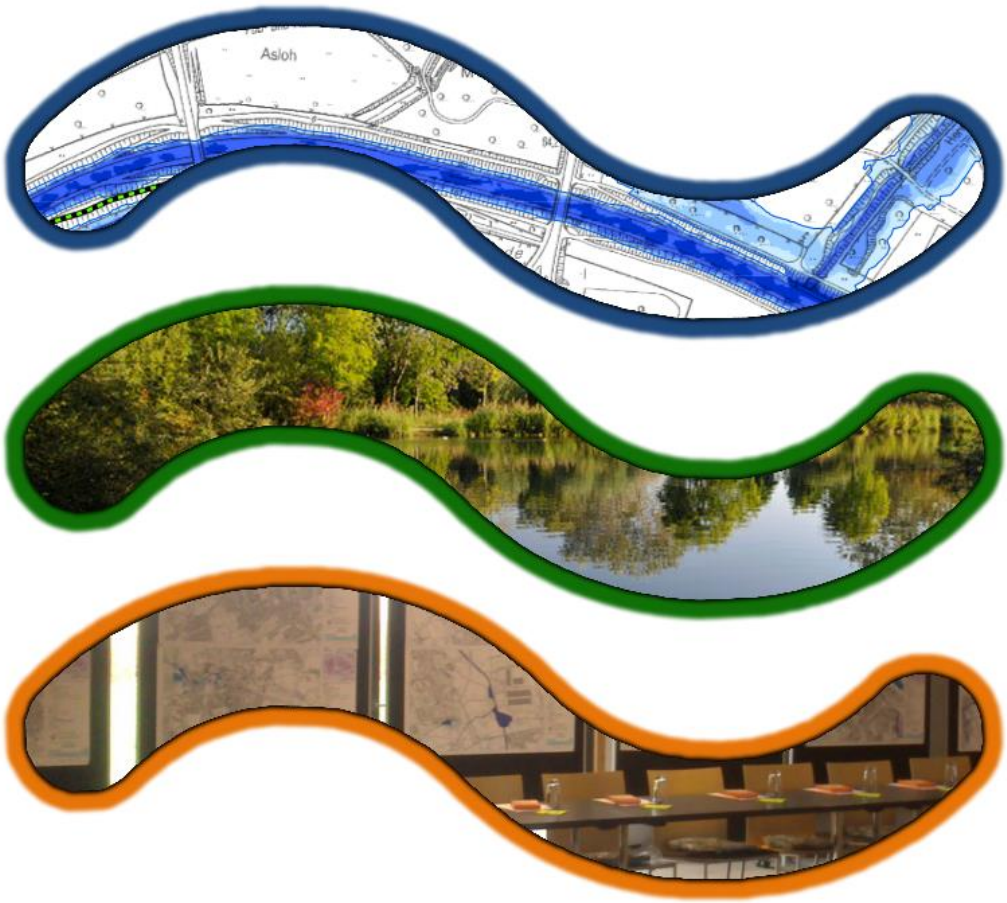
Constructing risks

Internalisation of flood risks using the flood risk management planning process



Matthijs Roos

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Constructing Risks

Internalisation of flood risks using the flood risk management planning process

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M.D. Roos
3489728

Supervisor
Thomas Hartmann
Faculty of Geosciences, Utrecht University

In cooperation with:
Georg Johann
Emschergenossenschaft/Lippeverband

Executive summary

Due to climate change, extreme weather event continue to increase in frequency. The last decade, Germany suffered from several major floods in a short time. The European Commission realised that it is not always possible to prevent a flood event and that governments should be prepared in the case a flood event occurs. The European Flood Directive has been made to make sure that government are prepared for flood event and its aim is to reduce the consequences of a flood event to human health, the environment, cultural heritage, economic activity and infrastructure. The Flood Directive consists of a cycle of six years that includes three stages: (1)Preliminary risk assessment, (2) Flood risk- and hazard maps and (3) Flood Risk Management Plans (FRMP). In North Rhine-Westphalia (Germany) this process is mainly done by three governmental institutions: the Bezirksregierung (District Authority), municipalities and water board. Some of the municipalities are not eager to participate in the flood risk management planning process for the rivers Lippe and Emscher. Apparently, their perception of the flood risk is different from municipalities that do participate.

The theoretical approach used to investigate the risk perceptions of governmental institutions in Emscher and Lippe region, is mainly based on two theoretical concepts. (1) The System Theory of risk by Luhmann (1993) and (2) the model of risk perception by Raaijmakers et al. (2008).
In the System Theory, there are four central concepts, namely: communication, distinction, observation and autopoiesis. For this research, the distinction Luhmann makes between danger and risk is crucial. It is the distinction that determines whether or not a person or organisation decides to take action. The distinction is that a risk is internal when it is both perceived as something manageable and as their responsibility. A danger, on the other hand, is perceived by the organisation as not manageable (or act of god) and not their responsibility.
The model of risk perception by Raaijmakers uses three different central concepts and, for this research, one has been added based on the work of Bradford et al (2012). These four central concepts are: awareness, worry, preparedness and experience. Combined these four concepts define the risk perception of an organisation or person.
A combination of the theoretical approach of Luhmann and Raaijmakers has been used to find an answer to the following research question:

To what extent is the planning process of flood risk management plans able to internalise risk perceptions of governmental institutions?

Next to an elaborated literature study, an empirical research has been done. The empirical part of this research has been conducted by doing semi-structured interviews with experts working at the Bezirksregierung, municipalities or water board.

The empirical research made clear that the combination of the hazard maps and regional meetings for the development of the FRMP are of great importance for both the risk perception and the internalisation process of these risks perceptions of local governmental institutions. When it comes to risk perception, the hazard maps are a great way to visualise the risks and thereby raise the awareness of governmental institutions. The hazard maps serve as an alternative to direct experience of a flood event. The meetings are, however, necessary to effectively communicate these risks to the governmental institutions.
The combination of hazard maps and meetings is also a effective in internalising the risk perceptions of local governmental institutions. The hazard maps not only show the potential risks, but also up to what probability the technical measures can hold back the water. This information shows the manageability of flood events. During the meetings, measures can be discussed for the scenario of a flood event. By discussing the potential measures, local governmental institutions realise that the consequences of a flood can be managed and they see it as their responsibility to make sure the potential damage is being reduced. By perceiving is as manageable and their responsibility, the governmental institutions see floods as an internal risk.

The internalisation process of risks by local governments is, however, partially compromised due to the fact that municipalities are only obliged to take measures for flood event with a probability up to 1-in-100 year. Therefore, all scenarios with a lower probability than 1-in-100 year are not perceived as their responsibility and thus effectively externalised. This compromises the vision of the European Commission to take extreme scenarios into account when developing the FRMP.

There are two recommendation that emerged from the empirical research:

1. While the hazard maps proved to be useful in the internalisation process, the risk maps are not used at all. Apparently, the data used for these maps is generalised to such an extent that maps are considered useless. There is, however, accurate data available that is not being used.
   Complemented by the hazard maps, risk maps with accurate data could be more effective in showing the probability and damage of flood risks in the region. It is therefore recommended, that for the next cycle, the risks maps contain the most comprehensive dataset that will only be generalised so it is the comparable on a river basin scale.
2. During the development of the FRMP all the bezirke were responsible for their own management unit, which contained the parts of the river basin that is in within their borders. Every bezirke was free to organise the development of the FRMP on their own way. As a consequence, it was harder for municipalities to exchange experiences with neighbouring municipalities in other bezirke. In order to get a better learning process and a more coherent FRMP, which will be more in line with the European vision of a river basin wide plan, it is recommended to either have one protocol for the development of the FRMP or have one governmental institution coordinate the whole planning process.

Preface

"Nothing in the world is more flexible and yielding than water. Yet when it attacks the firm and the strong, none can withstand it, because they have no way to change it. So the flexible overcome the adamant, the yielding overcome the forceful. Everyone knows this, but no one can do it."

(Lao Tzu)

Realising floods cannot always be prevented is one of the premises of European flood risk management policy. Therefore, flood risk management must be more flexible, just like the water in Lao Tzu's (founder of Taoism) quote. Apparently governments are now aware of the paradox in Lao Tzu's statement: what appears to be weak and flexible is strong. It was this interesting thought that triggered my interest in writing a thesis on flood risk management.

Luckily for me, just when I needed it, I was asked to do research on flood risk management in the Ruhr district for the Emschergenossenschaft/Lippeverband. For giving me the opportunity to do this research, I would like to thank Georg Johann. Without his support and that of the persons willing to do an interview, I would have never been able to learn so much about flood risk management in such a short time.

A special thanks goes out to my university supervisor, Thomas Hartmann. His expertise on water management, positive attitude and constructive feedback really helped to improve the quality of this thesis.

I would like to thank my girlfriend, family, friends and housemates for the support they gave during the months I have been working on this thesis. Especially the monthly thesis-feedback-sessions with Tirza, Elleke, Désirée, Suzan and Lucas were of great help to improve my thesis and to motivate me to work extra hard.

Now I have finished writing this thesis, there is just one hurdle left in getting my master's degree in Urban & Regional Planning. After that final course, 2015 will be the year my life as a student stopped and new challenges begin. Overall, during these five years studying and living in Utrecht, I have learned a lot. Not only scientifically, but also about myself. This gained knowledge will remain useful during all the new challenges that lie ahead of me.

Matthijs Roos
Utrecht, October 2014

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Introduction

1.1 Motivation research

Due to climate change extreme weather events continue to increase in frequency in the future. Extreme precipitation can result in flooding, which can damage crops, cause property damage, and even loss of life (Janssen et al, 2014). In Germany and Central-Europe, the frequency of flood events doubled since 1980 (Munich RE, 2013; Deutsche Welle, 2013a). Controlling extreme weather events by technical means is limited, which became clear during extreme weather events over the past years (Pawl-Wostl, 2007, p.51). In the 1990s there was a flood in Germany described as a 'once-in-a-century' event. The same title was given to the floods in 2002 (Deutsche Welle, 2013a, b).

> *"What used to happen once in a century could well become an event that recurs every decade or so."*
>
> *(Mojib Latif in Deutsche Welle, 2013a)*

The flood events in 2013 were in some places even worse than 2002 (BBC, 2013), but unlike during the flood of river Elbe in 2002 (Munich, RE, 2013; Pawl-Wostl, 2007, p.51), thanks to better flood control, the old city centre of Dresden got spared in 2013. However, this was at the costs of an increased flood wave downstream which caused more than 20,000 people to be evacuated (Munich RE, 2013).
The increased frequencies of flood events caused a change from resistance towards resilience in water management policies. Flood protection is not enough and spatial water governance is needed. Not just protection against floods, but at the same time managing the floodplains in such a way that in case of a flood the risks are minimized. It is about governing the areas behind the dikes (Tempels & Hartmann, 2014).

European flood risk policy

In 2007 the European Commission came with a directive on the assessment and management of flood risk. It aims at reducing the adverse consequences of floods for human health and life, the environment, cultural heritage, economic activity and infrastructure. Each member state has to follow the three stages set out by the European Commission. These stages consist of (1) preliminary flood risk assessment, (2) flood hazard maps and flood risk maps and (3) flood risk management plans (European Commission, 2014a). To keep data and measures up to date, this cycle of three stages has to be done every six years. So every time, the cycle is finished, it starts again with the preliminary flood risk assessment. The directive also strives to reinforce the rights of the public to have access to the gathered information about floods and that the public is able to participate in the planning process (European Commission, 2014b).

The Flood Risk Management Plans (FRMP) are a good example of the shift towards a governance approach of water management. This shift in processes focusses on close collaboration between public, private and societal actors and was preceded by the change from fixating water boundaries towards an adaptive water management, generating room for water and water retention areas. (Van Buuren et al, 2012, p.629). By that the disciplines of water management and spatial planning are tied together (Hartmann & Juepner, 2014).
The European directive is the same for all member states. However, each member state is free to implement it in their own way. In Germany the responsibility of the flood risk management plans has been given to the *Bezirksregierung,* a kind of district authority. Each Bezirksregierung is free to manage the process in their own way. The three main actors involved in the process are the Bezirksregierung, municipalities and the water boards. In cooperation with local private actors they set out the plans that will be implemented in the FRMP. Municipalities are not obliged to participate in the process and the Bezirksregierung acts only as the facilitator of the process. During meetings it was noticed that, since they are not obliged, not all the municipalities are eager participate. Even some major cities with a substantial riverbank choose not to participate. Why these municipalities are not so eager to participate seems to be a big mystery for the involved Bezirksregierung and water board. Somehow the perception and/or awareness of flood risks of these municipalities seems to be different than those of the actors that do participate.

1.2 General aim

By the looks of it, perception and/or awareness of flood risks differ among governmental institutions. To be certain whether or not this presumption is right, this matter needs to be clarified by doing more scientific research. It might also be interesting to know if the flood risk management planning process has any influence on the risk perceptions of governmental institutions. Therefore, the general aim of this research is as follows.

Give insight in the flood risk perceptions of local governmental institutions, see if the flood risk management planning process has had any influence on these risk perceptions and then use this gained knowledge to give recommendations for upcoming flood risk management planning processes.

In order to conduct a proper scientific research and thereby achieve the general aim, certain decision have to be made. First, it is necessary to know what a 'risk' is and how it can be defined. The following sections will first describe the theoretical insights that have been used and why they were chosen. The second part will describe the method that is used for the empirical part of the research. It will be explained why this method best suites the investigated case as well as the theoretical insights that are used. In chapter two, the theories being used will be described in more detail.

1.3 What is 'risk'?

In order to do a research on flood risks, it must be clear what the definition of a risk is. Since risk is a perceptual concept, it is hard to make one clear definition of the term risk (Aven & Renn, 2010, p.2). Risk has been subject to change during the course of history (Lupton, 2013, pp.1-20). Renn (2008, p.1) states that all concepts of risk have one element in common: The distinction between possible and chosen action. The risk exists that the chosen action turns out to be worse than the potential alternative action. Also, the definition of risk contains three elements: outcomes that have an impact upon what humans value; the

possibility of occurrence (uncertainty); and a formula to combine both elements (Renn, 2008, p.2).
The definition used by the European Commission in the flood risk management directive contains the three elements Renn mentions:

*"'flood risk' means **the combination** of the **probability** of a flood event and of the **potential adverse consequences** for human health, the environment, cultural heritage and economic activity associated with a flood event." (European Commission, 2007, p.3)*

This is the definition used for this research, since it is the definition which is supposed to be used for the flood risk management plans. For the research, however, the definition by itself is not that interesting, it is the way it is used and given meaning to by the researched cases that is interesting. What meaning do governmental institutions give to flood risks? What is the flood risk threshold for these institutions to take action?
The answers to these questions all depend on what perception the governmental institutions have on flood risks. In this respect risk is not just a matter of costs, which can be calculated beforehand and weighed against the advantages. Risk is rather seen as a decision that is based on what can be foreseen and will be subsequently regretted if a loss that one hoped to avert occurs. The decision is the actual risk taken, which basically means that a decision will be made that permits actions that can cause avoidable loss, that is if the estimate of the possible degree of loss appears acceptable (Luhmann, 1993, pp.11-13).

Risk denial is a common phenomenon when it comes to natural hazards. The root of this lies in the relative rarity of natural disasters (Renn, 2008, p.113). However, the fact that an event does not occur often, does not mean it could not happen tomorrow (Renn, 2008, p.111). Also, compared to technical risks like the risks nuclear power plants pose, risk from nature are not yet anchored in people's mind as manageable. Because of that they are not assessed the same way as technical risks. Technical risks are perceived as consequences of peoples decisions and actions, while natural risks are often seen as 'an act of God' (Lupton, 2013, p.6; Renn, 2008, p.113; Aven & Renn, 2010, p.96). Due to the increasing awareness of human's influence on climate change, it is now seen that the problem accompanying climate change are not 'an act of God' but caused by humans and therefor humans have some sort of control over natural disasters (Renn, 2008, p.113). However, it is still possible for risk managers to cover their mismanagement by referring to the alleged randomness of the event (Aven & Renn, 2010, p.177) Others, on the other hand, claim that risks have become more globalized, less identifiable and more serious in their effect and therefore manageability decreased and anxiety towards risks increased (Lupton, 2013, p.16). By that risk managers might be blamed for events against which they could not possibly provide protective actions in advance (Aven & Renn, 2010, p.177).

1.4 Sociological theories of risk

This section is a brief introduction in the used theories to explain risk perceptions of governmental institutions. In chapter two, the theoretical insight will be further elaborated. This section is meant to give an indication of the theoretical insights and why they have been chosen for this research. It first starts with the model of risk perception by Raaijmakers et al (2008) and then continues with the more abstract theoretical approach of the System Theory as developed by Luhmann (1993).
The term risk is a social construct, which makes defining the term risk also one of the main problems when measuring risk perceptions. When there is no clear definition of risk, the

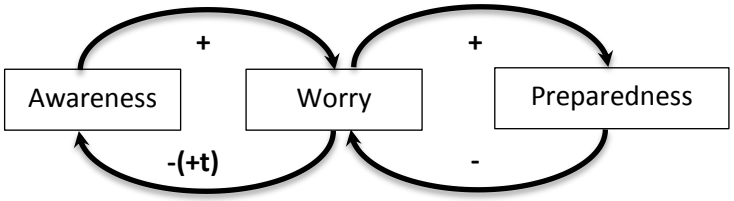
problem might occur that while talking about risks, everybody is speaking of something different (Renn, 1998, p.51).

"Human beings have invented the concept risk to help them understand and cope with the dangers and uncertainties of life. Although these dangers are real, there is no such thing as 'real risk' or 'objective risk'. (Slovic, 1998, p.74)

The worldview of a certain actor determines which dangers are magnified, while obscuring other threats and selecting others for minimal attention or even being disregarded (Dake, 1992, p.33; Slovic, 1998, p.76; Pidgeon, 1998, p.9). Language is used to restrict the range of possible options. While some may use complex mathematical models, others lay emphasis on moral issues or economic efficiency (Dake, 1992, p.24-25).

To be able to measure risk perception, Raaijmakers et al (2008) developed a model (figure 1.1) which uses three variables, namely: Awareness, Worry and preparedness. Together these three variables form the risk perception of an individual or organisation.

Figure 1.1 Relationship between elements of risk perception



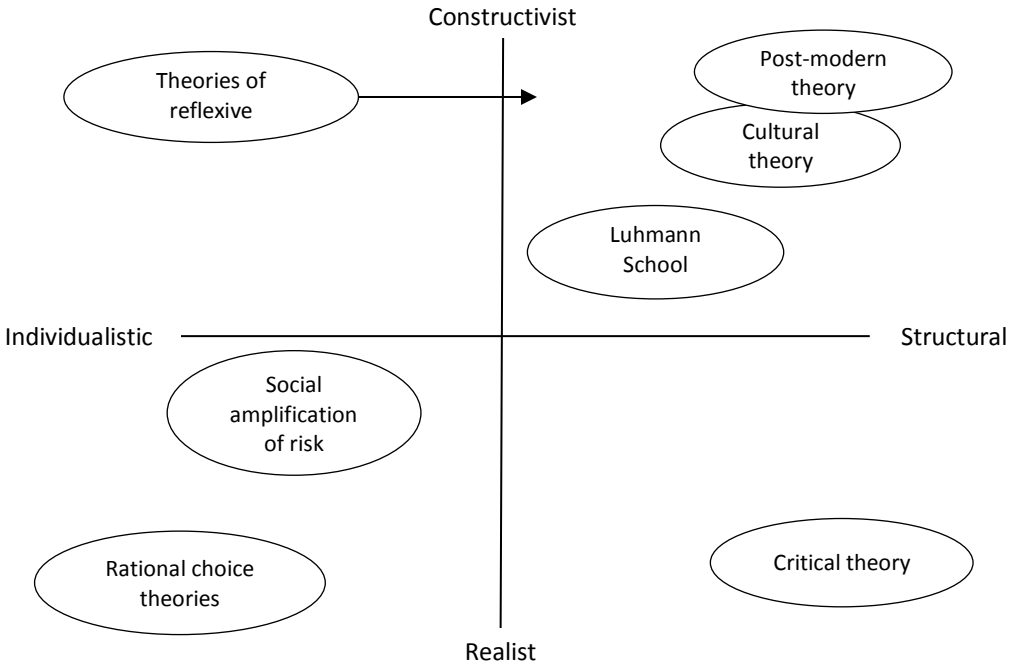
Source: Raaijmakers et al, 2008, p.312

Flood risk awareness is defined as "[the] knowledge or consciousness of the flood risk that an individual is exposed to (Raaijmakers et al, 2008, p.311)." Awareness of a flood risk does not necessarily mean action will be taken to prepare for a flood event. That is because an individual or organisation, despite its awareness, is not afraid of the flood risk. A higher level of *worry* will serve as a trigger to increase the preparedness (Bradford et al, 2012, p.2301; Raaijmakers et al, 2008, p.311). The more people worry, the larger the demand to reduce the risk (Raaijmakers et al, 2008, p.311).
There are also circumstances that cause the level of awareness, worry and preparedness to lower. Preparedness can be lowered when organisations rely too much on structural flood protection. They get a (false) sense of security and worry less about the flood risks, which in turn reduces their preparedness. The same holds for individuals or organisations that do not take the ownership of the flood risk and responsibility of protecting their own properties. The longer a community is not exposed to a certain risk, the more likely it is they will forget it and thus worry will be reduced. This reduced worry may lead to a decline of awareness (Raaijmakers et al, 2008, p.312).

Within sociology and anthropology a lot research has been done on 'risk'. They each have their own framework and classification criteria, but do have in common that they state that humans perceive the world through perceptual lenses filtering social and cultural meanings, which are primarily influenced by family, friends, subordinates and fellow workers (Renn, 2008, p.23). Apart from this there is no real dominant sociological approach towards risk. Compared to Raaijmakers' model, these sociological theories have a higher level of abstraction.

Approaches range from adaptions of the rational actor approach to Marxist and post-modern analysis (Renn, 2008, p.23). Renn (2008) divided sociological approaches towards risk by using two dimensions: individualistic versus structural, and realist versus constructivist (figure 1.2). A similar division of social theories of risk is used by Zinn (2008, p.8).

Figure 1.2: Sociological approaches to risk



Source: Renn, 2008, p.24

The horizontal axis makes a distinction between either individualistic or structural approaches of risk. Individualistic approaches of risk are agency oriented and are either focused on individuals or aggregated groups, like an institution, a social group, a subculture or a society. Structural approaches say that social phenomena cannot be explained by individuals alone, but that they are the outcome of interactive effects among individuals and between individuals and institutions (Renn, 2008, p.23-24).
On the vertical axis there is the distinction between the constructivist and realist view on risk. Constructivists claim that risks are social constructs made by social groups or institutions. Realists claim that risks can be directly experienced through a combination of data collection and theoretical reasoning (Renn, 2008, p.24).

The case study of German flood risk management planning involves multiple actors cooperating in a planning process. In this planning process, the whole plan is formed through a process of interaction between the actors. By analysing just one of these actors, thus choosing for a individualistic approach, the importance of interaction would be ignored. So, a individualistic approach wouldn't fit in this case and thus a structural approach towards risk is needed. A theory that does fit this case, is the System Theory by Luhmann. This theory builds on the distinction between system and environment and the continuous interaction of the system with its environment (Van Assche & Verschraegen, 2008, p.266). Risk perceptions are analysed by seeing them as a result of communications using different distinctions (Japp & Kusche, 2008, p.79) Methodologically speaking each actor can be seen as a system of its own that interacts with its environment (the other systems). In this way the System Theory serves as both a theoretical understanding of risk and at the same time as a basis for the research method of this thesis.

The System Theory claims to have the status of a general theory of modern society (Japp & Kusche, 2008, p.76), or sometimes (critically) called a grand theory. The universalism of the theory (Holmström, 2007, p.257) is not achieved via rigorous simplification, but rather by an inclusive, interdisciplinary and historically informed network of sociological theories. It is this universalism that makes it so attractive to use in a variety of disciplines (Stichweh, 2011, p.306; Hieronymi, 2013; examples of usage in various disciplines: Boldyrev, 2013; Gershon, 2005; Kihlström, 2012; Parks & Roberts, 2010; Raak & Paulus, 2001). The basics of System Theory was made by Talcott Parsons and later the idea was used and modified by Niklas Luhmann (Luhmann, 1993;Elder-Vass, 2007, pp.416-417; Japp & Klusche, 2008, p.76). Parsons' view was that society consists of societal subsystems which fulfil all kinds of societal functions. Luhmann used this principle of subsystem, but instead of taking *action* as the starting point, he used *communication* (Luhmann, 1995, p.137-139; 2006, p.47; Knodt, 1995, pp.xxvii-xxx). For the idea is that someone has to have knowledge in order to make decisions and in order to know something, communication is needed. According to Luhmann modern society consists of mass communications operations. Most of this communication takes on specific forms and each form belongs to a specific subsystem. Each subsystem specializes in a specific function and uses communications that belong to that function. For example, the economic subsystem is specialized in economic communications, politics in political communications, science in scientific communications, etc. Because of all the different functions within society, society can be seen as a functionally differentiated. Since society depends on all these different functions, all subsystems are equally important and there is no hierarchy between them (Japp & Kusche, 2008, p.77). Risk is regarded as a consequence of this functionally differentiated society.
Distinctions are one of the main principles of the System Theory (Luhmann, 2006). When it comes to risk, the Systems Theory makes the distinction between the concepts *danger* and *risk*. It is a distinction between internal and external conditions. When a condition is part of the (sub)system, it is perceived as manageable and therefore considered a risk. When a condition is the cause of an external force that does not belong to the (sub)system, it is seen as unmanageable and considered a danger. While natural hazards used to be seen as an act of god or fate and thus as an unmanageable danger, nowadays they are more and more perceived as a manageable risk (Luhmann, 1993).

1.5 Research methods

In order to be able to use the theoretical insights for achieving the research aim, a research design must be made. In this research design, the used methodology is described and it is explained why these methods best suit this research. The choice for a certain method depends on the theories used and the goal the research tries to achieve.

1.5.1 Research strategy

Using both risk perception and System Theory poses a methodological challenge. The System Theory requires the research units to be generalised into social systems, while studying risk perceptions searches for the understanding of meanings and behaviour of the research units. This is where a tension between quantitative and qualitative research becomes visible. However, by using the System Theory's concept of observation, the researcher can be seen as a second order observer who uses its own observations to divide the research units into social systems. Therefore, qualitative research can be used to find out the risk perceptions of these systems.

1.5.2 Research design

As for the research design of this research, it has been chosen to do a case study. Doing case studies is common practice for empirical research on flood risk perception (See Kellens et al, 2013, for an extensive review of empirical research on flood risk perceptions). Often case studies are done for specific rivers (see e.g.: De Villiers & Maharaj, 1994), river delta's (see e.g.: Ge et al, 2011; Armas & Avram, 2009), coastal zones (see e.g.: Kellens et al, 2011; Lara et al, 2010), cities (see e.g.: Kreibich et al, 2009; Takao et al, 2004) or regions (see e.g.: Thieken et al, 2007; McEwen et al, 2002).

The main reason that makes case studies the best choice for doing research on flood risk perception is the context sensitive nature of risk perceptions. Kellens et al (2013) state that "differences among countries may be explained by cultural differences or differences in social norms and values among societies." The main reason for choosing to do a case study, the context sensitivity, is often seen as a drawback. It is claimed that outcomes of case studies cannot be generalized outside the research area. Flyvbjerg (2006) on the other hand, states that the force of example is underestimated and case studies can be especially useful to test theories. In the case of flood risk perception and System Theory, a case study can test whether or not social systems can be distinguished, if risk perceptions differ among those social systems and what role risk communication has. The case study in this research is therefore also needed to check if current knowledge about flood risk perception also holds for the case of the regions of the rivers Emscher and Lippe . In order to test theories hypothesis have been formulated (see section 4.1.3).

The case study in this research is on the one hand for a specific region, but at the same time for specific rivers. The rivers Emscher and Lippe were selected for this case study. The choice for these rivers is because of the region they are flowing through. The rivers are both situated in North Rhine-Westphalia and are therefore subjected to a (societal) context that is fairly the same. While the Lippe is on the northern border of the Ruhr region, the Emscher flows directly through the most densely populated areas in the Ruhr region. It is not just the location of the rivers that makes it an interesting case, it is also the industrial history of the region. This history had a major impact on the rivers, especially the Emscher. Probably the most important reason to choose for these two specific rivers, is because they run through one of the most densely populated and industrialised areas in Europe. An extensive description of the cases will be given in chapter five.

The aim for this research is, however, not to compare the two rivers, but to find out to what extent the implementation of the European Flood Directive is of influence on the risk perception of local governmental institutions. Doing two cases is to check for possible influences of contextual factors on the results.

1.6 Relevance of this research

The previous sections showed the motivation, the aim of this research and what theories and methods that are used to achieve this research aim. This section will clarify why this research is relevant for both science and society.

Societal relevance

Since the steps taken in the Flood Directive have to be done every six years, lessons learned from this research can be used in future development of flood risk management plans. And because this is the first time the Flood Directive is being implemented, it is expected that the process can be optimised. The relevance of this research for society lies in this learning

process. According to Aven (2010, pp.85-86), research focussed on risk perception can contribute to improving risk policies in a number of ways:

- Revealing public concerns and values
- Serving as indicators for public preferences
- Documenting desired lifestyles
- Helping to design risk communicating strategies
- Representing personal experiences in ways that may not be available to the scientific assessment of risk.

The outcomes of this research will eventually determine which contributions it can have for policies regarding flood risk management. Besides its usefulness for German flood risk policies, the insights might also be useful for other member states of the European Union during the implementation of the Flood Directive in their countries.

Scientific relevance

Research on risk perception has been done for quite some time. Especially with the rise of nuclear energy in the '60s, when people were concerned about the potential risks of nuclear energy on the environment and human health. Also, research on risk perceptions of flood risks has been done fairly often (see for example: Raaijmakers et al, 2008; Terpstra et al, 2009; Bradford et al, 2009; Baan & Klijn, 2004; McPherson & Saarinen, 1977). This research will use Raaijmakers' (2008) model on risk perception and Luhmann's System Theory as the main theoretical framework. From Luhmann's work, his distinction between risk and danger is of particular interest for this research. In his theory something is a risk when it is 'internalised'. This means that the risk is perceived as manageable and their responsibility. A danger on the other hand is seen by the actor as unmanageable (or fate) and not their responsibility. It is this distinction that determines whether or not an actor will take action to reduce the risk.

The use of Luhmann's System Theory in case studies of flood risk perceptions is rather unusual. The use of the System's theory is mainly theoretical and used in a variety of disciplines (see for example: Boldyrev, 2013; Gershon, 2005; Khilström, 2011; Parks & Roberts, 2010; Raak & Paulus, 2001), but rarely as the basis for case studies (Hatfield & Hipel, 2002, p.1044).

It is the combination of (1) risk perception, (2) Luhmann's System Theory and (3) a case study design that makes it an unique and innovative research. It brings a very abstract "grand theory" into action, using an exciting case (the rivers Emscher and Lippe) because of its unique aspects as one of most densely populated and industrialised areas in Europe.

1.7 Central question and sub-questions

Following the System Theoretical distinction of internal risk and external danger regarding the risk perceptions of German governmental institutions (i.e. Bezirksregierung, water boards and municipalities) in the flood risk management planning process leads to the following central research question:

To what extent is the planning process of flood risk management plans able to internalise risk perceptions of governmental institutions?

In order to find an answer to this research question four sub questions have been formulated:

1. What are the different risk perceptions among governmental institutions in North Rhine-Westphalia?

2. To what extend have risk perceptions of governmental institutions in North Rhine-Westphalia changed as a result of the planning process of flood risk management plans?
3. In what way are risk perceptions of participating governmental organisations different from the ones that do not participate in flood risk management planning?
4. To what extend have flood risks been internalized by governmental institutions in North Rhine-Westphalia due to the planning process of flood risk management plans?

1.8 Gathering and analysing information

In order to find an answer to the central question and sub-questions, empirical research has to be done. This section will explain how the information was gathered and why it had to be done in this way. After the information has been gathered, it must be analysed. The way this has been done will also be explained in this section.

1.8.1 Information gathering

Three methods of information gathering have been used during the research: *exploratory observations, semi-structured interviews* and *policy analysis.* By using more than one research method, findings can be checked for their credibility. If one result has been found on more than one occasion using different research methods, it is more likely to be correct. The exploratory observations is the first used method and was used to get familiar with the theme and involved actors. These observations were done at several meetings which are part of the flood risk management planning process in North Rhine-Westphalia. During these meetings the involved actors mostly discuss the progress they have made and the measures that have to be taken for the flood risk management plans. The meetings were a good way to make first contacts with potential interviewees and to get an impression of their involvement in the process. As said in the introduction, one of these meetings was the inspiration for the research question. This shows that these meetings are a great source of inspiration and information.

The semi-structured interviews are the most important data collection method used in this research. The structured way of doing interviews gives consistency to the results and thereby make them comparable. However, by giving the interviews a bit of an open character new insights might emerge. By determining the topics for the interview in advance, the interviewer is well prepared and makes sure to cover all the important topics. Yet, the interviewee is allowed to answer in their own words and give their view on the addressed topics (Stuckey, 2013, pp.57-58). To structure the interviews a topic list is used. The content of this topic list is based on the theoretical insights from chapters two and three.

The subjects of this research are the governmental institutions involved in the flood risk management planning process for the river Lippe and the river Emscher, which are the Bezirksregierung, water board and municipalities. The selection of municipalities for interviews has been done in two stage. First, both the list of invited people and attendance list of meetings between the different governmental institutions for the flood risk management plan are used to select the people to do an interview with. By comparing the invitations and the actual attendance, it can be determined whether or not an organisation participated in the planning process. Selecting from the attendance list has the advantage that the people that are being invited for the interviews are definitely involved in the planning process. The second stage is based on the assumption that larger municipalities might have

more administrative capacity to deal with flood risk management. Therefore, the population of municipalities will be used to make a selection of small, large and medium sized municipalities. By having both municipalities with a lot of inhabitants and some with less inhabitants, size related influences on research findings can be ruled out.

Next to these two data collection methods, a policy analysis is conducted. This will be done both before and after the interviews. It will be done beforehand to get a good impression of the case and to have some background information before doing the interviews. After the interviews, policy analysis are used to check if what is said in the interviews corresponds with the actual policies conducted.

1.8.2 Analysing information

The gathered information has been analysed in several ways. The most important step in the analysis of the interviews is recording them. This makes it possible to listen back the interviews in order to do further analysis. In addition, third parties can use the recordings to check if the researcher interpreted the information right and made the correct conclusions. Also, during the interview, the interviewer is making notes. By doing this the interviewer filters the important issues and is at the same time able to respond to these topics later on in the interview.
After the interviews, the recording were used to write a transcription of the interview. Subsequently, the content in these transcriptions has been coded according to the concepts of the System Theory and risk perception. As a consequence of doing semi-structured interviews, new topics come up next to the expected topics. Also these new topics need to be coded accordingly.

Mental models

After the interviews have been coded and analysed, mental models are developed. A mental model is basically a visual representations of a system's mindset or the worldview of an individual or group on a certain topic. In this case, a mental model is the schematic visualisation of the local governments view on flood risks of the rivers Emscher and Lippe.

What are mental models?

Since the beginning of the field of system dynamics, mental models have been vitally important (Doyle & Ford, 1997, p.3) and have been in use for quite some time (see for example: Bostrom et al, 1992; Atman et al, 1994; Hatfield & Hipel, 2002; Wood et al, 2012). The use of mental models fit well with the use of System Theory and the concept of risk perception. The connection between mental models and System Theory is easily recognized in the definition formulated by Rouse and Morris (1986, p.351):

"Mental models are the mechanisms whereby humans generate descriptions of system purpose and form, explanations of system functioning and observed system states, and predictions of future system states."

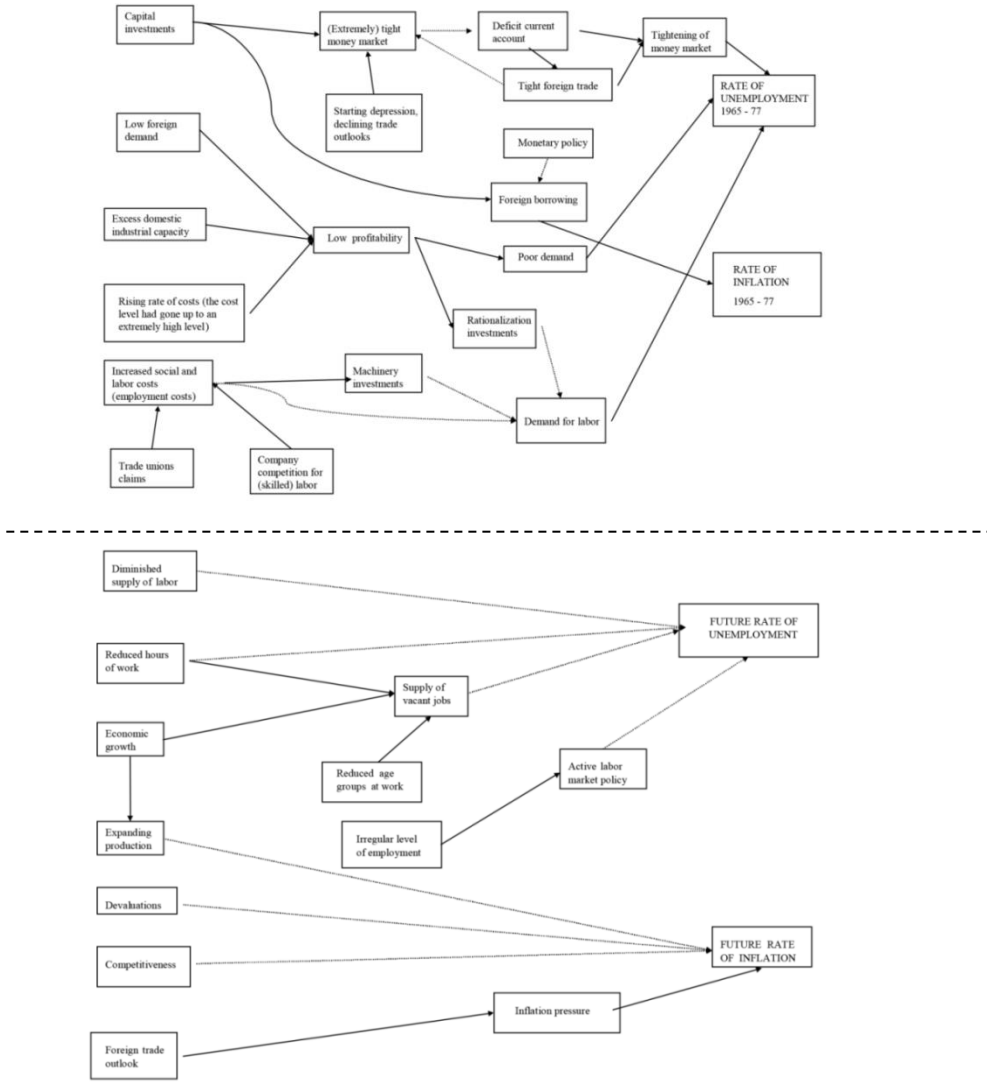
Since there are numerous different definitions and interpretations of what a mental model is, Rouse & Morris used the different purposes a mental model (figure 1.3) can be used, for to come to the general definition of a mental model as stated above (Rouse & Morris, 1986, p.351). They used these different purposes in the definition, because there are a lot of different definitions in use that each serve a different purpose. The definition they give is, however, rather general and vaguely formulated.

A mental model consists of two kinds of elements: *variables* which may refer to component of a problem (e.g., options/actions, events, states, goals) and *relations* between the variables which describe the interdependencies among components (NEA, 2004, p.8). To give an impression of what a mental model can look like, box 1.1 gives an example of the use of mental models in economics. It shows that the way questions are framed (past or future) can have significant influence on the mental model. Thüring and Jungermann (1986) also found that if questions are asked slightly different, they can result in different mental models about the same problem. Another research that produced two different mental models is the research done by Biel & Montgomery (1986). In that research, the variables given by the interviewees were basically the same, but the relations between the variables were seen differently by the interviewees. This is a good example where two systems disagree over the same problem, because they have a different worldview. This different view on the same subject can lead to conflicts (NEA, 2004, p.11).
Mental models are researched in a variety of discipline, like earthquakes, (nuclear) energy, flood risks, healthcare, economics, etc. (NEA, 2004, p.17). Research on mental models have mostly taken place in interdisciplinary fields of research on the fringes of cognitive sciences (Doyle & Ford, 1998, p.11).

Box 1.1: Mental models of past and future economic events (Sevón, 1984)

Sevón conducted interviews in order to find the mental models of managers regarding recent and future inflation and unemployment in Finland. Figure B1.1 shows the mental models of these interviews and makes evident that managers have a much more comprehensive explanatory framework for recent inflation and unemployment than for future ones.

Figure B1.1: Mental models of recent (top) and future (bottom) inflation and unemployment in Finland



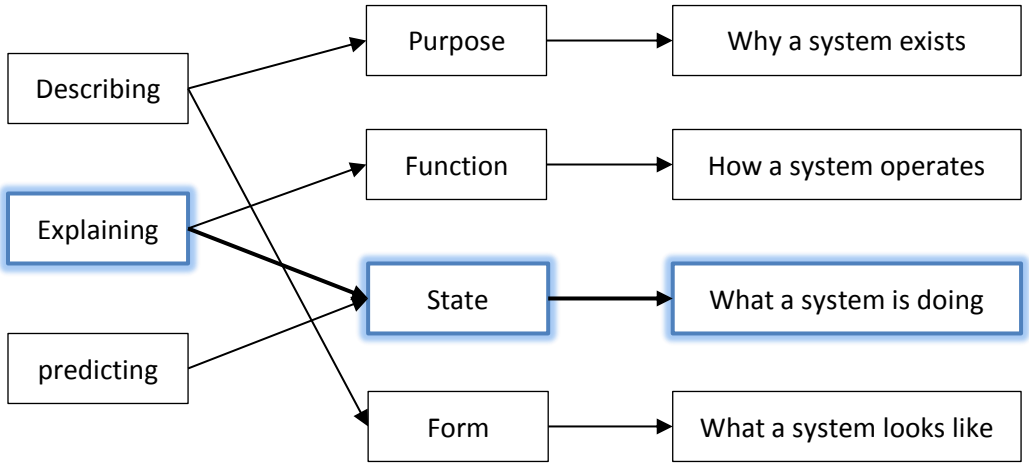
Source: Sevón, 1984, pp.75-76

Why use mental models?

The use of a mental model depends on its purpose. Rouse and Morris (1986) recognized that mental models differ from each other because of the different purpose they were used for in the researches they reviewed. The purpose of a mental model can be either describing, explaining or predicting (see figure 1.3). For this research the purpose of the mental model is to explain what the system is doing. The explanation is theoretically based on the concepts of risk perception and the inter- and externalisation of risk. Mental models are used to analyse the behaviour and thoughts of governmental institutions. Eventually, the influence of the flood risk management planning process will become visible within these mental models. Or when it appears that the flood risk management planning process hardly has any influence, it will only have a minor place in the mental model.

After all the mental models of the governmental institutions have been made, they can be compared to see if there are (dis)similarities between the mental models. Dissimilarities might explain disagreements between different actors, since they are operating from a different mindset. This is a strong point of mental models, they underline the importance of contextual factors in risk perception, but also point out specific models and structures of mental processing depending upon the risk and the cause of risk (Renn, 2008, p.110).

Figure 1.3: Purposes of mental models (purpose of this research in blue)



Source: Rouse & Morris, 1986, p.351

Developing the mental model

The previous section dealt with the question why mental models are used. However, it is still not clear how to build a mental model. There are a lot of ways to structure and represent mental models. The two most frequently used ways of structuring mental models are *influence diagrams* and *scenarios*. While both representations contain interconnected nodes which represent variables (e.g. actions, events and states)and arrows that represent the causal relations between the variables (NEA, 2004, p.8; Axelrod, 1976, p.58), scenarios exist of a chain of causal related states and events that does not contain loops within the model. In influence diagrams, however, loops are possible (NEA, 2004, p.8). The mental models in box??? are an example of an influence diagram.

Using interviews to collect the data necessary for the development of a mental model is common practice. The interview itself can be either open-ended or semi-structured (NEA, 2004, p.8). Since this research is about flood risk planning in a specific area, the interview has to be semi-structured to be able to reveal the views on flood risks in this area of governmental institutions. The chosen method of data collection (section 4.4) suits the method of analysis and vice versa.

2

The System Theory and risk perception

The definition of a risk and the theoretical approach used in this research has been explained briefly in the introduction (see chapter 1). This chapter goes into further detail on these theoretical approach. The outline of the chapter is as follows. First, the System Theory by Luhmann is explained in detail. Second, the concept of risk perception is discussed. These two theories (concept of risk perception and System Theory) will also serve as a basis for the empirical part of the thesis, as explained in chapter one. Third, the Prisoner's Dilemma is used as a theoretical way to cope with the unwillingness of actors to participate in the planning process. Fourth, the Spatial Turn in both science and policy is used to explain the fading boundaries between spatial planning and water management. Lastly, in the final section of this chapter, a conclusion will be made based on the insights of all the other sections of the chapter.

2.1 System Theory of risk

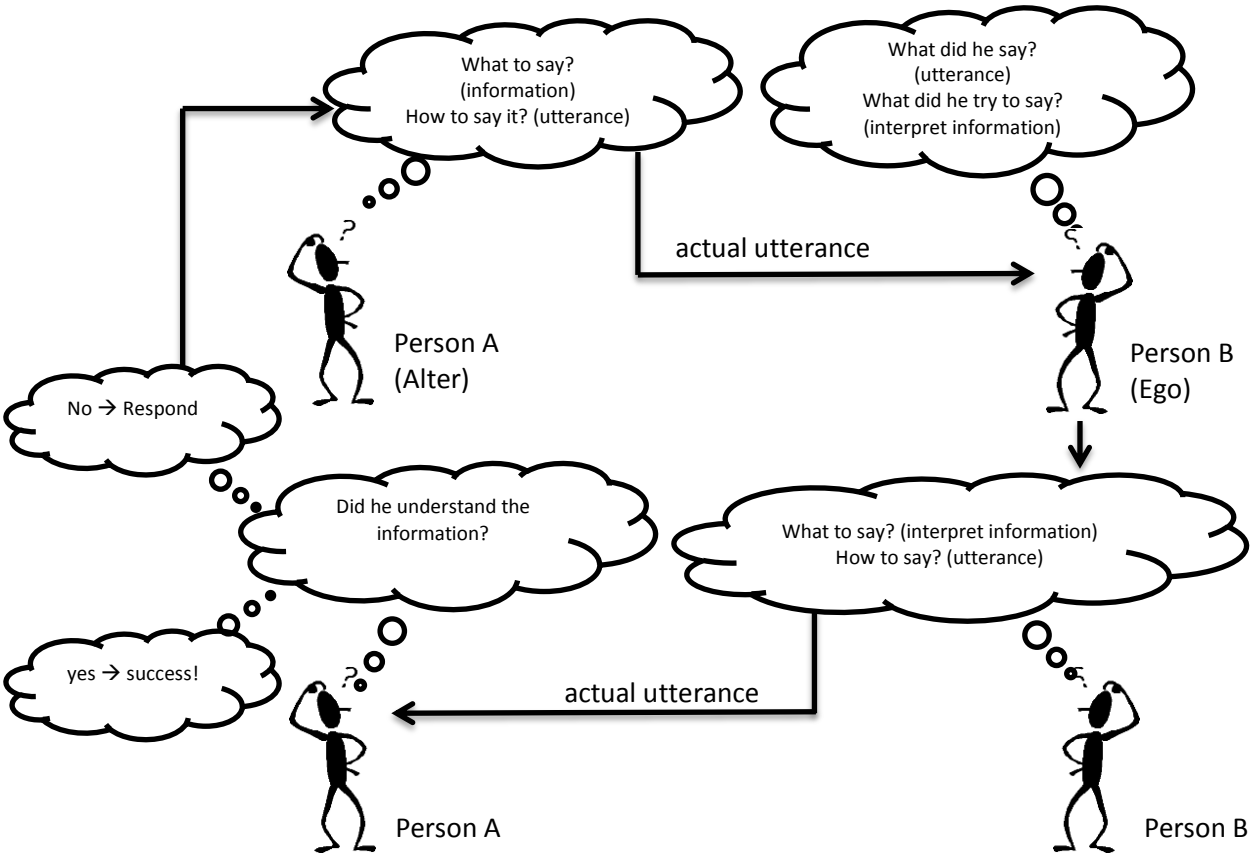
The System Theory claims to have the status of a general theory of modern society (Japp & Kusche, 2008, p.76), or sometimes (critically) called a grand theory. The universalism of the theory (Holmström, 2007, p.257) is not achieved via rigorous simplification, but rather by an inclusive, interdisciplinary and historically informed network of sociological theories. It is this universalism that makes it so attractive to use in a variety of disciplines (Stichweh, 2011, p.306; Hieronymi, 2013; examples of usage in various disciplines: Boldyrev, 2013; Gershon, 2005; Kihlström, 2012; Parks & Roberts, 2010; van Raak & Paulus, 2001). The basics of System Theory was made by Talcott Parsons and later the idea was used and modified by Niklas Luhmann (Luhmann, 1993;Elder-Vass, 2007, pp.416-417; Japp & Kusche, 2008, p.76). Parsons view was that society consists of societal subsystems which fulfil all kinds of societal functions. Luhmann used this principle of subsystem, but instead of taking *action* as the starting point, he used *communication* (Luhmann, 1995, pp.137-139; 2006, p.47; Knodt, 1995, pp.xxvii-xxx). For someone has to have knowledge in order to make decisions and in order to know something, communication is needed. According to Luhmann modern society consists of mass communications operations. Most of this communication takes on specific forms and each form belongs to a specific subsystem. Each subsystem specializes in a specific function and uses communications that belong to that function. For example, the economic subsystem is specialized in economic communications, politics in political communications, science in scientific communications, etc. Because of all the different functions within society, society can be seen as a functionally differentiated. Since society depends on all these different functions, all subsystems are equally important and there is no hierarchy between them (Japp & Kusche, 2008, p.77). Risk is regarded as a consequence of this functionally differentiated society.

2.1.1 Network of communication

As said above, Luhmann uses communication instead of action as the starting point for operations. In this view communication is the synthesis of information, utterance and understanding. Communication happens when information that has been uttered is understood (Luhmann, 1995; 2006, p.47). Communication is not seen as just a process of sending and receiving information. Communication is a process in which a selections are made on three occasions. First, information is selected from a repertoire of possibilities. Second, a choice must be made how to express this communication, which can occur intentionally or unintentionally. The third selection is based on a distinction, namely, the distinction between information and its utterance. To explain this Luhmann calls the addressee "ego" and the utterer "alter". During the process, ego observes alter and by doing so he is in the position of distinguishing the utterance from what is being uttered. If alter knows he is being observed, he can take over this difference between information and utterance appropriate it, develop it, exploit it and use it to steer the communication process. The steering of communication causes communicative action to follow another communicative action and is used to test whether the preceding communication was understood (Luhmann, 1995).

For example (see figure 2.1), when two people are speaking to each other what person A ("alter") says (i.e. the utterance) might be slightly different than the information he wants to say. Person B ("ego") listens and tries to distinguish the information Person A tries to utter from the actual utterance. Person B follows the same pattern as Person A did, by selecting the information he wants to say and then selects how he will say it. Since person A knows that person B is listening and responds to what is said, person A can now steer the conversation in such a way that person B get the information person A wants to utter. One action of communication leads to the next until person A is certain the information he tries to transfer to Person B is understood.

Figure 2.1: Communication scheme according to Luhmann's principle



The selections a system makes are influenced by many factors, but not determined by them. By making these selections, the system constitutes *meaning* to itself. Meaning is both a process and a result, it's autopoietic. The selection-making is 'meaning as a process' and the system's accumulation of these meanings is the 'meaning as a result'. A system remembers these selections made and selections negated and uses them for making future selections. Using these past selections reduces complexity for the system. Communication however increases complexity since systems use communication to receive other meanings and use them to adapt their own meanings (Bausch, 1997, p.316).
In short, this network of communicating is a complex learning process. The selections made have a certain result which will be remembered and can be used later. A negative experience with a chosen selection, might cause this certain selection to be negated in future for an alternative selection. Through these experiences people and organisations not just send and receive information, but at the same time build their meanings and learn how to express them.

2.1.2 System as difference

Distinction lies at the basis of the differentiated society (Lee, 2000, p.327). Luhmann sees every decision as a consequences of a made distinction. Even the system itself is claimed to be a distinction.

"[…] a system *is* difference – the difference between system and environment."
(Luhmann, 2006, p.38)

There are two ways of drawing distinctions. The first way indicates that something is distinct from everything else, without specifying the other side of the distinction. That what is specified by these distinctions are called *objects* (Luhmann, 1993, p.15). The other way of drawing distinctions restricts what is on the other side of the distinction. For example men/women; true/false; hot/cold. These distinctions are referred to as *concepts* (Luhmann, 1993, p.16; Kjaer, 2006, p.72). The purpose of these distinctions is to produce a difference, because only a difference between this and that makes the observation of this *or* that possible (Kjaer, 2006, p.67). The distinctions are actually a binary code. If the decision has been made that something is "true", the alternative(s) must be "false". This decision creates the risk that the alternative to the decision might actually be true. That is because the binary code does not contain an indication of what is correct (Luhmann, 1993, p78).
A system develops its own code by experience. At first there is the distinction between e.g. profit and loss. These two sides are equally balanced since there is no third variable associated with one of the two sides which could shift the weighing. However, when the code is institutionalized and operations are attributed to it, an imbalance arises. It is past experience that will then determine which decisions will be made. This past experience learned the system which projects are likely to be profitable and which are not. This does not eliminate the risk of making the wrong decision. The other side of the distinction (loss) is still a possibility of occurrence. When a system is open towards both sides of the distinction it is possible to make a decision based on its *own* code. The system and code are firmly coupled and the code is the form in which the system distinguishes itself from the environment. This coupling between system and code eliminates decision criteria external to the particular system (Luhmann, 1993, pp.73-78).

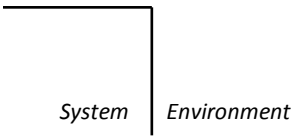
The distinction of past and future is one of the central distinctions made in the System Theory, but it are actually two separate distinctions with the present as the vantage point (see

figure 2.2). When one looks into the future, it is done from the vantage point of the present. The same goes for the past, which is actually a past present, while the present can also be seen as a past future and the future as a future present. For now they will just be called: *past, present* and *future.* The future appears to be uncertain, but we are certain that the future will be either the way we want it to be or quite different. At the same time we know that in the future it is known what the situation actually is and will then judge based on what we know at that time. What can happen in the future also depends on decisions made in the present. That is important to know, since we can only speak of a risk if there is a decision to identify without which the loss could not have occurred (Luhmann, 1993, p.16). These two temporal contingencies of event and loss are firmly coupled together. However it must be realised they are not coupled as facts, but as contingencies. This coupling as contingencies makes it possible for observers to differ in the way they see things (Luhmann, 1993, p.17).

Figure 2.2: The change of past, present and future using two point of reference in time.

In order to understand the operative use of the term risk by an observer, it is needed to know the 'form' that is used by the observer that guides him when he refers to an observation as a risk. The form is a boundary of a severance separating two sides. This requires to state which side is used to mark the point of departure for the next operation (Luhmann, 1993, p.18). This point can only be one of the two sides, since they cannot be used simultaneously. A distinction is used for the purpose of indicating one side and not the other (Luhmann, 2006, p.43). This construct of distinction and form originally was an idea by Spencer Brown and later used by Luhmann (1993; 2006; Kjaer, 2006, p.67).
Spencer Brown uses a figure made out of two components to explain his idea of distinction (figure 2.3). The vertical line as the distinction proper and the horizontal line as the indication. The vertical line separates two sides and a horizontal line that points to one side and not the other (Luhmann, 2006, p.42; Kjaer, 2006, p.68). Using the distinction between system and environment, what the environment is depends on what system draws the distinction. This explains the indicator (horizontal line) points towards the side of the system. A distinction thus refers to both a distinction and an indication.

Figure 2.3: The distinction of system and environment according to Spencer Brown's 'mark of distinction'.



Source: Luhmann, 2006, p.41

This reveals a paradox, because how can a distinction be drawn when part of this distinction is the distinction itself. Luhmann calls this *re-entry of the form* – referring to the same thing twice. This re-entry explains both the self-reference and the autopoietic aspects of a system.

In System Theory the system is distinguished from the environment. The system *is* the difference and will always indicate to itself (Luhmann, 2006, p.54). Re-entry of the distinction basically means that any distinction the system makes always refers to the system itself, or self-reference. This self-reference also explains a systems autopoietic nature. By referring to itself, a system uses itself to evolve. It basically reproduces itself from itself (Knodt, 1995, p.xxi; Kjaer, 2006, p.68; Van Assche & Verschraegen, 2008, p.266). The distinction that re-enters itself is the same and, at the same time, is not the same. This paradox can be dissolved if the distinction is drawn by an observer who can distinguish if his own distinction of system and environment is meant, or whether he is speaking of the distinction that is made within the observed system itself (Luhmann, 2006, p.54).

2.1.3 Observations and self-reference

Observation dissolves the distinction paradox and can be done on two levels, so called first- and second-order observations (Luhmann, 2006, p.55). Safety experts are an example of first-order observers. They believe in facts and see these facts as the real world. When they negotiate it is typically on different interpretations or differing claims on the same facts. Second-order observers on the other hand observe observations and thus, when they observe these safety experts, face the problem that what different observers consider to be the same thing produces different information for each of them (Luhmann, 1993, p.21).
This problem, of different interpretations of the same phenomena, can be circumvented by a second-order observer who observes another observer to see what the latter can and cannot see (Luhmann, 2006, p.54; Kjaer, 2006, p.72). The primary question in second-order observations is "[…]which distinctions the observed observer uses to make indications and how he does so. What does he regard as probable and what as improbable? Where does he locate the disaster threshold that makes him risk averse and causes him to reject all quantitative calculation (Luhmann, 1993, p.226)?" In the case of risk analysis, this way of observing by second-order observers requires the concept of risk to have another form. This has been done by making the distinction between risk and danger. This distinction presupposes that uncertainty exist in relation to future loss. When this future loss is a consequence of a decision, or attributed to this decision, we speak of risk. But if the future loss can be attributed to external conditions, or as to say by the environment, then we speak of a danger. So it's either a risk of decision or a danger of environment (Luhmann, 1993, pp.21-22; Renn, 2008, p.31).

Communications of the subsystems are always subject to their own logic and past. By using their own logic and past they can orient their operations. For example, when it comes to a new private university, the economic subsystem will look at investment cost, past and future interest rates, but not at results of scientific research. The latter only becomes interesting for the economic subsystem in terms of potential financial returns (Japp & Kusche, 2008, p.77). Lupton's (2013, pp.11-16) research on the use of the word 'risk' in the media shows that the term risk is used in a variety of ways and meanings. For example, troops risking their lives in a war, risk of inflation in an economy, risk of protest violence at the London Olympic Games, risk aversive behaviour of politicians, etc. These are all risks with a negative meaning. The only report where risk had a positive meaning was in relation to investments, in which a 'high risk' could result in 'high potential'. This interdisciplinary use of "risk" might be confusing, since it is used in different, but connected, ways (Zinn, 2008, p.4). Observations are also the reason why there is no uniform scientific definition of risk. Risk only exists when self-produced by observer systems in the environment of other systems. That is because the idea of what a risk is are observations of the system and base their definition of a risk on these

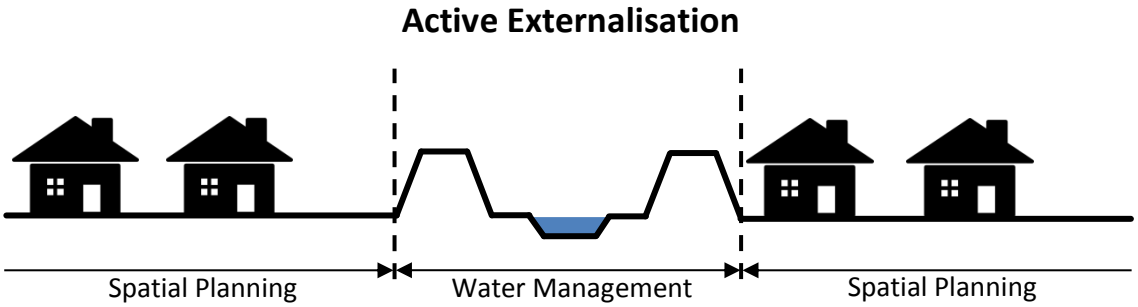
observations (Luhmann, 1993, p.6). In other words, a risk is a social construct and the meaning of what a risk is depends on the system that observes this risk.

2.1.4 Inter- and externalisation of risks

When it comes to risk, Luhmann makes a distinction between internal and external conditions. Conditions within a subsystem are manageable and called risks, external conditions are not manageable by the system and called dangers (Luhmann, 1993, pp.101-102; Aven & Renn, 2010, p.36). Risks are attributed to decisions made, whereas dangers are attributed externally (Luhmann, 1993, p.107). By internalizing dangers, and thus accepting that they are manageable, they become risks. However, The risks a decision maker takes become a danger for those affected (Luhmann, 1993, p.107). In this perspective, the future cannot be interpreted as being either predetermined or independent of human actions. Otherwise the term "Risk" would make no sense (Zinn, 2008, p.4). The declined importance of religion in western society meant that acts of god (dangers) are now seen as risks (Renn, 2008, p.31; Japp & Kusche, 2008, pp.88-89). Natural hazards, like floods, are now seen as manageable and perceived as risks. This does not always mean that risks have increased, they have just been internalized and by doing that people are more aware of them (Renn, 2008, p.31). The focus of this argument is not on whether there has been a change in 'actual risks' confronting society but rather on whether there has been a change in the way in which events are framed and managed as risks (Rothstein et al, 2006, p.98).

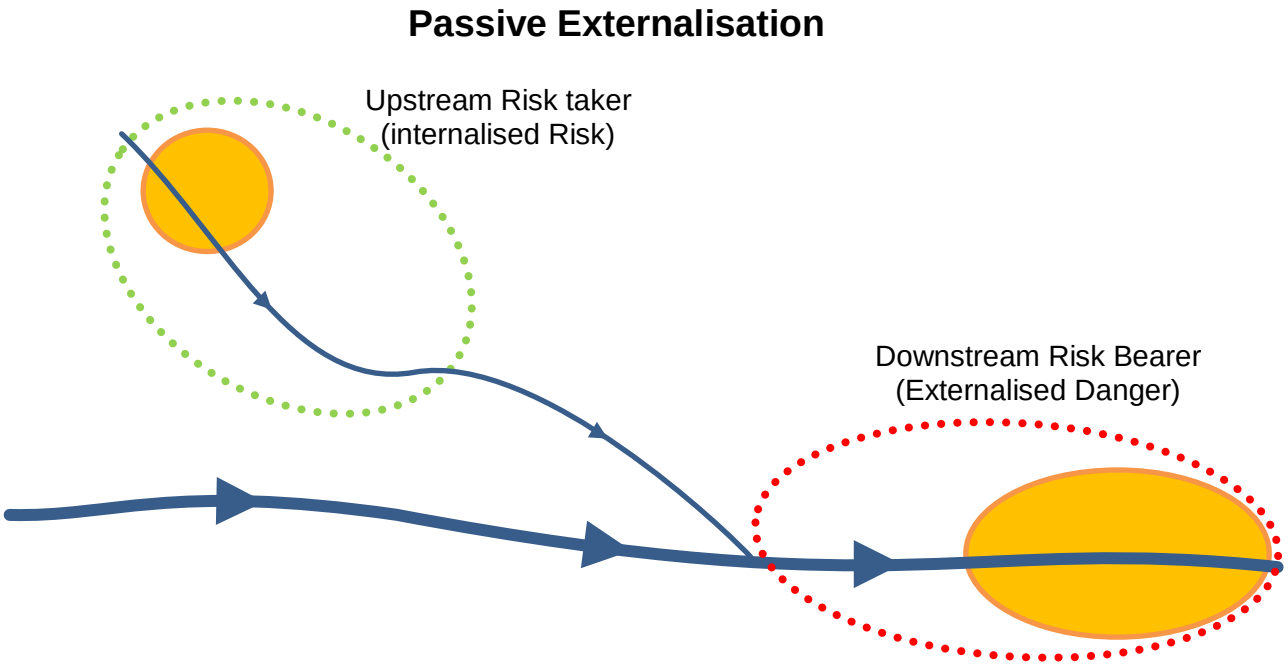
The inter- and externalization of risks and dangers is still possible for potential floods. When it comes to externalisation, this research makes a distinction between active and passive externalisation. In active externalisation, policy determines who is the risk taker and who is the risk bearer. In flood risk management it was a common practice to separate the work field of water management and spatial planning (see figure 2.4). In this practice the water management has the responsibility from dike-to-dike and the spatial planning is responsible for the surrounding areas. Water management must make sure that the water stays between the dikes. Due to this policy water management became the risk taker for flood risks, they managed the risks, and thus creating a danger for the surrounding area. For example, if the water management would decide to lower their budget for maintenance of the dikes, it would create a danger for the surrounding area. Or in Luhmannian thinking, the decision of the risk taker (water management) creates a danger for the risk bearer (surrounding area).

Figure 2.4: Active externalisation of flood risks



Next to active externalisation, there is also passive externalisation. This occurs when side-effects are caused due to decisions made by the risk taker. These side-effects are unintended and that is the reason why this kind of externalisation is called *passive externalisation.* In contrast with the active externalisation, these externalisations are not steered or communicated directly by policy. They are caused by policies, but are not an intrinsic part of these policies. Decisions made by authorities upstream can have an impact on areas downstream (see figure 2.5). Local authorities upstream might decide to heighten the dikes along the riverbank they are responsible for. This decision could cause dangers for the areas downstream, since the water can go nowhere else but downstream. This creation of danger downstream is an unintended consequence of decisions made upstream and thus a passive externalisation.

Figure 2.5: Passive externalisation of flood risks



2.2 Risk perception

The worldview of social systems, as explained in the previous section, is mainly determined by their form of communication, observation, distinctions made and their autopoietic evolution. This causes every system to be (slightly) different from one another and therefore have a different view on risks. In other words, risk perceptions of social systems differ from each other. Economics look at economical risks, environmentalists at risks for the environment and politicians at political risks. Since they look at risks in a different way, their definition of a risk might also be different. The term risk is a social construct and that makes defining the term risk also one of the main problems when measuring risk perceptions. When there is no clear definition of risk, the problem might occur that while talking about risks everybody is speaking of something different (Renn, 1998, p.51).

"Human beings have invented the concept risk to help them understand and cope with the dangers and uncertainties of life. Although these dangers are real, there is no such thing as 'real risk' or 'objective risk'. (Slovic, 1998, p.74)

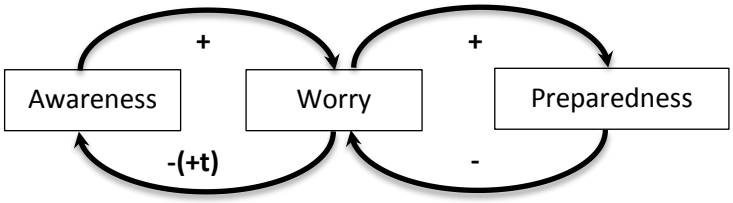
The worldview of a certain actor determines which dangers are magnified, while obscuring other threats and selecting others for minimal attention or even being disregarded (Dake, 1992, p.33; Slovic, 1998, p.76; Pidgeon, 1998, p.9). Language is used to restrict the range of possible options. While some may use complex mathematical models, others lay emphasis on moral issues or economic efficiency (Dake, 1992, p.24-25). Different social systems have their own worldviews and communicate in their own way. The social system that controls the definition of risk, controls the rational solution to the problem at hand. Defining risk is thus an exercise of power (Slovic, 1998, p.76).

In the traditional expert risk analyst's view, risks are seen as some objective function of probability (uncertainty) and adverse consequences. Experts tend to see riskiness as synonymous with expected mortality (slovic, 1998, p.74). Laypeople on the other hand take more qualitative and complex factors into consideration, such as uncertainty, controllability, equity , risk to future generations, and so forth, when defining their perception of risk. In this perspective, potential harm is seen as only one of many factors that form 'risk' (Renn, 2008, p.117; Slovic, 1998, p.75). This difference in perspectives may be the cause of many conflicts over 'risk' between experts and laypeople (Slovic, 1998, p.75). In some circumstances, the perceptions of laypeople and social amplification effects might be of aid for risk management. Laypeople have the potential to generate sufficient political pressure for regulation of a previously neglected hazard (Pidgeon, 1998, p.11).
The difference in communication of experts and laypeople is also one of the reasons of discrepancy between experts and laypeople. Renn (2008, p.104) states it as follows: "People simply aren't adept at multiplying probabilities by expected utilities of *n* different action alternatives, at least not without external aids.[…] Rather than systematically consider each action alternative, people are more likely to categorize similar action alternatives and make judgements about whole sets according to simple decision principles. These principles have been labelled as 'bounded rationality'." That is also one of the reasons why the perceived seriousness of risks do not match the calculated risk numbers of professionals (Renn, 1998, p.50).

Raaijmakers et al (2008) use three characteristics to form the concept of risk perception. The relationship between *awareness, worry and preparedness* determine the flood risk perception (figure 2.6). Flood risk awareness is defined as "[the] knowledge or consciousness of the flood risk that an individual is exposed to (Raaijmakers et al, 2008, p.311)." Awareness is vital to effectively adapt to a flood risk. When, however, there is not enough appropriate information available or when memories of previous flood events fade away, the risk awareness may diminish (Bradford et al, 2012, p.2300).
Awareness of a flood risk does not necessarily mean action will be taken to prepare for a flood event. That is because an individual or organisation, despite its awareness, is not afraid of the flood risk. A higher level of *worry* will serve as a trigger to increase the preparedness (Bradford et al, 2012, p.2301; Raaijmakers et al, 2008, p.11). The more people worry, the larger the demand to reduce the risk (Raaijmakers et al, 2008, p.311).
There are also circumstances that cause the level of awareness, worry and preparedness to lower. Preparedness can be lowered when organisations rely too much on structural flood protection. They get a (false) sense of security and worry less about the flood risks, which in turn reduces their preparedness. The same holds for individuals or organisations that do not take the ownership of the flood risk and responsibility of protecting their own properties. The longer a community is not exposed to a certain risk, the more likely it is they will forget it and thus worry will be reduced. This reduced worry may lead to a decline of awareness (Raaijmakers et al, 2008, p.312).

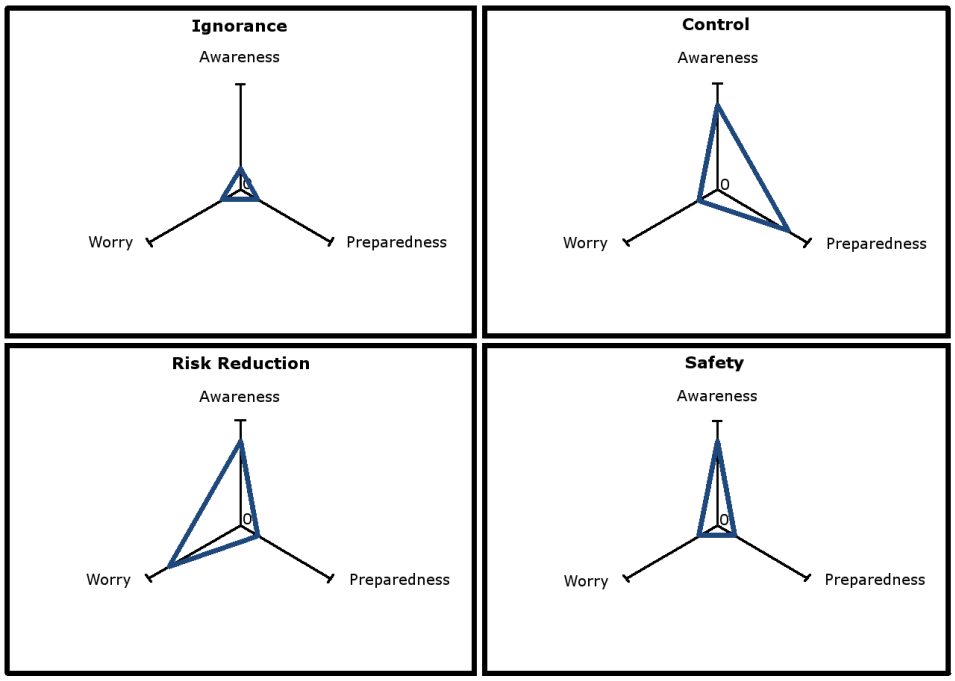
It must, however, be noted that awareness does not necessarily lead to worry, and worry not necessarily to preparedness. To explain this, Raaijmakers et al (2008) came up with four typologies of risk characteristics (figure 2.7).

Figure2.6: Relationship between elements of risk perception



Source: Raaijmakers et al, 2008

Figure 2.7: Typologies of risk characteristics



Source: Raaijmakers et al, 2008, p.313

The four types of risk characteristics are (Raaijmaker et al, 2008 , p.313):

- *Ignorance*: An ignorant individual will not worry about, and will not be prepared for the risk because he or she is not aware of it;
- *Safety*: An individual who imagines him or herself to be safe, will not worry, and is thus not prepared for a risk, because the risk is acceptably small (or believed to be small) or the individual may be prepared to take risks;
- *Risk reduction*: An individual who is highly aware, worried and badly prepared will demand risk reduction. When an individual considers exposure to a hazard as involuntary, he or she will assume the responsibility for preparing the population for a hazard lays in the hands of authorities, instead of taking individual action;
- *Control*: When an individual feels prepared, then he or she has a sense of control over the risk, and is, as a consequence, less worried.

The perceived seriousness of risks are mainly determined by past experiences. Direct personal experience is best capable of changing people's attitude towards a risks. In many cases, people tend to form their risk perception *after* an event happened (Slovic, 1987, p.280). This is

because they are more accessible in memory than vicarious experience. Personal hazard experience increases protection motivation because it provides greater vividness and detail of hazard information, more rapid recall of relevant information, greater personal involvement, and lower levels of uncertainty (Terpstra et al, 2009, p.1143). Personal (past) experience with floods had the largest influence on risk perception when Bradford et al (2012) did their research on risk perception of flood risks in Europe. In that research they used Raaijmakers' concept of risk perception. Generally, a higher perceived risk increase protection motivation, while a low risk perception give people a false sense of security and cause them to overlook a risk that should be dealt with (Terpstra et al, 2009, p.1141). This implies that flood risks are more likely to be internalized when one has direct personal experience with a flood event. This is a combination of Renn's (2008) 'availability' and 'representation' bias (table 2.1). These intuitive biases or ignorance of relevant information can partially explain the discrepancy between laypeople's perception and expert assessment (Renn, 2008, p.105).

Table 2.1: Intuitive biases of risk perception

Biases	Description
Availability	Events that come immediately to people's minds are rated as more probable than events that are of less personal importance
Anchoring	Probabilities are estimated according to the plausibility of contextual links between cause and effect, but not according to knowledge about statistical frequencies or distributions (people will 'anchor' the information that is of personal significance to them)
Representation	Singular events experienced in person or associated with the properties of an event are regarded as more typical than information based on frequency of occurrence
Avoidance of cognitive dissonance	Information that challenges perceived probabilities that are already part of a belief system will either be ignored or downplayed

Source: Renn, 2008, p.103

The perception of risk is often influenced by the attitude towards the cause of the risk (Renn, 2008, p.108). Flood risks are a good example of this influence. As explained before, people used to see flood events as an act of god and thus an unmanageable danger. Since people are aware of the influence of humans on climate change, the attitude towards the cause has changed. Flood events are now seen as (partially) caused by humans and therefore as a manageable risk. Nowadays. the attitude towards the cause of natural disasters is a mixture of a *stroke of fate model* and *risk caused by human action* (Renn, 2008, p.113). This mixture of perceptions makes the inter- or externalisation of risks more complex, since it is harder to determine whether or not a risks can be seen as manageable.

2.3 Prisoner's Dilemma

As explained in the introduction, the municipalities in North Rhine-Westphalia are not obliged to cooperate in the process of making the flood risk management plans. This means that in order to cooperate, there must some sort of incentive. In the case of flood risks the awareness of the risks themselves could serve as an incentive. When flood risk awareness is not present, there must be another sort of incentive, otherwise cooperation is unlikely.
This play of cooperation or defection is similar to a prisoner's dilemma. In the prisoner's dilemma, two actors can either cooperate or defect. The payoff depends on whether or not

the actors cooperate (table 2.2). The yield of the selfish choice of defection is always higher than to cooperate. Defection is thereby the dominant strategy. Dominant strategies are unconditionally best strategies (Zagare, 1988, p.52) However, if both actors decide to defect, the payoff will be the lowest for both (Axelrod, 1980a, p.4; Zagare, 1988, p.52). With regards to the System Theory, cooperation can be seen as internalisation and defection as externalisation.
It must be acknowledged that the prisoner's dilemma is a simplification of real life situations. Some examples of situations that are left out are: The presence of third parties, problems of implementing choices, uncertainty about prior choice of the other side, the possibility of messages that go alongside the choices, etc. The list of could be extended indefinitely (Axelrod, 1980a, p.5)

Table 2.2: Payoff matrix of the prisoner's dilemma

		Player A	
		Cooperate	Defect
Player B	Cooperate	3, 3	0, 5
	Defect	5, 0	1, 1

Source: Axelrod, 1980b, p.381

The fact that defecting is the most rational choice, since it is the dominant strategy, makes it hard to find an effective strategy to deal with a prisoner's dilemma. The Prisoner's Dilemma embodies the tension between individual rationality (the incentive of both sides to be selfish) and group rationality (the higher payoff of mutual cooperation over mutual defection)(Axelrod, 1980a, p.4; Zagare, 1988, pp.52-53). This tension is also the reason why it is one of the most popular game theories. For the tension between individual and collective interest lie at the heart of many real-life situations (Zagare, 1988, pp.52-53). The Tit-For-Tat (TFT) strategy has been proven to be an effective strategy (Axelrod, 1980a). In this strategy the player's first step is to cooperate. Every next step is a copy of the other player's previous action. So if player B decided to defect, the next action of player A is also to defect. This strategy is especially effective if the other player also uses the TFT-strategy. On the downside, because of the retaliating nature of the TFT-strategy it could easily lead to a dead spiral where both players defect.

2.4 Fading boundaries

With regards to the subject of this research, flood risk management planning, the place of social systems is changing. This has everything to do with the Spatial Turn and globalisation, which caused both boundaries of scientific disciplines and geographical boundaries to fade.

> "[…]*where* things happen is critical to knowing *how* and *why* they happen."
> (Warf & Arias, 2009, p.1)

Between the 1960s and 1980s space was seen as a container for economic and social processes (Manderscheid, 2012, p.199; Knieling & Othengrafen, 2009, p.XXIII). "Places in this conception tended to be viewed as isolated and static, and space in general was relegated to a passive role, a mere reflection of economic logic, not an actively constituent part (Warf, 2009, p.65)." But after two decades of debates in social theory, this view has changed and space is now seen as a result of social relations of people living in a certain area or region. In this new view space is socially constructed (Knieling & Othengrafen, 2009, p.XXIII). "Social

structures and relations are thus reproduced, and hence simultaneously changed, by the people who make them; individuals are both produced by, and producers of, history and geography. Given this logic, space could no longer be seen simply as a backdrop against which life unfolds sequentially, but rather, intimately tied to lived experience (Warf & Arias, 2009, p.4)." This change of thought about the importance of space in disciplines other than geography is called the Spatial Turn, a process that is still ongoing (Soja, 2009, p.12). The transdisciplinarity of the Spatial Turn makes it more and more difficult to draw boundaries between who is and who is not a geographer. The Spatial Turn makes every scholar a geographer to some degree (Soja, 2009, p.24). The multidisciplinary thinking also caused that in Europe the term 'spatial planning' replaced 'land-use planning' in order to better reflect the multidimensional nature of planning as a 'geopolitical vision' (Steele & Gleeson, 2009, p.8).

Not only the boundaries between academic disciplines are fading away, globalisation also raised the awareness that national borders are easier to cross. "Globalization has arguably become the defining process of the contemporary world (Warf, 2009, p.66)." The internet can be seen as the most spectacular example of a world where distance and borders become less obvious. Distant places are now just a mouse-click away (Warf, 2009, 67). Climate change is another example of globalization. "Issues that once could be understood and contained within relatively localized contexts, such as water pollution, are increasingly viewed as approachable only on a worldwide basis (Warf & Arias, 2009, p.6)."

Flood risk management planning is a good example of fading boundaries between countries (European Commission, 2007; Wiering & Immink, 2006) and different disciplines (Hartmann & Driessen, 2013). Due to climate change an increased frequency of extreme precipitation events has been observed (Janssen et al, 2014). Uncertainties caused by climate change makes it impossible to understand the likelihood of extreme events based on historical records and thus it becomes more and more difficult to predict probabilities for weather extremes. (Pahl-Wostl, 2007, p.51). The combination of more frequent extreme weather scenarios and increased uncertainty makes it necessary to manage water not only between the dikes, but also take into account that floods will occur eventually and thus develop management plans for entire river basins. By managing entire river basins, the problem of passive externalisation will (theoretically) disappear. Both up- and downstream are now included in the same management plan. But what if the downstream actor is not cooperating in the planning process? Would it then still be possible that decisions made upstream cause unintended danger downstream?
Water management which is not only 'between the dikes' means that the disciplines of water management and spatial planning meet. In most European countries there is still a clear separation of responsibilities between spatial planning and water management (Hartmann & Driessen, 2013), as seen in figure 2.3. The days of water managers working in a closed realm of technical expertise on hydraulic engineering within the autonomous policy domain of water management are over (Wiering & Immink, 2006, p.423). Within the extreme scenario approach water managers no longer provide the lines of defence against the water (Hartmann & Driessen, 2013, p.1). This scenario approach implies that the strict boundaries between water management and spatial planning disappear and thus that active externalisation will not occur in the future. By incorporating other disciplines in risk management, risks are internalized by these disciplines.

2.5 Conclusion

The System Theory basically has four key principles, namely, communication, distinction, observation and autopoiesis. It uses these principles to explain the interaction and evolution of social systems.

The spatial turn is basically the meeting point of several (sub)systems which have to communicate with each other. In science this are the different disciplines that now incorporate meaning of the subsystem of geography into their own set of meanings. For flood risk management this means that the system of the water managers as technical experts on hydraulic engineering need to communicate with the system of the spatial planners. The strict boundaries that were once part of the active externalisation of flood risks and formed the boundaries between the two systems are now torn down.

According to Systems Theory, this does not necessarily mean that these systems will understand each other. This is because during communication they make selections based on their *own* past experiences. They observe each other self-referential and might not understand each other from their own perspective. They can however adopt meanings from each other and use this meaning in later communication. By communicating and adopting meaning, the systems evolve next to each other. By doing so, the boundaries of active externalisation might dissolve. Communication leads to decisions, so the outcome is determined by the communication between the systems. In terms of risk, no communication of risks leads to externalised dangers. Climate change, however, made it harder to rely on past experiences to make decisions.

Because risk is a social construct, it is crucial to know the definition of "risk" used by a certain social system in order to understand their risk perception. This is because their actual experience might be the same, while at the same time one sees it as a risk while the other does not. The consequence might be that one policy-maker feels the need to reduce the risk while others do not.

Raaijmakers' concept of risk using awareness, worry and preparedness is a good way to help understand risk perceptions. The relationship between the three risk characteristics form the risk perception of an individual or organisation. While these three characteristics can be seen as the cornerstones of risk perception, past experience with (in our case) flood risks seems to have the biggest impact on risk perception. Even research using Raaijmakers' model came to this conclusion. An explanation for this might be that past experience increases the awareness and/or worry that people have of a risk and therefore has an influence on preparedness and thus the risk perception overall.

A factor that has an influence on risk perception, but is not mentioned in the concept of Raaijmakers et al, is the attitude towards the cause of the risk. This has everything to do with the feeling of control over a risk. If flood risks are seen as something natural that is a stroke of fate, it is seen as something out of our control. However, if it is seen as caused by humans, it is perceived as more controllable. This difference can be compared to the difference between risks and dangers in the System Theory as explained in the previous chapter.

The fading boundaries between disciplines therefore might lead to a better communication of risks between the disciplines. As a consequences, institutions are more aware of risks and therefore risks become more and more internalised. To them it might seem that there are more risks nowadays, but it might just be that they are more aware of the already existing risks.

3

Conceptual model & hypotheses

The theoretical insights from the previous chapter are used and translated into measurable items in order to do the empirical research needed to find an answer to the research questions. The empirical research focuses on the risk perceptions of governmental institutions regarding flood risks and will give an answer to the following research central and sub-questions:

To what extent is the planning process of flood risk management plans able to internalise risk perceptions of governmental institutions?

1. What are the different risk perceptions among governmental institutions in North Rhine-Westphalia?
2. To what extend have risk perceptions of governmental institutions in North Rhine-Westphalia changed as a result of the planning process of flood risk management plans?
3. In what way are risk perceptions of participating governmental organisations different from the ones that do not participate in flood risk management planning?
4. To what extend have flood risks been internalized by governmental institutions in North Rhine-Westphalia due to the planning process of flood risk management plans?

In order to answer these questions, a conceptual model has been made. This model is based on the theoretical insights of the precious chapter. It is basically a synthesis of these theoretical insights. This chapter starts with the explanation of the conceptual model in which the relation between the different theoretical concept are laid out. The relation between the concepts are then translated into hypotheses that are used to test the theoretical insights.

3.1 Conceptual model & research hypotheses

The theoretical insights from chapter two and three form the theoretical framework of this research. The main theoretical approaches used are the System Theory as developed by Luhmann (1993) and the description of risk perceptions by Raaijmakers et al (2008). These two theoretical approaches have been combined, together with other insights from chapter three regarding risk perceptions. By doing this, a conceptual model (figure 3.1) could be developed that will be used as a frame of reference for the empirical research. Since the influence of Flood Risk Management Planning is the main subject of the research it has been placed as the central concept.

This section will start with the explanation of the relations between "(past) experience", "awareness" and "worry", which combined form the concept of "risk perception" (from chapter 3). After this, the relation between "risk perception" and "flood risk management planning" is described.
This will be followed by an explanation of the relation between flood risk management planning and the system theoretical concepts (from chapter 2). The section ends with the formulation of hypotheses, which are based on the relations between the concepts in the conceptual model. These hypotheses will be tested in the empirical research.

3.1.1 Risk perception

In the conceptual model, the concept 'risk perception' is based on the model of Raaijmakers et al (2008) (see chapter 3). It has been altered slightly by adding "(past) experience" and change the placement of "preparedness" in the model. The addition of "(past) experience)" is an adaption taken from Bradford et al (2012). The different placement of "preparedness" will be explained in section 3.1.2.
Due to the similarities between Raaijmakers' model and the one used for this research, the explanation for the relations between the concepts "(past) experience", "Awareness" and "worry" is fairly the same as the one that has been given in chapter three.
As stated in chapter three, one concept does not automatically lead to the next and the starting point is not necessarily at a (past) experience. It is, however, likely that an organisation is more aware and/or worried of a flood risk when they have experienced a flood event themselves. The same goes for the influence of awareness on worry. If an organisation is really aware of the potential flood risks, it is likely that its worry towards flood risks will increase.

There are two instances in the model where the level of worry decreases. The first is "time", in the model shown as –(+t). It is based on the assumption that over time, worry decreases which in turn decreases the awareness of a risk. So the longer there is no flood event, the lower the level of worry and awareness will be. The second instance where the level of worry lowers is when the level of preparedness increases. This is based on the assumptions that preparedness will increase the sense of safety and therefore people are less worried.

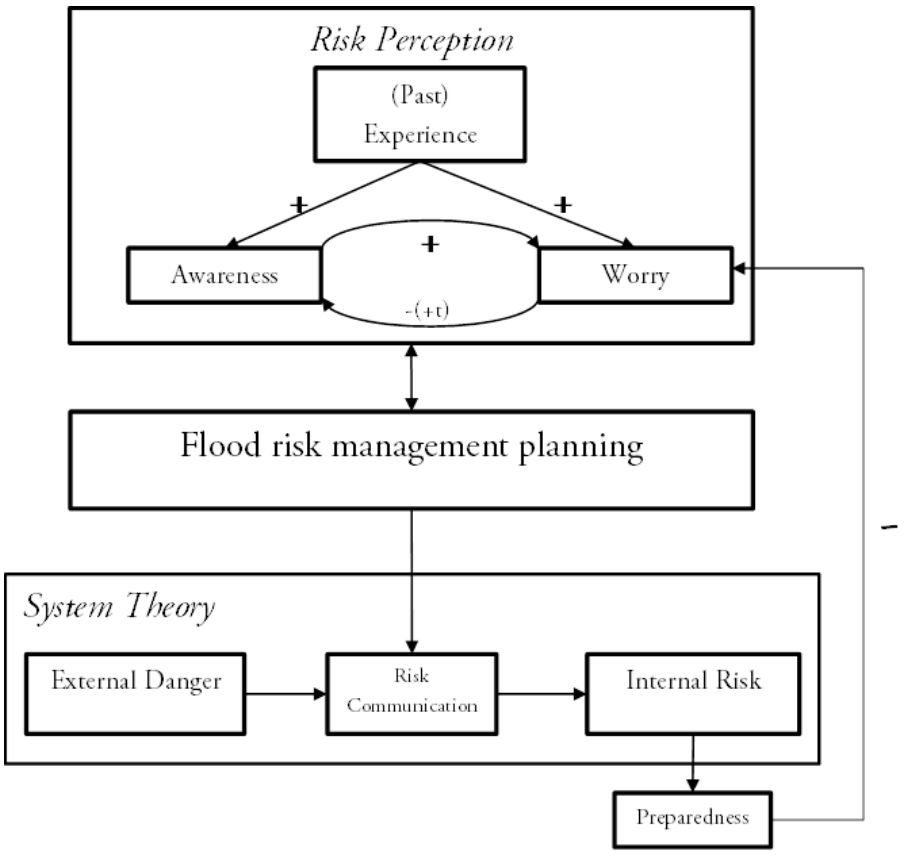
The relation between the concepts of 'Risk Perception' and 'Flood Risk Management Planning' is based on the assumption that the information provided during the planning process might influence the awareness and/or worry of an organisation and thus has an influence on their risk perception. An example of this influence might be the hazard maps, which show potentially flooded areas during flood events. The maps might show risks that were unknown to governments and they are now aware of and worried about.
At the same time the risk perception of an organisation has an influence of the manner in which they participate in the planning process. This can be explained by the four types of risk characteristics as explained in chapter three. An organisation's risk perception might be described as *safe* according to the characteristics of risk perception by Raaijmakers (2009). In that case an organisation thinks it is prepared and feels safe, therefore it is less worried and less likely to take action. It might be that the organisation's sense of safety is rational, but it might also be a false sense of safety, in which case they will not take measures when they should. This lack of action will have an influence on the planning process of Flood Risk Management Planning.

3.1.2 From external danger to internal risk

Even though organisations might be aware, worried or have experienced a flood event in the past, it does not automatically make them internalise the flood risk. That is because an organisation might see it as an inevitable event (fate) or not their responsibility (as explained in section???) and therefore has externalised the risk. Therefore risk perceptions do not have a direct influence on neither "external danger" nor "internal risk".

An aim of the research is to what extend Flood Risk Management Planning can be of influence on the internalisation of flood risk. Therefore it is necessary to understand the steps needed to go from "external danger" to "internal risk". According to Luhmann (1993), communication is the key factor to internalise risks. This "risk communication" is where Flood Risk Management Planning can be of influence. It does not only make organisation aware or worried about the risks, but at the same time it can show what can be done to have an influence on the risks. In other words, it communicates how to manage risks and to see it as an organisations responsibility to do something about the risks. If it succeeds to do that it is able to make an organisation internalise the flood risks.
However, if Flood Risk Management Planning is not able to make organisations internalise flood risks, they will not see it as a manageable problem or as their responsibility to take action. Action needs to be taken in order to be prepared for a flood risks, therefore it is necessary to internalise the problem in order to be prepared for a risk. This necessity to internalise flood risks is the reason why "preparedness" has been taken out of Raaijmakers' model of risk perception and placed underneath "internal risk". The negative effect of "preparedness" on "worry" remains the same and is still based on the assumption that when an organisation feels prepared, then it has a sense of control over the risk, and is, as a consequence, less worried (Raaijmakers, 2008).

Figure 3.1: Conceptual model



3.1.3 Research hypotheses

Based on the relations between the different concept in the conceptual model, hypotheses can be formulated. These hypotheses will then be used to test the theories from chapter two and three and will eventually lead to an answer to the research question.

H_1: *The more recent a government has experienced a flood event, the more aware and worried it is of the risk and will prioritize it.*

Based on the findings by Bradford et al (2012), that awareness diminishes when there is a long period without flood events, governments will not see the necessity or do not prioritise flood risk management and do less effort to participate in flood risk management planning. This hypothesis try to find out if governments prioritize flood risks more when they recently experienced a flood event.

H_2: *A government that is both aware and worried will be more likely to actively participate in the flood risk management planning.*

Based on the risk characteristic "risk reduction" a government that is both aware and worried, demands reduction of the risk and is thus more likely to participate. In the conceptual model, there is also a relationship from flood risk management planning towards risk perception. So, (parts of) the planning process also cause governmental institutions to are more aware and/or worried about flood risks.

H_3: *The different phases in the flood risk management planning process each have a different influence on risk perception.*

The different phases in the flood risk management planning process (flood risk assessment, creation of hazard and risk maps and creation of flood risk management plan) each have their own influence. As of now it is not clear what effect each of the phases has on the risk perceptions of governmental institutions. Therefore they are treated as a part of "flood risk management planning". During the empirical research, the phases will be treated individually to see their individual effect.

H_3: *The obligatory nature of flood risk management planning forces governmental institutions to internalise flood risks.*

Since the flood risk management plan (FRMP) is obliged by the European Commission, (local) governments feel the necessity to think about measures that have to be taken to reduce the risks of a potential flood event. They are basically forced to take responsibility and take measures. At first they might not have internalised it, but because an external force (the European Commission) says flood risks are manageable and it is the responsibility of local governments, these local governments will internalise it.

H_5: *The different phases in the flood risk management planning process each have a different influence on risk communication.*

Just like H_2 the different phases are expected to have a different influence on the risk communication and thus indirectly on the internalisation process of flood risks. The different phases of flood risk management planning will be treated separately in the empirical research in order to find the individual influence on risk communication.

H_6: *An organisation can only be prepared if it has internalised flood risks.*

According to the System Theory (Luhmann, 1993) a risk is internalised when the risk is perceived as their responsibility and manageable. Only when that is the case, action will be taken to manage the risk. So, to be prepared action has to have taken place and thus the risk has to be internalised first.

4

Geographical and policy context

The context of a certain case can have its influence on the results of the research. By knowing and describing these potential influences up front, any inconsistencies due to these contextual factors can be understood. This chapter describes this context and therefore increases the transferability of this research. In other words, when other researchers want to replicate this research they know the contextual factors that potentially influenced the results of this research and take this into account.
The first section of this chapter is a description of the European Flood Directive (DIRECTIVE 2007/60/EC). The second section is the most comprehensive part of the chapter and covers the context of the rivers Emscher and Lippe. These two rivers form the case of this research and thus the geographical, historical and administrative context are explicated.

4.1 European Flood Directive

In November 2007 the European Commission issued the Flood Risk Directive (DIRECTIVE 2007/60/EC) with the aim to reduce and manage the risks that floods pose to human health, the environment, cultural heritage and economic activity (European Commission, 2014). Each member state is now "required to assess if all water courses are at risk of flooding, map the flood extent and assets and humans at risk in these areas and to take adequate and coordinated measures to reduce this flood risk"(European Commission, 2014a).

It is a river basin wide approach and a Flood Risk Management Plan (FRMP) must be developed for each river basin. This approach towards entire river basins is not a new approach within the European Union. The Water Framework Directive (Directive 2000/60/EC) was also based on a river basin wide approach, called *integrated river basin management*. The Water Framework Directive is not about flood risks, but about water quality of European rivers, lakes, groundwater and coastal beaches (European Commission 2014b).
Flood risk management is an integral part of this integrated river basin management and therefore the Floods Directive is coordinated with the Water Framework Directive (European Commission, 2014a).
The development of the FRMP is done during a cycle of steps that takes six years, after which the cycle starts again to review/update the FRMP. The cycle consists of the following required tasks to be carried out by the member states:

1. Preliminary risk assessment (due the 22th of December 2011)
2. Hazard- and risk maps (due the 22th of December 2013)
3. Flood risk management plans (due the 22th of December 2015)

The development of the Flood Risk Management Plan (3) is the end product of the six year cycle. It is not just about reducing the probability of a flood occurring by means of technical flood protection, it is mainly about managing the risks in case a flood does occur. It is based on the assumption that although the probability might be low, the occurrence of a flood event is inevitable. Therefore it is not just planning the river and the dikes, but also creating measures for the floodplains. To do this flood risk management of the floodplains, the Flood Directive obliges *"active involvement of interested parties in the production, review and updating of the flood risk management plans."* (Article 10.2)

4.2 Historical, geographical and administrative context of the Lippe and Emscher region

This section is divided into two parts. The first part describes the geographic historical context that has an influence on the flood risks nowadays. The second part is about the geographical context.

4.2.1 Geographic historical context

The industrialisation of the Rurh Area during the 19th and 20th century has had a major impact the landscape in North Rhine-Westphalia. This is mostly due to hard coal mining activities that already started mid-18th century (Harnischmacher, 2007; Drecker, et al, 1995). With the invention of the steam engine it became possible to pump the groundwater to the surface and excavate hard coal from greater depths. This was also the time that mines appeared to the north of the river Ruhr, between the river Lippe and Ruhr. When mining moved into the lowlands between the Ruhr and the Lippe, the disposal of waste soil became a problem. Heaps of coal mining waste soil are still clearly visible in the landscape of North Rhine-Westphalia (Harnischmacher, 2007).

Compared to the enormous waste heaps, surface subsidence due to mining is less visible, but has had a major impact on both the river Lippe and the river Emscher (Harnischmacher, 2007). Floodings where always a characteristic of the lowlands of the Emscher and eastern Lowlands of the Lippe, but subsidence severely disturbed and reversed the flow direction of rivers, which resulted in severe flooding. Since the wastewater of households and industry was conducted into surface waters, these floods also caused major sanitary problems and outbreaks of cholera and typhus (Drecker et al, 1995; Harnischmacher, 2007). To overcome these problems, the Emschergenossenschaft was founded, entrusted with the disposal of wastewater and the design of a new sewage system for the Emscher. This new sewer system also resulted in the straightening of the river Emscher (see figure 4.1).

Not only the rivers themselves are affected, also a predominant part of the Emscher region turned into "polderland" due to mining subsidence (Drecker, et al, 1995). Subsidence also caused the formation of bodies of water, so called secondary biotopes. A good example of such a lake is "Lake Lanstrop" near Dortmund and is formed when the subsidence reached a level where the ground was lower than the groundwater level and thus forming a permanently flooded area. Also densely populated areas are below groundwater level due to subsidence. The use of a network of water pumps prevents these areas from being flooded (see table 4.1 for the number of pumping stations in the region). If the pumping stations in the polder regions were shutdown, most parts of the Ruhr District would be inundated (Harnischmacher, 2010, p.264). However, during floods or heavy rain events, these areas are like bowls where the water flows into. Subsidence thus increases the flood risks of these areas, but it is dealt with by using pumping stations.

Figure 4.1: The natural flow of the Emscher in 1899 during a flood event(left*) and Emscher nowadays (right**)

Source: *Emschergenossenschaft, 2010 **Kreis Recklinghausen, 2014

4.2.2 Geographical context

Both the rivers themselves as the areas they are flowing through differ from each other. One of the most easily recognizable differences is the type of river. While the Emscher transformed from a natural to a technical river during the industrialization period (see figure 4.1), the Lippe kept its natural course (see figure 4.2). The technical nature of the Emscher is noticeable when the total length of dikes of the Emscher and Lippe are compared. Even though the Emscher is shorter in length, the total length of dikes along the Emscher is bigger than the Lippe (table 4.1). Alongside its 85 kilometres of riverbank, the Emscher has over 60 kilometres of dikes. Which is substantially more than the 32 kilometres of dike along the 220 kilometre long Lippe.

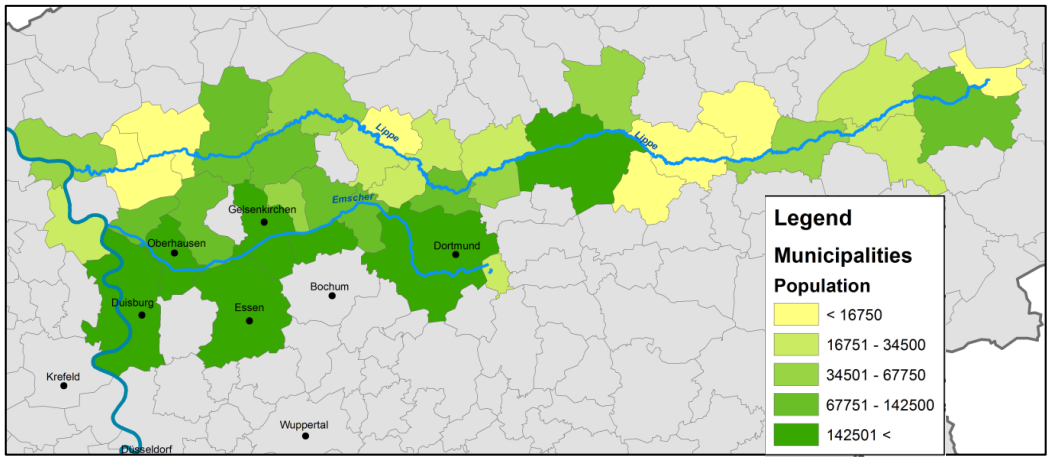
The Lippe kept its natural course because it flows through a more rural region. The population density is much lower than the Emscher region. The catchment area of the Lippe is much greater than that of the Emscher, while the population in the Emscher's catchment area is much greater (see table 4.1). In figure 4.3 this difference in population is also clearly visible.

Figure 4.2: The Lippe near the town Lünen

Source: Thomas Behrendt

The Emscher on the other hand flows through some of the biggest cities in the Ruhr Area (see figure 4.3) and one of the most densely populated areas of Germany (2700 pp/km^2). Therefore, the river does not have that much space in the case of high water levels and caused a lot of problems during flood events as described above in the historical context.

Figure 4.3: Population of the municipalities that are crossed by the Emscher and Lippe



Source: Statistische Ämter des Bundes und der Länder, 2011

Table 4.1: Factsheet of the rivers Emscher and Lippe***

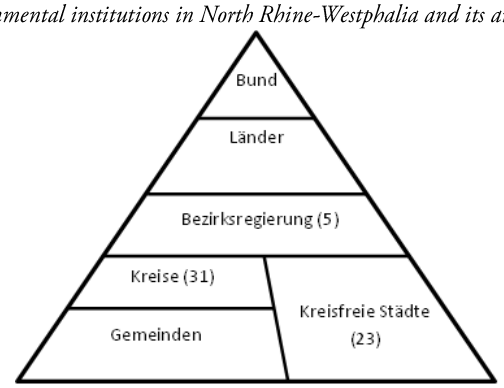
Emscher		***Lippe***	
Catchment area		**Catchment area**	
River length	85km	River length	220km
Catchment size (above ground)	865 km²	Catchment size Lippe (above ground)	4,882 km2
Inhabitants in the catchment area	± 2.2 million	Of this proportion Lippeverband	3,280 km²
Population density	2,700 pp/km²	Population within its territory	1400000
Mean annual precipitation	798 mm/y	Mean annual precipitation	764 mm/y
River basin		**River basin**	
Altitude (Emscher)	21-144m	Altitude	7-61 m
Height difference (Emscher)	123 m	Height difference	54m
Mean slope (Emscher)	1.5 ‰	The median slope	0.5 ‰
Average low water discharge (MNQ)	9.4 m³/s	Average low water discharge (MNQ)	16 m³/s
Average water discharge (MQ)	19 m³/s	Average water discharge (MQ)	46 m³/s
Average high water discharge (MHQ)	130 m³/s	Average high water discharge (MHQ)	211 m³/s
Highest flood (HHQ)	246 m³/s	Highest flood (HHQ)	700 m³/s
Mean groundwater recharge	130 mm/y	Mean groundwater recharge	190 mm/y
Dikes	116.92	**Dikes**	76.13 km
Emscher main run	60.47 km	which Lippe	32.61 km
Emscher tributaries	52.25 km	thereof tributaries	43.52 km
Rheindeich Beeckerwerth	4.2 km		
Pumping stations	107	**Pumping stations**	129
which sewage pumping stations	6	which sewage pumping stations	44
which drainage and *Vorflutpumpwerke*	101	which drainage pumping stations	85
Proportion of the dewatered by pumping stations surface of total area	38%	Proportion of the dewatered by pumping stations surface of total area	15,70%
Flood retention basins	22	Flood retention basins	34
rainwater retention basin	26	rainwater retention basin	27
Mixed water treatment plants	88	**Mixed water treatment plants**	142
Rain water treatment plants	72	Rain water treatment plants	120
rainwater overflows	16	rainwater overflows	22

*Source: *Emschergenosseschaft, 2014 **Lippeverband, 2014*

4.2.3 Administrative context

In order to fully understand the responsibilities the different governmental institutions have, it is necessary to have a good look at the administrative division of Germany and more specifically the division in the region. In figure 4.4., the division of governmental institutions in North Rhine-Westphalia is presented. This division basically consists of five governmental layers. For this research the most relevant is the division of responsibilities in respect to flood risk management policies.

Figure 4.4: Division of governmental institutions in North Rhine-Westphalia and its amount in brackets



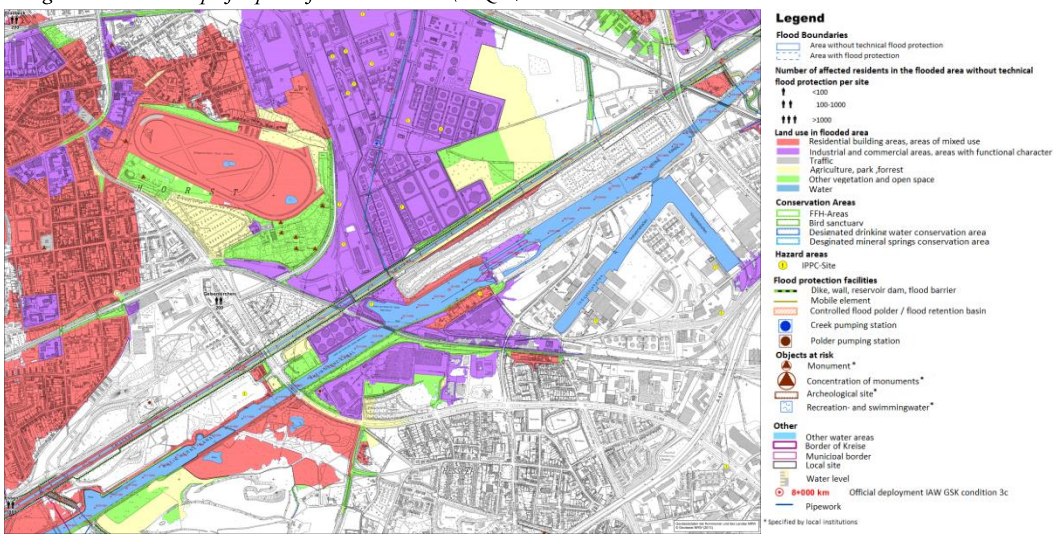
With reference to the European Flood Directive, Germany is required to develop Flood Risk Management Plans (FRMP) for all of its rivers. The main responsibility of the development of the FRMP lies with the Bezirksregierung (MKULNV, 2014). For the case of the Emscher and Lippe, there are three Bezirksregierungen involved, namely: Düsseldorf, Münster and Arnsberg.

To develop the FRMP, the Bezirksregierung assesses which actors should be involved in the process and thus serve as the facilitator of the process (MKULNV, 2014). The main actors involved in the development of the FRMP for the rivers Lippe and Emscher, besides the Bezirksregierung, are the municipalities and water boards (Emschergenossenschaft and Lippeverband). After that has been done they could start with the three phases as described in the European Flood Directive:

1. **Flood risk assessment**: This is done in cooperation with the actors involved by the Bezirksregierung. Together, they assess the flood risks in the area.
2. **Risk- and hazard maps**: The Bezirksregierung gave the task of the development of the risk- and hazard maps to the water boards Emschergenossenschaft and Lippeverband. When completed, all the risk- and hazard maps have been made available to public via the website of the Ministry for Climate Protection, Environment, Agriculture, Conservation and Consumer Protection of North Rhine-Westphalia (MKULNV, 2014). See figures 4.5 and 4.6 for an example of respectively a risk- and a hazard map.
3. **Development of FRMP**: With the use of the risk- and hazardmaps, the municipalities and water boards develop measures to reduce the flood risks in their area. The Bezirksregierung coordinates this process and compile all the measures in one document, the FRMP.

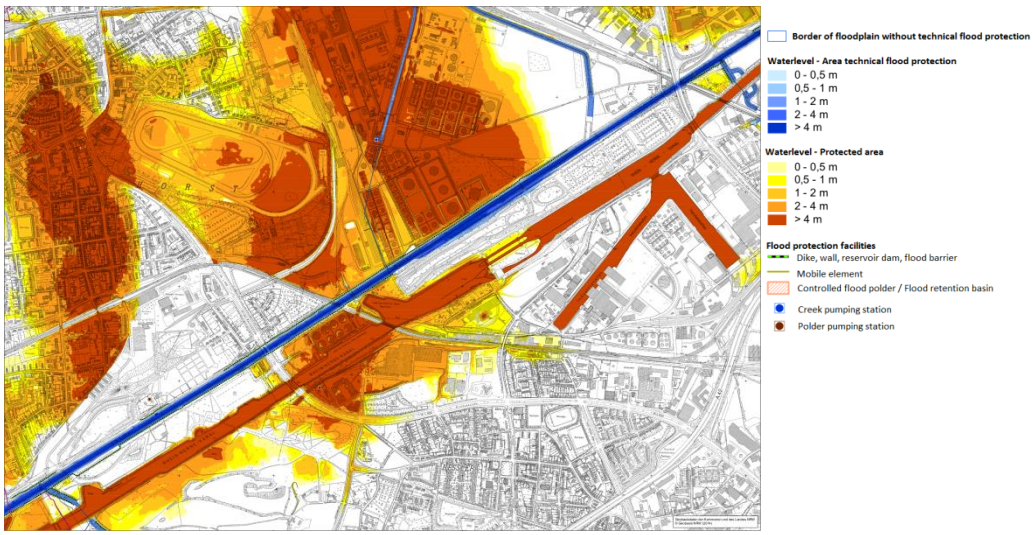
For the development of the FRMP each involved governmental institution has its own area of jurisdiction (see figure 4.7). Municipalities are however not required to cooperate in the planning process. So if they don't want to or have other priorities the Bezirksregierung cannot force them to participate.

Figure 4.5: Risk map of a part of Gelsenkirchen (HQ_{100})



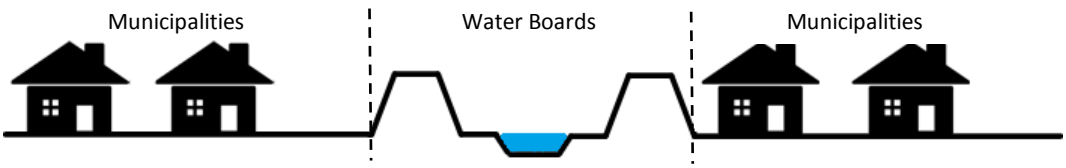
Source: Geobasis NRW, 2013a

Figure 4.6: Hazard map of a part of Gelsenkirchen (HQ_{100})



Source: Geobasis NRW, 2014a

Figure 4.7: The division of responsibilities between governmental institutions for the development of the FRMP



5

Risk perceptions of governmental institutions in the Emscher and Lippe Region

The hypotheses, as formulated in chapter 4, are being tested in this chapter. This is done by using the findings from the semi-structured interviews, which were partially derived from the mental models (See figures A1.1 t/m A1.6 in the appendix), and to a smaller extent by policy analysis. It must be noted that the hypotheses cannot be tested thoroughly based on six interviews and policy analysis.
This chapter first discusses the risk definition used by the governmental institutions. In the six following sections, each of the hypothesis is discussed and an answer will be given to the question whether or not the statement of the hypothesis is true. The chapter finishes with a conclusion.

5.1 The risk definition of governmental institutions

As stated in chapter two, a risk is the combination of probability and adverse consequences. The European commission uses the following definition of a flood risk, which contains the combination between the two elements.

"'flood risk' means the combination of the probability of a flood event and of the potential adverse consequences for human health, the environment, cultural heritage and economic activity associated with a flood event." (European Commission, 2007, p.3)

Since a flood risk is a perceptual concept, it is arguable whether policy makers interpret the definition the same way when working on their policies for the Flood Risk Management Plan (FRMP). If not, it is possible they are discussing the same concept, while attaching a different meaning to it.

It turned out not everyone has the same perception of what the definition a flood risk is. There are basically three ways of looking at it.

1. Use probability as main element of a flood risk
2. Potential damage as main determinant
3. Combine both probability and potential damage to define a flood risk

When it comes to probability every interviewee has the same perception. The probability is a calculation of the likelihood of a flood event occurring in years. So for example, if an event is likely to occur frequently they might call it a once-a-year event. Following this, an unlikely event could have the probability of occurrence as 1-in-200 year. All governmental institutions were aware of the fact that a probability is not a forecast and that it does not mean it will take 200 years for the next 1-in-200 year event to occur. It is also possible the flood event happens tomorrow. One interviewee made the analogy of the probability of a

flood event with gambling. *"It is like you are gambling with dice and throwing two times a six."(G. Johann)* The probability of throwing two sixes in a row is lower than throwing two different numbers. It basically means that, while the probability is low, it does not mean it is not impossible to occur at any random moment.

For the damage element of defining a flood risk, two ways of looking at it were found during the interviews. The first one merely refers to the four elements at risk of a flood event, namely human health, the environment, cultural heritage and economic activity. This does not take away the problem when to call it a risk. Is it a risk when there is one life on the line or only when there are more? Is it an environmental risk when a chemical plant spills hazardous chemicals or also when a rare plant is being destroyed? The main point is, that merely referring to the four elements that are at risk leaves a lot of, mainly ethical, questions unanswered.

The second way of looking at potential damage is based on the way the Länder of North Rhine-Westphalia explicated these element. They state:

"Während bei der menschlichen Gesundheit keine Zahlen für die Bewertung herangezogen werden können, wurde für die anderen Schutzgüter jeweils eine bestimmte potenzielle Schadenssumme als Anhaltswert angesetzt, z. B. ein Wert von 500.000 Euro pro Siedlungsgebiet. Gebiete mit historisch bedeutsamen Ortsteilen und Weltkulturerbestätten, die von Hochwasser beeinträchtigt werden können, wurden unabhängig vom möglichen finanziellen Schaden ebenfalls in die Liste aufgenommen." (MKULNV, 2013, p.7)

It is a monetary approach towards potential damage, stating that any potential damage caused by a flood event of more than €500.000,- is called a flood risk. It takes away some of the questions mentioned before, but at the same time the Länder acknowledges that it is not possible to use this €500.000,- guideline to define potential damage for human health. World cultural heritage on the other hand will always be treated as a flood risk, which means that no fixed amount of potential damage in euro's is assigned to their status as a flood risk. In all the other cases, it is up to the municipalities to decide which areas are designated as areas at risk of a flood event.

5.2 Experience with floods influence priorities

Based on the finding by Bradford et al (2012), the assumption is made that awareness diminishes over time and therefore, the prioritization of flood risk will become less over time.

H_1: *The more recent a government has experienced a flood event, the more aware and worried it is of the risk and will prioritize it.*

The first thing to mention is the rarity of a river flood in the region. According to the water board, it has been more than a hundred years ago that a 1-in-100 year event occurred. So following statistics, it gets more likely that it will occur at any given moment. However, it can also take another hundred years. According to the hypothesis this would mean awareness and worry decreases and thus flood risks would be less prioritized.
Next to floods caused by rivers, there are also flood events caused by heavy rain events. As it turned out, these heavy rain events are perceived as a bigger problem than river floods. Dortmund had such a flood because of heavy rain in 2008 at an economic loss of about €17 million. It was the highest flood in recent history, but was caused by heavy rain instead of a

river flood. Due to this flood caused by heavy rain flood risks became a big topic. The news and politics were talking about it and eventually policies changed. Part of the changed policy was the establishment of a "flood and flood control representative" and due to the establishment of such a representative, the cooperation between the city of Dortmund and the water board became much better. It had to go wrong first, in order to prioritize flood risks.
Dortmund is just a recent example, but when comparing municipalities that had or didn't have a flood experience, the water board (EG/LV) says it is easier to get municipalities involved which had a flood experience in the last 5-10 years. The necessity of a flood for the prioritisation of flood risk management becomes evident in the next quote:

"I could not imagine any flood event (in Germany) that could influence local policies as long as it isn't in front of their houses. […] The only way to really change awareness of flood risks is an actual flood event." (J. Bräunling)

Another example of a disaster which caused awareness and worry to rise, is a historical one. It was the flood of the Lippe in 1890 (highest flood to date), which caused the dikes of the Lippe to be raised up to their current level. That flood was necessary for measures to be taken.
Floods that happened in other regions do not seem to have an impact on local policies. Whenever a flood happens in the Elbe region (Eastern Germany), it does not affect the awareness or worry in the Emscher or Lippe region. When comparing the rivers, noticeable differences can be seen between rivers like the Elbe and Oder. These differences are then used as an explanation why it would not occur in the Emscher or Lippe region. For example, the Emscher is described as a small stream compared to the Elbe and the downstream problems of the Emscher are of a much smaller scale than the ones faced by the Elbe. Although these differences are correct, they do not explain whether or not the risks are different.

As for the hypothesis which states that past experience cause awareness and worry to increase and therefore cause flood risks to be prioritised, it can be said that this hold for the case of a local flood that has been recently experienced. Any floods happening in other regions do not cause a change in awareness or worry. However, in this case it were floods caused by a heavy rain event that help to prioritise flood risk management for river floods.

5.3 Worry and awareness as incentives to participate

The second hypotheses is based on the assumption, derived from Raaijmakers' typology of risk characteristics (Raaijmaker et al, 2008 , p.313), that people or institutions that are both worried and aware of a risk demand a reduction of the risk and are thus more likely to actively participate.

H_2: *A government that is both aware and worried will be more likely to actively participate in the flood risk management planning.*

To give an answer to the question whether or not the statement in the first hypothesis is true, it must first be noted that all the governmental institutions that have been interviewed participate in the flood risk management planning process. During the interviews it turned out that hardly any of the municipalities in the catchment area of the rivers Emscher and Lippe decided not to participate in the process. However, this does not mean that the hypothesis has been falsified.

As said in the previous section, floods caused by heavy rain events are seen as a bigger problem than river floods. Since not every municipality had experienced a flood event, both heavy rain or river flood, they were not aware of risks. In the Bezirk Münster, not all municipalities were willing to participate in the planning process at first. The Bezirksregierung had to convince them of the necessity of the whole process. The hazard maps proved to be a vital tool to convince the municipalities. At the Emscher, this was mainly caused by the sense of safety people have because of the high dikes. The existence of the dikes made them less worried about flood risks. They are not always aware of the risks in the case of an improbable, although not impossible, flood event. They are aware that the safety calculations are only based on the probability of an event occurring and that it can happen at any moment. But when this is being mentioned, things like "shit happens" or "just unlucky" are ways to go past it. Dikes make them feel less worried. Using the hazard maps, municipalities could see the potential damage without actually having to experience a flood event.
The only governmental institution that claimed river floods to be the biggest natural hazard in the region was the water board. Especially for the Emscher, the flood risk is perceived as high, because although the probability of a flood event is low, (1) the potential damage is extremely high due to a pollution density of 2700 pp/km^2 and (2) the time to evacuate is short. Since the water board is working on flood risk management for the rivers Emscher and Lippe on a daily basis, it makes sense they see it as a big hazard. For them managing these rivers is their main priority, while other governmental institutions also have other problems to think about.

As for the hypothesis that worry and awareness are incentives to participate more actively in the planning process. It can be said that awareness is vital for the participation in the planning process. A past experience with a flood event makes municipalities more aware and therefore they were more eager to participate. In the case of unwilling municipalities, hazard maps proved to be an effective tool to make them more aware of the risks. Eventually almost every municipality participated, but since there were no interviews with municipalities that were not participating in the planning process, there is no way to know there reasons for this choice. Also, it can't be said whether or not a municipality participated more or less actively than other municipalities based on the conducted interviews. The only thing that can be said about this hypothesis is that awareness is important for participation in the planning process, while the level of worry seems to have no influence at all.

5.4 Influence of planning process on risk perception

Prior to the interviews it was not clear what influence the different phases in the flood risk management planning process had on risk perception. The hypothesis states that each phase has its own influence on risk perception of governmental institutions. In this section, the influence of each phase on the risk perception is discussed separately in order of their execution.

H_3: The different phases in the flood risk management planning process each have a different influence on risk perception.

Preliminary risk assessment

The only time the preliminary risk assessment has been mentioned (not even directly) during the interviews, was by the city of Dortmund. They asked during the preliminary risk assessment if the water board could calculate the flood risk for a specific area in Dortmund. The city knew they had a potential flood risk in that area and wanted to know what the

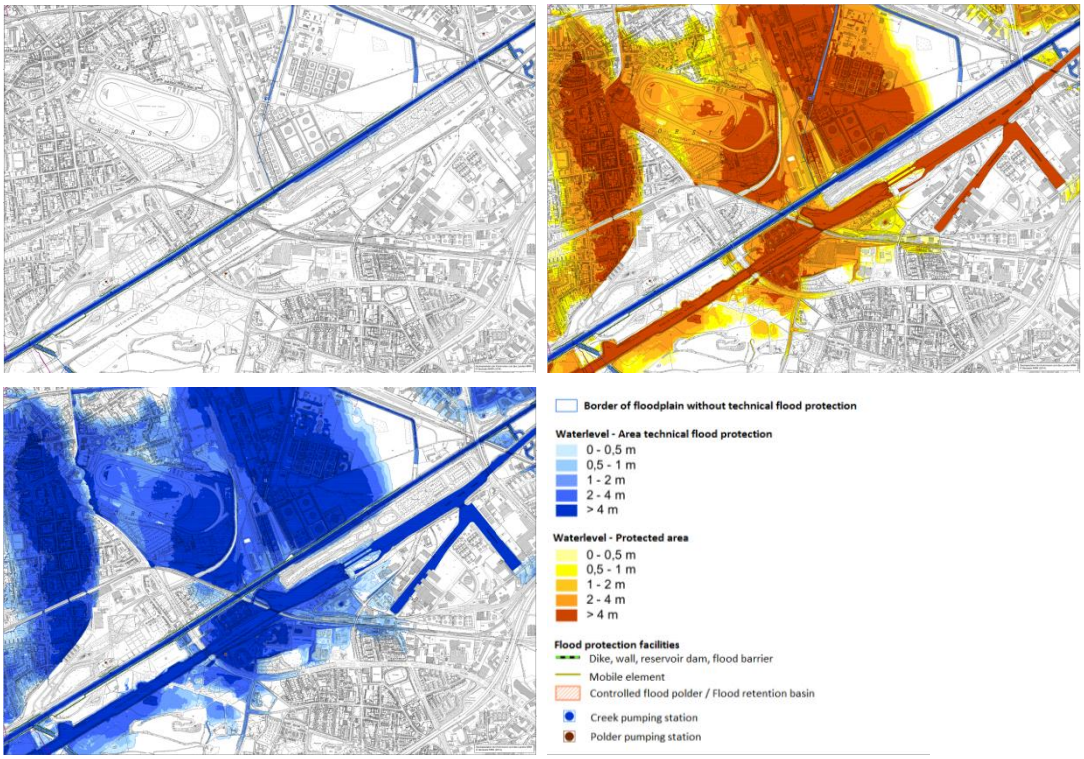
water flow would look like in the case of a flood. It is an example where the awareness of a flood risk is of influence on a part the planning process.
In the actual preliminary risk assessment document (MKULNV, 2011), all the rivers basins in the region were analysed. The rivers that have a potentially significant flood risk, using the definition as stated in section 5.1, are assigned. Significant flood events the river had in history have been documented, cultural heritage has been identified and mapped, the same goes for sights of environmental importance, IPPC-sites (for more information see: Directive 2008/1/EC) and population density per municipality. For the Emscher 97% and Lippe 57% (MKULNV, 2011, p.67) of the river and the creeks attached to it has been assigned as a potentially significant flood risk area based on the data collected during the preliminary risk assessment.
As said, the interviews did not shed light on the influence and participation of governmental institutions during the preliminary risk assessment phase. The example of Dortmund showed the influence of awareness can have on the preliminary risk assessment phase.

Risk and hazard maps

The risk and hazard maps were discussed extensively during the interviews and everybody had the same opinion about them: the risk maps are useless and the hazard maps very useful. The risk maps are seen as useless because the data they contain is too generalised, while the hazard maps are far more precise. No one is using the risk maps. The protocol for the risk maps was made by LAWA (Bund/Länder-Arbeitsgemeinschaft Wasser), a cooperation between the Bund (federal government) and Länder (state government). The protocol had to be made in such a way that every Länder was able to execute it. Therefore it is, according to the water board (EG/LV), compromised to such an extent which made the maps useless. The municipalities have better, more precise and up to date data available to them, than used in the maps.
On the other hand, the hazard maps (figure 5.1) were perceived as very useful by all the governmental institutions. "*Now a problem became visible we weren't aware of*" (M. Leismann) and "*now we look at the risk maps and see what could happen*" (G. Johann) are just two quotes that accurately describe the influence of the hazard maps. Leismann's quote refers to the new floodplains discovered by the development of the hazard maps. He estimates that now more than 1500km^2 of floodplains is known in Arnsberg, while previously only 300km^2 of the floodplains was known. Johann's quote refers to the ability of local government to actually see the extent of the water flow in case a flood event. The added value of the hazard maps is twofold, (1) gain new knowledge of the floodplains (2) make flood risks visible to local governments.
The visibility of flood risks due to the hazards maps also helped the local governments to involve other departments in their work. In Gelsenkirchen, for example, it was hard to explain to the other department that a 1-in-100 year event could happen any time, not just in a hundred years. *"To most of our departments it became more real that we are not 100% safe"* (U. Niehoff).

As for the question whether or not the risk and hazard maps had an influence on risk perception, the interviews gave a good indication of their influence. The risk maps are useless, while the hazard maps influence is twofold. Firstly, due to the development of the hazard maps new floodplains were discovered. Since one can only be aware of things that are known, the discovery of floodplains raises the awareness. Secondly, the hazard maps also made the flood risk visible, more real and thereby raising awareness. It cannot be said the maps made governmental institutions more worried, but it did make them aware that 100% safety cannot be guaranteed.

Figure 5.1: Hazard maps of Gelsenkirchen for the three different scenarios HQ_{often} (top-left), HQ_{100} (top-right) & $HQ_{extreme}$ (bottom-left)



Source: Geobasis NRW, 2014a,b,c

Regional meetings

The regional meetings for the development of the flood risk management plan (FRMP) receive mixed reviews by the involved governmental institutions. The main problem lays in the fact that the river basins are divided into management units, which are mainly based on the boundaries of the bezirke. Every Bezirksregierung organises meetings for their respective management units.

The meetings themselves are not new to the Bezirksregierungen. They already had them as a part of the Water Framework Directive (WFD). The only thing that was new is that the policy is a more pro-active way of water management, instead of the more reactive water management policy they had prior to the Flood Directive. The Bezirksregierung sees the meetings as a way to learn to cope with this change in policy.

Municipalities agree with the ability to learn from the meetings. However, they see that the division into management units reduces its learning potential. "*If you want to exchange experience, you have to organise it on your own. That is the complication here. Gelsenkirchen is the responsibility of the Bezirk Münster, our neighbouring city Essen is Bezirksregierung Düsseldorf and Bochum is Bezirksregierung Arnsberg.*" (U. Niehoff)

Since the water board (EG/LV) manages the entire river Emscher and Lippe, they are involved in all the meeting for the development of the FRMP. They do not see the division into management units itself as the problem, but the fact that all the bezirke act differently. This makes communication more difficult.

Only the Bezirksregierung sees the meetings as a way to learn, while the municipalities think a cooperative learning process will be more of more importance when the measures have to

be implemented. The meetings were mainly used to explain and show the hazard maps and to inform the involved stakeholders.

The direct influence of the meetings on the risk perception is fairly low, which is mainly due to the division into management units and the use of the meetings. The use of the hazard maps during the meetings mainly highlights the importance of these maps. The maps are the ones that have a direct influence on the risk perception, not the meetings themselves. The meetings are merely a way to communicate the information on the maps to involved stakeholders. With regards to this communicative ability of the meetings, they are useful in raising awareness.

5.5 Obligatory nature forces internalisation

The Flood Directive is a European directive which has to be carried out by all the Member States of the European Union. The German gave the responsibility of the implementation of the Flood Directive to the lower government of the Bezirksregierung and municipalities. The hypothesis is that these local governments are now forced to internalise flood risks due to the obligatory nature of the Flood Directive.

H_4: The obligatory nature of flood risk management planning forces governmental institutions to internalise flood risks.

The answer to this hypothesis influenced by two types of regulations. On the one hand there is the European Flood Directive and on the other hand there are German laws. As for the influence of the European Directive, all the governmental institutions agree on one thing: the usefulness of the flood directive to be able to force policies.

"We had the force to really contact people. If it is all free willing they don't come, but we just say "you have to come to our meeting". (J. Bräunling) If this force really helped to internalise the flood risk is questionable. At least it made the municipalities think about the subject and the probability of a flood occurring in their region. Of the municipalities that came to the meeting some said "we have no problem", at least they thought about it and perhaps they really did not have a significant flood risk. If there really was no significant flood risk, there is nothing to internalise. However, nothing can be said about their claim that there is no significant flood risk based on the conducted interviews.

"It gives the management more power. Some municipalities didn't like it, but now they have to." (G. Johann) Although apparently not all the municipalities liked to do water management, others find it useful that the Flood Directive comes from higher governments. For some municipalities the obligatory nature of the directive was useful to get other departments from within their municipality involved. *"After we explained what is required and what we have to do and also that it had to be done. So they couldn't say: oh no I'm not interested."* (U. Niehoff) The fact that they could say it was a European Directive and that they were assigned by the Bezirksregierung to carry it out proved to be of great value to get other departments involved and develop interdisciplinary measures for flood risks.
Also since flood was not the biggest problem in municipalities, it did not get prioritised. The flood directive made sure there is some focus on the subject. An often heard benefit of that is that municipalities *"can do things we couldn't do otherwise."*(I. Lakes) The directive forces them to do it another way. While previously it had to go wrong first in order to change policies, now they had to think ahead and develop measures to reduce the risks.

The water board (EG/LV) did not have to change a thing in their work because of the Flood Directive. They were already doing the things that are standing in the Flood Directive. It is just they can do it with a bit more power now and there is more money available for the risk calculations. Flood risks were an already internalised risk for the water board, the Flood Directive did not change that.

As stated in the beginning of this section, the answer to the hypothesis has two sides. The other side are the German laws with regards to the responsibilities of municipalities and the laws regarding water management and floodplains in particular.
The municipalities are responsible for all the local affairs. This right, also called *kommunale selbstverwaltung*, is part of the German Constitution. Article 28.2 of the German Constitution states:
"*Municipalities must be guaranteed the right to regulate all local affairs within the law into their own responsibility. Also the community associations as part of their statutory area of responsibility in accordance with the laws of the right of self-government. The guarantee of self-government includes the basics of financial responsibility; to these basics include a multiplier the municipalities with law are entitled to economic power related control source."* (Deutscher Bundestag, 2012, p.32)

This part of the constitution means the Bezirksregierung cannot force the municipalities to participate in the flood risk management planning process. This municipal self-government is according to the Bezirksregierung a "holy" part of German law.
The city of Gelsenkirchen sees crisis management as the responsibility of municipalities and therefore flood risk management is the responsibility of the municipality. Since it is the responsibility of the municipalities, they are basically forced to internalise flood risks. However, the municipalities gave the responsibility of the river to the water board (EG/LV). Since this water board is not actually an official governmental institution, "in last things the municipalities are responsible." (G. Johann) By giving the responsibility to the water board, the municipalities basically externalised a part of the flood risk, while in fact the final responsibility lies with the municipalities.
Another law that is of influence on the internalisation of flood risks by the Flood Directive is the *Wasserhaushaltsgesetz* (WHG) or Water Resources Act in English. This states that if there is a statistical certainty for an area that it will flood once in a hundred year, this area can be established as a floodplain. This basically means, and is also interpreted by municipalities in this way, that measures are only necessary to keep an area safe up to a statistical level of a 1-in-100 year event. Once established as a floodplain, building restriction are applicable to the area. Since most of the Emscher and Lippe region is kept safe by dikes up to a level of 1-in-200 year flood event, municipalities do not feel the necessity to take preventive action for these areas. This also means that the hazard maps containing calculation for 1-in-200 year events are not used by municipalities. Therefore, internalisation of flood risk is only up to a statistical level of 1-in-100 year flood events. Governments do not feel responsible for flood events with a lower probability.

Can it be stated that the obligatory nature of the Flood Directive forces governmental institutions to internalise flood risks? To a certain extent the directive does force governments to internalise flood risks. However, this is partially compromised by German Law. Since by law areas only have to be kept safe up to a statistical level of 1-in-100 year flood events, internalisation of the risk stops at this point. The extreme scenarios, as stated in the Flood Directive, are not looked at because of that reason. The fact that the Flood Directive comes from the European Commission gives it some "status" which is used by the Bezirksregierung

to force municipalities to cooperate. Due to the *kommunale selbstverwaltung* there is no legal basis for this force, this forceful approach was nevertheless effective based on its ability to get every municipality to the regional meetings. This last finding can be seen as an indication for the ability of the obligatory nature of the Flood Directive to internalise flood risks, it shows the responsibility municipalities feel towards flood risk management. This last statement is actually more saying something about the influence of the meetings on the internalisation of flood risk, which will be discussed in the next section.

5.6 Influence of the planning process on risk communication

Just like the third hypothesis, the different phases in the flood risk management planning process are being investigated. Only this time it is not their influence on the risk perception, but the influence of the planning process on the risk communication. In Luhmann's System Theory, risk communication is seen as the variable that explains the process of going from an external danger towards internal risk (see chapter 2).

H_5: *The different phases in the flood risk management planning process each have a different influence on risk communication.*

Preliminary risk assessment

As already explained in section 5.4, the preliminary risk assessment phase has not been mentioned a lot during the interviews. This unfortunately means it is not possible to know what influence the preliminary risk assessment has had on risk communication. It can however be said that if the hazard and risk maps had an influence on risk communication, the preliminary risk assessment at least had an indirect influence on risk communication since the risk areas calculated in the risk maps are designated in the preliminary risk assessment phase. This is however a logically reasoned statement and not an actual observation.

Risk and hazard maps

While section 5.4 showed the ability of the hazard maps to raise awareness of the governmental institutions, it seemed harder to show their effect on risk communication. The question this hypothesis tries to answer is whether or not the risk maps cause governmental institutions to go from an external danger towards an internal risk. So, do the maps help to get the governmental institutions from the perception that a flood is unmanageable and not their responsibility towards the perception that floods are manageable and the responsibility of the respective governmental institution?

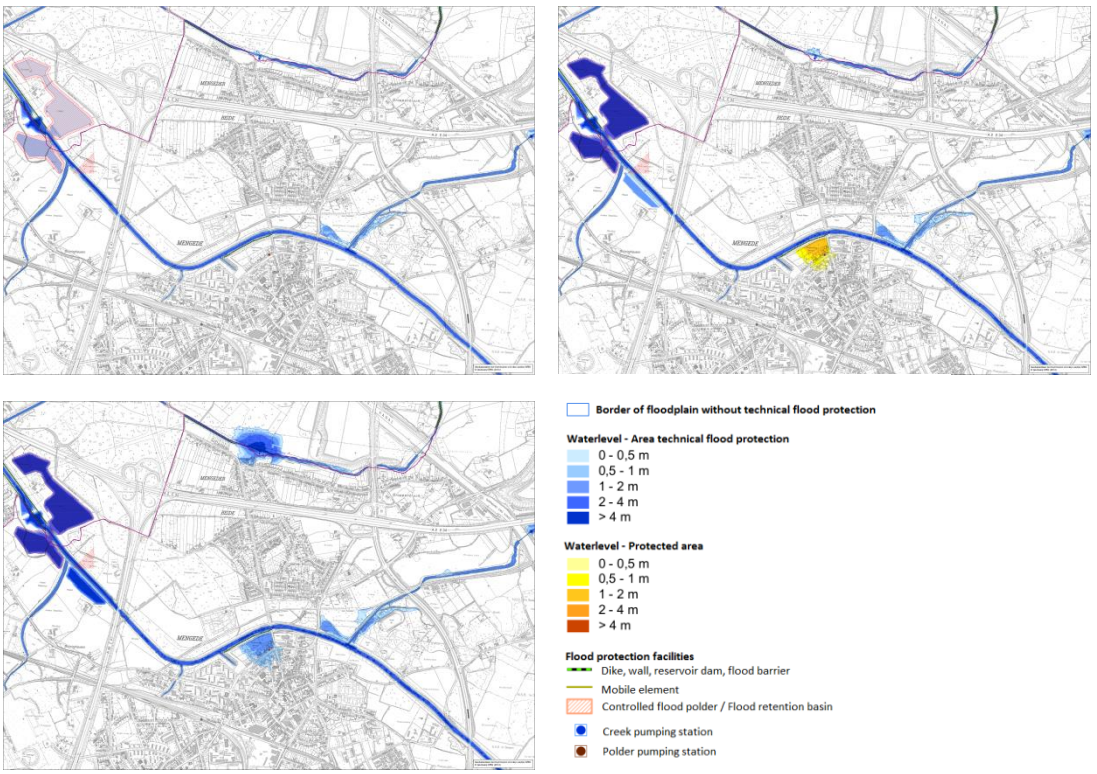
Since the risk maps are hardly used by the governmental institutions (as explained in section 5.4), it can be assumed that the risk maps have no influence on risk communication. During the meetings for the development of the FRMP the risk maps are not used, while the hazard maps on the other hand are being used extensively. But do risk maps convince governmental institutions that a flood is manageable and their responsibility?
The manageability of floods is only partly shown by the hazard maps. In the maps there is a difference between water flows for areas protected by technical flood protection measures (e.g. dikes or flood barriers) and areas which are not protected by technical flood protection measures. This difference by itself shows that floods are at least partially manageable by technical measures (see figure 5.1). Since the responsibility of the dikes lies with the water board, the perception of the manageability of flood risks will not affect other governmental institutions.

The maps also show the effectiveness of retention areas (figure 5.2) in the Emscher region. Although the governmental institutions are aware of this and are willing to create more of them, it is simply not possible due to the lack of free space in the Emscher region. For the Lippe region, these retention areas are less necessary since "*the Lippe has a lot of room for the water to spread outside populated areas as well as flood protection devices within populated areas" (J. Bräunling)*

For the water board, the hazard maps are not that helpful in internalising the risks, since they already internalised it in the first place. The only influence it had was that some floodplains were unknown before the development of the maps. Now the water board knows the risks it can think about the measures they want to take to reduce the risks.

The hazard maps also help municipalities to see the flood risks into perspective. When the maps of figures 5.1 and 5.2 are compared it is easy to see that the risk is higher in Gelsenkirchen. The comparison between Dortmund and Gelsenkirchen shows the higher risks in the downstream areas. An issue which is also recognized by the water board. *"Mostly downstream have more problems, but they also have the highest dikes."* (G. Johann)

Figure 5.2: Flood basin near Dortmund-Mengede in three different scenarios: HQ_{often} (top-left), HQ_{100} (top-right) & $HQ_{extreme}$ (bottom-left)



Source: Geobasis NRW, 2014[d,e,f]

Regional meetings

During the regional meetings the hazard maps are being used to show the risks, discuss these risks and the measures that could be taken by the involved governmental institutions in order to reduce the flood risks.

In the different phases of the flood risk management planning process, the actual change in perception from external danger towards an internal risk starts at the meetings. During the meetings the involved stakeholders are informed about the procedures of the flood risk management planning process. All bezirke organise them differently. For example the Bezirksregierung Düsseldorf organises small round table discussion, while the

Bezirksregierung Arnsberg organises large meetings with all the involved stakeholders at once. During the meetings in Arnsberg, the hazard maps were hanging in the room and were discussed by the stakeholders. The meetings use the information gathered in the previous phases and discusses them in order to make sure the municipalities know what they can do and is expected of them. The added value of the meetings for the internalisation process becomes evident in the example of an engineer from Oberhausen. When asking him if they are prepared for a 1-in-200 year event, which are the extreme scenarios in the FRMP, the answer was: *"Then you must think "can we be prepared". Is there a chance to be prepared?"* (R. Kopka) For him the answer on this question came during a meeting with the Bezirksregierung Düsseldorf. It gave him the insight that they can inform the public where the risks are and let the fire department develop an evacuation plan.

The phases of the flood risk management planning process each have their influence on the internalisation process of the involved stakeholders. The hazard maps make the extent of potential flood events visible and the meetings use this information to discuss what can be done to reduce the risks that these flood events pose to the area (figure 5.3).

Figure 5.3: Room of the regional meeting of the Bezirksregierung Arnsberg (left) and hazard map with notes from the meeting of the Bezirksregierung Arnsberg (right)

Source: Georg Johann

The main achievement of the meetings is well expressed in a quote by J. Bräunling. *"The communication and cooperation itself doesn't really lead to new insights, but it encourages people of other disciplines that water management to deal with flood risks".* This quote highlights the fact that the actual internalisation phase takes place after the meetings in the offices of the respective organisations. This was also recognized by the city of Gelsenkirchen. There they demanded the involved departments to develop their own measures, and not only let the water department take care of the measures. They involved all the necessary departments and gave the responsibilities of measures that had something to do with these departments to them. This made sure that it became an interdisciplinary project involving departments like, the fire department, planning department, traffic department, public relations department, etc.

5.7 Internalisation necessary for preparedness

According to the System Theory, a risk has been internalised once a person or organisation sees the risk as their responsibility and thinks the risk is manageable. So, to be prepared and have taken the proper measures, the governmental institutions have to have internalised the flood risks.

H_6: An organisation can only be prepared if it has internalised flood risks.

To shed some light on this hypothesis, it is important to recognize the fact that the municipalities gave the responsibilities of water management of the rivers Emscher and Lippe to the water board (EG/LV), while at the same time the final responsibility for the rivers still lies with the municipalities (as explained in section 5.2). Nevertheless, the municipalities see the rivers as the responsibility of the water board. Also, the municipalities see flood events as inevitable and think they are safe enough since the dikes of the Emscher are calculated for 1-in-200 year events. So as for the areas between the dikes, the municipalities see it as an external danger that is managed by the water board.
The plans made for the areas outside the dikes are made in case the technical flood protection measures (like dikes and flood barriers) fail. These plans are mainly the responsibility of the municipalities, even though they cannot be forced by the Bezirksregierung (as explained in section 5.5). For the development of the plans, there were some indications that is does matter what background a person has. For some people developing measures also requires a slight change in mindset. The example of the engineer, in section 5.6, showed that his first thought of a measure was not a communicative measure. His doubt if it is possible to be prepared lies in the fact that there is no space for technical measures in the area. During discussions at the regional meetings and communication with the Bezirksregierung, he now realised that flood risks are manageable. The way flood risks are manageable is, however, not the way he is used to. Nevertheless, he realised the manageability of flood risks and sees it as his responsibility. Therefore he has internalised the flood risk.

The actual challenge of flood risk management planning lies in the realisation of the inevitability of a flood event, but that the consequences such an event poses can be reduced by using a pro-active flood risk management policy. It is a pro-active way of looking at worst case scenarios. Since municipalities are not used to pro-active policy, a lot of the measures are now called "concept creation" (in German: Konzepterstellung) or are aimed at informing and communicating the flood risks to the public.

5.8 Conclusion

This chapter was meant to give an insight on the influence of the flood risk management planning process on the risk perceptions and internalisation process of governmental institutions in North Rhine-Westphalia.

Mutual influence of planning process and risk perception

The interviews and policy analysis showed a mutual influence of the planning process and risk perception. The probability of a flood occurring in the region seems to be of great importance. Since it has been a long time since either the Lippe or Emscher had a major flood, flood risks are not prioritised. Since the probability of a flood event is low, municipalities are not worried about floods. Instead, heavy rain events are perceived as a bigger problem. The experience of a heavy rain event in recent history appears to have an influence on the prioritisation of flood risk caused by rivers. It has to go wrong first in order to have a change in policy. At the same time this prioritisation made it easier for the Bezirksregierung and water board to cooperate with these municipalities.
The majority of the municipalities did not experience a flood event in recent history and the awareness of the possibility that a flood might occur in their region is rather low. Therefore it was harder for the Bezirksregierung to get every municipality actively involved in the planning process. At this point, the different phases in the planning process prove to be helpful. Especially the hazard maps were a good way to show the actual flood risks and convinced municipalities to participate.

However, to be able to show and explain the hazard maps, the Bezirksregierung first had to get the municipalities to the regional meetings. The fact that it is an European directive, proved to be helpful in engaging the municipalities. Both the Bezirksregierung and the water board feel that the status as a European directive, gives the directive more power.

Internalisation of flood risks

The previous section showed the way in which risks perception and the flood risk management planning process have an influence each other. However, a municipality that is aware of flood risks does not necessarily see a flood risks as something manageable or as their responsibility.

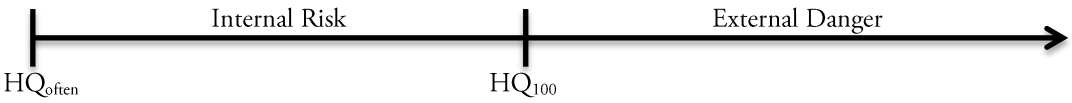
The interviews and policy analysis made clear the manageability and responsibility of flood risks are internalised to a certain extent. The inter- and externalisation of flood risks happens on four levels:

1. Definition: every potential damage lower than €500.000,- is not a risk, except for world cultural heritage which is always considered at risk.
2. Probability: responsibility of flood risk only goes up to a probability level of 1-in-100 years (HQ_{100}).
3. Division of responsibilities: water board for everything between the dikes, municipalities for areas outside the dikes.
4. Hazard maps and regional meetings show flood risks and possibilities of flood risk management

The definition of a risk (1) sets a clear boundary between what is and what is not considered a risk. Any potential damage below €500.000 or when it is not a cultural heritage is not automatically considered as a flood risk. The municipalities stick to this guideline and thus only internalise flood risks for areas that fall within this guideline. For any other potential damage for human health, environment or cultural heritage, it is up to the judgement of the municipalities if they consider it as a risk.

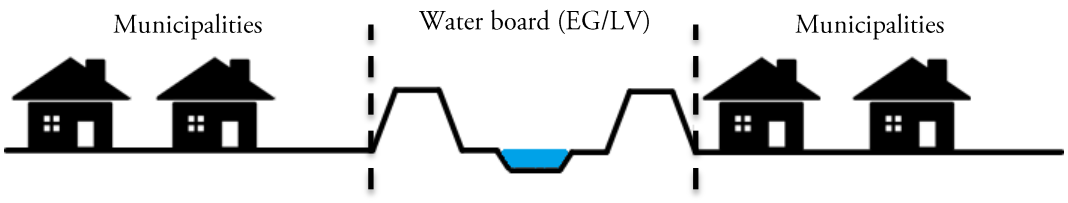
Probabilities (2) seem to be of great importance when considering the responsibility and manageability of flood risks. By (German) law, municipalities are only responsible for areas that have a probability of flooding up to 1-in-100 years. Therefore any flood event with a lower probability will not be the responsibility of municipalities. Events with a lower probability than 1-in-100 year are seen as unpreventable. Therefore it can be stated that the probability sets a clear boundary for the internalisation of flood risks. This boundary is set at a probability of 1-in-100 years, any event with a lower probability is seen as an external danger (figure 5.4).

Figure 5.4: Inter- and externalisation of flood risk by probability.



The third way the internalisation process is determined by the division of the responsibilities (figure 5.5). While the municipalities are responsible, based on the *kommunale selbstverwaltung*, they decided to give the responsibility of the river and dikes to the water board. The municipalities are still the institution with the final responsibility, although the municipalities do not see it this way.

Figure 5.5: Division of responsibilities of the river basin



When looking at the division of responsibility at a larger scale, the division as shown in figure 5.5 is only a small part of the total division. There is also a division in management units, in which each of the Bezirksregierungen is responsible of the coordination of the flood risk management planning process of the part of the river in their Bezirke.
The fourth and final way the internalisation process is determined, is by the flood risk management planning process itself. It is a combination of the hazard maps and regional meetings. On the one hand, the hazard maps show the effectiveness of technical flood protection, but on the other hand the inability to prevent extreme flood events from happening. In the case of the Emscher and Lippe, this inability mostly evokes a perception that a flood risk is unmanageable. The regional meeting are then able to explain that flood risk management is not only about prevention of flood event, but also about damage control and risk reduction. By discussing the flood risks visible on the maps and measures that can be taken to reduce the risks, the risk can be seen as manageable to a certain extent. The division in management units, however, make experience exchange between municipalities harder. It is possible for a municipality to have neighbouring municipalities in different management units. Exchange of views on the subject and the measures taken becomes harder.
Although the manageability of 1-in-200 year flood events might be discussed during meetings and shown on hazard maps, they are simply ignored due to fact that municipalities only have to look at events with a probability up to 1-in-100 years as mentioned above.

6

Conclusions and recommendations

This final chapter discusses the conclusions from previous sections in order to answer to the sub- and central research questions. It starts with answering the sub-questions by combining both the theoretical insights from chapter two, the local context as described in chapter four and the empirical research findings from chapter five. Eventually, by answering the sub questions, it will be possible to give an answer to the central question this research tried to answer, namely:

To what extent is the planning process of flood risk management plans able to internalise risk perceptions of governmental institutions?

6.1 Answers to sub questions

6.1.1 Differences in risk perception among governmental institutions

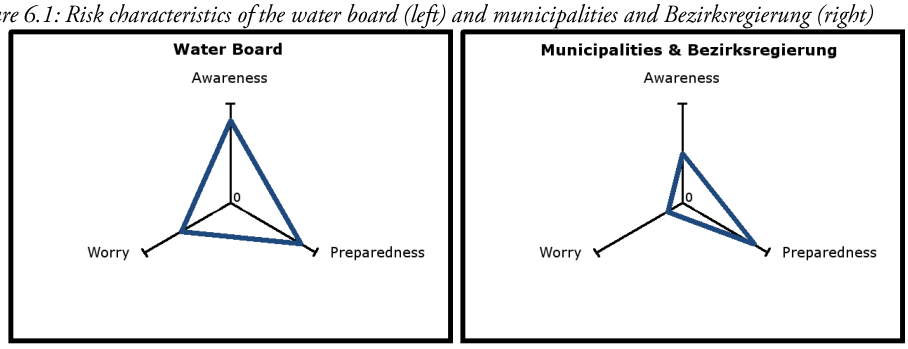
> *What are the different risk perceptions among governmental institutions in North Rhine-Westphalia?*

As explained in the introduction (section 1.8.2), mental model have been used to analyse the views the interviews had on flood risk management planning in the Lippe and Emscher region. The mental models (see appendix A3) showed some differences between the governmental institutions. When it comes to the risk perceptions of governmental institutions, there are similarities and some minor differences noticeable. The approach towards the concept 'flood risk' is nearly the same for all the governmental institutions. They all see risk as the combination of probability and potential damage. Although looking at both probability and damage, the probability of a flood event occurring is often seen as the most important determinant of defining a flood risk.
Overall, the governmental institutions do not see flood risks as a major risks. Except for the water board, which sees floods as the biggest natural hazard in the region. The water board realises the probability is low, but since the potential damage is high, the overall risks is perceived as very high. The water board bases the high potential damage mostly on the population density of the region and the surface subsidence.
The Bezirksregierung and municipalities on the other hand, mainly look at the probability when considering the risk of a flood. They see a flood event as something highly unlikely to happen. They mainly base the extend of the flood risk on the probability, which is low for the Emscher and Lippe since the dikes are calculated for flood event that occur 1-in-200 year. Since the probability is relatively low, their perception of flood risks is also low. This

low probability of a risk occurring and the low perceived risk is mainly due to the dikes. Especially the municipalities feel safe behind the dikes. This corresponds with the model of Raaijmakers et al (2008), in which a higher level of preparedness reduces the level of worry.
Some of the governmental institutions are, however, familiar with floods occurring due to heavy rainfall and are therefore more aware of the risks a flood poses. This caused flood risks to be more prioritised. Dortmund is a good example of this. They experienced a flood due to heavy rainfall in 2008 and, even though there are very few floodplains near Dortmund, therefore prioritised flood risk management. Even though it was not a river flood, the flood experience raised awareness and made them wanting to be more prepared for a flood event. It is thus not worry, but an experience that raises awareness and preparedness. Apparently, in contrast with the model of Raaijmakers et al (2008), worry has no influence on preparedness. A finding also done by Bradford et al (2012) when they used Raaijmakers' model for their research. The influence of experience on risk perception is in accordance with the representation bias of risk perception (Renn, 2008, p.103) and Luhmann's (1993) concept of the development of a systems code. In Luhmann's concept, a systems decision is based on past experiences. As long as the decision of not prioritising flood risk management does not cause negative consequences, a system uses this experience in the future. So as long as this choice has no negative consequences, the system will make the same selection every time and policy will remain the same.

When looking at the risk perception of local governmental institutions, two different risk characteristics can be distinguished (see figure 6.1). On the one hand, there is the water board, which is highly aware and prepared and also relatively worried about flood risks. On the other hand, there are the municipalities and Bezirksregierung, which feel highly prepared, but are less aware and even less worried of flood risks. According to the System Theory (Luhmann, 1993), this might indicate that these are two separate (sub)systems, which could be called a *hydrology expert system* and an *administrative system.* This can, however, not be claimed after conducting six interviews.
The difference might be explained due to the fact that hydrologists at the water board, work on flood risks on a daily basis. The administrative system, working at the Bezirksregierung and municipalities, only have flood risk management as a part-time side project and have many more topics and projects to take care of. These other topics and projects put flood risks into perspective. Therefore, the flood risk perception of bezirksregiering and municipalities is influenced by other priorities they have to deal with.
The systems make a selection of what to incorporate into their system and what meaning they give to this selection (Luhmann, 1995; 2006). Since water boards are working with water related topics on a daily basis, they are more likely to make flood risks part of their system. Since most municipalities did not have direct experience with floods and at the same time have other topics to worry about, they make a different selection in which flood risks are of less importance. This selection is, however, a risk by itself, since this it is not guaranteed that it is the right choice.

Figure 6.1: Risk characteristics of the water board (left) and municipalities and Bezirksregierung (right)



6.1.2 Change in risk perception due to planning process

> *To what extend have risk perceptions of governmental institutions in North Rhine-Westphalia changed as a result of the planning process of flood risk management plans?*

The flood risk management planning process can be distinguished in three phases.

1. Preliminary risk assessment
2. Development of risk/hazard maps
3. Regional meetings for development of the Flood Risk Management Plan (FRMP)

During the interviews, the preliminary risk assessments were not mentioned. It is thus not possible to include this phase when answering the sub-question. The other phases were discussed in detail during the interviews.

It became apparent that the development of the hazard maps was vital for the process. Their main added value during the whole process was their ability to visualize the risks and discover new floodplains. Discovering new floodplains raised the municipalities' awareness of flood risks. This raise in awareness due to new knowledge shows that a 'risk' is a social construct, which is in accordance with statements by Dake (1992), Slovic (1998), Pidgeon (1998) & Renn (1998). It is not that the risk was not there in the first place. It was already there, but since it is known, it is labelled as a risk. Although the actual situation did not change, hazard maps made governmental institutions aware and therefore changed their perspectives on the situation. The same situation is now perceived as a risk, while at first it was not.
The visualisation of risks by using hazard maps is a way to communicate the risk to the involved governmental institutions. In this case, a picture is worth a thousand words. The visualisation of flood risks also helped municipalities to involve other departments within their organisation to help defining measures. However, without additional words, a picture is not enough. Therefore, the regional meetings are necessary to discuss the meaning of the maps for the affected areas they contain. It is this combination of visualisation and discussion that makes the planning process an effective tool to raise the awareness of the governmental institutions involved. The value of visualisation is an often mentioned strength of maps in literature about GIS and PSS (see for example: Wang, 2005; Ware, 2000; Hall, 1993)The importance these two tools of risk communicating have, is in accordance with the place it has in the System Theory (Luhmann, 1995). The visualisation of flood risks by the hazard maps is one way of utterance. The meetings are another way of utterance in which it can be checked whether or not the information uttered by the hazard maps has been understood.

Some of the governmental institutions were not eager to participate in the planning process, but due to the fact that the development of the FRMP comes from a European directive and the visualisation and communication of the risks, almost every municipality is now involved in the process. It shows the status a directive gets when it is coming from the European Union.
In the previous section (section 6.1.1), the importance of flood experience on risk perception became apparent. Within the planning process, the hazard maps function as an alternative for this experience. Governmental institutions are now able to see what the consequences of a flood event can be for their area, without actually having to experience a flood event. While the important of the risk maps is being acknowledged by the governmental institutions, at the same time they say that an actual flood event is necessary to really raise the awareness of a flood risk.

The planning process only affected the level of awareness of the governmental institutions. They did not became more worried about flood risks. This is because they believe in the effectivity of the technical flood protection measures that are currently in place.

6.1.3 Risk perception of participating Vs non-participating institutions

> *In what way are risk perceptions of participating governmental organisations different from the ones that do not participate in flood risk management planning?*

Of the governmental organisations, the Bezirksregierung and water board were obliged to participate in the flood risk management planning process. For the municipalitites it was up to their judgement if they wanted to participate. The *kommunale selbstverwaltung* (local self-government) makes the municipalities more autonomous, but they are obliged to develop measures for floodplains with a flood probability up to 1-in-100 year. How the municipalities come to these measures is up to them.
It is not that they all participate in the same extent. Some only come to certain meetings and others participate in all the meetings. It is the municipalities' own responsibility how much effort they put into the development of the FRMP for their area.
Although the first observations during the regional meetings gave the impression that there were numerous municipalities that were not willing to participate in the planning process, eventually almost all of the municipalities participated. There were some municipalities that were not eager to participate, but participated after talking to the Bezirksregierung. The deliberate creation of a Prisoners Dilemma turned out not to be necessary.
An answer to the question to what extent the risk perception between participating and non-participating governmental institutions differs, cannot be given. This is not possible due to the fact that no interviews have been conducted with non-participating governmental institutions. Although an interesting question, the inability to answer it is not a major problem to answer the central question of this research.

6.1.4 Internalisation due to planning process

> *To what extend have flood risks been internalized by governmental institutions in North Rhine-Westphalia due to the planning process of flood risk management plans?*

Just like the influence of the planning process on risk perception (section 6.1.2), the influence of the planning process on the internalisation of flood risk is due to the combination of the hazard maps and regional meetings.
The hazard maps show the effectivity of the technical flood protection measures that are currently in place. At the same time, the hazard maps show which areas are flooded in case these technical measure fail. These measures show the manageability of flood risks, but also the inevitability of floods.
This inevitability is mainly based on the probability of a flood and therefor some municipalities see it as something unmanageable. They ask themselves the question "what can we do?" in the case a 1-in-200 year flood event occurs. They see the maps and come the conclusion that a lot of areas will be flooded in such a case. This is when a slight difference between engineers and geographers becomes visible. The first thing an engineer thinks about are technical solutions to prevent floods, while geographers recognize the inevitability of a flood event occurring and therefor looks for communicative solutions. It is the difference

between flood prevention and damage control. It is the distinction, made by Luhmann (1993), between seeing floods as an external danger or an internal risk.
The meetings proved to be helpful to go from flood prevention towards damage control. During the meetings it could be discussed that floods are indeed inevitable, but that FRMP's are made to reduce the risk a flood event poses. It is the bridge between seeing floods as inevitable and not their responsibility (an external danger) towards recognizing the manageability of the risk a flood events poses and the responsibility of the governmental institutions (an internal risk). Just like the influence of the planning process on risk perception, the hazard maps and meetings are the utterance between the governmental institutions. It is meant to utter information and check if it has been understood by the other governmental institutions.

Although the hazard maps and regional meetings are effective in internalising flood risks, this process is partially compromised by German law. Governmental institutions are by law only required to take measures for flood risks with a probability up to 1-in-100 years. Therefore, the extreme scenarios are completely ignored and not seen as their responsibility. This causes a strict boundary of exter- and internalisation of flood risks. It can, however, also be seen as a way to be certain flood risks will be internalised up to a certain extent. In this case, it is relatively certain flood risks will be internalised to a probability of 1-in-100 years, which would not be certain if this was not part of German law.
Another way the planning process is less effective at internalising flood risks than it could have been, is because of the overly compromised risk maps. These maps should show the potential damage a flood event causes in the case an area floods. The content the maps contain, must however be the same for all regions in Germany and therefor the content of the maps has been compromised to such an extent, that made them useless for the Lippe and Emscher region. The risk maps are completely neglected, while they could have been useful to show the extent of the damage a flood event poses to the region. Combined, the hazard and risk maps could have shown both the probability and damage of flood events, which are the main components of the definition of a risk.

6.2 Conclusion

The general aim of this research was to give an insight in the flood risk perceptions of local governmental institutions, see if the flood risk management planning process has had any influence on these risk perceptions and then use this gained knowledge to give recommendations for upcoming flood risk management planning processes. Now the answers to the sub-questions are known, it is possible to formulate an answer to the central research question and thereby give an overall conclusion for this research.

To what extent is the planning process of flood risk management plans able to internalise risk perceptions of governmental institutions?

The most important finding of this research is the importance of the hazard maps and regional meetings. By themselves, they are not enough to make governmental institutions internalise risks, but the hazard maps and regional meetings combined are very effective in achieving internalisation of flood risks by governmental institutions. Even though the municipalities are not obliged to participate, the hazard maps and meetings made them realise the manageability and their responsibility for flood risks. Although not obliged, it is expected of the municipalities that they develop the measures and in order to develop these measures, they first need to internalise the flood risks. To successfully develop a FRMP the

municipalities need to internalise the flood risk. The Bezirksregierung and water board, on the other hand, are obliged to participate and therefor do not have the choice whether or not to participate.
Risk awareness is the first step to the internalisation of a flood risk. Experience with a flood event helps to raise this awareness, but the hazard maps function as an alternative to this direct experience. During the meetings this 'alternative experience' is communicated to the involved organisations. Though aware, the governmental institutions are not worried about flood risks. In contrast to Raaijmakers' model, this research showed that worry had no influence on preparedness.
As said, risk awareness is the first step towards internalisation of risks. The hazard maps and meetings made governmental institutions aware of risks, but this does not necessarily mean they also see it as something that can be managed or as their responsibility. Some municipalities did not see floods as something manageable and due to German law, which states that responsibility only goes up to flood events with a probability 1-in-100 years. These municipalities were aware of the risks, but saw it as an external danger. The hazard maps and regional meeting can be seen as the bridge between this 'external danger' and 'internal risk'. Combined, the hazard maps and regional meetings were able to convince municipalities of the manageability of flood risks by discussing the measures that could be taken.
There are, however, still two ways flood risks are externalised. One of them is the already mentioned responsibility that goes up to a probability level of 1-in-100 year flood events. The other is the 'active externalisation' of responsibilities. There is a strict boundary in responsibilities between the water board and municipalities. These two ways of externalisation are, however, not necessarily bad. The 1-in-100 year boundary makes sure that flood risks are at least internalised up to that probability level and therefore creates some certainty in flood risks management. Also, the strict boundary in responsibilities makes sure that there is a river wide approach of flood protection and maintenance of the rivers and their technical flood protection measures (like dikes). It creates some continuity in the water management of the rivers and makes sure that downstream problems, and therefore passive internalisation, are kept to a bare minimum by taking measures upstream (like retention basins).

In respect of the used theories, the risk perception model of Raaijmakers et al (2008) and the System Theory (Luhmann, 1993), the flood risk management planning process formed the link between the risk perception and converting this perception towards action. By communicating the risks through maps and meetings, governmental institutions became more aware of and are better capable to deal with flood risks.

6.3 Policy recommendations

Based on the conducted research two recommendations can be made to further improve the flood risk management planning process.

(1) During the observations of the regional meetings, it was easily noticed that each Bezirksregierung had its own approach to conduct the regional meetings and gathering the measures the municipalities established for the Flood Risk Management Plan (FRMP). An often heard complaint by municipalities and water board, during the interviews, is the lack of one clear policy for the development of the FRMP used by all the bezirke. The water board finds it difficult to do one project in three different ways, since they have to adapt their approach in every bezirke. At the same time, the municipalities complain about the fact that they are sometimes not even able to discuss their plans with their neighbouring cities, since these neighbours are in a different

bezirke and therefor have to do their development of the FRMP in a slightly different way. This compromises mutual learning processes governmental institutions can have when discussing the development of the FRMP.
The Bezirksregierung Münster has been appointed as the main responsible bezirke for the river Emscher, but still all three bezirke have their own way of making the FRMP in their region. Münster only serves as the compiler of the measures into one document.
There are basically multiple FRMP's per river basin, which are compiled into one document. This separation of the river basin into management units based on the borders of the bezirke goes against the Flood Directive's intention to develop FRMP's on a river basin scale.

It is therefore recommended to:
Develop one specified protocol, which the management units use for the development of a FRMP
Or
Appoint one institution which not only compiles the measures into one document, but also coordinates the development of the FRMP on a river basin scale.

(2) It became evident that the risk maps are completely neglected, because they are seen as useless. During multiple interviews it has been said that the risk maps are useless because the data used for these maps is too generalised and that the municipalities have far more accurate data. The risk maps are a mandatory part of the development of the FRMP, so it is not an option not to make them. The only way to not let the development of the risk maps be a waste of time, is to use the accurate data that is available for the municipalities. It makes no sense to develop useless maps, while the necessary data to develop useful risk maps is available.
Therefore, it is recommended to use the most accurate data available, provided that this data is the same for all the municipalities in the river basin. This ensures comparability of the data on a river basin wide scale, while it is still useful when developing the FRMP.

6.4 Final remarks

This research showed the ability of social theories in explaining real life action with respect to the development of Flood Risk Management Plans. The number of interviews conducted is, however, too low to be able to actually test theories. Therefore, the insights gained by this research must be treated as merely indications based on small-scale empirical research. Further research must determine whether or not the insight gained in this research also holds in a more comprehensive research.

It must also be noted, that researching a case in another country comes with some constraints. These constraints are mainly because of differences in culture and language of the researcher and the researched case. From a System Theory point of view, this research can be seen as a second-order observation. These second-order observations can give some new interesting insights due to the fact that the case is looked at from another perspective.

During the interviews it was mentioned that the governmental institutions expect the biggest challenge is not the development of the FRMP, but communicating it to the public once it has been finished. Most of the measures developed for the FRMP are of a communicative nature. It is, however, the first time the governmental institutions in North Rhine-Westphalia do these kind of communicative measures regarding flood risks and they are not sure how to do this. They wonder how the public will respond to these measures. They recognized the development of the FRMP goes rather smooth, because all the involved people are well informed and think the same about flood risks.

The topic of the risk perceptions of the public was not a part of this research, but for future research it is interesting to get to know the risk perceptions of the public and how the risk perception of the public differs to that of governmental institutions. The theoretical approach used for this research could also be used to do research about the risk perceptions of the public. By knowing the differences in risk perception, risk communication between the government and the public can be enhanced. Bradford et al (2012) also stated that research on the risk perception of the public is necessary to develop better risk communication.

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A1

Topic list

Name:
Organisation:
Function (position + short description of main activities):
Years of experience:

What would be your definition of the term "flood risk"?

This first set of questions is about experiences with flood events and their impact on local policies.

- What is the first flood event that comes to your mind?
- Most recent flood in your region
- To what extent does a flood event have an influence on local policies?
    - To what extent is there a difference between local and non-local flood events in their influence on local policies?
    - Has there been a flood event that had a significant impact on policies? *(which one and what influence?)*
- To what extent do water management policies have an influence on other disciplines? *(e.g. spatial planning)*

The next questions are about the cause of flood events.

- Do you see flood events as manageable events or some sort of fate that will occur anyway? *(please explain)*
- What would be the main reason for a flood event to occur in your region?
    - To what extent do you think this reason is caused by humans or is it just a natural event?

The next question are about the European Flood Directive and the impact of this directive on the awareness of flood risks.

- What is your opinion about the European Flood Directive that is now being implemented? Do you see it as something useful or just more work coming from the European Union?
- Would you rather get the flood risks maps and see what to do with it by yourself **OR** have somebody explain them and let him tell you what measures to take?
- Is the process of using risk maps and meetings with different organisations on a regional scale new to your organisation?
    - Would you rather see a different approach to communicate flood risks? *(why and how or why not)*
- To what extent is there a learning process involved within the planning process? Does the communication and cooperation with other organisations lead to new insights on possible measures?
- Did the actual process cause a change in awareness of flood risks? Any difference between before and during process?

The importance of risk calculations.

- How often do you think a flood event occurs in your Region? (tomorrow, 1/10 years, 1/100 years or even less often?)
- How big is the risk of a flood of the Lippe or Emscher river?
    - Are there risks that are seen as more important than flood risk? (if yes, which risks and why?)
- Part of the Flood Risk Management Plan are the "risk maps" and "hazard maps". Are these used equally or are decisions primarily based on the hazard (height of water) or risk (potential harm) maps? *(Why?)*
- What influences decisions most: Technical expert's calculations and models or personal (in)direct experiences of policy makers?
    - Would values and fear of citizens, companies or other stakeholders be taken into account when making decisions, even if they are not rational? Why or why not? Any examples?

This set of questions is about the distribution of responsibilities of the different governmental institutions.

- Above you see a schematic cross-sectional view of a river and the areas behind the dikes. How are the responsibilities of the different governmental institutions distributed between the sections (river, dikes, build areas)?
  Please divide the sections accordingly with name of responsible governmental institution
  Should this distribution in your opinion be different? (explain)
  If yes, divide in figure below the way it should be in your opinion

- Do you see the flood risks as something that should be primarily managed by municipalities or should it be the responsibility of regional governments?
- Since rivers cross both borders of regions (bezirk) and municipalities (Gemeinde).
  Does the river-basin-wide approach of the European Flood Directive cause frictions or confusion about responsibilities of local and regional governments?
- To what extent is there a hierarchical structure when it comes to the distribution of responsibilities and work between the different layers of government?
    - Should this be different?
- Were responsibilities divided differently among governmental institutions before the FRMP process?
- Have priorities towards flood risks changed since the flood risk management planning process started?
    - What is (or could be) the influence of politics & media in the shift of priorities towards flood risks?
- How many people in your organisation working on Flood Risk Management Planning?

- Is this more than before project started? *(if yes, How much more?)*

- Do actors work together to find solutions?
  - Yes→ in what way?
  - No→ why not? Should they?
- Any unwilling actors that (in your opinion) should participate?

The Flood Risk Management Plan has to be finished in 2015. Do you expect any difficulties until then or has the hardest part already been done? *(Please explain)*

A2

List of participants semi-structured interviews

The table below contains the list of participant of the semi-structured interviews. The recordings and transcriptions of these interviews can be found on the CD at the back of this thesis.

Name:	Date of interview	Organisation
M. Leismann	6 June 2014	Bezirksregierung Arnsberg
R. Kopka	18 June 2014	City of Oberhausen
I. Lakes & J. Göttlicher	23 June 2014	City of Dortmund
G. Johann	23 June 2014	Emschergenossenschaft/Lippeverband
U. Niehoff	14 July 2014	City of Gelsenkirchen
J. Bräunling	25 September 2014	Bezirksregierung Münster

A3

Mental models of semi-structured interviews

Figure A1.1: Mental model of interview with M. Leismann (Bezirksregierung Arnsberg)

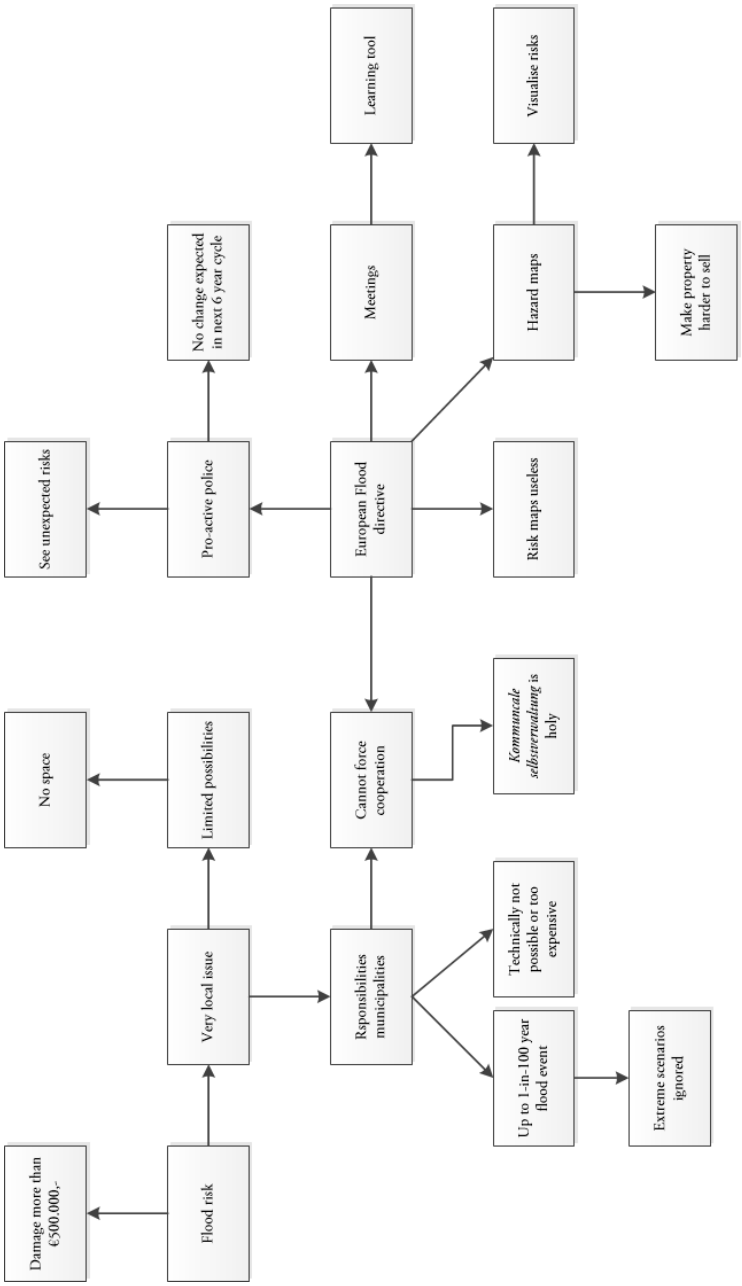

Figure A1.2: Mental model of interview with R. Kopka (City of Oberhausen)

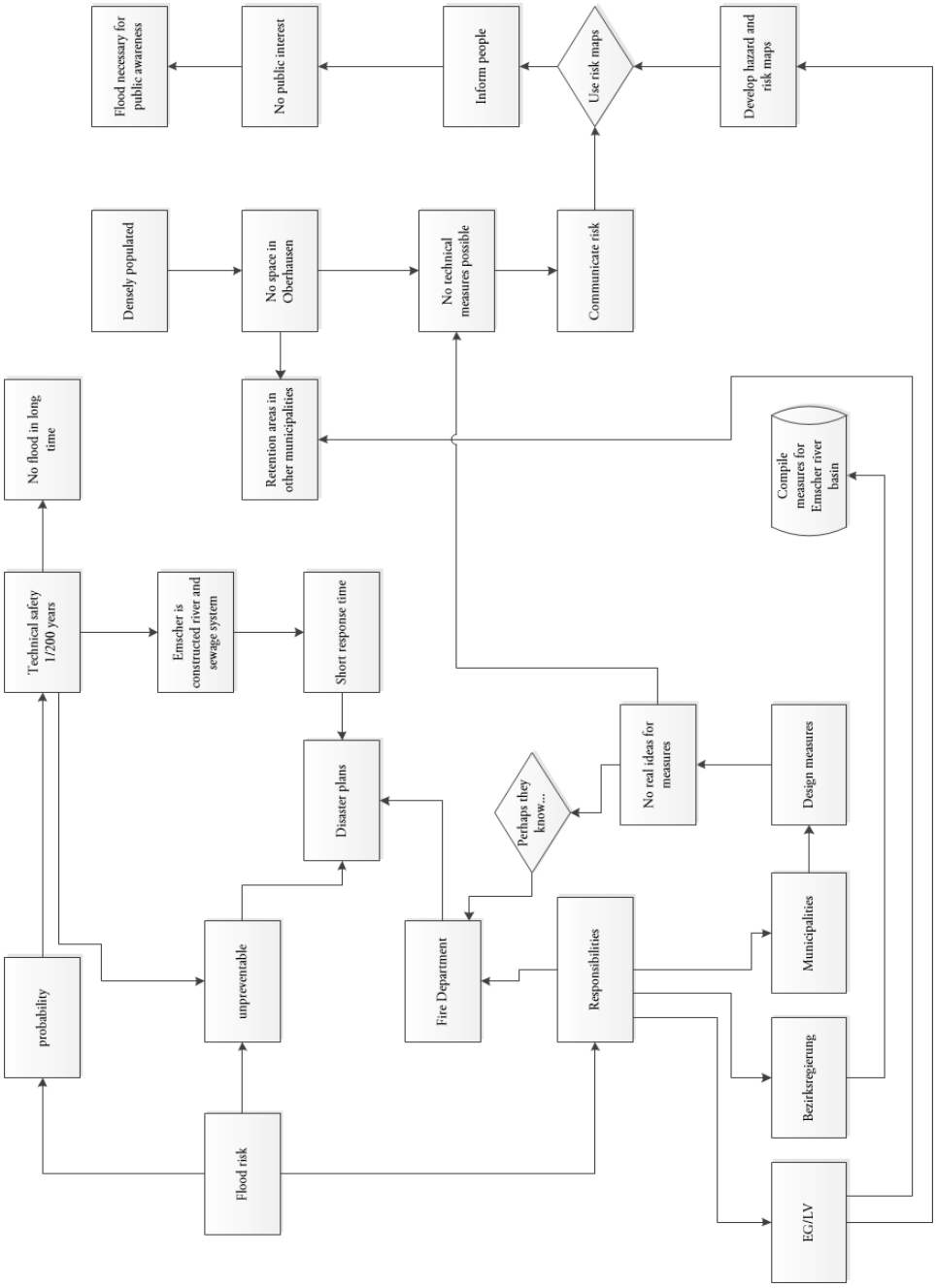

Figure A1.3: Mental model of interview with I. Lakes & J. Göttlicher (City of Dortmund)

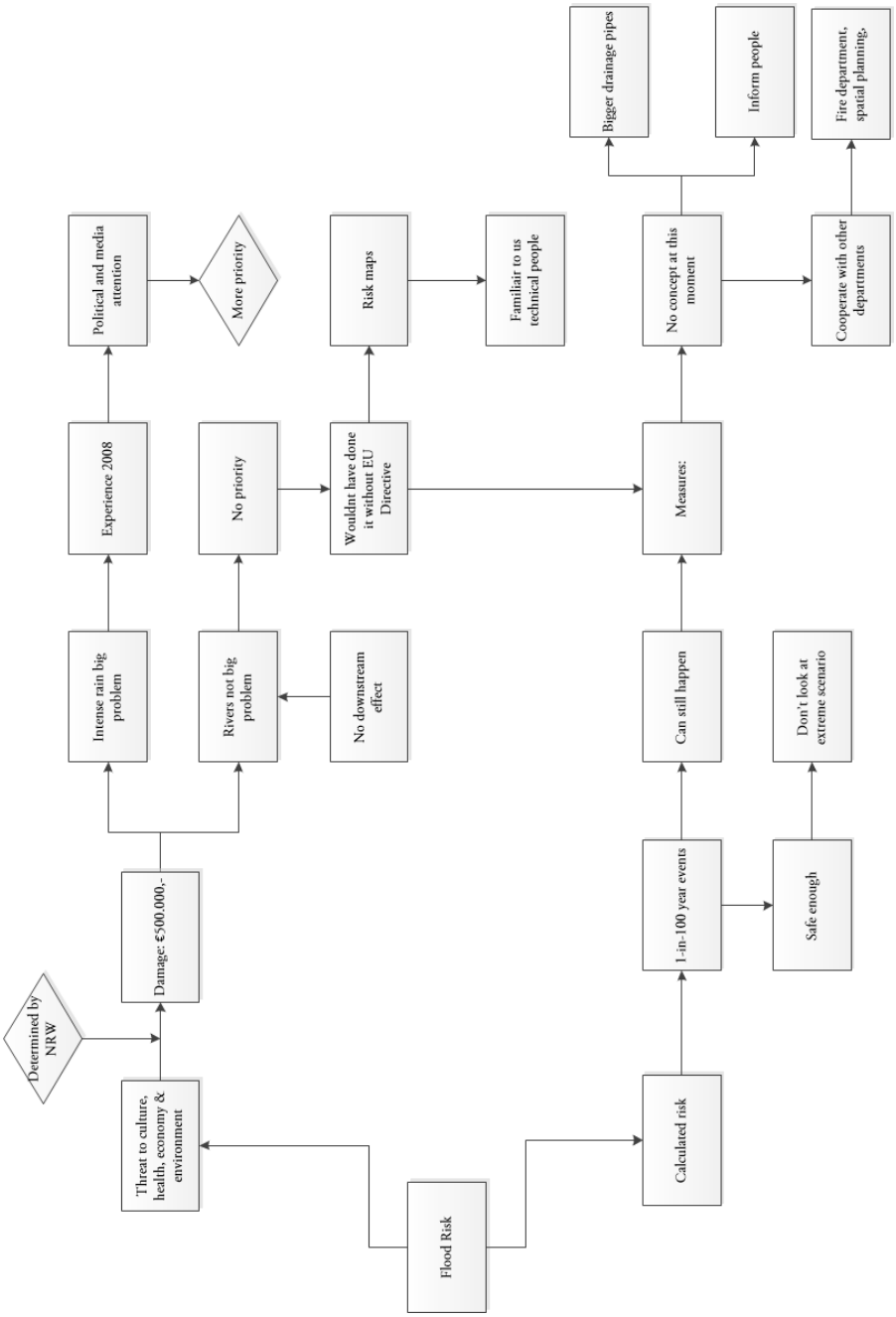

Figure A1.4: Mental model of interview with G. Johann (Emschergenossenschaft/Lippeverband)

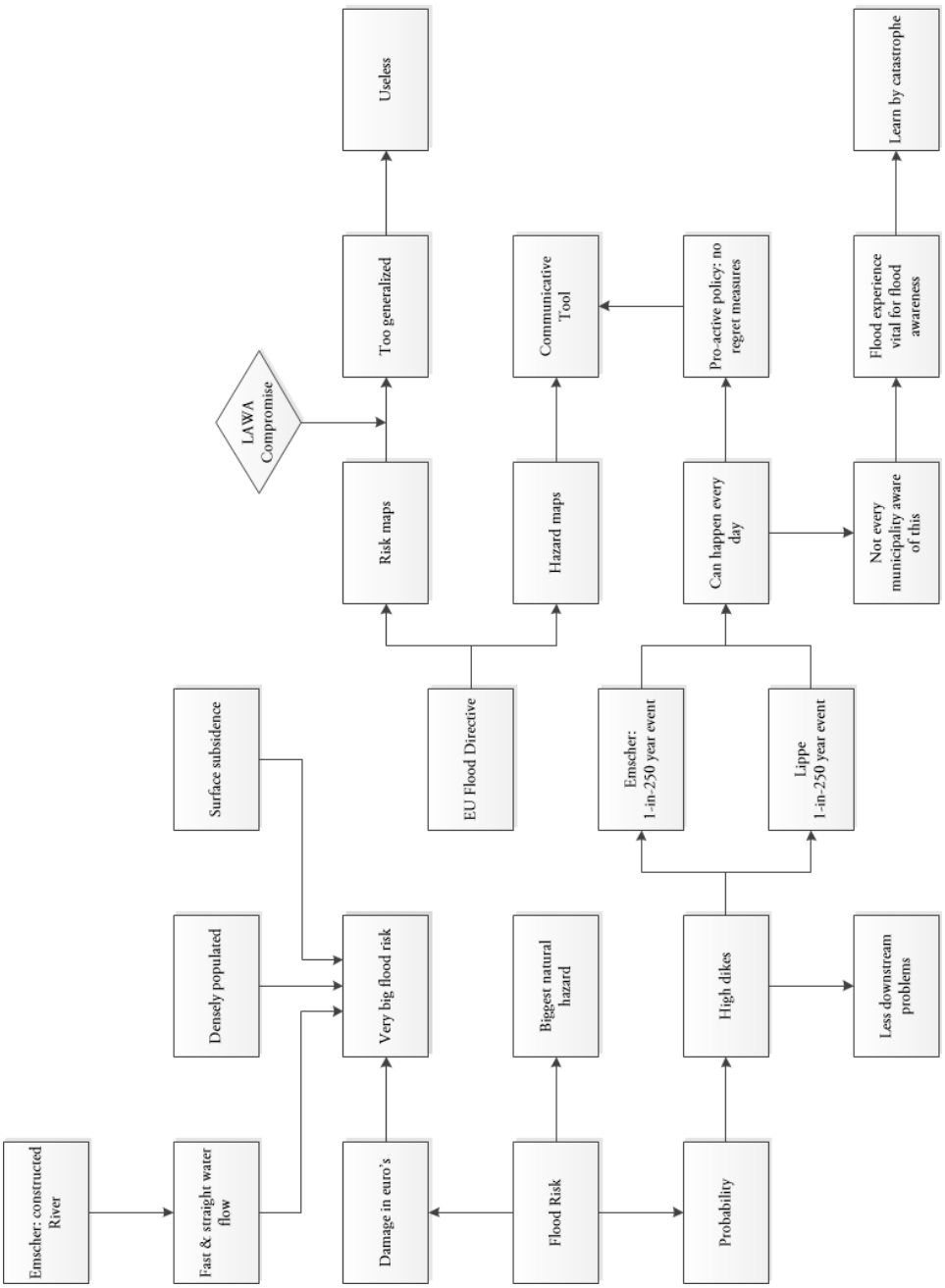

Figure A1.5: Mental model of interview with U. Niehoff (City of Gelsenkirchen)

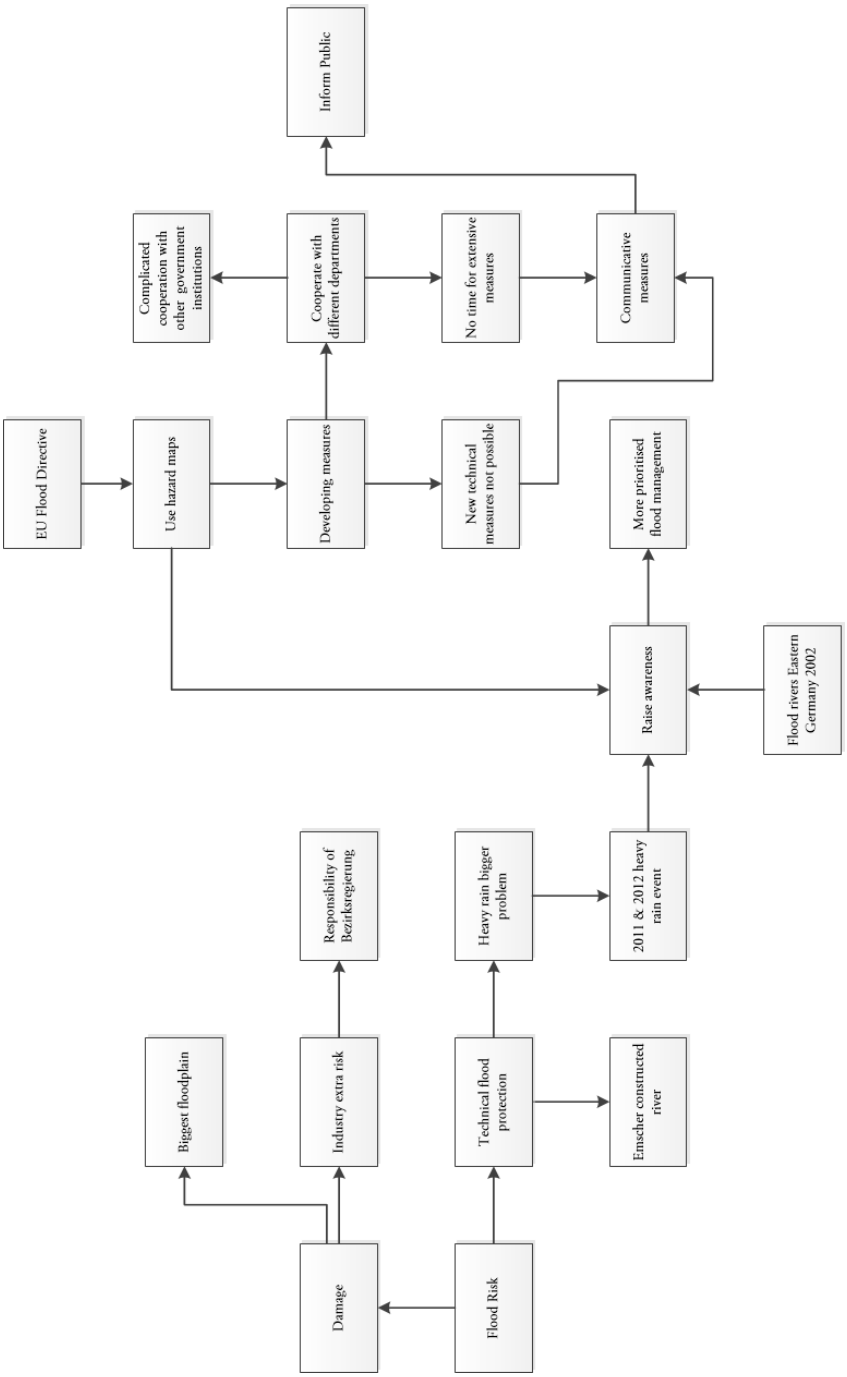

Figure A1.6: Mental model of interview with J. Bräunling (Bezirksregierung Münster)