the areas at danger of being flooded. In combination with figure 6 it clarifies that the vulnerable areas are mainly industrial or agricultural.

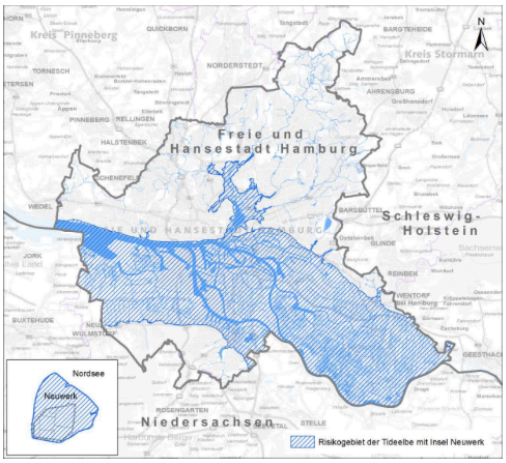

Figure 5: vulnerable areas (FRMP Hamburg, 2015, p. 26)

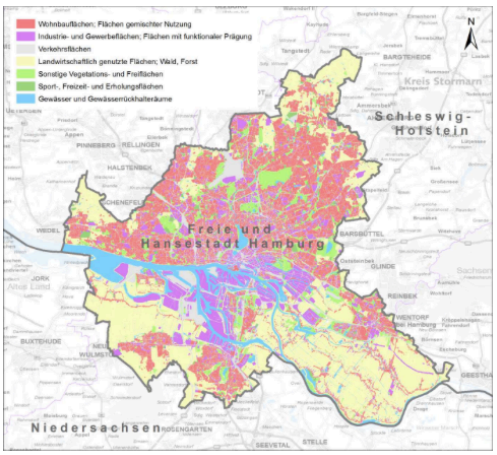

Figure 6: land-use Hamburg (FRMP Hamburg, 2015, p. 13)

4.1.3 Flood risk management: The system in Hamburg

Although the strategy of FRM belongs to the fourth dimension of the policy arrangement, the system will already be explained at this point of the thesis since it facilitates the understanding of the following policy arrangement on which the system is based.

Hamburg sets on the application of multiple measures in terms of FRM which spread across the three safety layers: prevention, adaptation and evacuation. Such measures are the elevation of plots and evacuation routes and the adaptation of the design and application of flood doors in individual buildings. Despite the application of multiple measures, he most effective one in Hamburg remains the flood defence line. Hamburg cannot be protected by means of a storm surge barrage against the North Sea because of its port, which means that installations for flood control in the parts of the Elbe that are influenced by tides are necessary for coastal protection. Theses installations

mainly consists of dikes, flood walls, barrages and control doors. (HafenCity & IBA, 2011) In total, the urban public dike-line consists out of 78km of dikes, 25km of flood walls which are mainly located in the inner-city, and 75 individual installations for flood control (such as floodgates, flood doors, barrages etc.). (Drucksache 20/5561, 2012) In addition to the technical part of FRM, areas outside of the main levee system are protected by additional measures such as the *Objektschutz*, whereby for instance, openings in certain buildings get closed. Another measure is the construction of terpen, which are used to construct buildings on elevated surfaces. This terpen concept is, for instance, applied in the area of HafenCity. (HafenCity & IBA, 2011)

4.2 Policy Arrangement of Flood Risk Management

This chapter contains an analysis of the policy arrangement of FRM in Hamburg, based on the four dimensions of the PA: rules of the game (or institutional framework, as it is called in the following), actor and coalitions, power and resources, as well as discourses.

4.2.1 Institutional framework

To begin with, the legal context of FRM in Hamburg will be assessed by means of the city's institutional framework in order to clarify the rules the system, related actors and strategies are bound to and which measures can legally be taken. The institutional framework, therefore, is divided into the historical development of FRM, the legal framework applied to the city and the available policy instruments.

Historical development

The coastal protection system in Hamburg already exists for 800 years but for most of the time people have only reacted to floodings rather than taking preventive measures. (Müller, p.c.[1], 2016) In fact, action to raise the dikes has only been taken just in the moment they turned out to be too low. The flood catastrophe of 1962 marks the moment of change in the protection system. (LSBG, 2012) The local government responded to the emerging sense of urgency by centralising and concentrating FRM in the specialised authority and therewith ascribing great importance to the subject. (Simon, 2016) One specific consequence was, that in the context of the "*Deichordnungsgesetz*" from 1964, existing installations for flood protection became public property. (LSBG, 2012) As a result, the dike associations were no longer in charge and thus the responsibility shifted to the municipality of Hamburg. In response to the following floods of the rivers Elbe and Oder in the beginning of the 21st century, the federal legislation was adapted in order to further restrict activities in flood-prone areas. (ten Brinke, Saeijs, Helsloot, & van Alphen, 2008) Emphasis has been put on pro-active measures which automatically resulted in a greater need for spatial planning in flood risk policy-making. In combination with adjustments in the Spatial Planning Act, National Building Code and National Waterways Act, general principles for flood control and vulnerable areas were provided.

This shows that realisation that the human-being with his technical achievements is fallible was the turning point in FRM in Germany. As Zimmermann (2016, p. 2) repeatedly underlines, there is always a catastrophe needed to make people act: *"Ich denke das Grundproblem ist […] unsere*

[1] P.c. will in the following be used as abbreviation for personal communication.

Unfähigkeit an die Möglichkeit einer Katastrophe zu glauben. Es gibt sozusagen im Aufbau der Psyche des Menschen sozusagen eine Blockade, die verdrängt, dass Katastrophen möglich sind."

Legal framework

The EU Flood Risk Management Directive

In 2010, the National Water Act (*Wasserhaushaltsgesetz*) came into effect which regulated the management of water resources in Germany. By means of this act, the FRMD from 2007 was completely integrated into the German law. (§§ 73-75 National Water Act) Related to that, the so-called FRMP FGG Elbe was developed in cooperation of concerned federal states for the whole catchment area of the river. The FRMP Elbe, therefore, is applicable to the city of Hamburg. The plan deals with the prevention, protection, adaptation, regeneration and rehabilitation aspects of FRM. In addition to the FRMP Elbe the area of Hamburg published a concretisation for the city. This background document provides basic information on FRM in Hamburg and lists about 240 individual flood risk measures that are also incorporated in the national FRMP in an aggregative way. (FRMP Hamburg, 2015)

However, the FRMD had no direct impact on FRM in Hamburg as it is limited to formal instruments and does not include material objectives or measures for protection. (LSBG, 2012) According to Müller (p.c., 2016), the FRMD has an informing character only, in that it informs about three different scenarios presenting how the country could be flooded if no protection measures were taken. This means that the FRMD creates awareness, a feature whose importance Müller emphasises several times during the interview (code frequency 5). Simon (p.c., 2016) adds to this that the FRMD is only supporting FRM by impacting on the public image of Hamburg. This means that protection level and management are documented and accordingly revised by the European Union. In combination with the directive being taken over by the National Water Act, this ensured that the flood protection enjoys legal importance.

However, the city feels no pressure coming from the FRMD. (Simon, p.c., 2016) Germany's, and especially Hamburg's FRM is already developed quite well which means that the requirements of the directive are already satisfied. Also Müller (p.c., 2016) puts forward that the directive does not impact on existing protection systems which had been there before the EU regulation became law. Hamburg for instance operates within a flood risk of 1:7200, while the FRMD only prescribes one of 1:200. Despite the FRMD does not impact on the protection system in Hamburg itself, the content was accomplished by establishing risks maps and FRMPs.

Regulation and legislation

FRM is an existential feature of Hamburg and therefore requires an appropriate legal framework. The applicable national legislation is limited to the National Water Act. On the local level the Water Law Hamburg (WLH, *Hamburgisches Wassergesetz*), the dike regulation and the polder regulation are applicable. This legal basis forms the dike law, or *"Deichrecht"* of the city. (LSBG, 2012) Together, the dike law regulates the construction, maintenance and protection of installations for flood control, *"Deichschauen"*, measures for crisis management, and restrictions for living in flood-prone areas

To start on the national level, the establishment of the National Water Act in 2010 was the first time the national government made use of its legislative power in the field of coastal protection. The Water Act regulates inland, as well as coastal flood protection with regards to construction, redevelopment and removal of installation for flood protection. The national government, though, does not provide legislation on material norms which shifts the authority to the federal states.

Therefore, the German Constitution obliges and empowers federal states to establish their own legislation for coastal protection. (LSBG, 2012) This coastal protection encompasses all measures taken in order to enhance the protection against storm surges along the coast and in tidal areas.

Coming to the local level it is important that Hamburg is federal state and city in one meaning that the city has the power to establish its own legislation. As a result, the WLH was established as Hamburg's version of the federal water law. The WLH regulates the construction, maintenance and protection of flood risk measures. § 3 as well as §§ 55-62 of the WLH deal with regulations on waterway construction, dikes and construction for coastal protection. §§ 52-54 specifically deal with preventive flood management.

On the public site of FRM in Hamburg, the dike regulation (*Deichordnung*) provides guidance for FRM in Hamburg by governing legal relationships with respect to dikes and barrages. It further prescribes construction norms for public installations for flood control and regulates keeping free spaces around the dikes-line. Although this is not always possible due to private properties in proximity to flood constructions, the dikes do have a safety stripe of ten meters, based on § 6 of the dike regulation.

On the private site of FRM in Hamburg, the polder regulation (*Polderordnung*) which is similar to the dike regulation, sets safety norms for private FRM in terms of building codes (§§ 3-19), maintenance and controls (§§ 20-26) as well as crisis management (§§ 27-30). Additionally, private areas can make use of specific stationary instrument which regulate obligatory precautionary measures that have to be taken by the people living in the certain area. (Simon, p.c., 2016) The *"Flutschutzverordnung HafenCity"* which legally secures flood protection in this neighbourhood is one example. It prescribes a height of 7.5m above MSL for all installations for flood control (§ 10(2)), as well a minimum height of the ground floors of houses (§ 10(3)). More generally, the *Flutschutzverordnung* forms the legal framework for Hamburg's terpen-concept.

Policy instruments

As mentioned before, Hamburg differentiates between public and private FRM which is also reflected in the use of policy instruments. Public installations for flood control are constructed or reconstructed based on planning permission hearings (PPH) and plan approvals as legal instruments. Private installations are built and maintained based on building permit procedures. (LSBG, 2012)

Another tool of public FRM, is "*Deichschauen"* (Müller, p.c., 2016, p. 2) as operation- and quality instrument. Like the WLH § 60(1) states: "*Die in öffentlichem Eigentum der Freien und Hansestadt Hamburg stehenden Hochwasserschutzanlagen sind von der Wasserbehörde regelmäßig zu schauen."* The condition of dikes in terms of maintenance and shape of construction is revised based on such *Deichschauen*. Beyond that, the protection measures are revised with regards to dike legislation. Did the construction take place in too close proximity to the dike or did someone place something on the dike without permission? In that case, the FRM field takes legal action through restraint procedures. (Simon, p.c., 2016)

Furthermore, there is the cost-benefit analysis in the field of FRM which needs to be conducted when financial resources for a protection measure are required. According to Simon (2016), these cost-benefit analyses consistently reveal that the construction costs are in positive proportion to the fixed assets protected by such a measure. (Simon, p.c., 2016)

Another instrument of FRM is land-use precaution. This means that the city buys land in proximity of dikes in case that they might get raised and accordingly would become broader, too. (Simon, p.c., 2016) Such a land purchase can be done by means of an option-right or via free channels of communication. The option-right for public FRM is regulated in the WLH § 55: "*Der Freien und Hansestadt Hamburg steht beim Verkauf von Grundstücken ein gesetzliches Vorkaufsrecht zu (...) an*

den Flächen, die an eine öffentliche Hochwasserschutzanlage angrenzen und für Zwecke des Hochwasserschutzes gegenwärtig oder zukünftig benötigt werden." This means that the municipality has the right to buy areas surrounding flood defence measures before they become publically available. The option-right is exercised when the land, which is up for sale, is located within the protection stripe surrounding a dike. In any other case, the purchase goes through free channels of communication.

In addition to the flood related instruments listed above, FRM actively makes use of spatial instruments such as land-use plans and urban development plans (UDP). This is necessary since installations for flood control cannot be over-planned. UDPs for instance, have the power to regulate land elevation which makes it a necessary tool for Hamburg's terpen concept. Although necessary, these measures need to be implemented by the spatial planning field. Therefore, they will be examined in detail in the PA of urban planning.

4.2.2 Actors and coalitions

The organisation of FRM in Hamburg involves several parties. The public actors on the one hand, are the *Behörde für Umwelt und Energie* (BUE), the related *Landesbetrieb für Straßen, Brücken und Gewässer* (LSBG), the HafenCity GmbH, the *Behörde für Inneres und Sport* (BIS), the *Behörde für Stadentwicklung und Wohnen* (BSW), and the *Oberbaudirektor*. On the other hand, the Hamburg Port Authority (HPA) and property owners are representing the private sector of FRM.

Actors and their responsibilities

The BUE is the official state authority of Hamburg whose responsibility for flood protection is based on the German federal law. The BUE, as the decisive institution on ministry level, manages and monitors water courses in Hamburg, develops flood risk policy and is also responsible for PPHs. (Hensel, p.c., 2016; Müller, p.c., 2016) The BUE is mainly active in the agenda-setting process and the initiation of policies for flood protection. Moreover, they are involved in the decision-making process on a FRM-strategy for HafenCity and on policy instruments. Eventually, all installations for flood control are concentrated in the BUE. (Amtl. Anz., 1987)

On behalf of the BUE, the LSBG as local governmental agency conducts research on climate change and sea level rise. In addition, the agency is responsible for target setting in terms of norms for flood protection that need to ensure protection against storm surges and sea level rise. This is especially important in relation to the tidal activities of the Elbe. (Mees, Driessen, & Runhaar, 2014) Moreover, the LSBG is responsible for the development and implementation of the FRMPs and for conducting the *Deichschauen* during which they need to correspond with the responsible waterboards. (Müller, p.c., 2016) As been stated in the WLH § 60: "*Die Wasserbehörde soll bei der Schau der in öffentlichem Eigentum der Freien und Hansestadt Hamburg stehenden Hochwasserschutzanlagen den Wasser- und Bodenverbänden, zu deren satzungsgemäßen Aufgaben die Beteiligung an Deichschauen gehört, Gelegenheit zur Teilnahme und zur Äußerung geben."*

A third public actor is the HafenCity GmbH, a development company of Hamburg that is completely city-owned. Its responsibility is the coordination of the HafenCity, by means of which the GmbH represents the bridge between governmental authorities, private investors and developers. A specific task is the climate proofing of the urban infrastructure of the HafenCity by implementing the terpen-concept. This means that they both implement and finance measures for adapting to flood risks. (Mees et al., 2014)

Moreover, there is the BIS, or *"Katastrophenbehörde"* (Simon, p.c., 2016, p. 6), is responsible for crisis management when an installation for flood control malfunctions or when a

storm surge causes higher water levels than the one rated. Thus, the BIS gets in charge during a flood event and accordingly has to coordinate dike controls, provide sandbags and work forces.

Besides, there is the BSW operating in the field of urban land-use planning. For instance, in reaction to the events of 1962, the BSW prescribed that every building on the circle dike *Willemsburg* requires a roof hatch that is big enough for people to climb out during a flood event in order to be evacuated by a helicopter. (Müller, p.c., 2016) Noticeable is that the LSBG does not really know which responsibilities the BSW has in FRM, whereas the BSW knows a lot about what is going on in the water sector. As Hensel (p.c., 2016, p. 6) notes: *"Ich stelle gerade fest, dass ich (...) als Stadtplaner in der Zwischenzeit auch viel vom Wasser weiß."*

The urban image is an important feature of FRM in Hamburg. As Müller (p.c., 2016, p. 7) states: *"Natürlich könnten wir uns technisch Wände in die Stadt reinsetzen, was aber stadtentwicklungspolitisch keine schöne Angelegenheit wäre."* This shows that flood protection is not the only priority in the water field, urban planning and architectural aspects need to be taken into consideration, too. In order to ensure that, Hamburg has a *Oberbaudirektor* who takes care of the urban image which underlines the importance of that aspect.

Coming to the private site of FRM, the HPA is responsible for flood protection in certain areas in Hamburg, but yet, needs to follow-up on the BUE who is property owner of all installations for flood control. (Amtl. Anz., 1987) The HPA is a public enterprise which is ultimately private, but still bound to the municipality and its regulations. (Simon, p.c., 2016)

Property owners are the other relevant private actors active in the field of designing adaptive building measures. (Mees et al., 2014) This comes due to the fact that when dikes are raised they become broader, too. This means that, despite the 10-meter protection stripe around the dike line, property owners living nearby sooner or later get in touch with new developments. (Müller, p.c., 2016) Sometimes this can be problematically due to the "Not In My Backyard" effect on the one hand, and the administration trying to ensure people's security on the other hand.

Actors and their interactions

Interaction and cooperation between the different actors takes place when something concrete is about to being planned. One example is the so-called *"Drucksache 20/5561"* from September 2012 which contains information on how FRM in Hamburg is organised. This document was aligned by all departments and therefore happened in consensus. (Müller, 2016) During the five-year preparation period of this Drucksache, all relevant actors worked closely and regularly together.

Besides the above, there is a regular exchange between all relevant actors as well as politicians. This administrative board comes together twice a year to discuss current FRM issues. As Simon (p.c., 2016, p. 6) states: *"Wir haben sozusagen mehrere Kanäle und mehrere Ebenen auf denen Akteuer gemeinsam mit einander über das Thema Hochwasserschutz reden."* Such meetings deal with all FRM related issues such as general questions, developments in dike safety, climate change, rated water levels, to name a few. This regular cooperation and interaction prevents problems in terms of FRM: *"Es werden dadurch Probleme verhindert, weil die mit Hochwasserschutz verbundenen Akteure in Kommunikation stehen und damit ein ständiger Austausch zu all diesen Themen stattfindet, sodass hochwasserrelevante Veränderungen, Bedeutungen oder auch Planungen diskutiert werden können und damit viele Probleme eben nicht entstehen."* (Simon, p.c., 2016, p. 7)

4.2.3 Power and resources

Power

When it comes to power-relations, it is most striking that the FRM field alone has not the power to take all necessary protection measures. Therefore, the spatial planning field is needed to compensate this lack of power. The federal state government has the power to appoint flood-plains in areas which are occasionally flooded or needed for water storage. The WLH § 54 prescribes that: *"Gebiete an Gewässern und Gewässerabschnitten (...), die bei Hochwasser überschwemmt, durchflossen oder für die Hochwasserentlastung oder Rückhaltung beansprucht werden, werden ermittelt und durch Rechtsverordnung des Senats als Überschwemmungsgebiete festgesetzt."* This specifically links FRM and urban planning since the water sector cannot make determinations on urban land-use.

Another factor linking the two domains in terms of power is the PPH. As regulated in the WLH § 48(1) and § 55(1), construction, disposal and maintenance of installations for flood protection are subject to PPH. § 48(1) specifically refers to the interrelation with spatial planning by stating: "*Bei der Planfeststellung ist sicherzustellen, dass Einrichtungen hergestellt und unterhalten werden, die im öffentlichen Interesse erforderlich sind, insbesondere, dass Verkehrs- und Versorgungseinrichtungen geändert werden, soweit es der Ausbau erfordert."* This means that no measures can be taken without the approval of the spatial planning department with respect to the named aspects. Eventually, however, power lies with Hamburg's senate or the Bürgerschaft determine the decision- and policy-making. (Simon, p.c., 2016)

Resources

When it comes to resources, FRM is the responsibility of the federal state. Therefore, Hamburg finances its flood protection measures by the collection of taxes, both on national and local level. To be more specific, the municipality finances installations for flood control but receives 70% of the expenses for coastal flood protection from the state in the context of the common task law *Verbesserung der Agrarstruktur und des Küstenschutzes* from September 1969. (Simon, p.c., 2016; Drucksache 20/5561, 2012) The reason for this state funding is that the German Constitution declares coastal protection as *"Gemeinschaftsaufgabe des Bundes und der Länder"*. In combination with other subsidies by the state, Hamburg receives about 10.2 Million euros annually for coastal FRM. (Drucksache 20/5561, 2012) Besides, subsidies can also be obtained from the European Union when measures are going to be taken in regions which are already subsidised by the EU. (Simon, 2016) In Hamburg, this is the case in the rural area where money can be made available through the *"Förderfond zur Stärkung des ländlichen Raumes"*. (Müller, p.c., 2016, p. 11)

In case an actor needs external expertise, he or she buys that knowledge at university departments or research institutions. Such expertise is not permanently required and therefore only used when necessary. Notable is that the LSBG conducts its own research and therefore has created its own expertise. (Müller, p.c., 2016) Additionally, many installations for flood control, located in the inner-city, have been developed by means of architectural contests as source of external knowledge. (Simon, p.c., 2016)

4.2.4 Discourses

Problem framing

The problem in Hamburg is clearly framed as flood risk for people and assets which enjoys a high level of attention. There are two causes of flooding in Hamburg that are meant to be addressed; the tidal Elbe and internal flooding smaller water courses such as Alster and Bille. (Hensel, p.c., 2016) According to the WLH § 52(1): "*Nach Maßgabe nachfolgender Vorschriften werden der durch Tidehochwasser, insbesondere Sturmfluten, gefährdete Bereich im Tidegebiet der Elbe (...) und die durch Binnenhochwasser gefährdeten Gebiete (...) geschützt*." Regarding the high level of attention paid to FRM, the catastrophe of 1962 created a common level of risk awareness as well as sense of urgency in terms of flood protection. As Simon states (p.c., 2016, p. 4): *"solche Katastrophenereignisse prägen eine Kultur und eine Gesellschaft."* Eventually, Hamburg would not exist without flood protection; therefore, it enjoys political priority.

Likewise, the actors in the field of FRM in Hamburg are extremely aware of flood risks because the possibility of a dike to break always exists. The different actors have the same high level of urgency because of their regular meetings in which they obtain the same information booth. (Simon, p.c., 2016) Consequently, the consensus on FRM in Hamburg is very high.

Mind-set

Regarding the values, playing a role in Hamburg's FRM, it gets obvious that the city has internalized the values of the FRMD; human health and life, the environment, cultural heritage, economic activity and infrastructure associated with floods. (FRMD, 2007; Simon, p.c., 2016) The most important value, however, is the security of people and assets as well as infrastructures. (Müller, p.c., 2016; Simon, p.c., 2016) This is reflected by particular areas being prioritised in FRM. The neighbourhood *Veddel* is one example as it is an own island and therewith particularly vulnerable to flooding since people cannot escape during a flood event and properties cannot be evacuated.

According to Müller (p.c., 2016), the concrete objectives of FRM are; to recognise floods and prevent floods, as well as to create awareness, all of which are of equal importance and need to be implemented simultaneously. (Drucksache 20/5561) However, FRM in Hamburg is also put into a more spatially relevant context. The urban image is consequently conceived as significant factor FRM has to take into account. (Simon, 2016) This leads to two priorities in Hamburg's FRM strategy: On the one hand, FRM has to ensure that dikes protect the city. On the other hand, FRM needs to safeguard the urban infrastructure from being damaged by such dikes. (Simon, p.c., 2016)

The related vision in terms of FRM is to maintain and extend existing installations for flood control and to let them more and more become part of the constructed city and integrated into the urban fabric, rather than only being an element of the landscape. (Simon, p.c., 2016) As a consequence, they might become better accepted by means of which they can be used jointly, or *"mitgenutzt"* (Simon, p.c., 2016, p. 7). One example is the *Niederhafen* promenade where the dike is made accessible through stairs that get launched on the flood protection construction. These are not even apparent as flood protection measure, but rather as attractive promenade which means that flood protection almost gets into the background. (Müller, p.c., 2016)

The FRM strategy of Hamburg

Although, Hamburg differentiates between public and private FRM, the related strategies are similar and therefore not discussed separately. The FRM system in Hamburg is based on the multi-layer safety approach. The first layer focusses on technical protection measures meant to avoid flood risk. The second layer is based on the idea of dealing with damage-potential which requires flood

adaptation measures in vulnerable areas. How can urban systems and structures be developed in advance so that water has no impact on in the event of a flood? These two layers combined, form the preventive part of FRM. (Zimmermann, p.c., 2016) The third layer deals with the risk of a flood event to occur, despite the implementation of the first two layers. The third layer is only of marginal relevance for this thesis and will therefore not further be discussed.

Preventive FRM, which enjoys most attention in Hamburg, consists out of five pillars; the flood protection line, polders, living with water, terpen and *Objektschutz*. Priority is given to the first pillar, the protection through closed dike and flood protection lines. As Müller (p.c., 2016, p. 1) states: *"Das Beste wie wir uns vor Sturmfluten schützen können sind geschlossene Deich- und Hochwasserschutzlinien."* The importance of the dike system is further underlined in the interview with Simon (2016) in which this factor has the code frequency of 6, the highest frequency of all codes. Such dikes are meant to protect the functions located in the city. Therefore, technical protection is the central feature of FRM in Hamburg. This shows that, after all, protection remains the dominant strategy in the city.

The use of polders as additional technical measure forms the second pillar. The port of Hamburg counts 50 polders alone. These polders mostly occur in the form of flood protection walls. As the harbour cannot be fully closed due to shipping, the polder line in this area is often interrupted. Every interruption is equipped by protection gates that can be closed during a flood event. In order to close these gates in time, a flood warning service has been established by the port enterprises. (Müller, p.c., 2016)

As third pillar, the city applies the concept of living with the water. This means that there are areas in which occasional flooding might occur. This points to the importance of land-use regulations in flood-prone areas. Residential use, for instance, might be prohibited in areas where parking is still permitted, as cars can easily be evacuated in the case of a flooding without causing damage.

The fourth pillar is based on the protection of urban structures, people and assets by means of the terpen-concept. This concept allows residential use in un-embanked areas which have historically been flooded. Their protection nowadays is guaranteed through terpen referring to the elevation of the whole area at least up to the height of a dike.

The fifth pillar consists out of *Objektschutz*. Regarding the historical development of flooding in Hamburg, there are always certain buildings and areas in danger of storm surges. Objektschutz means that existing openings are closed by means of protection gates. (Müller, p.c., 2016)

4.3 Policy Arrangement of Urban Planning

4.3.1 Institutional framework

Historical development

Water is responsible for the uniqueness and attractiveness of Hamburg. This is the reason the city "has a long tradition of meeting the technical and town or open space planning challenges posed by water in a respectful manner" (BSU, 2014, p. 12). This goes back to the damming of the *Alster* in the 12th century whose river sides were turned into parks. Together with *Binnen-* and *Außenalster*, this river forms a landmark element of urban space in Hamburg. The close relation between water and urban planning was followed-up in the 1980s when parts of the harbour became available for urban activities. (BSU, 2014)

Legal framework

The EU Flood Risk Management Directive

As opposed to the FRM field, the FRMD does affect spatial planning. One example is that flood-plains just as FRM-areas, designated in the FRMP, are integrated into the land-use plan of Hamburg. (Hensel, p.c., 2016) Another factor bringing FRM and planning together are the flood maps which have to be established in the context of the directive. According to Zimmermann (p.c., 2016), flood maps, as part of the FRMD, form an important contribution to the data available in spatial planning since planners need credible and reliable data bases, and floor risk maps provide such additional data. It also appears that where FRMPs are available, they are more often integrated in spatial development plans. One example is the planning of a metro in which has to be checked which water bodies are being crossed so that flood plains remain free and damage from flooding in new developments is prevented. As Hensel (p.c., 2016, p. 6) points out, this is *"normales planerisches Vorgehen."*

Regulation and legislation

There are three governmental layers in Germany responsible for spatial planning, the state, the federal states and municipalities. This means that spatial planning in the country is decentralised. Despite the decentralisation of spatial planning in Germany, the system is based on a mix of top-down and bottom-up planning, though. (Pahl-Weber & Henckel, 2008)

Nowadays, Hamburg, is still obliged to the old comprehensive planning law from the 1950s which means that there are only over planned areas in the city area. (Hensel, p.c, 2016) This underlines the finiteness of space in Hamburg by reason of which existing urban spaces need to be redeveloped instead of newly developed.

Beyond that, there are many specific regulations applicable since spatial planning is a multidisciplinary field. They range from the National Building Code over the WLH, Hamburg's Environmental Impact Assessment Act, Drainage Act to laws regulating planning and responsibilities in the field. The most important regulation for Hamburg, though, is the Building Code since state building regulations empower municipalities to prepare local building regulations. Such building regulations focus on certain physical structures and buildings which aim at pointing out dangers, preventing unsightly development, and at observing standards for healthy housing and working conditions. (Pahl-Weber & Henckel, 2008) That means that under the Building Code, municipalities are gaining autonomy in terms of the development of UDPs as they are given a legal basis for controlling land-use patterns.

In addition to the Building Code there are design- and preservation regulations. The design regulation prescribes what the construction has to look like and the preservation regulation deals with historical plans which are meant to be preserved in a certain way. In addition, there are social regulations aiming at preserving social structures in certain areas.

Policy instruments

Since Hamburg is federal state and city it one, it is not only responsible for urban development planning in terms of both land and building (§ 1(1) Building Code), but for land-use planning, too. Therefore, the preparatory land-use plan and the binding urban development plan (UDP) are the most important planning instruments in Hamburg. The land-use plan provides information on which function is ascribed to which land. (§ 5Building Code) The UDP is based on the land-use plan and provides property arrangements for the urban structure. (§ 8(2) Building Code)

Spatial planning can be effective when it comes to keeping spaces for flood protection free, land-use planning thus, which is according to the § 1(1) of the Building Code, a formalised tool. To give some examples, land-use plans cover elements such as construction sites, facilities and infrastructure, transportation sites, green and open spaces, environmental protection sites, water bodies (which can be ports, areas for flood control or water management), or agricultural land. (§ 5(2) Building Code) It has to be noted that the water sector has the power to prohibit the appointment of new construction sites in flood plains according to § 54(1) of the WLH: *"Die Ausweisung neuer Baugebiete in Überschwemmungsgebieten (...) bedarf (...) der Zustimmung der Wasserbehörde."*

As been regulated in § 5(2) of the Building Code, land-use plans can be used to assign areas that need to be kept free in order to be used as retention spaces: *"Im Flächennutzungsplan können insbesondere dargestellt werden: [...] die Flächen, die im Interesse des Hochwasserschutzes und der Regelung des Wasserabflusses freizuhalten sind"*. Such retention spaces are effective in terms of managing exceeding rain- or river water discharges as well as in minimising the magnitude of flooding. The Building Code also prescribes that zones need to be marked that require specific precautionary measures against external exposures and natural forces. *"Im Flächennutzungsplan sollen gekennzeichnet werden: Flächen, bei deren Bebauung besondere bauliche Vorkehrungen gegen äußere Einwirkungen oder bei denen besondere bauliche Sicherheitsmaßnahmen erforderlich sind"*. (§ 5(3) Building Code) Spatial planning, thus, offers the possibility to minimise damages caused by flooding by preventing flood-prone areas from being built on and sealed. (DST, 2011) Moreover, they can determine areas in which construction is only allowed above a certain flood level in order to flood-proof the buildings.

The second main instrument is urban development planning which determines the category and construction-density of certain areas can be determined. (Müller, p.c., 2016; § 9 Building Code) The role of urban planning in FRM, thus, is to consider water issues in spatial developments and to free up space for flood control. The Building Code contains several regulations with respect to flood control. § 6(12) for instance, specifically focuses on the concerns of flood control: *"Bei der Aufstellung der Bauleitpläne sind insbesondere zu berücksichtigen: […] die Belange des Hochwasserschutzes"*. By integrating the concerns of FRM into urban development planning, the legislator ensures that areas for flooding are provided and that within the planning of such areas, protective measures against flooding are taken. (Brenner, 2009)

Even though urban planners have the power to integrate flood issues in UDPs, this remains rarely put into practice. Only the UDPs for the HafenCity, the harbour and inner-city area contain flood defence building regulations in which progress is observable. The plan for Bamburg-Altstadt39/HafenCity5 from 2008 prescribes measures for better water infiltration on pavements and cycle paths. The UDP from October 2012 (HafenCity 6) already contains particular building regulations at the edges of areas that are at risk of being flooded. The explanation attached to this plan contains a paragraph on flood risk, stating that the HafenCity is located within the flood-plain of the Elbe and outside of the main dike line. The plan prescribes that developments within this area need have the same level of protection as developments behind the dike-line.

A third instrument to minimise flood damages is building precaution which relates to flood-proof construction and taking protective construction measures such as the *Objektschutz*. One aspect of building precaution is adapting the use and equipment of buildings to the flood risk. Three measures are related to that: elevated building or shielding, waterproofing and reinforcing buildings, or adapting the use of buildings to flooding. (MELUR, n.y.)

4.3.2 Actors and coalitions

According to a document review as well as information obtained through interviews, the following institutions and parties are identified as relevant public actors in the field of urban planning: The BSW and the seven district authorities. Hamburg has the peculiarity of being both city and federal state at the same time which involves the *Bürgerschaft* and senate as additional actors on the urban scale. Private actors do not play a significant role in this policy arrangement.

Actors and their responsibilities

The BSW functions as department and the district administrations are responsible for the different districts. The coalition contract states that the BSW is responsible for surface drainage, mainly by taking this aspect into consideration, for instance by means of greening. (Hensel, p.c., 2016) On the one hand, the *Bürgerschaft* establishes the land-use plan and if wanted, also issues laws such as the Building Code. This is important since building permissions, forming the basis of the UDP, are examined and compared with regards to Hamburg's Building Code. (Hensel, p.c., 2016) On the other hand, the senate has the competency to develop UDPs and land-use plans, but it has to be noted that the land-use plan of the Bürgerschaft is final. So, land-use plans are finalised by the Bürgerschaft and UDPs by the senate or the district authority. The seven district authorities also have political committees (water management, street planning, environmental planning etc.) just as the ministry.

Private actors are not listed as relevant actors in urban planning. Only when action groups are formed they can play a role as advisors in the planning process. Moreover, there are private planning offices involved, but since they are commissioned by the municipality, they cannot be regarded as relevant actor. (Hensel, p.c., 2016)

Actors and their interactions

The highest degree of interaction and cooperation between actors takes place in the context of the development of a UDP. The different district authorities develop their own UDPs which are compared and discussed during a district assembly. When an UDP is about to be developed, a list of fifty representatives and offices needs to be contacted under the name *"öffentliche Träger"* (BSW, n. y.). This is regulated in § 4(1) of the Building Code: "*In der frühzeitigen Behördenbeteiligung werden die Behörden und sonstigen Träger öffentlicher Belange, die von der Planung in ihrem Aufgabenbereich berührt werden, aufgefordert (gem. §4 (1) BauGB), sich zur Festlegung von Umfang und Detaillierungsgrad der Umweltprüfung (Scoping) zu äußern."* They get the contents of the UDP in the form of a plan, an enactment text and a justification. The different offices give their statement to the plan afterwards which are discussed face-to-face during an assembly. Afterwards, the plan is presented to the citizens who can give their statement, too.

4.3.3 Power and resources

Power

The Bürgerschaft transfers the competency for establishing UDPs to the senate but is also free to delegate this competency to the seven districts, which is the case in Hamburg. There are some exceptions from this rule in which the senate keeps certain reservation areas for himself. One example is the HafenCity where the BSW has the planning sovereignty. (Hensel, p.c., 2016)

It has to be noted that, even though water issues are treated in UDP, urban land-use planning has no final determining power. Urban development planning rather has to assure that it is possible to treat surface water issues. This can be done in two ways. Firstly, a storage space can be appointed

in the UDP in terms of an area appointment. Secondly, it can be worked with non-binding reservations. In the latter case an area gets marked as space that requires further water related actions. What concretely has to be done will be determined in later procedures. The aim of such a reservation is to raise awareness and to point to the necessity of water treatment in the certain area. (Hensel, p.c., 2016)

It is further important to mention that the UDP-procedure is no construction determination, it rather creates the legal framework determining the sort of construction that is permitted and the density the construction might have. The concrete design is determined in subordinate procedures. (Hensel, p.c., 2016) Eventually, the formal power in decision-making in the field of urban planning lies in the hands of the Bürgerschaft, the federal state government and the district assembly.

Regarding the procedures in the field of urban planning, PPHs or permission reviews have to be conducted for almost every kind of proposition. The permission review is carried out on a district level. The PPHs are not conducted by the urban planning department either but by special departments. The BUE and LSBG are responsible for water issues, the department for economy and traffic is responsible for traffic issues (including the harbour area), and the department of economy and traffic, for instance, conducted the PPH for the extension of the motorway A7. (Hensel, p.c., 2016) The urban planning department, however, gives statements to every PPH containing aspects they would like to be taken into consideration and whether they generally agree to the proposed measures.

Resources

Regarding the financial resources available for urban planning in Hamburg, most resources are used in the context of settlement development since this is the main objective of spatial planning. (Zimmermann, p.c., 2016) Because financial resources are scare anyway, spatial planning does not invest in flood protection. That means that spatial planning mainly becomes active in the FRM field through external projects such as RISA.

When it comes to the use of knowledge resources, some parts of urban development planning procedures are delegated to private planning offices. Moreover, competitions are set up to generate new ideas and assessments are conducted. These aim at developing urban development concepts by investigating how the city is going to develop and should develop in future. This means that there are several steps and development considerations in advance to the legally binding and concrete urban development planning. (Hensel, p.c., 2016) Also, the HafenCity University which is specialised in spatial planning is always concerned by water related projects carried out in the city, such as RISA. Projects therefore are always carried out in cooperation between spatial planning and water management, although they are initiated and management by the water department.

4.3.4 Discourses

Problem framing

The main problem urban planning in Hamburg has to deal with is that “space is a finite resource in a city that is becoming increasingly compact.” (BSU, 2014, p. 18) This means that there are only limited possibilities to create new open or construction spaces. Instead, already existing spaces need to be redeveloped in the inner-city as well as the outskirts of Hamburg. This lack of urban space points to the need for multi-functional land-use.

Mind-set

Hamburg aims at remaining a green, waterfront metropolis. (BSU, 2014) Therefore, open spaces in terms of parks, playgrounds, squares and green corridors along water courses play an important role in enhancing the urban quality of live and in supporting climate protection and adaptation. The most important value in Hamburg's urban planning field, thus, is sustainable development. In the context of Hamburg this refers to climate resilience, social diversity and economic growth.

The Spatial Strategy of Hamburg

In the context of Hamburg's urban development strategy, called "green, inclusive, growing city by the water", four objectives are formulated:

1. More city in the city
2. The inclusive city
3. Green and environment-friendly city
4. Urban development in the business metropolis

According to the city vision, Hamburg is committed to sustainable urban development. In that context, urban planning aims at creating a mixed city in the future. This is referred to as "More City in the City"-strategy. (BSU, 2014) The concept implies the intensification of building sites in the inner-city as well as the preservation of quality urban spaces. The intend of the strategy is to "meet the anticipated growth of the population and the economy with sustainable urban development that conserves land resources." (BSU, 2014, p. 15) Regarding the huge and continuously growing need of housing, recently reinforced by refugee flows, the political objective has been established to provide 6000 new building permissions every year. (Hensel, p.c., 2016) In relation to the objective of constructing new housing units, a metropolis strategy has been developed in cooperation with the state in which the approach of mixed land-use is promoted in order to deal with the limited space. (Hensel, p.c., 2016)

The concept of the "inclusive city" deals with the social diversity in Hamburg. The basic strategy implies to provide appropriate, affordable homes for all kinds of citizens. Along with that, urban mobility has to be improved and community spaces will be developed.

Regarding the objective of building a green and environment-friendly city, Hamburg tries to "enhance and promote biodiversity, urban greenery and natural areas and (…) protecting nature and climate." (BSU, 2014, p. 36) An important factor to achieve this is to raise environmental awareness amongst the population. In memory of the flood event of 1962, Hamburg "has put the subject of flood protection at the top of the agenda" (BSU, 2014, p. 44) Regarding that aspect, urban development aims at integrating FRM where necessary into the urban design as element of the public space, such as the barrier at *Baumwall*. (LSBG, 2012) The ultimate goal of Hamburg is to become resilient to all extreme climatic events, including floods, eventually.

The title "Gateway to the World" stands at the centre of the fourth objective "urban development in the business metropolis". Hamburg aims at strengthening its position at the centre of the metropolitan region. Therefore, the city tries to make use of the opportunities emerging with the socially and culturally diverse society. Main feature in achieving that objective is the port of Hamburg since "in Hamburg it is impossible to separate urban development from port development." (BSU, 2014, p. 58) Reasons for that are among others the traffic connection with the city, linkages with the industries in the hinterlands, and the provision of sustainable housing and business locations. Due to the limited area, the harbour also needs to intensify the use of existing spaces similar to the first objective of the city's strategy.

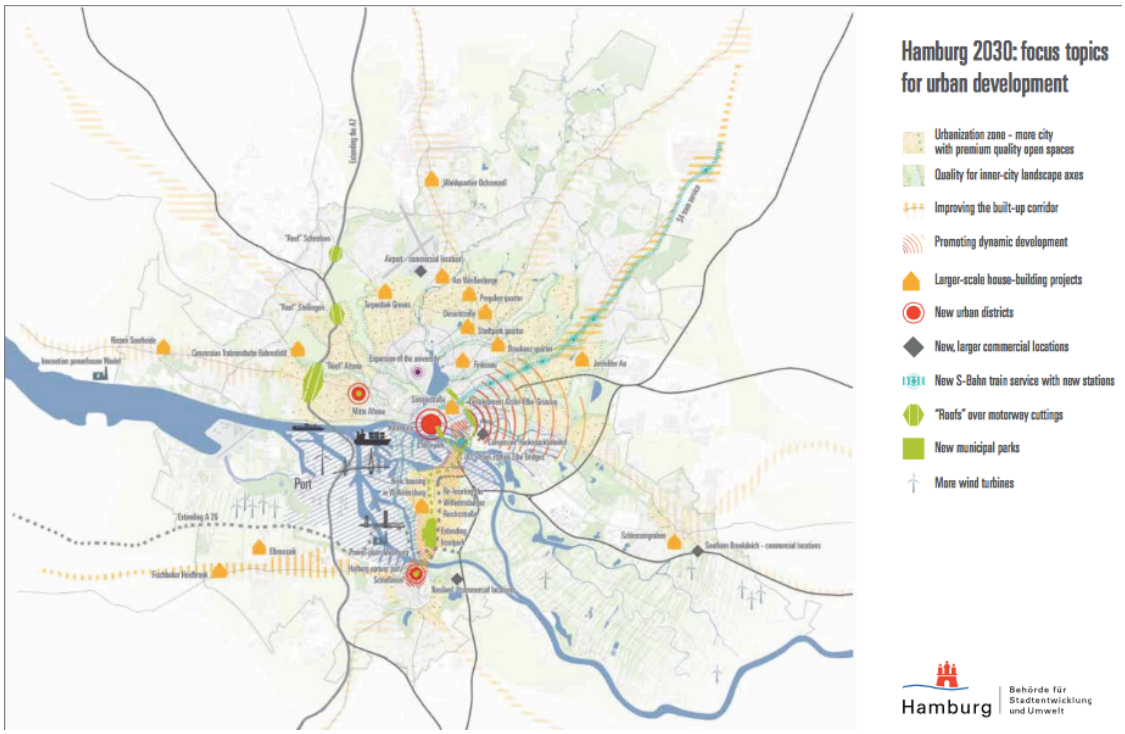

Figure 7: Hamburg 2013: focus topics for urban development (BSU, 2014)

Alongside this strategy, there is the overarching approach of multi-functional land-use resulting from the RISA project Hamburg, in which a rainwater plan was developed. The project dealt with the issue of limited surface and land-use conflicts going along with that, the flood risk of the Elbe and internal water courses, and problems resulting from climate change. (Hensel, p.c., 2016) RISA therefore tried to find a way to create new living space in order to skirt the water problem. The result is the approach of multi-functional land-use, in Hamburg so-called *"Mitnutzen"* (Hensel, p.c., 2016, p. 3). In this context, ideas have been developed on how UDPs treat the water topic and how it should be treated after all. One example of the multi-functional land-use strategy in the city, is a dike along which cycle paths are constructed. On the one hand, this dike is a means for FRM, on the other hand, it functions as traffic infrastructure or *"Stadtraumnutzungskultur"* as Simon (p.c., 2016, p. 4) calls it. Another example of the more rural areas in Hamburg's metropolitan area is that the function as local recreational area is more and more ascribed to installation for flood control. (Simon, p.c., 2016) This has the advantage that such rural area gains in importance as whereabouts and therewith is a means to redevelop and improve Hamburg's areas. This puts emphasis on the co-benefits arising from a multi-functional strategy.

4.4 Prospects and Barriers in the Integration of FRM and Urban Planning in Hamburg

The following chapter compares both PAs of the case study Hamburg in order to identify existing prospects and barriers in the integration of FRM and urban planning. The comparison is based on the four dimensions of the PA and accordingly structured in the same way. Each dimension addresses both prospects and barriers.

Hensel (p.c., 2016) puts emphasis on the fact that the aspect water is inevitable in the context of Hamburg, which also holds for the spatial planning domain. Since flood protection gets tailored to city planning issues, integration is actually being practiced in Hamburg. But Hensel (p.c., 2016, p. 10) also points to the remaining barriers in the integration: *"Ich denke es gibt da in der Zwischenzeit schon ganz gute Verknüpfungen, die müssen nur noch gelernt werden zu leben."*

Institutional framework

Despite the technological path-dependency visible in Germany, there has been a general shift towards pro-active measures in response to the shock events of 1962 and the early 2000s. Regardless of these events, urban planning in Hamburg traditionally used to integrate the water challenge into urban development which is illustrated by the waterfront developments and the harbour area. As a result of the historical development in both fields, the first steps towards an integration have been made. This basis is supported by national legislation with overlaps in terms of the Spatial Planning Act, the Building Code and the WLH.

Another aspect encouraging the integration of FRM and urban planning is the use of political instruments which overlap in the two fields, too. FRM applies instruments which need to be implemented via urban development. Such instruments are the land-use plan and the UDP.

Impact of the FRMD on the integration of FRM and urban planning

Although the FRMD did not have a significant impact on the FRM system of Hamburg, it did affect its integration with urban planning in terms of the related FRMPs. The FRMP Elbe lists the following measures which point to the role of urban planning in the field of preventive FRM and the treatment of damage-potential (FRMP FGG Elbe, 2014):

1. Prevention: Spatial and regional planning, designation of flood-prone areas, urban development planning, adapted land-use
2. Minimising impacts: adaptive planning and building, Objektschutz

The first measure refers to land-use precautions in terms of designating priority- and retention spaces. Areas are kept free for FRM and possibly obliged by land-use regulations. The designation of flood-prone areas secures land which is important for FRM measures. Such areas can be obliged by water law-related land-use regulations. When it comes to urban development planning, FRM objectives need be taken into consideration in order to keep spaces free and to identify potential evasion areas. Adapting land-use patterns in certain areas just as applying building precaution such as Objektschutz bears the potential of minimising flood damage.

Besides the FRMP Elbe, Hamburg established its own background document which, however, contains the same measures as the FRMP FGG Elbe. Yet, it is more specific about local risks and damage potential. The document and related measures were established in cooperation between the actors listed in the PA of FRM. Eventually, the BSW, together with all actors if the FRM field, participated in the development of the catalogue of measures that had to be established as part of the EU Floods Directive. The FRMD therewith, impacted on the integration of FRM and urban planning.

Moreover, a strategic environmental assessment (SEA) was carried out in the context of the FRMP. The aim of this assessment was to identify possible effects the measures formulated in the FRMP

might have on people, health, flora and fauna, biological diversity, ground, water, climate and landscape, cultural heritage and property. By means of that, the SEA linked FRM to urban planning. One reason is that the SEA is a spatial instrument being used in the field of flood safety. Another reason is that the assessment examines the effects of each FRM measure listed in the FRMP, on the environment as one factor of spatial planning. (FGG Elbe, 2014)

Actors and coalitions

In Hamburg, there is a constant exchange between FRM and urban planning. This comes due to the fact that the UDP needs to be aligned by all special departments. Since the senate or *Bürgerschaft* eventually has the final power in decision- and policy making in both fields, their interests are brought together at the most decisive moment. This means that the UDPs need to be aligned by the different departments in advance which is only possible if they cooperate properly.

Regarding the collaboration between FRM and urban planning, there appears to be a close interrelation. On the one hand, the specific role FRM assigns to urban planning is to consider flood risk and protection measures in urban development, by freeing up space and by making clear that some spaces are not available as construction sites. On the other hand, the role of the planner, varies for the different pillars of preventive FRM, though. Water storage, for instance, fully lies in the hands of the water managers since there are no legally binding regulations that empower the planner in this field. As Zimmerman (p.c., 2016) found, even in cases where land-use plans contain flood risk determinations, they are not integrated in UDPs and therewith do not have any effect. When it comes to the maintenance and development of retention spaces, though, the planner can designate spaces as priority area. In this way, the water sector is supported by the prohibition to build on these grounds. Moreover, urban planning has to keep spaces free for retention and installations for flood control. Dike adjustments for instance, are facilitated when the area around the dike is kept free from construction. This is especially important since the water sector has no legal power to determine land-use patterns. In addition, urban planning can be useful in terms of building regulations. Determinations on adaptive building support the FRM's treatment of damage potential, but the water field cannot make such determination itself. All in all, this clarifies that FRM and urban planning are interconnected since they supplement each others responsibilities.

This interrelation of FRM and urban planning can also be problematical, though. The water sector has always been responsible for all water related issues, but now that another actor is entering the field, it might feel like competencies are taken away from them. Another problem getting obvious when regarding the dimension of actors and coalitions, is institutional fragmentation. FRM in Hamburg remains split into many different offices. Permissions are given by other actors than the ones making policies. Flood defence is again organised by other offices and the local permissions are given by the seven districts. There are too many different actors involved who are not sure about each others responsibilities.

Power and resources

In terms of the distribution of power in Hamburg, senate and *Bürgerschaft* have the decisive power in FRM as well as in urban planning by means of which they use to integrate both fields during the process of decision- and policy making. The integration is further enhanced by means of PPHs as the UDP is not legally-determining but the PPH is. The PPH, yet, requires the approval of the urban development department.

In the field of resources, the integration of FRM and urban planning has no impact on the availability or distribution of financial resources. However, a greater knowledge- and data-base becomes available which is especially beneficial for the planning field which is dependent on reliable data.

The knowledge resources of both fields overlap when it comes to requesting external knowledge from universities or generating new ideas through urban contests.

Discourses

Comparing the discourses of FRM and urban planning points to the different cultures of water managers and planners which might lead to a mutual communication problem. Water managers think in yes-no-categories and legal norms, whereas the spatial planner acts more deliberatively and conceptually. (Zimmermann, p.c., 2016) Therefore, a kind of communication problem arises. An important step in integrating FRM and urban planning, thus, could be made over the education of both water managers and urban planners, by making both topics more present in each others field.

Unlike FRM, urban planning does no have a high level of risk awareness which results in different priorities. As Zimmermann (p.c., 2016) mentions, people need a catastrophe to recognise that actions have to be taken. Even though this is not the case in the water management field, urban planning gives no priority to FRM by reason that there are always other, more urgent problems emerging. In order to achieve progress in the integration of FRM and urban planning, both fields need to recognise that technical measures are fallible, but that is very non-planning and non-engineering way of thinking.

As been stated before, urban planning does not prioritise flood risk over other, in the planners' opinion, more urgent problems. This results from the fact that FRM is not the central feature of urban planning, but settlement development is. This opposing problem framing leads to opposing visions, too. Those on FRM are generally problematical as it is difficult to merchandise the topic in a positive way. FRM actually can only prevent damage but cannot really develop a positive vision since it does not lead to a development. The main problem, thus, is that visions on FRM kind of restrict urban developments by keeping spaces free from construction of living space, whereas the visions on urban planning are based on the expansion of urban settlements.

Despite the opposing visions, the strategies of both fields are combined in the multi-functional land-use concept. This is possible since both fields share similar values which form the basis for a mutually beneficial strategy. Through the integration of FRM into the urban fabric co-benefits are created for both sites. In terms of sharing space as part of multi-functional land-use, FRM and urban planning mainly get in contact when installations for flood control are in close proximity to significant urban functions, which is almost always the case when it comes to the inner-city. (Simon, p.c., 2016) In such cases, FRM and urban planning work closely together in order to develop pretentious architecturally attractive and effective flood measures.

The multi-layer safety approach supports this integration, particularly with respect to the second layer whose implementation depends on urban planning. The main prospect in the field of discourses, therefore, is to make another aware of problems which then can be addressed with combined power of FRM and urban planning. (Müller, p.c., 2016; Zimmermann, p.c., 2016)

5. Case Study Rotterdam

The Dutch city Rotterdam, which will serve as second case study for this research, belongs to the few harbour cities which have successfully taken the challenge to adapt to increasing flood risks. This has started in the context of the Rotterdam Climate Initiative, when the city established the programme "Rotterdam Climate Proof" in 2008, aiming at making the city 100% resilient by 2025. This programme is unique in the Netherlands by reason of which Rotterdam is regarded as front runner city in terms of climate adaptation. The focus lays on activities specifically related to flood risks. One main objective of the initiative is to ensure that the city remains one of the safest harbour areas world-wide. In order to achieve this objective, the programme points to the need, and already makes use of, the integration of FRM and urban planning when it comes to new developments and harbour reconstruction. (Becker, et al., 2013) Another important factor for Rotterdam's success in terms of flood risk adaptation is that the city regards climate adaptation as an opportunity to enhance the cities liveability while protecting it against climate impacts.

5.1 Background

The following chapter provides a descriptive elaboration of the case Rotterdam. This aims at putting the case into a context in order to better understand the following policy analysis. Therefore, this chapter firstly provides information on the city's geographical, spatial and organisational characteristics, followed by its vulnerability to floods and a first draft of Rotterdam's FRM system.

5.1.1 Geographical, spatial and organisational characteristics

Geography

Rotterdam is a Dutch harbour city located in the province South-Holland and is part of the agglomeration Randstad. The city covers an area of about 320 km^2, of which 155km^2 is water. (de Moel, 2014) Due do Rotterdam's location, in the Rhine-Meuse-Delta, both rivers represent an essential feature of the urban system. That is why many neighbourhoods are built in close proximity to the water (see figure 8). On the one hand, the location close to the water brings many benefits for the local economy, but on the other hand it also poses the city and its population at flood risk and the related losses and damages.

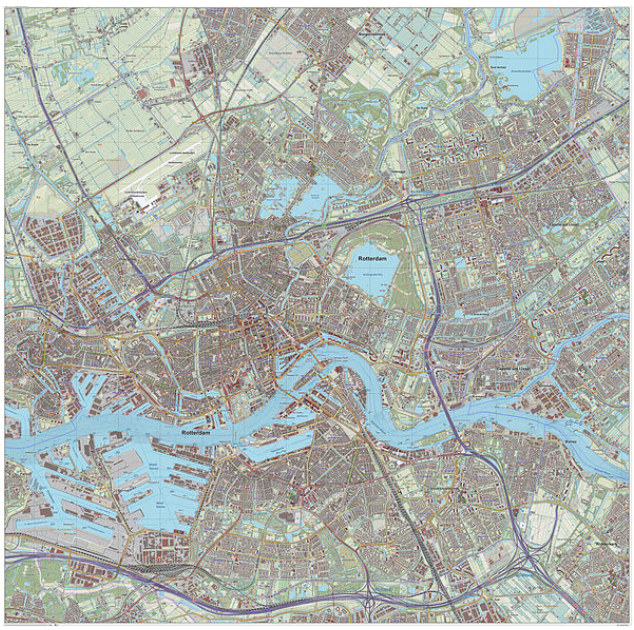

Figure 8: Topographic map of Rotterdam (van Aalst, 2014)

As major distributary of the Rhine-delta, the new Meuse runs through the city separating it into north south. The inner-city is located in the northern part of Rotterdam, harbour and related worker neighbourhoods in the south. During the last years the inner-city began to spread towards the southern parts, mainly towards *Kop van Zuid*. (Dickson, 2003)

Demography

The population of the municipality counts 631.155 citizens (CBS, 2016) and thereby makes Rotterdam the second-largest city in the country. Compared to the Dutch average, the educational level of Rotterdam's citizens is low which is related to the selective migration in the area. This demographic development refers to employed, highly educated people with high incomes leaving the city to a degree the young generation cannot compensate. The result is an unequal composition of the population. The primary reasons for migrating are the lack of appropriate living environment and the urban climate. (Gemeente Rotterdam et al., 2013) In combination with the stagnating population this might lead to a decrease in welfare. This clarifies that Rotterdam needs to take action in making the economy stronger and in making the city more attractive, safe and stable in order to reach an equal composition of the population. In order to so, Rotterdam puts emphasis on the importance of water in its development as it bears the potential to increase the living environment and safety of the city.

Economy and harbour

The port of Rotterdam became one of the biggest and most important harbours worldwide and the biggest in Europe due to the construction of the *Nieuwe Waterweg* in 1835. The *Nieuwe Waterweg* is an open canal without floodgate connecting the harbour with the North Sea. (Frijhoff & Spies, 2004) This makes the city an important transportation hub of national and international waterway, as well as air-, rail- and road- networks. In relation to that, Rotterdam is called the "Gateway to Europe". This made the port of Rotterdam become a crucial economic factor for the city.

Beyond the port related activities, the economic sectors of transport, logistics and industry gained in importance in recent years. The average yield per capita is about 67.000 euros per year which is higher than in Amsterdam and The Hague, for instance. (van den Berg, 2005)

5.1.2 Vulnerability of Rotterdam

Flood hazards in the Netherlands are mainly caused by the two great rivers Meuse and Rhine, or storm surges coming from the North-Sea. The related flood risk is reinforced by 26% of the Netherlands lying below sea level. (PBL, 2010) According to different climate projections, Rotterdam will become subject to more extreme weather events such as heavy rainfalls and storms in addition to the main threats, sea-level rise and changing river runoffs, all of which are likely to increase the flood risk in the city. The combination of the rising sea-level, probably going to rise by 35 cm to 85 cm by 2100 (de Moel, 2014), and increasing river discharges will lead to an overall increase in water levels in Rotterdam. In that case, normative high water levels will be exceeded more often and the flood defence systems will not hold the water back if no new standards are adopted. Another simultaneous development will increase the flood risk in Rotterdam; the increasing number of citizens and economic activities in the inner-dike area. They have already been growing and will continue to do so up to 2100. (de Moel, 2014) Figure 9 illustrates the economic damage in terms of the additional casualties in the areas of Rotterdam which are at risk of being flooded if the technical protection infrastructure malfunctions.

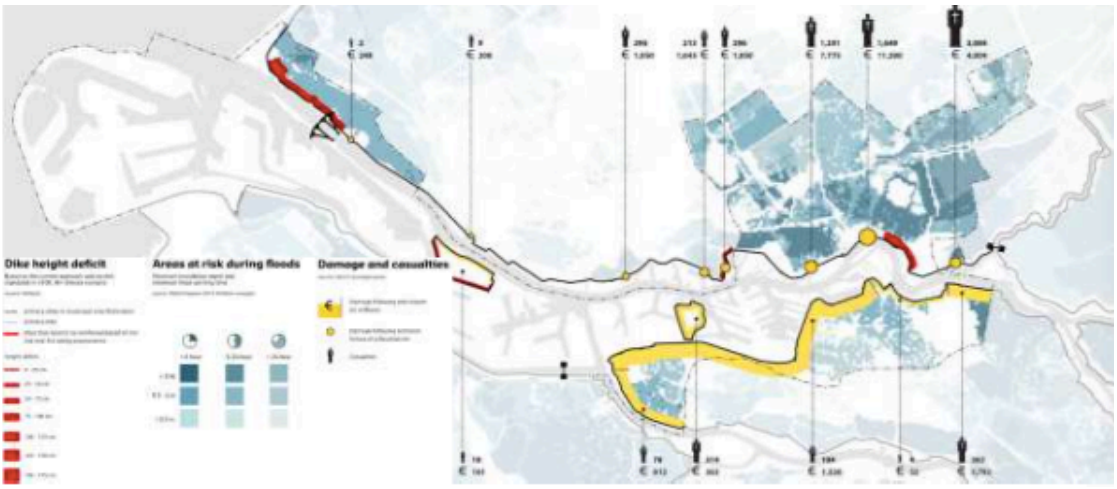

Figure 9: Inner-dike water safety risk map - 2100 (de Moel, 2014, p. 61)

Rotterdam is protected by a network of primary flood defences and the polders of the Randstad conurbation. However, there are parts of highly developed areas lying outside of the primary dike system. Most parts of these un-embanked areas are elevated up to 3 to 3.5 meters above the MSL. People living in such un-embanked areas cannot rely on flood protection measures, legally set by the state. These vulnerable districts combined cover and area of 2000 hectares and 40000 citizens. (Kronberger-Nabielek & Van Veelen, 2012) In total, the annual flood related damage for infrastructure and housing in un-embanked areas is estimated at 77,000 euros. (Van Veelen, 2013)

Even though currently the most severe things that happen are some infrequent floodings of the old harbour areas, the sea-level rise as well as the urban development triggers in un-embanked harbour areas, will increase the flood risk in future. Huge infrastructural solutions in relation to the delta are not adequate any longer with regards to uncertain but changing climatic conditions. That is the reason adaptation strategies aiming to reduce flood risks are implemented at the local scale. This can, for instance, be done by means of adaptive architecture that takes potential floods into consideration. (Kronberger-Nabielek & Van Veelen, 2012)

5.1.3 Flood risk management: The system in Rotterdam

Although the strategy of FRM belongs to the fourth dimension of the PA, the system will already be explained at this point of the thesis as it facilitates the understanding of the following analysis of each dimension and their correlation, on which the system is based.

Rotterdam is protected by the Delta Works, a system of dams, dikes, flood gates and barriers. Even though the harbour city has to keep some connections to the sea open for the shipping, the flood risk is only an estimated 1/10.000. (Dircke, 2011) The urban defence system consists of constructed dikes along the rivers and natural dunes along the coastline. Together, these measures form the so-called “dike-rings”. Besides this primary line of protection, there are storm surge barriers which can flexibly be closed during a flood event. The areas located within this protection line also contain polders which are lying beneath the MSL so that a water surplus has to be pumped towards the sea and rivers. Additionally, there is a second line of dikes within the protected area. Figure 10 illustrates the different features of the FRM system of Rotterdam.

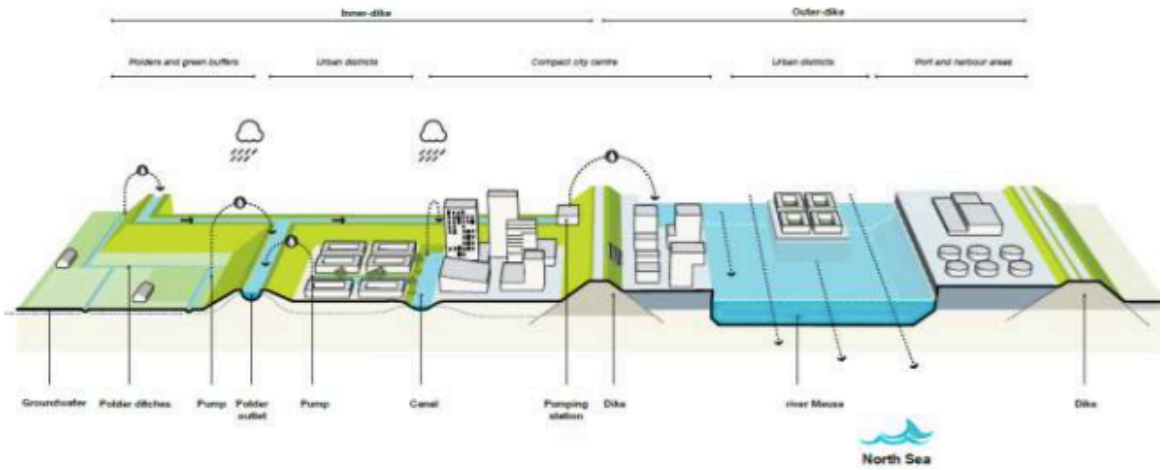

Figure 10: Rotterdam water system (RAS, 2013, p. 15)

Rotterdam's dikes are not only flood defence measures; they are part of the urban structure. This is because dikes are at some parts running through the inner-city. In these parts the dikes are designed in an innovative way, for instance by using staircases or by creating multi-functional spaces on top of the dikes. (Dircke, 2011) In addition to these measures, the city relies on water-proof buildings, floating houses and even communities.

The un-embanked areas of Rotterdam, to which the harbour belongs, are vulnerable to high water levels of the rivers and storm tides. In order to create a safety level in these outer-dike areas the grounds have been raised in most places. The level of elevation varies from about 3 meters in the city to 5.5 meters above MSL in the industrial areas of the *Maasvlakte* above sea level. (de Moel, 2014)

5.2 Policy Arrangement of Flood Risk Management

This chapter contains an analysis of the policy arrangement of FRM in Hamburg, based on the four dimensions of the PA: the institutional framework, actor and coalitions, power and resources, as well as discourses.

5.2.1 Institutional framework

The following passage deals with the institutional framework of FRM in Rotterdam. It is divided into the historical development of FRM, the legal framework applicable to the city and the available policy instruments.

Historical development

Regarding the historical context of FRM, it gets obvious that the Dutch society strongly relies on technical flood protection. FRM in the low-lying and therefore vulnerable Netherlands has a long history dating back to the 11th century when people began to built local dikes in order to protect their villages against flooding. (ten Brinke et al., 2008) This path-dependency was interrupted by shock events causing institutional changes and a reframing of the system.

The Delta Commission was established after a severe storm in the 1953 aiming to develop the Delta plan which was meant to ensure greater protection against floodings from the sea. As a result, large infrastructure projects such as the Delta Works were implemented These, however, were

criticised by different interest groups with regards to the projects' disregard of environmental impacts. (Lu & Stead, 2013)

The second policy change occurred after a major flooding in 1995, caused by extreme discharges of Meuse and Rhine. Since hundred thousands of people were evacuated in the fear of being flooded, this was the moment the society recognised that flood protection only might not be sufficient. (ten Brinke et al., 2008) Even though the floods had no serious impact, they led to debates surrounding the Dutch history of fighting the water.

The next step was to take pro-active measures, which aimed at combining the water sector's objectives with the ones from nature conservation, cultural heritage and landscape. The related "room for the river" planning document from 2007 called for a change in the current river conditions by means of engineering infrastructure and land-use planning. Along with that, local and regional authorities introduced adaptive strategies. (Lu & Stead, 2013) The Room for the River programme, therewith, marks the beginning of the integration of FRM and spatial planning.

However, technical flood defences remain the main protection measure till today. As de Moel (2014, p. 76) states: "Because strong dykes (…) can reduce flood risk effective and continuously, this strategy represents the core of both current and future risk policy." Accordingly, a clear path-dependency on flood prevention policies is obvious in the Netherlands which is not realistic to be escaped from in future. (ten Brinke et al., 2008)

Legal framework

EU Flood Risk Management Directive

The FRMD had no particular impact on FRM in Rotterdam. This comes due to that fact that the Netherlands with their Delta Programme and National Water Plan are frontrunner in the field of FRM. Van Barneveld (p.c., 2016, p. 2) confirms this by saying: "I think when it comes to water management, the Netherlands are one of the countries which are really ahead of the other countries." The measures taken there, are already exceeding what the directive asks for. This goes along with what the national government, according to van Barneveld (p.c., 2016, p. 2) states: "when we combine all the things we are doing today, then we are actually already truly applying this new directive." Neither the FRMD itself, nor the FRMPs had any impact on Rotterdam's FRM system, respectively did not provide any additional value since they are "too general and what we are trying to do today is to be more specific about our flood risk." (van Barneveld, p.c., 2016, p. 2)

Regulation and legislation

The relevant legislation and regulations for FRM in Rotterdam, are the National Water Act, national and provincial Water Plans and the Delta Programme.

To begin with, the Water Act, established in 2009, provides legal protection for primary dike systems and main watercourses. It contains the approach of living with the water by providing resistance where necessary and by seizing opportunities to foster well-being and prosperity. In this law, the prevention of and adaptation to flood risk is regarded as essential part of water policy making, next to water quality and quantity issues. (van Rijswick, 2014) With regards to the spatial aspects of water management, the Water Act provides a vision based on the Spatial Planning Act which establishes a first link between FRM and urban planning. Also, the Water Act ascribes regions and municipalities the responsibility to assess under which circumstances building in un-embanked areas is acceptable. This however, is not much integrated into local plans and regulations, yet. (Van Veelen, 2013)

The Water Act is accompanied by Water Plans which contain policy goals and objectives. According to chapter 4 of the Water Act, these plans can have four different forms; the national waterplan, regional Water Plans, management plans by state and waterboards, and the Delta programme. (van Rijswick, 2014) The latter can be regarded as implementation programme of the Water Act, dealing with water safety and fresh water supply. (§ 4(9) Water Act) In addition to this water safety issue, the Delta Programme contains ambitions for other policy domains as well. It implies a regulatory action on spatial adaptation which is meant to make the spatial design of the Netherlands water-proof. (van Rijswick, 2014) There are three different sub-programmes of which *Rijnmond-Drechtsteden* is applicable to Rotterdam. "In 2013 the steering committee of the regional Deltaprogramma Rijnmond-Drechtsteden concluded that the current strategy is – even in the future - the most favourable one: storm surge barriers near the coast line combined with structural dike reinforcements." (de Moel, 2014, p. 63) This underlines that the focus in Dutch FRM strongly relies on technical protection measures.

Policy instruments

One main instrument type used by the FRM field is the spatial instrument, such as the UDP, which has to be implemented by the urban planning field and therefore will be explained in the following PA. In addition, the water test and local water plans function as FRM-relevant policy instruments.

To begin with, the water test is an obligatory procedure carried out by the waterboard in advance to the development of a local plan. The water test is used to assess the impact of spatial developments in terms of water quality and water quantity, including flood safety. That test contains a risk analysis for the particular area in order to ensure that vulnerable functions are located in the least risky areas and that construction is flood-proof. (van Rijswick, 2014) Therefore, the water test is a tool for incorporating the effects of spatial decision-making on water issues in early stages of the decision-making process. That is why the test can be regarded as process instrument, ensuring that spatial developments take water issues into account. Each spatial disposal needs to contain a paragraph that explains the water related effects, advice of the concerned water manager and the way these aspects are dealt with in the disposal. Theses water effects also contain issues of flood risk. (van Rijswick, 2014) Yet, this procedure is not applicable to un-embanked areas for which the municipality has no similar tool. (van Barneveld, p.c., 2016)

Another instrument is the local water plan which is, other than the national and provincial plan, not obligatory but functioning as a policy plan for the municipality. Rotterdam's "Waterplan2" was published in 2007 and explains the way the municipality and waterboards are going to deal with water issues in the city until 2030. In its Waterplan2, the city of Rotterdam states that protection measures in areas within and outside of the dikes need to be reinforced in short notice. The plan therefore mainly focuses on enhancing existing dikes and, as spatial measure, on keeping spaces for flood measures free that might be needed in future. On the long term, water managers and urban developers are meant to work together in order to use reserved spaces for more reinforcements as multi-functional spaces which can be parks, cycle routes of footpaths. (Gemeente Rotterdam, Waterschap Hollandse Delta, Hoogheemraadschap van Schieland/Krimpenerwaa, & Hoogheemraadschap van Delfland, 2013) Thus, urban planning in Rotterdam is based on integrated policy-making that combines land-use and water management. (Lu & Stead, 2013) One example of the combined intervention between water sector and urban planning is the *Dakpark* in Rotterdam in which a dike is integrated with real estate and commercial development, parking space, a public park and a bike path. (Boer, 2011)

Van Barneveld (p.c., 2016), however, states that the instruments described above, are not sufficient. In his opinion, more legal instruments such as building regulations from the national

government are required. This might, among others, be important for chemical plants in un-embanked areas since the municipality does not know what will happen if they became flooded. Another requirement is the inclusion of flood risk in the environmental permit. Van Barneveld (p.c., 2016, p. 5) states that "flood risk in relation to external safety or environmental permits is something that has not been organised in this country but they are dealing with it right now."

5.2.2 Actors and coalitions

Based on a document review and the information obtained through interviews, there are the following actors involved in FRM in Rotterdam: *Rijkswaterstaat*, waterboards, the municipality with water-, urban management- and urban development department, the safety region and the port of Rotterdam authority on the public site. On the private site, property owners in terms of civilians and companies are the relevant actors. The following passage deals with these actors and their responsibilities. Based on the code frequencies of the different actors, the municipality (19) is the most important party, followed by the waterboards (5). Property owners (2) and the port of Rotterdam authority (2) play the least important role. (van Barneveld, p.c., 2016)

Actors and their responsibilities

To begin with, the *Rijkswaterstaat*, as actor on the national level, is responsible for river management, but only from a water perspective. (Slomp, 2012) This is currently being discussed because some actors think that they actually bear more responsibility. The national government, as noted in their un-embankment policy from 2011, holds the view that people are responsible themselves and that this is not going to change in future. (van Barneveld, p.c., 2016) Yet again, other actors believe that the state has a responsibility as well.

When it comes to FRM on a regional and local scale, a distinction has to be made between embanked and un-embanked areas in Rotterdam in which waterboard and municipality play the most important role. The province and municipality are formally not responsible for flood protection in outer-dike areas but make decisions about the implementation and design of flood protection and adaptation measures. On the one hand, the waterboard is responsible for hard flood risk measures, especially the dike-rings. Their responsibility therefore, only covers Rotterdam's embanked areas. The water department of the municipality on the other hand, is responsible for measures taken in the un-embanked areas. (van Barneveld, p.c., 2016)

The urban development department has the responsibility of implementing spatial policies in un-embanked areas. This arises from the fact that the port of Rotterdam, as economic motor for both city and nation, is an important factor for the engagement with FRM. The national government handles the approach that risk in un-embanked areas is a private responsibility but since the harbour is located outside of the main dike-ring the municipality feels responsible, anyway. In addition, the water department implements the flood risk adaptation- and urban water strategy coming from the Rotterdam Climate Proof Programme.

Urban management, as operational department of the municipality is responsible for crisis management when high levels of the river are expected. "They actually warn people in the low-lying areas and inform them." (van Barneveld, p.c., 2016, p. 6) A second actor working on crisis management is the safety region. They come into play when things go wrong or when extremely high water levels are expected. The safety region is important since it can steer the police and, if necessary, the army, too. (ORBP Rijn, 2015)

The port of Rotterdam authority, as last public actor, "is responsible for development, maintenance and facilitation of all the companies we have in the harbour areas." (van Barneveld, p.c., 2016, p. 6) In the past, the port authority has been part of the municipality but since they were

separated the port authority is not run by the government any longer but turned into a business organisation.

Coming to the private parties, the responsibility of property owners, which can be both civilians and companies, is to finance and to implement adaptation measures, for instance, to raise their own terrains in order to prevent damage arising from a flood event. (van Barneveld, p.c., 2016)

Actors and their interaction

There is a high level of interaction and collaboration in the field of FRM in Rotterdam. The responsible person for FRM from the water department, for instance, collaborates with other municipalities such as Amsterdam, Zwolle or Dodrecht and with the national government. (van Barneveld, p.c., 2016) This collaboration aims at gathering knowledge on whether the second layer of the multi-layer safety approach also involves spatial actions in embanked areas.

There is also collaboration when a dike has to be reinforced. Waterboard and municipality then need to collaborate since in most cases, spatial difficulties arise with a reinforcement. (van Barneveld, p.c., 2016) In this context as well as when it comes to the elevation of private terrains, conflicts can occur because investors do not want to apply flood protection measures for cost reasons.

Moreover, there is currently a pilot project in the harbour area going on in which the effects of climate change on companies in this areas are assessed. According to van Barneveld (p.c., 2016, p. 6) "that's actually the first time that we are really talking to as well as collaborating with the companies to look at the flood risk and we are trying to solve the question if we need to take measures now or in future." Before that project was established, the only moment the municipality came across companies was when construction developments in un-embanked areas had to be adapted to flood protection standards.

Beyond that, there is a collaboration between the urban management department and the safety region with respect to crisis management. A current project of the safety region in cooperation with the urban management department of Rotterdam, investigates the optimisation of the city's evacuation plans. (van Barneveld, p.c., 2016)

5.2.3 Power and resources

Power

Regarding the power-relations in the field of FRM in Rotterdam, van Barneveld (p.c., 2016, p. 1) emphasises that the municipality has "no legally formalised responsibility" because the safety region, waterboards and *Rijkswaterstaat* are mainly in power of water issues in the Netherlands. Coming back to the elevation of buildings in un-embanked areas, it is important to know that the municipality can only prescribe the elevation of public land, but has no legal power to determine the function of private buildings. When it comes to elevating people's private terrains, thus, they can only advise them to raise their building to the same height of the streets of even higher. According to van Barneveld (p.c., 2016) that is a problem, which is because the next step will probably be to establish a spatial legislation and building codes on the national level. The municipality currently has no power to do so.

In Rotterdam's un-embanked areas, the water department is the decisive institution, although they have to cooperate with the urban development department. The directors of the urban management, and urban development department, thus, have the the formal power in decision-making. (van Barneveld, p.c., 2016) The waterboard is the decisive body when it comes to the embanked areas of Rotterdam.

The separation of municipality and port authority led to changing power relations. The port authority is taking over some responsibilities but since they are not governmental any longer, respectively do not have a legal position, they cannot exercise them. In the end, both actors need to discuss the actions that are to be taken and take them in collaboration with each other. (van Barneveld, p.c., 2016)

Resources

During the interview with van Barneveld (2016, p. 2) it is pointed out that Rotterdam's ambition in the field of FRM is quite unique: "Municipalities in general do not have the knowledge to deal with flood risk management [on the local level]. As a large municipality we are abler to put some money into it, so we can invest time in this topic." But also in Rotterdam, there is no structural money or budget available for this purpose. If money is required for a certain action or measure it has to be raised on the spot in most cases.

However, there are different ways of financing FRM. Specific water related projects or flood risk assessments, for instance, are paid for by the water department. Besides, the EU provides financial resources in particular cases when it comes to international projects and research activities. Research activities can also be paid for by the subsidy programme "Knowledge for Climate" or the Delta Programme. Another source of funding, are taxes for FRM the waterboard raises in the embanked areas of Rotterdam. Also people in un-embanked areas need to pay the waterboard tax, but only a quarter of the normal tax wages. (van Barneveld, p.c., 2016) Yet, this is controversial since the waterboards "are not doing anything at all" (van Barneveld, p.c., 2016, p. 4) with respect to FRM outside of the dike line. The elevation of terrains in un-embanked areas has to be paid by the property owners themselves because they chose the risky location. The waterboards, however, use the argument that people still profit from the safety in embanked areas. The municipality which is responsible for un-embanked areas on the contrary, does not raise any taxes at the moment, but regarding sea level rise in relation to climate change and the measures that will probably have to be implemented in the long-run and might actually be the next step the municipality takes.

Resources in terms of knowledge and expertise are on the one hand produced within the municipality itself. But since there is only one person concerned with FRM, additional resources are required. On the other hand, resources, are thus gathered by means of collaboration with knowledge institutions such as *Deltares* or universities, waterboards, the safety region and other municipalities. (van Barneveld, p.c., 2016)

5.2.4 Discourses

Problem framing

Following on the flood events of 1953 and 1995, something changed in the mind-set of civilians and politicians who did not want to experience a similar catastrophe again. (van Barneveld, p.c., 2016) In response to this low level of acceptance, the handled risk probabilities were tightened. According to van Barneveld (p.c., 2016, p. 4) that is the reason why nowadays "There appears a social thing going on in the Netherlands that we tend to reduce risks as far as possible."

This development is important for the problem framing of the municipality of Rotterdam because it makes them feel responsible for FRM in un-embanked areas, especially for the safety of the harbour. They say that the city might be safe today but that does not mean that does not mean that this cannot change in future. In the words of van Barneveld (p.c., 2016, p. 3): "You can actually conclude, from an academic point of view, that we are safe now. But when you face thinks like climate change and sea level rise, then there might be a shift in the future that the risk is actually

increasing and that there might occur some unacceptable level of risk." Therefore, the municipality is considerate of raising awareness and sense of urgency amongst civilians and companies.

These two factors are created on different levels by means of the Rotterdam Climate Initiative and the Delta Programme. This context is important because people used to be sceptical about climate change and related risks. But due to campaigns, lots of information and the reality of flood events happening more frequently, people are now more open and aware of the risks. (van Barneveld, p.c., 2016) Related to that, the Delta Programme handles catastrophes as selling point for flood risk awareness and a common sense of urgency. But according to van Barneveld (p.c., 2016), it is no longer the case that people need an incident to happen in order to become aware of the risks. A significant factor in enhancing people's awareness are important delegations from all over the world coming to Rotterdam in order to see how FRM is handled there. (van Barneveld, p.c., 2016)

Just like risk awareness and sense of urgency, the harbour, too, plays an important role in the problem framing of the municipality. Since the harbour creates wealth and economic growth, the city government "feels responsible for the future development of our city, so we feel responsible at a more abstract level for the welfare city." (van Barneveld, p.c., 2016, p. 2) Because of that, topics like climate change and FRM gain so much attention. Van Barneveld (2016) points out that the city, on the one hand, tries to stay as open-minded as possible when it comes to FRM. On the other hand, "there is a tendency of the water specialised organisations to only look towards water itself but we, as a municipality, always look at the combination of water in relation to economical developments, spatial developments." (van Barneveld, p.c., 2016, p. 2)

Mind-set

Regarding FRM in the Netherlands, it gets obvious that there are two competing discourses: the traditional thought of competing against the water and the newer approach of living with the water. (Wiering & Immink, 2006) As huge parts of the Netherlands are lying below the sea level, the country has always been struggling with keeping the water away from people, property and economic activity. This made FRM become cultural heritage as well as national identity. But regarding the fact that the population growth in the comparatively small country puts pressure on space along water courses, the Dutch are forced to constantly adapt their flood policies to the changing circumstances. The transition from building dikes, a measure that separates FRM from spatial planning, to the strategy of accommodating water, created the first important steps towards a more integrated approach in both policy domains. The new approach of accommodating the water was formalised in the Government Position Paper "A Different Approach to Water: Water Management Policy in the 21st Century." (Ministry of TWP, 2000)

Rotterdam applies this new approach on water issues, too. Since the International Biennale of 2005, water was promoted as a great opportunity to transform Rotterdam into a liveable and attractive city. In that, water became the starting point for urban design. (Mees & Driessen, 2011) This is the reason Rotterdam regards FRM as primary tool for climate-proofing the city and creating a liveable environment at the same time. (Mees & Driessen, 2011)

Related to that, the values prioritised in Rotterdam's future vision on FRM are health, quality of live and economic growth and their interrelation. Van Barneveld (p.c., 2016, p. 8) emphasises that "the main goal is not to reduce flood risk essentially but the most important thing is to have a good welfare now as well as in future so that our citizens can use their neighbourhoods as they want and that they can live as joyful as possible and therefore, we need a growing economy." The way these values are formulated makes them applicable to almost everyone. Only when it comes to private actors, the attitudes might change.

The FRM Strategy of Rotterdam

"By linking sustainable ambitions to a strong economy, Rotterdam will become the most sustainable world port city." (RCI, n.y.) This ambition is worked out in the context of the Rotterdam Climate Proof programme from 2008. The concrete aim is to become resilient to climate change by 2025. Resilience here refers to permanent protection, but also continuous accessibility of the city-region. The main document resulting from this programme is the Rotterdam Adaptation Strategy (RAS) from October 2013. In this strategy, the city makes clear to aim at becoming a sustainable city as response to climate related risks. The RAS (2013, p. 7) "sets the course that will enable the city to adapt to the changing climate. The goal is to create a climate proof city for all the people of Rotterdam both now and for future generations - a city that is both attractive and economically prosperous". Six goals are put emphasis on which are meant to prevent the city from being flooded:

1. The city and its inhabitants are protected from the flood risk of rivers and the sea
2. The city and its inhabitants experience minimal disruption from too much or too little rainfall
3. The port of Rotterdam remains safe and accessible
4. The inhabitants of Rotterdam are aware of the effects of climate change and know what they themselves can do
5. Climate change adaptation contributes to a comfortable, pleasant and attractive city in which to live and work
6. Climate change adaptation strengthens the economy of Rotterdam as well as its image.

In order to achieve the objectives listed above, Rotterdam sets on the application of the multi-layer safety approach as integral FRM-strategy. (van Barneveld, p.c., 2016) In that context, the water department looks at flood protection measures which are in conflict with spatial developments.

The second layer is not applicable to embanked areas for that they are protected by the main dike-ring. That means that people in such areas are not confronted with adaptive building measures and special spatial policies. In the un-embanked areas, though, one of which is the harbour area, there are spatial policies existing which prescribe companies, building in these areas, to elevate their ground levels towards a certain level that protects them from possible flooding. A difference is made between regular functions like houses and particularly vulnerable objects like chemical plants which need an extra level of protection. According to van Barneveld (p.c., 2016), this is a fairly new development. According to van Barneveld (p.c., 2016), related spatial measures are co-beneficial since soft measures are promoted by landscape architects and property owners and protect the area anyway. Elevating vulnerable terrain is also perceived as more efficient than doing nothing and properly managing the crisis afterwards.

Regarding the multi-layer safety approach in Rotterdam, it gets obvious that the first layer does not have priority any longer. This is because the hard infrastructure is already there and obviously works. The second layer appears most problematically because there are no concrete guidelines and policy instruments are missing. The third layer lacks somewhat behind the first due to which much effort, money and knowledge is put into the development of crisis management plans. Although progress is being made in that field it still enjoys most priority. This weighting in priority can also be found in the code frequencies in the interview with van Barneveld (p.c., 2016). The first layer has just one code, the second layer 4, and the third layer including counts 10. This shows that, despite the implementation of the multiple layers, the focus lays on crisis management.

5.3 Policy Arrangement of Urban Planning

5.3.1 Institutional framework

Historical development

Regarding the Dutch history, it gets obvious that the population has mainly been settling down in endangered areas. This results in highly populated flood-prone zones which significantly limit the possibilities for the implementation of pro-active measures. (ten Brinke et al., 2008) Although pro-action in FRM is not very common in the Netherlands, a key report by the Ministry of Housing, Spatial Planning and the Environment put that issue on the agenda. (ten Brinke et al., 2008) In the light of the changing climate, space has been ascribed to accommodating excess river discharges and to the enforcement of flood protection infrastructure. Also, building in un-embanked areas in proximity to sea or river flood plains was restricted. (ten Brinke et al., 2008) This goes along with the shift in Dutch FRM towards adapting to climate change, formalised in the "*beleidsnota: anders omgaan met water"* (2000). In that, the government chose not to exclusively rely on technical protection measures only, any longer, and put emphasis on the importance of spatial measures for the transition as well. (van Rijswick, 2014)

In the past, urban development was based on blue-prints of the city which determine the location of residential-, industrial- or recreational developments. After the economic crisis in 2009, the strategy has changed since governmental institutions do no longer have the financial resources for taking initiative. This goes along with a societal change by means of which top-down planning got discarded. According to van der Wal (p.c., 2016, p. 1), this is a consequence of the fact that "there are all kinds of groups in society who are able to initiate changes themselves." Therefore, the new related participatory planning approach, applied in Rotterdam, is led by the market and stakeholder's involvement and in which the planners function as a facilitating body. (van der Wal, p.c., 2016)

Legal framework

The EU Flood Risk Management Directive

The FRMD asks for the application of three aspects in the FRMP: protection, prevention and crisis management. The resulting FRMPs of Meuse and Rhine, applicable to Rotterdam, give most priority to the protection aspect but remarks that despite such hard measures, it cannot be ensured that floodings will not affect any people, properties or economic activities. This means that attention has to be paid to adaptive measures, pointing to the importance of spatial planning in FRM which had been largely overlooked before: *"De afgelopen jaren zijn echter stappen gezet om bij nieuwe ruimtelijke ontwikkelingen rekening te houden met de gevolgen van overstromingen."*. (ORBP Maas, 2015, p. 56) This shows that alongside the development and implementation of the FRMPs, a paradigm shift from only flood protection to FRM can be seen, which will, in future, lead to an increasing integration between FRM and spatial planning. This comes due to the fact that the FRMPs puts water safety on the agenda of different spatial interventions. (Hartmann & Juepner, 2014)

However, van der Wal (p.c., 2016) points to the importance of bottom-up planning in Rotterdam. Due to which the FRMD has no real impact on urban planning either, since it gets implemented from the top-down.

Regulation and Legislation

There are not many national legislations which determine actions in the field of urban planning, one of which is the Spatial Planning Act (SPA) or *"Wet ruimtelijke ordnening"*. The SPA, established in 2008, stands at the centre of the Dutch spatial planning system. It differentiates two fields of spatial planning; there is spatial policy on the one hand (structural visions), and legal instruments for the implementation of such policies on the other hand (UDP, environmental permit).

Another important factor in spatial planning is the environmental legislation, which according to van der Wal (p.c., 2016), has become particularly important, but as he remarks, also difficult to adjust to because of its fragmentation. There are sectoral laws such as noise, air pollution, nature and so on. In response to that problem, a new Spatial and Environmental Act is currently being developed aiming at providing a more integrated environmental legislation. (van der Wal, p.c., 2016)

Policy Instruments

Urban planners make use of urban development planning as well as building precaution as policy instruments. Moreover, they get in contact with Environmental Impact Assessments (EIA) as well as the water test when it comes to spatial plans or projects. The SPA emphasizes the role and power of UDPs as spatial instruments but also established the possibility of deviating from the designations through an environmental permit. Moreover, the structural vision was introduced as indicative instrument.

The legal enforcement of flood adaptation measures in Rotterdam lies in the hands of the urban planners. This enforcement appears to be difficult, even though only few policy restrictions exist. Looking at the urban development planning procedure, the water department formulates conditions that have to be implemented by the urban development department. The national building code provides regulations for buildings, walls, escape routes etc., but they do not contain regulations on flood-proof constructions. This is problematical since municipalities are not allowed to enforce stricter codes than the national building ones: "These measures require detailed local building regulations that go beyond the national building codes. As long as the national building codes do not pay attention to building the flood plain, municipalities lack the tools for these measures to subscribe." (Van Veelen, 2013, p. 56) Local authorities, however, can arrange such extra norms by using contracts in which adaptive measures are pre-condition for planning projects.

Contrary to this, developing local dike systems or other prevention measures imposes no legal difficulties, as it can be legally defined in the local UDP. (Van Veelen, 2013) According to the SPA, municipalities have to develop UDPs once in the ten years. The UDP is the instrument that makes legally binding determinations on the use of land and buildings. These plans, thus, regulate how to use a certain area and provide specific building regulations. (§ 3(1) SPA) Moreover, UDPs can regulate flood-prone functions and land-use.

In addition to building regulations and the UDP, urban development makes use of the EIA, which according to the Environmental Law (§ 7(23) *Wet milieubeheer*), contains a chapter addressing water quantity issues including flood risk and potential consequences. (Wiering & Immink, 2006) In order to do so, maps are developed presenting the water level in vulnerable areas and the related economic damage. The EIA, however, does not have to be conducted for each and every plan or project. Smaller projects are subject to an environmental permit, instead. (van der Wal, p.c., 2016)

In addition to the EIA, every plan or projects has to undergo a water test as legally-binding procedure in which all stakeholders from the water field (e.g. waterboards or water department) get the chance to give a statement on how water issues are treated and should be treated in it. Despite the water field gets the chance to advise, this advice is not legally-binding as the municipality can

decide not to change the UDP with regards to the water test. Yet, § 3(1) of the *Besluit ruimtelijke ordening* states that each UDP needs to contain a paragraph that explains how it was dealt with the effects for the water system. All of this shows that the water test has a rather weak character.

Beyond the points discussed above, a structural vision has to be developed by every municipality containing the main spatial policy visions and objectives with related implementation strategies. Despite the obligatory character of the structural vision, their contents are not legally-binding. (§ 3(46) *Algemene wet bestuursrecht*)

5.3.2 Actors and coalitions

The main actor in the field of urban planning in Rotterdam is the municipality with the urban planning department and water department. The concerned private actors are property owners.

Actors and their responsibilities

The main actor in urban planning in Rotterdam is the urban development department of the municipality. This department has several sub-departments each specialised on a different aspect of urban planning. To name a few, there is the urban economical department, traffic department, landscape department, engineering department, management department and so on.

The responsibility of the urban development department is to facilitate projects with all stakeholders and relevant parties in Rotterdam. (van der Wal, p.c., 2016) The departments of urban development and city management together, are present throughout the whole policy process. They are responsible for conducting research and risk assessments based on climate scenarios, they set safety norms for un-embanked areas and they develop strategies for the beyond the dikes. Another responsibility is the development of an assessment framework that ensures flood safety measures in existing urban planning procedures. The urban water department has traditionally been concerned with the sewage system only, but since the issue of climate change became big in Rotterdam, future plans and projects are always developed in close cooperation with the urban development department. (van der Wal, p.c., 2016)

On the private site, property owners are responsible for developments in their own territory. As stakeholders, they can also become involved in planning procedures or by means of private initiatives.

Actors and their interactions

The urban development department collaborates with the waterboard as regional institution as well as with the local water department. Together, they develop the water plan for Rotterdam. (van der Wal, p.c., 2016) Additionally, the different actors have discussions at the initiation stage of each plan or project in order clarify the water issues to be investigated. After the investigation they come together again in order to discuss whether this first analysis and the plans was sufficient or not. (van der Wal, p.c., 2016) Moreover, due to the water test procedure, the water department has to be involved in every plan or projects the urban development department is planning. The problem arising from this cooperation is that the city department is large which makes it difficult to keep an overview over all activities going on there.

5.3.3 Power and Resources

Power

Regarding the power-relations in the field of urban planning in Rotterdam, it gets obvious that the water department needs the urban development department to realise its strategies. (van der Wal, p.c., 2016) The water managers develop their ideas which are then facilitated by the urban development department. Beyond that, the city council *(college van B&W)* has to control every plan or project and therewith has the ultimate power.

The plans or projects are discussed during city council meetings where the decision-making consequently takes place. As a result, projects become more political rather than being a department-specific issue. This is again related to the economic crisis since the municipality is no longer providing the financial resources. Therefore, all kinds of parties need to be integrated into the process.

Resources

As the urban planning authorities do not have resources, spatial policy relies on intergovernmental cooperation by means of which sector-based departments provide the needed financial resources and knowledge. (Wiering & Immink, 2006) Traditionally, urban planning used to be financed by buying and selling local grounds to private parties to develop them. The economic crisis, however, evoked difficulties in Rotterdam since the city had bought too many grounds which could not be developed after all. As a consequence, the municipality is now very careful and considerate when is comes to buying land which in turn brings private parties in charge of taking initiative. (van der Wal, p.c., 2016) The problem is that they of course suffered from the economic crisis, too. Therefore, no party has the financial resource to realise projects and developments alone. The result is the collaboration of a huge range of actors.

On the one hand, a disadvantage of this multi-stakeholder cooperation is that development processes are slowed down. On the other hand, it stimulates creativity and leads to innovation. (van der Wal, p.c., 2016) Examples are small scale innovations with potential, such as the water squares, floating houses and building with nature. For generating additional resources in terms of knowledge, the urban development department collaborates with universities in order to generate external expertise where necessary. (van der Wal, p.c., 2016)

5.3.4 Discourses

Problem framing

The urban development department pays a lot of attention to climate change and the related flood risks in the urban area. As van der Wal (p.c., 2016, p. 3) states: “Of course we are aware that we are a big city in the delta region, so that we are below sea level and we realised soon that this is a big issue.” This specific location in combination with little floods that have happened in the past, led to a high level of risk awareness impacting on the problem framing of the spatial planning field. The related investigations already started about 10 years ago and were followed-up by the RAS and just recently by a concrete Resilience Strategy. Additionally, every urban plan or project has to consider climate change and investigate its potential impacts for the related area, possible solution and which stakeholders are concerned. According to van der Wal (p.c., 2016, p. 3) this is a big development since “ten years ago, nobody was thinking about that aspect, but now, every plan or project contains a paragraph discussing climate change impacts.”

Beyond the above, van der Wal (p.c., 2016) repeatedly emphasises the importance of participatory planning. Regarding the more strategic part of the planning discourse, Rotterdam pays much attention to open planning which ensures the involvement of a large number of stakeholders in planning processes. (Wiering & Immink, 2006)

The main problems urban planning in Rotterdam needs to address in its policies and actions are the traffic issues, social structure, environmental quality and flood risk. (van der Wal, p.c., 2016) When it comes to urban traffic, congestion in the inner-city is a problem Rotterdam faces and which threatens the liveability of the city centre. Regarding the social structure of the city, some problems get obvious. The population is decreasing, selective migration takes place and insufficient economical growth leads to an insufficient amount of employment opportunities. (Gemeente Rotterdam, 2007) Therefore, there are many low-income people, according to van der Wal (p.c., 2016, p. 2) "too many" related to the harbour and its activities. Moreover, the overall environmental quality has to be enhanced since it is related to a city's attractiveness and the urban liveability. Flood risk is regarded as problem since it bears the potential to endanger people, assets and economic activity.

Mind-set

The City Vision focuses on two main objectives related to the city's sustainable development: First, to create a strong economy with more employment opportunities, and second, to built an attractive residential city with a balanced composition of the population. Both objectives are interrelated and simultaneously addressed. The city further regards water sensitive development as economic chance. In this sense, Rotterdam aspires to become the most important harbour city in Europe and to remain frontrunner in terms of adaptation related science, research and innovation. This emphasises the value sustainability with regards to water safety, quality of live and economic development. Rotterdam used to give most priority to the economy as it has been the factor determining development. This, however, changed towards finding a balance between quality of live and the economy. (van der Wal, p.c., 2016) Besides, social inclusion and diversity as well as mobility are important values in Rotterdam.

The Spatial Strategy of Rotterdam

The municipality avoids specific targets as they are part of a top-down planning approach. Finding ways how solutions can be implemented from the bottom-up is where the city focuses on. The "city deal" is an example for this approach. It is basically a contract of municipality and other actors and stakeholders on how the implementation of the Rotterdam Adaptation Strategy can be stimulated instead of determining certain target that have to be reached. (van der Wal, p.c., 2016)

Regarding the city's economic development strategy, Rotterdam aims at transitioning from an industrial economy to a knowledge and service based economy. (Gemeente Rotterdam, 2007) More concretely, "*Rotterdam wil in 2030 op het gebied van kennis en innovatie de belangrijkste havenstad van Europa zijn."* (Gemeente Rotterdam, 2007)

When it comes to the uneven social structure, Rotterdam tries to address that problem by creating a more attractive and qualitative living environment. (Gemeente Rotterdam, 2007) In order to do so, the residential use of the inner-city is going to be intensified, urban greenery has to be enhanced and gentrification needs to be initiated around the city centre. Rotterdam, thus, sets on the concept of the compact city. Additionally, the city is trying to attract higher-income groups and to mix them up in order to address the problem of low-income groups dominating certain areas, (van der Wal, p.c., 2016) The strategy of the municipality, which is still in discussion, to deal with the

high amount of low-income groups in the city, is to "reduce the amount of low-income housing and build higher-income housing instead." (van der Wal, p.c., 2016, p. 2)

The strategy in the field of traffic is to create a condition in which urban development is not hindered by car mobility. (van der Wal, p.c., 2016) The city developed a traffic plan which aims at directing traffic movements away from the inner-city towards the outskirts of Rotterdam. Corridors for cars will be developed in order to moderating the traffic congestion in the city.

Regarding the factor of environmental quality, there are different projects going on based on "building with nature" (van der Wal, p.c., 2016, p. 4). One of them is the programme for river banks, in which hard quays are turned into soft and natural ones. This also has a positive effect on reducing flood risk, too, since water can better be infiltrated by means of soft quays.

Another important aspect the municipality gives priority to is climate change. (van der Wal, p.c., 2016) In order to address the flood risk in the city, there are plans aiming at extending the capacity of the sewage system and at constructing water basins. During a period of extreme rainfall, such basins store the exceeding water and therewith "act as a buffer in the system before flooding can occur." (van der Wal, p.c., 2016, p. 4) Another water storage measure the urban development department applies is the green roof by means of which rain water can be stored.

The combination of Rotterdam Climate Proof Initiative and Waterplan2 forms the framework for the climate adaptation strategy of the city. (Barbey, 2014) The main goal of the latter is to ensure the integration of flood adaptation into urban-planning processes. This is because Rotterdam regards water management a primary tool for climate-proofing the city and creating a liveable environment at the same time. (Mees & Driessen, 2011) The water-sector prescribes that each new or re-development area project must contain ten percent of surface water retention as a means to adapt to flood risk with green measures. (Mees & Driessen, 2011)

In the Waterplan 2, Rotterdam recognises the importance of an integral approach as they found that the most successful projects were the ones combining water issues with urban planning. One example of that is the *Zuidpark* for which a masterplan was established focusing on the transformation of the park. This included making the park liveable and accessible for a large part of Rotterdam's population. Open waters were created which increased the storing capacity of the area. In combination with that and the improvement of the local ecology, quality space for recreation was built. Resources and ambitious were combined and the project was implemented in cooperation of both domains. (Gemeente Rotterdam et al., 2013)

5.4 Prospects and Barriers in the Integration of FRM and Urban Planning in Rotterdam

The following chapter will compare both PAs for the case Rotterdam in order to identify existing prospects and barriers in the integration of FRM and urban planning in that context. The comparison is based on the four dimension of the PA and accordingly structured in the same way. Each dimension addresses both prospects and barriers.

Rotterdam's vulnerability to floods was the main driver for the city to become active in the light of adaptive urban development. That is the reason why the integration of FRM and urban planning is actually being practised, but only when it comes to new developments in the un-embanked areas of the city. The Rotterdam-approach of using economically beneficial FRM strategies and combining water-proof development with spatial plans was significant in creating the city's profile as frontrunner in in the fields of climate change, FRM and urban planning. As van der Wal (p.c., 2016,

p. 8) states: “There are two sides of a coin and you need both sited to spend it. So urban development is as important as water management to achieve our common goals.”

Despite the above, the code “barriers” in the interview with van Barneveld (p.c., 2016) has the third highest frequency (12) which underlines that there are still a couple of obstacles that need to be overcome in order to fully integrate FRM and urban planning as well as to improve the FRM system of Rotterdam.

5.4.1 Institutional framework

Regarding the institutional framework of FRM and urban planning in Rotterdam, both prospects and barriers become apparent. On the one hand, new policy instruments enhance the interconnection between FRM and urban planning. One of them is the water test as mandatory procedure in spatial plans, in which flood risk issues need to be taken into consideration. In the case that a plan might affect the water system in a negative way, measures need to be found which compensate these side effects. This refers to a new set of rules of the game.

On the other hand, the role of urban planning in FRM is limited to building- and land-use regulation. There are still things missing in order to enhance the integration. Legislation or regulation for spatial planning in delta areas, for instance, is needed and this is the responsibility of the national government. The problem, however, is that there is no sign the national government is thinking so, too. (van Barneveld, p.c., 2016) Additionally, the environmental permits need to be improved and building codes have to be developed. The most important obstacle, thus, is the lack of national legislation that would help to organise the integration of FRM and urban planning. Beyond that, technological path-dependency leads to little experience with adaptive measures. Consequently, laws and regulations remain vague about their use and implementation. Moreover, neither FRM is yet integrated in UDPs, nor are adaptive building regulations and measures integrated in the National Building Act. Therefore, there can neither be building codes on the local level.

Impact of the FRMD on the integration of FRM and urban planning

The Netherlands apply the multi-layer safety approach which contains the three layers of protection, prevention and crisis management which is formalised in the FRMPs. The second layer specifically refers to spatial design as a means to minimise flood damage. The specific objectives for the second layer, named in the FRMP *(ORBP)* Rijn (2015), are;

1. to limit flood damages by means of spatial planning, and
2. to prepare for future developments which might impact on prevention and flood damage.

Especially the first objective is formulated quite vague: *“Bij besluiten over nieuwe ruimtelijke ontwikkelingen zullen ook andere maatschappelijke belangen een rol spelen. Daarom gelden geen landelijke normen voor het beperken van de gevolgen, maar spelen deze gevolgen wel een rol bij ruimtelijke keuzen.”* (ORBP Rijn, 2015, p. 44)

Concrete instruments of the second safety layer are the water test as well as zoning and spatial regulations. With regard to zoning, provinces and municipalities are asked to regulate land-use in flood-prone areas. (ORBP Rijn, 2015) It is important to note that the FRMPs regard people in un-embanked areas responsible for flood protection and damage control themselves. However, provinces and municipalities are asked to integrate flood risks in their spatial decision-making when necessary. The FRMPs, thus, are formulated in a very general way. Although there are separate plans for each river basin, they all have the same context and no measures specifically adapted to the local context. Only the risk maps vary. (ORBP Maas, 2015)

Interesting, however, is that the integration of FRM and urban planning in Rotterdam starts parallel to the FRMD. When the directive became law, the municipality of Rotterdam tried to assess the influences and consequences for the city, but according to van Barneveld (p.c., 2016, p. 2) "it was not very clear and on the other hand, I was already busy with climate change and we were ding things like making maps in order to understand flood risk." The development of such flood maps was also part of what the FRMD asked for, which again shows that Rotterdam's FRM-actions are ahead of the directive.

It can be concluded that the FRMD in the Netherlands has no direct impact on the integration of FRM and urban planning. It encourages thinking about the integration at some points but does not list specific measures related to that. The European legislation can only be regarded as necessary tool for reviewing national legislation in terms of their effectiveness, efficiency and consistency not as supporting factor in the integration the two domains.

5.4.2 Actors and coalitions

Regarding the PAs of FRM and urban planning, it gets obvious that the policy fields become more and more determined by local institutions. In this sense, FRM and urban planning are clearly affected by a process of institutional downscaling. (Wiering & Immink, 2006) FRM is shifting from a technical and engineering domain to a more open and communicative policy field which goes along with the general call for more open and communicative practices in urban planning. Opposed to the strong focus of urban planning on stakeholder involvement, the Dutch water policies remain dominated by governmental authorities. (Wiering & Immink, 2006)

Yet, the water management and urban development department are closely interconnected. The urban development department, on the one hand, facilitates the plans and projects of the water department and implements safety standards in the un-embanked area. This points to the particular importance of urban planning in the second layer of the multi-layer safety approach. On the other hand, the water department needs to be involved in any plan or project in the urban planning field. Moreover, the Waterplan for Rotterdam is developed in cooperation of urban development department and water managers.

There are many different actors, especially in the FRM field (waterboard, safety region, national government, *Rijkswaterstaat*), following their own plans. Especially in the context of the second layer of the multi-layer safety approach it is not clear what concretely has to be done and by whom. (van Barneveld, p.c., 2016) An overarching body or institution is needed that coordinates and balances all three safety layers together. The municipality is currently working on this issue in Rotterdam but the situation is instable. In his words: "Our work within the municipality is potentially vulnerable as there is no formal position for this kind of work in a general municipality in the Netherlands." (van Barneveld, p.c., 2016, p. 10) This institutional fragmentation, thus, currently hinders the further integration if FRM and urban planning.

5.4.3 Power and resources

In the end, any plan or project is discussed by the city council as cross-sectoral body. This makes both FRM and urban planning become a political issue rather than a specific department-based responsibility. In that, integration automatically takes place on the decision- and policy making level.

One problem in the field of power and decision-making is that the municipality, promoting the integration of FRM and urban planning, has no legally-formalised power in FRM. Eventually, the decision-making power lies in the hands of the safety region, waterboard and *Rijkswaterstaat*. Since these bodies do not focus on integrating urban planning in FRM, this power relation might hinder the integration of both fields.

When it comes to resources, multi-stakeholder cooperation going along with the integration of FRM and urban planning increases the availability of resources both in terms of money and knowledge. The cooperation stimulates public-private financing and partnerships which in the end also stimulate creative solution. In that, multi-stakeholder involvement functions as co-beneficial strategy.

5.4.4 Discourses

Regarding the dimension of discourses, an important step towards integrating FRM and urban planning was the transitions from building dikes, which separates FRM from urban planning, to accommodating water, which brings the two field together. The integration, though, is not fully being lived yet. One reason are the different perceptions of the urgency of FRM. Regarding the urban planning domain, it gets obvious that flood protection is not given priority above other issues such as economics or environmental quality. Urban planners, thus, perceive flood safety as one indicator for resilient and attractive urban landscapes. In the FRM-domain on the contrary, water issues are regarded as guiding principles. In the flood risk managers' view, safety has to come first in order to reduce the probability of risk. Both fields, however, take flood risk into account meaning that they both have a certain level of risk awareness, they just set their priorities differently. Urban planning addresses problems that go beyond flood risk and which might appear more urgent at the moment.

Besides the different problem perceptions, both fields share similar values in that they both prioritise economic development and quality of live as the overarching concept. Resulting from similar values, the strategies of FRM and urban planning overlap. Therefore, the RAS, Rotterdam Climate Initiative as well as the City Vision are applicable for both domains. These documents basically regard FRM as a means to create a more attractive, wealthy, and liveable city which is co-beneficial.

Multi-functional land-use, thus, appears as solution for implementing the strategies of FRM and urban planning despite their different problem perceptions. In combination with the participatory planning approach of the urban development department, and the multi-layer safety approach whose second layer clearly involves urban planning, forms a good basis for interaction and supports the further integration of FRM and urban planning.

6. Conclusion

6.1 Main findings and comparison of both cases

This chapter is based on the comparison of the two cases Hamburg and Rotterdam. Firstly, the effect of the FRMD on the two FRM-systems will be assessed. Afterwards, the integration of FRM and urban planning in both cities will be compared, based on the four dimension of the PA.

6.1.1 The impact of the FRMD on FRM in harbour cities

Comparing the cases of Hamburg and Rotterdam, it gets obvious that the FRMD had no direct impact on their flood protection systems. The reason for that is that the directive addresses countries in which no flood protection system exists. Moreover, it is limited to formal instruments and therewith does not provide any material objectives or measures. In Rotterdam neither directive nor FRMPs had any impact at all because of their general character. They were regarded as necessary tool only, not as additional value. Hamburg on the contrary, perceived the directive as information tool. They created additional value by establishing a background document for Hamburg, by means of which the FRMPs and related risk maps were used to enhance the local risk awareness. In addition, FRM enjoyed more legal importance due to the translation of the FRMD into the National Water Act, which has not been done in the Dutch case. However, the multi-layer safety approach was supported by means of the directive.

From the above, the conclusion can be drawn that the FRMD is not of importance for cities in which FRM is already actively being practiced. It can create an additional value, though, when it is perceived as a chance from the bottom-up.

The impact of the FRMD on the integration of FRM and urban planning varies between the two cases, too. In Hamburg, FRMPs impact on urban planning in that related flood-plains and areas for flood protection measures need to be taken over into land-use plans. In addition, the BSW uses the risk maps for detail planning by means of which the integration of both fields is supported. In Rotterdam on the contrary, urban planning focused on bottom-up initiatives which makes the directive as top-down policy useless. Despite that, the FRMPs assign the spatial planner roles in FRM, in both cases. Hamburg and the FGG Elbe focus on land-use as well as building-precaution which makes the urban planner part of the FRM-aspects prevention and adaptation. In the case of Rotterdam, the FRMPs of Rhine and Maas assign the planer the role of land-use precaution in flood-prone areas only.

This shows that the EU directive, based on its national implementation, can support the integration of FRM and urban planning by organising the tasks of the planner in FRM. The impact of the directive on the integration is enhanced by the strategic environmental assessment that was carried out for the FRMP of the Elbe in that is assessed FRM measures in relation to spatially relevant aspects, and because it was used as a spatial instrument for the purpose of FRM.

6.1.2 The integration of FRM and urban planning in harbour cities

Institutional framework

The impact of the institutional framework on the integration of FRM and urban planning is similar in both cases. As well Hamburg's as Rotterdam's technological path-dependency is the reason why protection is still regarded as essential and most important feature in FRM. In combination with the related lack of experience with adaptation measures, this hinders the integration of both fields. Shock events, however played an important role in changing the mind-set related to FRM and created a high level of risk awareness. This evoked changes in the FRM approach from only keeping the water away to first steps towards living with the water.

Another factor supporting the integration of FRM and urban planning is the overlapping legislation in both fields in both cases. In Rotterdam however, there is a lack of legislation visible that could coordinate the integration. Regarding the legislative framework in that context, there is a tension between national laws and standards and local bottom-up initiatives visible. This lack of top-down support hinders the enhancement of local adaptation policies. In the case of Rotterdam national legislation has to be developed from the bottom-up, in response to the call from municipalities. In Hamburg, this does not seem to be an issue. There is sufficient national guidance available which also leaves room for local innovation.

Beyond that, the development of new policy instruments plays a role. In Rotterdam, new policy instruments, such as the water test, play a role in integrating FRM and urban planning, which are not available in Hamburg. However, overlapping instruments enhance the integration in both cities due to their co-dependency (see UDP and PPH). An important difference between Hamburg and Rotterdam, though, are the building codes which are already applied in Hamburg (see HafenCity). Rotterdam still lacks behind in that field.

Actors and coalitions

Regarding the dimension of actors and coalitions, it gets obvious that the integration of FRM and urban planning in both cities is hindered by institutional fragmentation. There are too many responsible actors who are not aware of each others responsibilities. In order to coordinate the different parties and responsibilities, it would be useful to establish a boundary organisation which is able to work closely with the municipality. Existing studies show that the creation of a lead organisation can be an effective means in the coordination planning stages and the involvement of key stakeholders. (Hunt & Watkiss, 2011)

Another barrier is the FRM field which in general remains sector-based, whereas the urban planning field is more open and communicative towards FRM. An important stimulating factor in that context is the *Oberbaudirektor* in Hamburg, who supervises the integration of installations for flood control into the urban image. Rotterdam has multi-stakeholder involvement as supporting factor.

Besides there is a remaining governmental domination observable in Rotterdam and particularly Hamburg. Rotterdam's water sector, however, is positively influenced by the participatory planning approach of urban planning. This fits to the two types of governance Kern & Bulkeley (2009) define. The first is a narrow set of actors, only incorporating governmental institutions which is applicable to Hamburg. The second type, also contains non-state actors and public-private partnerships which is the case in Rotterdam. Such cooperation amongst various stakeholders has the potential to put different objectives, risk perceptions and values together and therewith bears the potential to enrich the overall decision-making process.

Furthermore, some scholars address the concept of policy entrepreneurs, referring to the role of individuals in agenda setting of policy issues. This is also visible in Rotterdam, where van Barneveld put FRM and climate adaptation on the agenda. However, policy entrepreneurs are helpful but not necessary, which is illustrated by the case of Hamburg in which no individual actor initiated FRM but shock events did.

Power and resources

When it comes to the dimension of resources it gets obvious that they do not impact on the integration as much as the integration impacts on resources. Although the integration in Hamburg has no impact on financial resources, it does lead to a greater knowledge and data-base. In Rotterdam, multi-stakeholder involvement in planning processes leads to more financial resources as well as to an increase in knowledge and creativity. This creativity is especially useful in finding new solutions on how to integrate FRM and urban planning. The participatory planning approach, thus, leads to a more beneficial integration of the two domains in Rotterdam than in Hamburg which emphasises the importance of stakeholder involvement.

Another aspect in the light of knowledge resources in Hamburg and Rotterdam are "governance experiments" (see RISA, HafenCity). (Hoffmann, 2011) Such urban experiments generally aim at finding win-win situations that generate co-benefits for other sectors, too. Such experiments are meant to create knowledge on how innervations work in practice.

Discourses

The dimension of discourses reveals that the different cultures of water managers and urban planners still lead to opposing problem perceptions and priority setting. The approaches of Hamburg and Rotterdam with regards to the integration of FRM and urban planning thus vary. The main aspect in Hamburg is the integration of flood protection measures into the urban system in terms of architectural urban development. Rotterdam on the other site, limits the integration to un-embanked areas in terms of adaptive building. For Rotterdam, FRM functions as a co-beneficial strategy for economic development and the creation of an attractive urban environment. This shows that economy and liveability stand at the centre of Rotterdam's strategy, enhanced flood protection is the co-benefit. In Hamburg it is the other way round, the integration is necessary because installations for flood control are located in the inner-city and need to be covered. Therefore, protection stands at the centre and attractiveness is the co-benefit.

Despite the different priorities, both harbour cities apply the multi-layer safety approach. This points to the concept of uncertainty-oriented planning that involves planning and controlling climate related uncertainties in terms of either taking actions in advance to possible hazards and impacts, or by preparing actions that are supposed to be taken in case of the actual occurrence of those hazards and impacts. (Jabareen, 2013) Moreover, Hamburg integrated a climate variable into the assessment of the heights of flood protections which points to dealing with uncertainty. Furthermore, both cities regard multi-functional land-use as a solution for combining the strategies of FRM and urban planning. This shows that FRM-strategies can be put into practice more easily if they include co-benefits for other sectors.

6.2 General Conclusion

The sub-questions of this research are worked out in the previous chapters. This chapter will therefore answer the central question only, followed by suggestions for further policy making.

The aim of this research is to acquire a better understanding of the practices of integrating flood risk management and urban planning in harbour cities with regards to their European context in order to help in making recommendations for the improvement of future policy making.

The European context, with respect to the FRMD, has no direct impact on neither prospects nor barriers. This became visible by analysing the FRMD, its implementation in different national contexts as well as the analysis of the resulting FRMPs. The directive can, when perceived as opportunity enhance the risk awareness in the field of FRM, but does not provide any additional guidance on the integration. Both cases already practiced FRM and the integration with urban planning to the extend to which the directive and related FRMPs make regulations.

The assessment of the prospects and barriers in the integration is based on the analysis of the policy arrangements for FRM and urban planning. The arrangements were compared for each case in order to analyse the integration based on the four dimensions of the PA. This part answered the sub-questions on how FRM and urban planning in harbour cities are organised. Afterwards, the results from both cases were compared in order to come to a general conclusion on the prospects and barriers in the integration of FRM and urban planning in harbour cities. The factor harbour is addressed throughout the analysis. From the analysis in the previous chapter, the conclusion can be drawn that there are many prospects in the integration of FRM and urban planning in European harbour cities, but that there remain a few barriers, too.

To begin with the prospects, endogenous changes as a consequence of the interplay between policy domains, societal developments, or shock events can, when addressed properly, support the integration of FRM and urban planning. Despite the technological path-dependency and the resulting lack of experience with urban planning in FRM, both cities shifted their protection system towards more adaptive measures and integrating the urban planning field into FRM. Therewith, they applied the learning by doing approach, mainly in response to the sense of urgency resulting from shock events in the 20th century. In relation to such events stands seizing the opportunity when a window of opportunity opens. Close cooperation and new, respectively overlapping policy instruments, make urban development and re-development projects take FRM into account at early stages of the planning-process. This enables to integrate flood risk with social and economic interests. Spatial instruments are necessary for the implementation of FRM measures as the legal power of water managers is limited. Therefore, urban planners represent a crucial contribution to FRM with respect to land-use and building-regulations.

Additionally, the motivation and ambition at the local level is of great importance for the integration since there is no pressure coming from the regional or national level. It is necessary that interdisciplinary actors come together and when they do, stay open-minded and make each other aware of problems. This helps to translate FRM into concrete urban planning. The interaction of cross-sectoral departments, as well as cooperation with stakeholders and research institutions is essential for the creation of knowledge and for developing innovative solutions for the integration of FRM and urban planning on city level.

The geographical space of cities is limited which means that FRM and urban planning operate in the same area and the same system, thereby affecting each other in terms of urban functioning and structure. Integrating both fields is crucial in order to adapt related actions to each

other and to use the available space as efficient as possible. The related strategy is multi-functional use of spaces and objects which can provide several functions or services at the same time. The co-benefits arising from the integration of FRM and urban planning secure long-term political and social support.

Despite the prospects in the integration of FRM and urban planning listed above, there remain barriers, too, hindering the further integration of both fields. One is the technological path-dependency which leads to a lack of experience with facilitating integrated management processes and to a persistent focus on the protection part of FRM. Moreover, institutional fragmentation hinders an efficient integration since the responsibilities of the several actors are not clearly defined. Municipalities are often divided into sectoral departments such as water, urban development, traffic and so on. Integrating FRM and urban planning leads to cross-department involvement which can result in confusion about responsibilities. Also there is a lack of a common vision amongst FRM and urban planning field which leads to different problem perceptions and priorities.

In the end, FRM and urban planning are, despite some remaining barriers, already integrated with each other. In some cases, the integration is only being practiced in particular urban areas and particular aspects of FRM, in other cases urban planning is involved during the whole FRM-process. However, urban planning represents a necessary and valuable contribution to measures FRM could not take on its own. This is especially the case when it comes to harbour cities since they are not able to protect themselves completely by means of flood protection measures. The water ways and harbour area need to remain accessible for shipping which points to the necessity of other measures that can be implemented by the urban planning field. The co-benefits of the integration have been recognised by European harbour cities and they try to further enhance the mutual cooperation.

6.3 Recommendations

Based on the results of this research, the following policy recommendations can be made which might help harbour cities in Europe to facilitate the integration of FRM and urban planning:

- National and regional legislation have to be improved. A legal basis is needed which makes urban planning part of FRM and communicates specific tasks and responsibilities of the interdisciplinary concerned actors more clearly. Particularly in the Dutch context, legislation is required that regulates spatial planning in delta regions. Also referring to the Dutch context, adaptive building regulations need to be integrated into the National Building Act so that the municipalities become empowered to develop specific local building codes for vulnerable areas. In addition, the environmental permits should be extended so that they include flood risks as well.
- The interdisciplinary multi-actor cooperation asks for the establishment of a boundary organisation which coordinates the activities of FRM and urban planning and monitors the balance between the three layers of the multi-layer safety approach.
- In order to address the different cultures of water managers and urban planners and their mutual misunderstanding, the education in both domains needs to be adapted so that both field become more open-minded and understanding with regards to each other.

7. References

Algemene wet bestuursrecht. (1992, 4 June). Wet van 4 juni 1992, houdende algemene regels van bestuursrecht (Algemene wet bestuursrecht). The Netherlands.

Amtl. Anz. (1987, 7 April). Anordnung über Zuständigkeiten auf dem Gebiet des Wasserrechts und der Wasserwirtschaft.

Barbey, K. (2014). *Metropolregion im Klimawandel-Räumliche Strategien Klimaschutz und Klimaanpassung, Zur Entwicklung gesamträumlicher Konzepte am Beispiel der Metropolregion Rhein-Neckar.* KIT Scientific Publishing.

Baugesetzbuch (BauGB). (1960, 23 June). Baugesetzbuch in der Fassung der Bekanntmachung vom 23. September 2004 (BGBl. I S. 2414), das zuletzt durch Artikel 6 des Gesetzes vom 20. Oktober 2015 (BGBl. I S. 1722) geändert worden ist. Germany.

Becker, A., Acciaro, M., Asariotis, R., Cabrera, E., Cretegny, L., Crist, P., . . . Velegrakis, A. F. (2013). A Note on Climate Change Adaptation for Seaports: A Challenge for Global Ports, a Challenge for Global Society. *Climatic Change, 120*(4), pp. 683-695.

Becker, A., Newell, D., Fischer, M., & Schwegler, B. (2011). Will Ports Become Forts? Climate Change Impacts, Opportunities and Challenge. *Terra et Aqua, 122*, pp. 11-17.

Besluit ruimtelijke ordening. (2008, 21 April). Besluit van 21 april 2008 tot uitvoering van de Wet ruimtelijke ordening (Besluit ruimtelijke ordening). Geldend van 01-07-2015 t/m heden. The Netherlands.

Biswas, A. (2004). Integrated Water Resources Management: A Reassessment. *Water International, 29*(2), S. 248-256.

Boer, F. (2011). Urban Dike Landscapes in Rotterdam. *Stadtküste Hamburg: Herausforderung Stadtentwicklung und Hochwasserschutz. Dokumentation zum HafenCity IBA LABOR vom 4./5./6. Mai 2011.*

Bouwer, S., & Biermann, F. (2011). Towards Adaptive Management: Examining the Strategies of Policy Entrepreneurs in Dutch Water Management. *Ecology and Society, 16*(4), p. 5.

Brantlinger, E., Jimenez, R., Klingner, J., Pugach, M., & Richardson, V. (2005). Qualitative studies in special education. *Exceptional children, 71*(2), pp. 195-207.

Brenner, M. (2009). *Öffentliches Baurecht. Start ins Rechtsgebiet.* Heidelberg, München, Landsberg, Frechen, Hamburg: C.F. Müller, Verlagsgruppe Hüthig Jehle Rehm GmbH.

Brooks, N., Nicholls, R., & Hall, J. (2006). *Sea level rise: coastal impacts and responses.*

BSU. (n.y.). *Hochwasserschutz in Hamburg*. Accessed on 18 March 2016 on, Behörde für Stadtentwicklung und Umwelt: http://www.hamburg.de/hochwasser/3268878/hochwasser/

BSU, B. (2014). *Green, inclusive, Growing city by the water: Perspectives on urban development in Hamburg.* Hamburg.

BSW, B. (n. y.). *hamburg.de*. Accessed on 12 May 2016, on Schritte des Bebauungsplanverfahrens: Das Planverfahren (Regelverfahren) in groben Schritten: http://www.hamburg.de/bauleitplanung/39362/planverfahren/

Bulkeley, H. (2010). Cities and the governing of climate change. *Annual Review of Environment and Resources, 35*, pp. 229-253.

Carter, N., Kreutswizer, R., & de Loe, R. (2005). Closing the circle: linking land use planning and water management at the local level. *Land Use Policy, 22*, pp. 115-127.

CBS. (2016, 24 May). *Centraal Bureau voor de Statistiek*. Accessed in May 2016, on Bevolkingsontwikkeling; regio per maand: http://statline.cbs.nl/Statweb/publication/?DM=SLNL&PA=37230ned&D1=0-2,4-5,7-8,13-15,17&D2=442&D3=118-119,131-132,144-145,157-158,170-171,183-184&HDR=G2&STB=G1,T&VW=T

City of Rotterdam. (2013). *Rotterdam Climate Change Adaptation Strategy (RAS).* Rotterdam.
Contestabile, M. (2014, July 30). Flood risk governance. *Nature Climate Change*, p. 662.
Creswell, J. W. (2012). *Qualitative inquiry & research design: choosing among five approaches.* Thousand Oaks: Sage.
de Moel, H. (2014). *TURAS Transitioning towards urban resilience and sustainability. Deliverable D4.5: Improved planning for urban resilience and sustainability – tools, measures and recommendations.*
Dickson, R. E. (2003). *The West European City. A Geographical Interpretation.* Routledge.
Dircke, P. (2011). Challenges and Perspectives of Waterfront Cities in the Age of Climate Change. *Stadtküste Hamburg: Herausforderung Stadtentwicklung und Hochwasserschutz. Dokumentation zum HafenCity IBA LABOR vom 4./5./6. Mai 2011*.
Deutscher Städtetag (DST). (2011). *Klimagerechte und energieeffiziente Stadtentwicklung. Positionspapier der Fachkommission "Stadtentwicklungsplanung" des Deutschen Städtetages.* Berlin.
Europäische Gemeinschaft. (2007). Richtlinie 2007/60/EG des Europäischen Parlaments und des Rates vom 23. Oktober 2007 über die Bewertung und das Management von Hochwasserrisiken. *ABl. L, 288*.
FGG Elbe. (2014). *Umweltbericht: Strategische Umweltprüfung zum Hochwasserrisikomanagementplan gem. § 75 WHG bzw. Artikel 7 der Richtlinie 2007/60/EG über die Bewertung und das Management von Hochwasserrisiken für den deutschen Teil der Flussgebietseinheit Elbe.* Hannover/Potsdam.
Field, C. B., Barros, V. R., Mastrandrea, M. D., Mach, K. J., Abdrabo, M. K., Adger, N., & Burkett, V. R. (2014). Summary for policymakers. *Climate change 2014: impacts, adaptation, and vulnerability. Part A: global and sectoral aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*, pp. 1-32.
Flutschutzverordnung. (2002, 18 June). Verordnung zum Schutz vor Sturmfluten im Gebiet der HafenCity (Flutschutzverordnung-HafenCity) Vom 18. Juni 2002. *Source: HmbGVBl. 2002, p. 107*. Hamburg.
Frijhoff, W., & Spies, M. (2004). *Dutch Culture in a European Perspective.* Uitgeverij van Gorcum.
FRMD. (2007). Directive 2007/60/EC on the assessment and management of flood risks. *Official Journal of the European Union*.
FRMP FGG Elbe. (2014). *Entwurf des Hochwasserrisikomanagementplans gem. § 75 WHG bzw. Artikel 7 der Richtlinie 2007/60/EG über die Bewertung und das Management von Hochwasserrisiken für den deutschen Teil der Flussgebietseinheit Elbe.*
FRMP Hamburg, B. f. (2015). *Hintergrunddokument der Freien und Hansestadt Hamburg zum Hochwasserrisikomanagementplan der Flussgebietsgemeinschaft Elbe: nformation der Öffentlichkeit gemäß § 79 Wasserhaushaltsgesetz (WHG) über die Umsetzung der Hochwasserrisikomanagementrichtlinie (Richtlinie 2007/60/EG) in der Flussgebietsgemeinschaft Elbe.* Hamburg.
Gemeente Rotterdam. (2007). *Stadsvisie Rotterdam: Ruimtelijke Ontwikkelingsstrategie 2030.* Rotterdam.
Gemeente Rotterdam, Waterschap Hollandse Delta, Hoogheemraadschap van Schieland/Krimpenerwaa, & Hoogheemraadschap van Delfland. (2013). *Herijking Waterplan 2 Rotterdam: Werken aan water voor een aantrekkelijke en klimaatbestendige stad.* Rotterdam: Veenman.

Greiving, S., & Fleischhauer, M. (2012). National climate change adaptation strategies of European states from a spatial planning and development perspective. *European Planning Studies, 20*(1), pp. 27-48.

Hafen Hamburg Marketing e.V. (n.y.). *Port of Hamburg*. Accessed on 14 June 2016, on https://www.hafen-hamburg.de/de/geschichte

HafenCity Hamburg. (25. March 2016). *Themen Quartiere Projekte.* (H. H. GmbH, Hrsg.) Assessed in May 2016, on http://www.hafencity.com/upload/files/files/HafenCityProjekte_Ma__776_rz_2016_.pdf

HafenCity, H., & IBA, I. (2011). *Stadtküste Hamburg: Herausforderung Stadtentwicklung und Hochwasserschutz. Dokumentation zum HafenCity IBA LABOR vom 4./5./6. Mai 2011.* Hamburg.

Hamburgisches Wassergesetz (HWaG). (2005, 29 March). *Source: HmbGVBl. 2005, p. 97. letzte berücksichtigte Änderung: § 63a geändert durch Artikel 12 des Gesetzes vom 4. Dezember 2012 (HmbGVBl. S. 510. 519)*. Hamburg.

Hanson, S., Nicholls, R., Ranger, N., Hallegatte, S., Corfee-Morlot, J., Herweijer, C., & Chateau, J. (2011). A global ranking of port cities with high exposure to climate extremes. *Climatic change, 104*(1), pp. 89-111.

Hartmann, T., & Albrecht, J. (2014). From flood protection to flood risk management: Condition-based and performance-based regulations in German water law. *Journal of Environmental Law, 26*(2), pp. 243-268.

Hartmann, T., & Driessen, P. (2013). The flood risk management plan: towards spatial water governance. *Journal of Flood Risk Management, 6*(1), pp. 1-10.

Hartmann, T., & Juepner, R. (2014). The Flood Risk Management Plan: An essential step towards the institutionalization of a paradigm shift. *International Journal of Water Governance, 2*(1), pp. 107-118.

Healey, P. (2007). *Urban complexity and spatial strategies: Towards a relational planning for our times.* New York: Routledge.

Hegger, D. L., Driessen, P. P., Dieperink, C., Wiering, M., Raadgever, T. G., & van Rijswick, H. F. (2014, 26 June). Assessing Stability and Dynamics in Flood Risk Governance: An Empirically Illustrated Research Approach. *Water Resource Management*, pp. 4127-4142.

Hegger, D., Green, C., Driessen, P., Bakker, M., Dieperink, C., Crabbé, A., . . . Goytia Casermeiro, S. (2013, 13 June). Accessed on 13 May, on www.starflood.eu: http://www.starflood.eu/documents/2013/06/flood-risk-management-in-europe-similarities-and-differences-between-the-star-flood-consortium-countries.pdf

Hensel, R. (2016, 25 May). BSW: Behörde für Stadtentwicklung und Wohnen Hamburg. Interview by L. Clermont [Tape recording]. Hamburg.

Hoffmann, M. J. (2011). *Climate governance at the crossroads: experimenting with a global response after Kyoto.* New York: Oxford University Press.

Hunt, A., & Watkiss, P. (2011). Climate change impacts and adaptation in cities: a review of the literature. *Climatic Change, 104*(1), pp. 13-49.

IPCC. (2007). *Fourth Assessment Report: Climate Change 2007.* Geneva: IPCC.

Jabareen, Y. (2013). Planning the resilient city: Concepts and strategies for coping with climate change and environmental risk. *Cities, 31*, pp. 220-229.

Kronberger-Nabielek, P., & Van Veelen, P. C. (2012). Klaar voor hoogwater: waterveiligheid en gebiedsontwikkeling in Rotterdam. . *S+ RO Stedenbouw en Ruimtelijke Ordening, 93*(5).

LSBG, L. (September 2012). *Sturmflutschutz in Hamburg: Berichte des Landesbetriebes Straßen, Brücken und Gewässer Nr. 10/2012.* Accessed on 17 May, on http://www.hamburg.de/contentblob/3286388/data/sturmflutschutz-broschuere.pdf

Müller, D. O. (23. May 2016). LSBG: Landesbetrieb für Straßen, Brücken und Gewässer Hamburg. Interview by L. Clermont [Tape recording]. Hamburg.

Mees, H. L., & Driessen, P. P. (2011). Adaptation to climate change in urban areas: Climate-greening London, Rotterdam, and Toronto. *Climate Law, 2*(2), pp. 251-280.

Mees, H. L., Driessen, P. P., & Runhaar, H. A. (2014). Legitimate adaptive flood risk governance beyond the dikes: the cases of Hamburg, Helsinki and Rotterdam. *Regional Environmental Change, 14*, pp. 671-682.

MELUR. (n.y.). *Ministerium für Energiewende, Landwirtschaft, Umwelt und ländliche Räume*. Accessed on 3rd April 2016, on Bauvorsorge: http://www.schleswig-holstein.de/UmweltLandwirtschaft/DE/WasserMeer /05_Hochwasser-schutz/03_GeneralplanBHWS/06_WeitergHWVorsorge/01_Bauvorsorge/ein_node.html

Ministry of Transport, Public Works and Water Management. (Feburary 2010). Water Act. The Netherlands.

Ministry of Transport, Public Works and Water Management. (2000). *A Different Approach to Water: Water Management Policy in the 21st Century.* Accessed in June, on Ministry of Transport, Public Works and Water Management: http://verkeerenwaterstraat.nl

OECD. (2010). *Cities and Climate Change.* OECD Publishing.

ORBP Maas, M. (2015). *Overstromingsrisicobeheerplan voor het stroomgebied van de Maas 2016-2021: Doelen en maatregelen voor het beheersen van overstromingsrisico's.*

ORBP Rijn, M. v. (2015). *Overstromingsrisicobeheerplan voor het stroomgebied van de Rijn 2016-2021: Doelen en maatregelen voor het beheersen van overstromingsrisico's.*

Pahl-Weber, E., & Henckel, D. (2008). *The planning system and planning terms in Germany: A glossary. Studies in Spatial Development* (Bd. 7). Hanover: ARL.

PBL. (2010). *Plan Bureau voor de Leefomgeving, Correctieformulering over overstromingsrisico*. Accessed in May, on http://www.pbl.nl/dosiers/klimaatverandering/content/correctie-formulering-over-overstromingsrisico

Polderordnung. (1977, 13 December). Verordnung über private Hochwasserschutzanlagen (Polderordnung - PolderO) Vom 13. Dezember 1977. *Source: HmbGVBl. 1977, p. 394. Letzte berücksichtigte Änderung: § 2 geändert, Überschrift ergänzt durch Rechtsvorschrift vom 3. Februar 1981 (HmbGVBL. S. 28)*. Hamburg.

Quevauviller, P. (2011). Adapting to climate change: reducing water-related risks in Europe - EU policy and research considerations. *Environmental Science & Policy, 14*, pp. 722-729.

Raadgever, T., Hegger, D., Wiering, M., & Gersonius, B. (2013). *Implementatie meerlaagsveiligheid in Nederland: realisatie plannen vergt institutionele verandering.* Accessed on 3rd March 2016, on Vakblad H2O: http://vakbladh2o.nl/index.php?option=com_easyblog&view=entry&id=88&Itemid=171

RCI. (n.y.). *ROTTERDAM.CLIMATE.INITIATIVE*. Accessed in May on www.rotterdamclimateinitiative.nl

Regionaldatenbank Deutschland. (n.y.). *Statistische Ämter des Bundes und der Länder*. Accessed on 18 June 2016, on Regionalatlas Deutschland: https://www.regionalstatistik.de/genesis/online/data;jsessionid=B3B0A0F1B92B92D3EAC45CFEDA039EFA?operation=statistikAbruftabellen&levelindex=1&levelid=1466245762252&index=3

Simon, O. (2016, 13 June). BUE: Behörde für Umwelt und Energie. Interview by L. Clermont [Tape recording]. Hamburg.

Slomp, R. (2012). *Flood Risk and Water Management in the Netherlands: A 2012 Update.* Ministry of Infrastructure and the Environment.

Smit, B., & Wandel, J. (March 2006). Adaptation, adaptive capacity and vulnerability. *Global Environmental Change, 16*, S. 282-292.

Stadt Hamburg. (2008, 19 February). Bebauungsplan Hamburg-Altstadt 39-HafenCity 5 Hamburg (HmbGVBl. p. 105). Hamburg. Accessed on 5 May, on http://daten-hamburg.de/infrastruktur_bauen_wohnen/bebauungsplaene/pdfs/bplan/hamburg-altstadt39-hafencity5.pdf

Stadt Hamburg. (2012, 29 October). Verordnung über den Bebauungsplan HafenCity 6. Hamburg.

Statistikamt Nord. (2016, 17 June). *Statistischen Amt für Hamburg und Schleswig-Holstein*. Accessed on 18 June 2016, on Monatszahlen - Bevölkerung: http://www.statistik-nord.de/daten/bevoelkerung-und-gebiet/monatszahlen-4/

ten Brinke, W. B., Saeijs, G. E., Helsloot, I., & van Alphen, J. (June 2008). Safety chain approach in flood risk management . *Proceedings of the Institution of Civil Engineers-Municipal Engineer, 161*(2), pp. 93-102.

UN-Habitat. (2011). *Global Report on Human Settlements 2011 Cities and Climate Change.* London: Earthscan.

van Barneveld, N. (2016, 6 June). Senior Advisor Water and City Management: Municiality of Rotterdam. Interview by L. Clermont [Tape recording]. Rotterdam.

Van Buuren, A., Driessen, P. P., van Rijkswick, 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, 10*(1), pp. 29-53.

van Buuren, A., Klijn, E. H., & Edelenbos, J. (2012). Democratic Legitimacy of New Forms of Water Management in the Netherlands. *International Journal of Water Resources Development, 28*(4), pp. 629- 645.

van den Berg, L. (2005). *European Cities in the Knowledge Economy.* Ashgate Publishing.

van der Brugge, R., Rotmans, J., & Loorbach, D. (2005). The transition in Dutch water management. *Regional Environmental Change, 4*(5), pp. 164-176.

van der Schrier, G., van den Besselaar, E., Leander, R., Verver, G., Klein Tank, A., Beersma, J., Bissoli, P. (n.y.). *Koninklijk Nederlands Meteorologisch Instituut - Ministerie van Infrastructuur en Milieu*. Accessed on 10 March 2016, on Central European flooding 2013: https://www.knmi.nl/kennis-en-datacentrum/achtergrond/central-european-flooding-2013

van der Wal, L. (2016, 14 June). Department of urban development: municipality of Rotterdam. Interview by L. Clermont [Tape recording]. Rotterdam.

Van Eerd, M. C., Weiring, M. A., & Dieperink, C. (2014). Exploring the prospects for cross-border climate change adaptation between North Rhine-Westphalia and the Netherlands. *Utrecht Law Review, 10*(2).

van Herk, S., Rijke, J., Zevenbergen, C., & Ashley, R. (2013). Understanding the transition to integrated flood risk management in the Netherlands. *Environmental Innovation and Societal Transitions*.

van Rijswick, M. (2014). Water en ruimtelijke ordening: wat brengt de toekomst?

Van Veelen, P. C. (2013). *Adaptive strategies for the Rotterdam unembanked area: Synthesis report.* Kennis voor Klimaat.

Vennix, J. (2011). *Theorie en praktijk van empirisch onderzoek.* Harlow: Pearson.

Vermeer, M., & Rahmstorf, S. (2009). Global sea level linked to global temperature. *Proceedings of the National Academy of Sciences, 106*(51), pp. 21527-21532.

Verwijmeren, J., & Wiering, M. (2007). *Many Rivers To Cross: Cross Border Co-operation in River Management.* Delft: Eburon Academic Publishers.

Wamsler, C., Brink, E., & Rivera, C. (2013). Planning for climate change in urban areas: from theory to practice. *Journal of Cleaner Production, 50*, pp. 68-81.

Wegener, M. (2012). Chapter 8: Government or Governance? The challenge of planning of sustainability in the Ruhr. In Hartmann, & Needham, *Planning by law and property rights reconsidered.* Farnham: Ashgate.

Wet milieubeheer. (1979, 13 June). Wet van 13 juni 1979, houdende regelen met betrekking tot een aantal algemene onderwerpen op het gebied van de milieuhygiëne. Geldend van 01-07-2016 t/m heden. The Netherlands.

Wet ruimtelijke ordening. (2006, 20 October). Wet van 20 oktober 2006, houdende nieuwe regels omtrent de ruimtelijke ordening (Wet ruimtelijke ordening). Geldend van 14-04-2016 t/m heden. The Netherlands.

Wasserhaushaltsgesetz. (2009, 31 July). *Gesetz zur Ordnung des Wasserhaushalts.* Wasserhaushaltsgesetz vom 31. Juli 2009 (BGBl. I S. 2585), das durch Artikel 4 Absatz 73 des Gesetzes vom 18. Juli 2016 (BGBl. I S. 1666) geändert worden ist. Germany.

White, I. (2008). The absorbent city: urban form and flood risk management. *Urban Design & Planning, 161*(4), pp. 151-161.

White, I. (2010). *Water and the City: Risk. Resilience and planning for sustainable future.* London and New York: Routlesge.

White, I., & Howe, J. (2003). Policy and Practice: Planning and the European union water framework directive. *Journal of Environmental Planning and Management, 46*(4), pp. 621-631.

Wiering, M., & Immink, I. (2006). When water management meets spatial planning: a policy-arrangement perspective. *Environment and Planning C: Government and Policy, 24*, pp. 423-438.

Wilson, E. (December 2006). Adapting to Climate Change at the Local Level: The Spatial Planning Response. *Local Environment, 11*(6), pp. 609-625.

Woltjer, J., & Al, N. (2007). Integrating water management and spatial planning: Strategies based on the Dutch experience. *Journal of the American Planning Association, 73*(2), pp. 211-222.

World-Bank. (2010). *Cities and Climate Change: An Urgent Agenda.* Washington: World Bank.

Zevenbergen, C., Veerbeek, W., Gersonius, B., & Van Herk, S. (2008). Challenges in urban flood management: travelling across spatial and temporal scales. *Journal of Flood Risk Management, 1*(2), pp. 81-88.

Zimmermann, T. (2016, 27 May). HCU: HafenCity University. Interview by L. Clermont [Tape recording]

8. List of Figures

9. Appendix

9.1 Reflection

This paragraph reflects on this research, based on reliability and validity. Reliability refers to the the extend to which the measurements are independent of coincidence. (Vennix, 2011) Validity is based on the accuracy of the research results. Validity therewith refers to the extend to which the results are an actual refection of the reality.

The replication-requirement is difficult to meet in qualitative research, which is applied in this thesis. The reliability issue is addressed by making this thesis as controllable and reviewable as possible. That makes it possible to check where the conclusions of this research are based on. In addition, interviews were recorded and transcribed so that the analysis in this research can be examined based on the primary data. The interviews were based on semi-structured guides in order to deal with the factor coincidence. One disadvantage is that interview findings are dependent on individuals' generalisation and therefore may be difficult to evaluate properly. By combining interviews, documents and theory to corroborate the verbal and cognitive information of the main data source, the research findings remain valid, anyway.

There are three different types of validity; internal, external and data collection based validity. Internal validity is based on the choices made with regards to the setup of the research. This point is addressed in the methodological framework. External validity deals with the extend to which the results of a research can be generalised. Only two cases could be addressed due to limited time and resourced available for this research which makes the results location based and less generalizable. It is advisable to validate the results of this thesis in sequel-research based in a multiple-case study of European harbour cities. The validity of data-collection is secured by means of triangulation. This research is based on a literature study, content based analysis of policy documents and interviews. The literature used for the literature study was searched via the library of Radboud University, Cardiff University and TU Dortmund, as well as the scientific search engine google scholar.

When reflecting on my personal experiences with the thesis writing process, the most striking obstacle that comes to my mind are the interviews. It was hard to find interviewees due to a high level of non-response, especially when it comes to approaching people by mail. But also via telephone, even repeated calls, not everyone was reachable, available or willing to be part of an interview mainly because of a lack of time or knowledge. The port authorities of Hamburg and Rotterdam, for instance, both claimed they were not able to answer the questions and had no time anyway. Other potential respondents were not reachable over a long period, some even in maternity protection. Due to such difficulties, only two interviews could be arranged for the case Rotterdam. However, there are many policy documents available which enhances the validity anyway. Another negative point is that the land-use plans addressed in the context of Hamburg are not online available. Therefore, their contents could not be analysed with respect to FRM.

Due to the extent of the thesis, I was forced to reflect on earlier written parts in the form of an iterative process. That was difficult for me since I am usually working in a more linear way. This was not possible here because the obtained data changed the views I got from the literature study. Therefore, I had to adapt the theoretical and methodological part of the thesis. Likewise, I needed to check the information retrieved from the document study after the interview analyses. Of course I learned about

the iterative process from the first lecture on, but I never thought I would have to practice it to such a degree.

Since my study is limited to the Dutch national context, devoting myself to the German planning system was especially interesting for me. I wondered how the system would be like in my home country but never found the motivation to engage in that topic in my free time. Moreover, it was fascinating to hear about all the FRM measures that are taken in Hamburg because I have been there several times already but never recognised this high level of protection in the urban image.

In the end, writing the thesis was a good leaning experience in terms of improving my English speaking and writing as well as academic writing and thinking skills. It was interesting to engage in one topic very detailed and to compare how things are going on two different countries.

9.2 List of Interviewees

Interviewee	**Function**	**City**
Dr. Olaf Müller	LSBG (Landesbetrieb Straßen, Brücken und Gewässer)	Hamburg
Olaf Simon	BUE (Behörde für Umwelt und Energie): Amt für Umweltschutz Wasserwirtschaft Grundsatz, Wasserwirtschaftliche Grundlagen, Informationssysteme	Hamburg
Renate Hensel	BSW: Behörde für Stadtentwicklung und Wohnen Amt für Landesplanung und Stadtentwicklung	Hamburg
Diplom- Ingenieur Thomas Zimmermann	HafenCity Universität Hamburg Stadtplanung und Regionalentwicklung	Hamburg
Nick van Barneveld	Gemeente Rotterdam Stadsbeheer Water	Rotterdam
Leo van der Wal	Gemeente Rotterdam stadtsontwikkeling en stadsbeheer: afdeling stadsontwikkeling	Rotterdam

9.3 Interview Guide

9.3.1 Interview-guide FRM/Spatial planning in Rotterdam

Introductory questions

1. What does Rotterdam do in terms of flood protection/ urban development?
2. What are the problems, Rotterdam has to deal with in terms of FRM/urban development? Think of the aspects organisation, procedures or policy making for instance.

Institutional Framework

1. In how far is FRM/ urban planning in Rotterdam influenced by European regulation?
2. In how far did the EU Flood Directive impact on FRM/ urban development in Rotterdam?
3. In how far is FRM/ urban development in Rotterdam influenced by national and regional legislation?
4. Which local documents are relevant for FRM/ urban development in Rotterdam?
5. In how far have past choices and events impacted on the current situation of flood protection?
6. Which procedures do your actions in the field of FRM/ urban planning need to undergo?
7. Which instruments are concretely being used in the field of urban planning?

Actors

1. Who are the relevant public actors involved in FRM/ urban planning in Rotterdam?
2. Who are the relevant private actors?
3. What are the main responsibilities of the different actors?
4. Which coalitions and oppositions have been formed between the different actors?
5. How do the different actors interact and cooperate with each other?
6. Which kind of problems occur within the interaction of different actors?

Resources and Power

1. Which financial resources are available for FRM/urban planning in Rotterdam?
2. Which resources in terms of expertise and knowledge are used?
3. Can you describe the decision-making structure of FRM/urban development in Rotterdam?
4. Which actors have the power to influence or determine decision-making processes?

Discourses

1. What are the visions, Rotterdam has in terms of FRM/urban development?
2. Which values determine the actions in the field FRM/urban development?
3. Which aspects of FRM/urban development are regarded as most urgent and important?
4. What are the concrete aims and objectives regarding FRM/urban development in Rotterdam?

Integration

1. How do you assess the current situation of FRM/urban development in Rotterdam?
2. To what extent are flood risk management and urban development in Rotterdam integrated?
3. Which role do you think can urban planning play in flood risk management in Rotterdam?
4. How can urban planning structurally get a place in flood management?
5. What does the integration mean for the financing, organization and policy making of urban development?
6. What are the advantages that go along with the integration of the two domains?
7. What would you say are the problems that go along with the integration of flood risk management and urban development?

9.3.2 Interviewplan Hochwasserrisikomanagement in Hamburg

Einleitende Fragen

1. Wie ist der Hochwasserschutz in Hamburg gewährleistet?
2. Mit welchen Problemen hat das Hochwassermanagment der Stadt zu kämpfen? Denken Sie hierbei z.B. an Organisation, Verfahren und Politikgestaltung.
3. Inwiefern wird der Hochwasserschutz von der Tatsache beeinflusst, dass Hamburg eine Hafenstadt ist?

Institutionelle Rahmenordnungen

1. Inwiefern ist das Hochwassermanagement in Hamburg durch europäische Regel- und Gesetzgebung, wie der Hochwasserschutzrichtlinie beeinflusst?
2. Inwiefern beeinflussen nationale und regionale Reglungen und Gesetze, wie das Wasserhaushaltsgesetz das Hochwassermanagement in Hamburg?
3. Inwiefern sind die lokalen Gesetze und Reglungen wie das Hamburgisches Wassergesetz, die Deich- und Polderordnung für das Hochwassermanagment der Stadt relevant?
4. Wie haben z.B. vergangene Entscheidungen und Ereignisse die heutige Problemdefinition beeinflusst? Denken sie z.B. an das Hochwasser von 1962
   Würden sie sagen, dass der Mensch eine Katastrophe braucht um im Hochwasserschutz etwas zu verändern?
5. Von welchen Instrumenten wird im Hochwassermanagement dann konkret Gebraucht gemacht?

Akteure

1. Dann kommen wir nun zum Teil über die betroffenen Akteure. Auf der Website der Stadt sind die staatlichen Akteure BUE, LSBG, BSW, BIS, HafenCity Hamburg GmbH, Deichverbände und Bezirksämter angegeben. Fehlt hier noch eine relevante Partei?
2. Können sie auch private Parteien nennen?
3. Was sind die Hauptverantwortlichkeiten der verschiedenen Akteure?
4. Welche Koalitionen und Oppositionen wurden im Hochwassermanagement geformt?
5. Wie interagieren und kooperieren die verschiedenen Akteure?
6. Welche Probleme entstehen mit der Interaktion der verschiedenen Akteure?

Ressourcen und Machtverhältnisse

1. Welche finanziellen Ressourcen stehen dem Hochwasserschutz in Hamburg zur Verfügung?
2. Welche Ressourcen im Bereich Expertise und Fachwissen werden genutzt?
3. Welche Akteure haben die Macht um Entscheidungsprozesse und Beschlüsse zu beeinflussen? Welche Faktoren sind dabei ausschlaggebend?

Diskurse

1. Welche Visionen hat die Stadt Hamburg im Bereich Hochwassermanagement?
2. Welche Werte bestimmen die Handlungen im Hochwassermanagement der Stadt?
   Gelten diese Werte für alle Akteure gleichermaßen?
3. Welche Aspekte des Hochwassermanagements genießen das höchste Maß an Dringlichkeit?
4. Wie beurteilen Sie das Problembewusstsein verschiedener Akteure im Bereich des Hochwassermanagements?
5. Was sind die konkreten Zielsetzungen der Stadt im Hochwassermanagement in Hamburg?

Integration

1. Wie beurteilen sie die aktuelle Situation des Hochwassermanagements in Hamburg?
2. Inwiefern sind Hochwasserschutz und Raum-/Stadtplanung in Hamburg integriert? (Hochwasserschutzmaßnahmen in Architektur und Stadtbild integrieren: Landungsbrücke, Flutschutzwände die als Treppen mit der Promenade verbunden werden)
3. Welche Rolle kann die Raumplanung Ihrer Meinung nach im Hochwassermanagement in Hamburg spielen? (Bauvorsorge, Bauleitplanung, Flächennutzungsplanung)
4. Welche Vorteile könnte die Integration des Hochwassermanagements mit der Raumplanung ihrer Meinung nach bringen?
5. Was sind Ihrer Meinung nach die Nachteile die mit der Integration von Raumplanung und Hochwasserschutz entstehen?

9.3.3 Interviewplan Stadtplanung in Hamburg

Einleitende Fragen

1. Wie ist die Stadtplanung in Hamburg organisiert, bzw. was tut die Stadt im Bereich der Stadtplanung?
2. Mit welchen Problemen hat die Stadtentwicklung in Hamburg zu kämpfen?

Institutionelle Rahmenordnungen

1. Inwiefern ist die Stadtplanung in Hamburg durch europäische Regel- und Gesetzgebung beeinflusst? Inwiefern sind Sie mit der HWMR-Richtlinie in Kontakt gekommen?
2. Inwiefern beeinflussen nationale und regionale Reglungen und Gesetze, die Stadtplanung in Hamburg?
3. Inwiefern sind die lokalen Gesetze und Reglungen die die Stadtplanung in Hamburg relevant?
4. Wie haben vergangene Entscheidungen und Ereignisse die heutige Problemdefinition beeinflusst?
5. Welche Verfahren müssen im Bereich der Stadtplanung durchlaufen werden?
6. Wie werden politische Instrumente entwickelt und in der Stadtplanung eingesetzt?
7. Von welchen Instrumenten wird in der Raumplanung dann konkret Gebraucht gemacht?

Akteure

1. Wer sind die relevanten Akteure in der Hamburgischen Stadtplanung?
2. Können sie auch private Akteure nennen?
3. Welche Hauptaufgaben haben die verschiedenen Akteure?
4. Welche Rolle spielt die EU in der Stadtplanung in Hamburg?
5. Welche Koalitionen und Oppositionen wurden in der Stadtplanung geformt?
6. Wie interagieren und kooperieren die verschiedenen Akteure?
7. Welche Probleme entstehen mit der Interaktion der verschiedenen Akteure?

Ressourcen

1. Welche finanziellen Ressourcen stehen der Stadtplanung in Hamburg zur Verfügung?
2. Welche Ressourcen im Bereich Expertise und Fachwissen werden genutzt?
3. Welche Akteure haben die Macht um Entscheidungsprozesse und Beschlüsse zu beeinflussen? Welche Faktoren sind dabei ausschlaggebend?
4. Wie werden die zur Verfügung stehenden Ressourcen zwischen den Akteuren verteilt?
5. Wer entscheidet wie die Ressourcen verteilt werden?

Diskurse

1. Welche Visionen hat die Stadt Hamburg im Bereich Stadtentwicklung?
2. Welche Strategien verfolgt die Stadt und welche Faktoren und Motive haben darin eine Rolle gespielt?
3. Welche Werte bestimmen die Handlungen im Hochwassermanagement der Stadt?
4. Inwiefern bestimmen diese Werte die Problemdefinition und Lösungsansätze verschiedener Akteure?
5. Welche Aspekte der Stadtplanung genießen das höchste Maß an Dringlichkeit?
6. Wie beurteilen Sie das Problembewusstsein verschiedener Akteure im Bereich der Stadtplanung?
7. Was sind die konkreten Zielsetzungen der verschiedenen Akteure in der Stadtplanung in Hamburg?

Integration

1. Wie beurteilen sie die aktuelle Situation der Stadtplanung in Hamburg?
2. Inwiefern sind Hochwasserschutz und Stadtplanung in Hamburg integriert?
3. Inwiefern wird die Raumplanung als Mittel des Hochwassermanagements eingesetzt?
4. Welche Rolle kann die Raumplanung Ihrer Meinung nach im Hochwassermanagement in Hamburg spielen? (Bauvorsorge, Bauleitplanung, Flächennutzungsplanung)
5. Welche Vorteile könnte die Integration des Hochwassermanagements mit der Raumplanung ihrer Meinung nach bringen?
6. Wie kann Hochwassermanagement strukturell einen Platz in der Raumplanung bekommen, oder umgekehrt?
7. Was bedeutet die Integration für die Finanzierung, Organisation und Strategieplanung des Hochwassermanagements?
8. Was sind Ihrer Meinung nach die Nachteile die mit der Integration von Raumplanung und Hochwasserschutz entstehen?