BONDING AND BRIDGING IN CAPACITY DEVELOPMENT NETWORKS TO ADDRESS WICKED WATER CHALLENGES

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This thesis, written as a last assignment in obtaining a MSc double degree in the fields of Water Resources Management and Science Communication at Delft University of Technology, focuses on the role of social network characteristics on capacity development processes in the water sector.

Capacity development has become an increasingly hot topic in the water sector. The development of individual, organisational, institutional and even societal capacities is argued to be required to be able to addressing the present-day water challenges. From a natural resources management context, much literature is available on WHAT is required for capacity development: social learning in social networks, by means of which an integrated view of the challenges under consideration could be established, effective participation is enabled, and a resilient adaptive water system should be developed. However, HOW to achieve this is a much less considered topic in water related contexts and forms the main topic of this thesis, which centres on the following central research question:

*Which social network characteristics, with a focus on bonding and bridging mechanisms, facilitate social learning in capacity development networks that aim to address wicked water challenges?*

Combining insights from the Science Communications field and other related fields of study regarding knowledge management, social network analysis and social capital provided a framework on the important roles of bonding and bridging mechanisms in social networks and their benefits for social learning for capacity development. Bonding mechanisms are closely related to similarities between network members (also called relational proximity), while bridging mechanisms are on the contrary characterised by diversity on the relational level. Paradoxically both mechanisms, and both proximity and diversity, turn out to have important benefits for capacity development to address water challenges, which are often considered to be ‘wicked’ due to the involvement of great systems complexity, stakeholders diversity and uncertainty. Bonding mechanisms in social networks benefit the knowledge sharing efficiency, quality and frequency, resulting in a high potential for effective stakeholder participation. Cross-boundary bridges within such capacity development networks facilitate social learning by introducing novel and nonredundant knowledge into the network, enabling the establishment of an integrated multidisciplinary view on the water system and an adaptive water management approach.

This thesis concludes that a careful balance is required between bonding and bridging on the network level, proximity and diversity on the relational level, and the ‘right’ personal characteristics on the individual level. It provides a scientific basis for practical insights and recommendation for capacity developers on how to design their capacity development projects.

**Abstract**

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This thesis concludes that a careful balance is required between bonding and bridging on the network level, proximity and diversity on the relational level, and the ‘right’ personal characteristics on the individual level. It provides a scientific basis for practical insights and recommendation for capacity developers on how to design their capacity development projects.
Een jaar lang aan de slag geweest... schrijf dan maar eens een voorwoord! Zo’n 370 dagen geleden wandelde ik voor het eerst bij KWR binnen, op zoek naar een afstudeeropdracht. Wat ik daar vond was een omgeving waarin ontzettend veel mogelijk was, als het maar iets te maken zou hebben met kennisnetwerken in de watersector. Mijn eigen plan was eigenlijk om een mooie strak gedefinieerde opdracht binnen een ‘uitvoerend’ bedrijf te vinden waarmee ik de Nederlandse watersector zou kunnen verkennen. Geheel ‘onverwacht’ werd het een zeer ongedefinieerde opdracht binnen een onderzoeksinstituut waarvoor ik zo’n vijf maanden naar Duitsland ben vertrokken. Het kan gek lopen!

Laten we even teruggaan naar zeven jaar geleden, toen ik als ‘nul’ mijn eerste Mijnbouwcollege binnen wandelde: ‘Gluck Auf’! Al zeker een jaar was ik er toen vrij zeker van dat mijn toekomst in de Technische Aardwetenschappen zou liggen. Maar in zeven jaar kan er blijkbaar een hoop veranderen. Wat bezielde mij (samen met een paar andere Mijnbouwers) in ons derde studiejaar om onze vrije keuzeruimte op te vullen met een vak als Wetenschapsjournalistiek? Dat hebben onze studiegenoten zich vast en zeker afgevraagd. Maar voor mij was het de ontdekking van de eeuw, en een keuze die de rest van mijn studietijd toch drastisch zou veranderen. En wat ben ik blij dat ik hier nu sta, niet als afstuderend Mijnbouwer, maar wel als Watermanager en Wetenschapscommunicator!

En wat heb ik veel geleerd het afgelopen jaar! De wereld blijkt niet te vergaan als ik per ongeluk een paar steken laat vallen of als ik even het volledige overzicht niet meer heb. Verder is mij tiebatllen keren duidelijk geworden dat het ontbreken van een tastbaar resultaat niet per se hoeft te betekenen dat ik nog niets hebt uitgevoerd. Wat heb ik weer een hoop van de wereld mogen ontdekken het afgelopen jaar en geweldig interessante mensen ontmoet! En oja (ik moet mijzelf er steeds even aan helpen herinneren): ik heb dit project een jaar lang gedaan omdat ik het echt oprecht heel interessant vind! Ik ben hier niet aan begonnen voor docenten, voor de examencommissie, voor ouders of voor toekomstige werkgevers. Uiteindelijk was het doel altijd om zelf wijzer deze campus aflopen dan dat ik er zeven jaar geleden binnenkwam, om zelf de uitdaging te zoeken en vooral te doen wat ik leuk vind. Op het moment dat de mooie kansen zich voordeden heb ik ze met beide handen aangegrepen, als ik het gevoel had dat ik er mijn grenzen weer wat mee kon verleggen. Over het algemeen is dat een zeer voordelig uitgangspunt, omdat het uiteindelijk betekent dat niet iedere dag een feestje hoeft te zijn om toch een zeer mooie tijd te beleven. En dat is, zeker ook het afgelopen afstudeerjaar gelukt!

Wat ben ik enorm blij dat dit boekwerk hier nu ligt! Met vallen en opstaan, over bergen en door een paar dalletjes, is nu mijn afstudeerwerk klaar. Maar gelukkig mag ik door met de kennisnetwerken: een mooie baan bij KWR ligt alweer in het verschiet.
De afgelopen drie jaar heb ik twee opleidingen aan de TU Delft gevolgd: Water-management en Wetenschapscommunicatie. Of andersom: Wetenschapscommunicatie en Watermanagement. Daar ben ik nog steeds niet helemaal uit. Waar ik wel achter ben gekomen is dat het een ideale combinatie is! Eigenlijk zou een opleiding ‘Watercommunicatie’ ook geen kwaad kunnen. Er zijn zo veel vlakken waar de inhoud van mijn twee opleidingen elkaar vinden, en niet alleen dat: communicatie is naar mijn mening ook nog eens een zeer relevant onderwerp in de water-wereld. Hoe veel meningsverschillen (leidend tot een consensus in het beste geval en tot een oorlog in het slechtste geval) zijn er niet ontstaan door (meestal een gebrek aan) water? En wat voor een belangrijke rol speelde communicatie in deze gevallen? Hieronder staan een aantal gedachten die hier alles mee te maken hebben, en naar mijn idee het overdenken waard voor diegenen die hier normaals gesproken niet zo bij stil staan.

De watersector is bij uitstek een werkveld waar effectieve en efficiënte communicatie van levensbelang is; samenwerking binnen de vaak complexe waterproblematiek en de veelheid aan betrokken partijen biedt maar weinig ruimte voor misverstanden.

Onderzoek naar communicatie is gaaf, zeker vanuit een water perspectief gezien! Communicatietheorieën spreken vaak nog al voor zich, want ze verklaren gedrag dat iedereen dagelijks uitvoert of tegenkomt: met name met elkaar praten. Echter, zodra de processen worden doorgrond kunnen ze worden ingezet om allerlei doelen te bereiken: sociale acceptatie, effectieve samenwerking, kennisuitwisseling, en het gezamenlijk aanpakken van complexe problemen.

Water management is ‘subjectief’. In ieder geval kan het niet los gezien worden van subjectieve meningen en percepties van mensen. Water hoeft niet voor zichzelf gemanaged te worden; water is er gewoon en het zal er voor altijd blijven. De natuur regelt over het algemeen zichzelf wel. Water moet worden gemanaged omdat wij mensen er allerlei dingen mee willen. Om er achter te komen wat ‘goed’ management is en hoe we dat kunnen bereiken is communicatie dus essentieel.
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BONDING AND BRIDGING IN CAPACITY DEVELOPMENT NETWORKS TO ADDRESS WICKED WATER CHALLENGES
Nowadays managing our global waters is more and more focused on participation, cooperation, coordination and communication among stakeholders. However, these terms lately have obtained increasingly negative connotations, because they are often used to indicate processes that lead to high levels of frustration instead of effective capacity development. To overcome this, many practical capacity development guides have been developed to support such stakeholder management. These guides show capacity developers what they should achieve for success: establish a social network, let social learning processes take place, ensure effective communication and collaboration, etc. However, how the underlying mechanisms of these social processes work in such a water related capacity development context has not yet been topic of extensive research, even though it provides inevitable knowledge for capacity developers.

This thesis applies insights from the fields of Water Resources Management and (Science) Communication to explain how social network characteristics on various analytical levels benefit social learning processes, which are argued to be a key ingredient for capacity development in global water management. The research that is reported here was conducted as a final project in obtaining the MSc degree in Water Resources Management and Science Education and Communication at Delft University of Technology, in close cooperation with KWR Watercycle Research Institute.

1.1 Background

Capacity development has become an increasingly hot topic in the water sector and in the field of environmental sciences in general. Many researchers with a special focus on water resources management in the developing world argue that the development of individual, organisational, institutional and even societal capacities is required to be able to addressing the present-day water challenges (e.g. Blokland et al, 2009; Baser & Morgan, 2008; Ubels, 2010).
The last decades water related challenges have become more and more difficult to address. An increasing global water demand causes the need to manage the water system in such a critical way that small changes could cause huge (negative) social and economical effects. Next to this, managing the global waters is especially challenging because water is a fugitive resource, implying that upstream interventions might have great downstream (positive or negative) impacts. This combination causes the interdependencies within the water system to be often complex and opaque. Moreover, in many parts of the world society has developed into an environment where more and more (groups of) people are involved as stakeholders in water related decision-making. This leads to a situation in which many sensible and potentially clashing perspectives on the same challenges have to be taken into account in a capacity development process. And thirdly the trend is also to take into account not only the stakeholders of today, but also the future generations; current interventions should contribute to the water system’s resilience to rapid unpredictable changes in the environment, which in turn might cause a long chain of unforeseen consequences within the interdependent parts of the water system. This combination of water system complexity, stakeholder diversity and uncertainty causes water challenges to be ‘wicked’, characterized by the fact that we never know when we know enough to address them. Such wicked problems can not really be understood until a solution is tried to be formulated, have solutions are never just right or wrong, they have no stopping rule (meaning that they are never really solved from the perspectives of all stakeholders), and solving them is a one-shot operation, because there is no room for trial and error in the water system and it can not completely be foreseen what the consequences of certain interventions will be (Rittel & Webber, 1978). In this context researchers in the Water Resources Management field have concluded that an integrated, participative and adaptive approach is required to address such wicked challenges (Segrave et al, 2012:250).

Within the Water Resources Management field a group of researchers have focused on the benefits of social learning to achieve capacity development by an integrated, participative and adaptive water management approach (reviewed by Reed et al, 2010). This type of learning is called ‘social’ because it refers to a change in understanding that occurs across social boundaries and through social interactions between people. Social learning among stakeholders is argued to facilitate effective stakeholder participation, which enables the establishment of an integrated view on the water system and collective action towards interventions that improve the system’s adaptivity.

This is where the line of reasoning mostly ends; the WHAT for capacity development to address wicked water challenges is identified as social learning for an integrated, participative and adaptive approach, but HOW the mechanisms behind social learning function remains unresolved.

However, this social learning perspective on capacity development makes it very appealing to apply the concept of social networks in this context of addressing wicked water challenges. Social networks consist of individuals (i.e. stakeholders) and the relations...
between them, which could consist of friendship, professional bonds, family ties, etc. (e.g. Wasserman & Faust, 1994; Marin & Wellman, 2008). Such networks could be considered as the infrastructure for social learning, where the ties between stakeholders facilitate social interaction such as exchange of knowledge (e.g. Luijendijk & Mejia-Velez, 2005).

With this approach, social network theories, combined with insights from communications (e.g. Monge & Contractor, 2003), knowledge management (e.g. Nonaka & Takeuchi, 1994) and learning (e.g. Lave & Wenger, 1991) backgrounds could provide an understanding of the interactive mechanisms behind social learning.

Diving deeper into the field of social network analysis, social capital theories refer to two types of important social network mechanisms as regards the exchange of resources such as knowledge: bonding and bridging (e.g. Adler & Kwon, 2002; Svendsen & Patulny, 2007). These mechanisms are respectively closely related to two extremes of relational characteristics: proximity and diversity. Bonding mechanisms inherently happen in social networks that are characterized by tightly knit close and proximate relations in which individuals share many similarities, whereas social networks in which bridging is the main mechanism have loose and open structures in which very diverse people are connected. Both mechanisms and their associated network characteristics have advantages and disadvantages for the social processes that take place (Boschma, 2005; Knoben & Oerlemans, 2006), depending on the network’s objectives. For the specific case of capacity development networks that aim to address wicked water challenges, the influence of such network characteristics on social learning has not yet been investigated.

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**Figure 1.1: The context of this research assignment: bringing together the WHAT from a Water Resources Management background and the HOW from the communications background to provide useful insights on addressing wicked water challenges.**
1.2 Research objectives and questions

Combining the concepts of ‘capacity development’, ‘wicked water challenges’ and ‘social networks’, the main purpose of this thesis is to gain understanding on how social networks characteristics, with a special focus on bonding and bridging mechanisms, facilitate social learning processes that benefit capacity development to address wicked water challenges.

The main research objectives is to develop a basis from which practical insights and recommendations can be derived for capacity developers, with a focus on bonding and bridging in the social networks in which capacity should be developed. This is done:

• By developing a theoretical framework that connects the insights from different fields of study (Water Resources Management & Communication) into an overview of how bonding and bridging in social networks facilitate social learning for capacity development to address wicked water challenges.

• By assessing the theoretical framework by means of a case study, in order to find out to which degree the frame is applicable to an actual capacity development network and whether it would be a suitable basis to derive practical capacity development guidelines from. The framework combines insights from different fields of study that originate from various backgrounds; often not necessarily a capacity development and/or water related context. The study of a capacity development network aims to evaluate to which degree this motley gathering of theoretical insights is representative for a ‘real-world’ situation.

The following research questions function as a central thread running through the thesis:

Which social network characteristics, with a focus on bonding and bridging mechanisms, facilitate social learning in capacity development networks that aim to address wicked water challenges?

1. How could capacity development networks be defined and what should be their outcomes, considering the focus on addressing wicked water challenges?

2. What is the role of social learning in capacity development networks?

3. How do bonding and bridging mechanisms, including the social network characteristics with which they are associated, facilitate social learning processes in capacity development networks aiming to address wicked water challenges?

4. Which other network characteristics, apart from those related to bonding and bridging mechanisms, should be taken into account in this context of social learning in capacity development networks for addressing wicked water challenges?
In order to achieve the research objectives and answer the research questions, a two-stage research approach was applied. The first stage consists of a literature review, resulting in the theoretical framework (first research objective). In the second stage the case study was conducted to assess the theoretical findings in a real-world context and evaluate to which degree the framework could be used to derive practical insights from for capacity developers (second research objective).

1.3 Methodology

In order to achieve the research objectives and answer the research questions, a two-stage research approach was applied. The first stage consists of a literature review, resulting in the theoretical framework (first research objective). In the second stage the case study was conducted to assess the theoretical findings in a real-world context and evaluate to which degree the framework could be used to derive practical insights from for capacity developers (second research objective).
In the first stage scientific articles, books, research reports and conference papers were reviewed that were relevant to the topic of this thesis. The key words ‘capacity development’, ‘water management’, ‘social learning’ and ‘social networks’ were used and extended to collect (mostly scientific) insights for the creation of the theoretical framework about how bonding and bridging mechanisms and related social network characteristics facilitate social learning for capacity development to address wicked water challenges.

The case study, aiming to assess the theoretical framework, was focused on the Safe Use of Wastewater in Agriculture project, a capacity development initiative of UN-Water. UN-Water is a United Nations inter-agency mechanism that aims to strengthen coordination and coherence among UN entities dealing with issues related to all aspects of freshwater and sanitation. The Safe Use of Wastewater in Agriculture project consists of a series of Regional Workshops, initiated by the UN-Water Decade Programme on Capacity Development (UNW-DPC), jointly organized by a group of UN-Water members and partners, and attended by government officials and researchers from the various relevant ministries and research institutes in developing countries and countries in transition. The project’s objectives are to create awareness and induce action on the national level regarding safe application of wastewater in agriculture (considering health and environmental impacts) and to facilitate sharing of knowledge and best practices among countries. Furthermore it aims to establish an international social network for the longer term that supports capacity development at the national levels. The case study comprises two of the five Regional Workshops within the Safe Use of Wastewater project as sub cases: the 1st Regional Workshop in Morocco for Francophone African countries, and the 2nd Regional Workshop in India for West Asian and Middle Eastern countries.

Surveys were used as the main method to collect data for the case study, complemented with insights from the researcher’s observations during the workshops to give the survey results more relief and depth. The survey questions and focus points for the observations were based on the theoretical framework in order to be able to match the case study results to the theoretical results. Data was collected in total from 45 workshop participants, which implies that the case study results do not allow extensive quantitative analysis. However, the surveys were a fitting method for a systematic comparison among individual and relational network characteristics and outcomes and different types of questions (combined with the observations) provide a good source of qualitative insights into the relevant processes.

Figure 1.4: The poster of the 1st Regional Workshop on Safe Use of Wastewater in Agriculture in Marrakech, Morocco.
Chapter 1    Introduction

The starting points of this thesis, being a graduation assignment for two MSc programmes at Delft University of Technology, are the fields of Water Management and Science Communication. The interest in the value that these fields can contribute to each other determined the topic of this thesis to a large extent. This paragraph introduces the researcher’s perspective on these two scientific fields and the positioning of the thesis topic herein, aiming to clarify the chosen focus and basic assumptions that lie at the basis of this report. Chapter 6 (Discussion) reflects on the relative positioning of the fields that is proposed in this paragraph, taking into account the research results.

The Water Management field combines insights from hydrological studies, about the movement, distribution and quality of the global water system, and management studies, about resource planning to achieve specific goals. The Communications field combines insights from psychological studies, about the human behaviour, and sociological studies, about human social interaction. The main focus of Water Management is on the complex interdependencies within the water system and that the main focus of Communication is on social systems of human interactions. However, the water system is generally considered to also involve stakeholders as ‘social actors’, and it is generally accepted that the communicators’ context cannot be seen separately from the communication processes themselves. This is where the two fields meet. Thus, combining these two fields of study results in valuable insights for both of them, providing the Water Management field with knowledge on relevant social interaction processes that influence the system’s management, and providing the Communications field with a context in which communication processes are essential.

1.4 Positioning

Figure 1.5: Positioning of this thesis in the overlap of the Water Resources Management and Communications fields.
This added value is particularly obvious when considering the social process of capacity development with the objective of addressing wicked water challenges. Where the water system and its management challenges and capacity development approaches (including social learning) are studied within the Water Management field, Communication studies closely relate to the mechanisms behind social learning as social interactions within social networks. The positioning of these disciplines, with the concerned thesis topic as a combination of both is visualized in figure 1.5.

![Figure 1.5: Visualizing the positioning of disciplines related to social learning and communication.](image)

The terms of ‘communication’, ‘interaction’, ‘knowledge sharing’, ‘learning’ and ‘social learning’ are all used in this report, referring to different concepts. How these terms are relatively positioned is shown in figure 1.6. The figure differentiates between processes that happen within an individual and social processes that happen between individuals (e.g. in a social network).

The concept of communication is defined here as the act of sending and receiving messages (e.g. thoughts, ideas, or information) by certain message carriers (e.g. speech, visuals, signals, writing, or behaviour). This definition is freely translated from classic communications literature (e.g. Weaver & Shannon, 1963). Communication is considered to happen between people, and is thus located completely within the social network part of figure 1.6. However, communication can be one-way (in which one actor is just sending and the other is just receiving) or two-way (in which both actors are sending and receiving, also referred to as ‘interaction’). Especially this two-way type of communication is considered in this thesis.

![Figure 1.6: Relative positioning of the concepts 'communication', 'knowledge sharing', and 'learning'. 'Social learning' could conceptually be defined as the overlap of these.](image)
The concept of knowledge sharing comes from knowledge- and organisational management literature. It refers generally to communication of knowledge (including information, skills, attitudes and experiences) aiming to achieve a specific objective, and could as such be considered a sub concept of communication. Like communication knowledge sharing can refer to a one-way or two-way transfer of knowledge. Within organisational management literature, knowledge sharing is mostly referred to as an instrument or means to achieve the organisational objectives (e.g. Nonaka & Takeuchi, 1995). The term can also be found in capacity development literature, referring to the central social process to achieve capacity development objectives (e.g. Luijendijk & Mejia-Velez, 2005). The latter interpretation is followed in this thesis.

The concept of learning is historically developed from a psychological background and is generally defined as the process of establishing a change in understanding (e.g. Reed et al, 2010). Considering learning theories, learning is sometimes referred to as a process that happens within an individual, whereas others argue that learning happens between individuals. Considering the idea that learning happens between individuals, this could happen to achieve specific development objectives by knowledge sharing, or by communication that is not directed towards a specific goal. A combination of these insights results in the relative position of the learning concept as shown in figure 1.6.

Social learning is defined as the establishment of a change in understanding that is situated in a wider social unit (crossing social boundaries) and happens through social interaction. This refers only to two-way interaction, intentionally by a knowledge sharing process or unintentionally by serendipitous communication, and collective learning in the social network. This positioning of social learning relative to and within the other fields of study is shown as a blue area in figure 1.6.

Combining insights and theories from multiple fields of research is one of the major strengths of this thesis; it shows how concepts that were earlier studied within the different research fields of water management and communication can be combined to develop useful and interesting insights regarding the topic of capacity development in the water sector. However, at the same time it is also one of the major challenges. Different fields of study operate from different perspectives that originate from different backgrounds. Researchers apply different terms and definitions while referring to similar concepts. To prevent conceptual misunderstandings or ambiguity, each of the relevant concepts are redefined for the purposes of this thesis, and shown in coloured boxes throughout the following chapters.

1.5 Relevance for two scientific fields of study

This research was done as a graduation assignment for the MSc programmes of Water Management and Science Communication at Delft University of Technology. Next to the fact that it aims to show that the two fields of study could complement each other, as
stated in section 1.4, this research is relevant for both disciplines for a couple of other reasons.

Water Resources Management focuses on the management of water systems. It has a physical component, relating to the behaviour of the water cycle itself, but recently the social components relating to the behaviour and interactions of/among the involved stakeholders get increasingly more attention. While it is presently generally agreed on that these social aspects of the water system are important to consider in management and decision-making, it is still a big scientific leap to the understanding of social mechanisms that underlie stakeholder networks and determine to which degree social learning (that enables participation, cooperation and coordination) takes place. This research aims to provide insights into such mechanisms and characteristics (with a focus on social learning for capacity development), because these social processes that are so closely related to proper management of the water system can only be managed when their underlying properties are understood.

For the Science Communication field this thesis also comes with some relevant insights. It is always the question how communication processes can be analysed properly, to be able to come to conclusions on how they can be improved. To study and analyse the social interactions, this thesis uses a social network perspective that distinguishes between characteristics on multiple analytical levels. The influence of characteristics on the individual level, as well as on the relational and on the whole network level are considered to explain social interactions (and specifically social learning for capacity development to address wicked water challenges) between the members of the network. This perspective provides a systematic way to analyse the full social context of communication processes.

1.6 Road map

This report is divided into three parts (see figure 1.7). Part 1 centres on the first research stage in which the theoretical framework was developed. The case study is the focus of Part 2. The conclusion, discussion and recommendations are presented in Part 3.

Part 1 consists of one single chapter (chapter 2), which presents the theoretical framework on the role of bonding and bridging networks facilitate social learning for capacity development with the objective of addressing wicked water challenges. The framework is developed step by step, and accordingly presented by the consecutive sections of chapter 2.
Part 2 describes the case study and contains chapters 3 and 4, respectively elaborating on the case study methodology and its results. Chapter 3 presents the reasons for choosing the case study methodology, including relevant considerations that were made, followed by a detailed description of the Safe Use of Wastewater in Agriculture project as the case under study. Lastly, chapter 3 is closed off showing the selected research methods and instruments and the operationalisation of the theoretical framework. The results of the case study are described in chapter 4, containing a section for each part of the theoretical framework.

Part 3, lastly, is all about the conclusions that can be drawn from the results that were obtained from the first two parts and their discussion. Chapter 5 presents the answers to the research questions, as far as the research results allow. The applied research methods, as well as the results, the research relevance and recommendations for future research are discussed respectively in the consecutive sections of chapter 6.
PART 1

THEORETICAL FRAMEWORK
This chapter presents the step-wise development of a theoretical framework as a theoretical approach to answer the research questions that were posed in Chapter 1, led by the central question:

Which social network characteristics, with a focus on bonding and bridging mechanisms, facilitate social learning in capacity development networks that aim to address wicked water challenges?

The (sub) research questions (see Section 1.2) focus on the required nature of capacity development networks as regards addressing wicked water challenges, the reasons why a focus on social learning in these networks is valuable, and the social network characteristics that have a major influence on the social learning process. Much research was done and many scientific articles and reports were written on these topics. Literature on different topics and from different backgrounds, such as ‘capacity development’, ‘integrated water management’, ‘learning’, ‘knowledge management’, and ‘communication’ was combined to create insights that will help to answer the research questions from a theoretical perspective.

Figure 2.1 shows a road map of this chapter, and represents the theoretical framework in its basic form. The first section (2.1) elaborates on the applied methodology and the sources that were used. Different views on the main concept of this thesis, ‘capacity development networks’, related to the focus of this thesis are presented in the second section (2.2). Next the considered context of capacity development networks is discussed: wicked water challenges (2.3). After this the reasoning behind the choice for a focus on social learning is clarified (2.4). From here it follows how a critical balance between the paradoxical bonding and bridging mechanisms is required in capacity development networks that aim to address wicked water challenges (2.5). Furthermore the considered literature indicates some elements that are less directly related to bonding and bridging,
which are presented in the next section (2.6). The last section (2.7) presents the final theoretical framework about the benefits of bonding and bridging mechanisms and their associated social network characteristics in capacity development networks, from a context of wicked water challenges.

Figure 2.1: A road map for chapter 2, which describes step wise how a framework was developed to answer the central research question from a theoretical perspective.
This chapter reviews various sources of literature containing useful findings for the fundamental basis, perspectives and conceptual framework of this thesis. According to Van der Sanden & Meijman (2004) there are no general conventions for conducting a literature study, and in order to prevent ‘random’ and incomplete literature reviews they developed a systematic method for reviewing literature, to increase reliability and accountability of the results. Especially in a case where many relevant insights are derived from multiple disciplines and field of research, Van der Sanden & Meijman (2004) argue that a thorough approach for literature studies and a systematic method is required “to help ensure that the choices one makes are based on studies that, in turn, are based on sound theories and not on reflections”. Within this research project their recommendations were applied for a systematic way of searching for and reviewing relevant literature.

The literature search process developed parallelly with the statement of the creation of the thesis’ story line and research questions. While getting more insights into capacity development processes and social networks, it became clear how social learning is a key

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**Figure 2.2: The contours of a two-phased model for systematic literature review (Van der Sanden & Meijman, 2004).**
concept in this regard. Relating this to the characteristics of the wicked challenges that exist in the water sector the focus moved ‘deeper’ into bonding and bridging network mechanisms, which are respectively paradoxically related to proximity and diversity on the relational level, and have both relevant benefits for capacity development in this water related context. This resulted in an approach where multiple cycles of literature search and review followed each other up, each time focusing on different (combinations) of keywords and concepts.

Van der Sanden & Meijman (2004) focus on the literature review process from a medical scientific background and describe such a cyclical process in three steps (referred to as ‘phase 1’ in figure 2.2):

1. Selection of relevant keywords, scientists and journals that might lead to an answer on the posed research questions.
2. Search for scientific articles from the starting points that were defined in step 1. This step may lead to new keywords, scientists and journals that are relevant for the research project, leading to a new search cycle starting at step 1.
3. Search for primary literature, such as congress papers, theses and research reports, in which the relevant researches and their outcomes and conclusions are elaborated on in more detail. This step may also lead to new subjects, keywords, persons and journals, which lead back to a new searching cycle from step 1.

The search cycles that were completed for this literature review chapter are visualized in figure 2.3
The second phase of literature review process is the selection process. By checking the quality (consisting of reliability, validity and informational value) of the sources it could be determined whether they are usable for incorporation in the framework. An overview of the quality of the most central literature that was used to construct the theoretical framework is presented in appendix A.

2.2 Capacity development networks

Although there are many views on what capacity development is and what its characteristics are, still little attention went to understanding underlying structural and content related patterns and dynamics in capacity development networks. Over the last decade there has been growing interest in the concept of capacity development, especially in relation to developmental work; it is considered a fundamental ingredient of development effectiveness (Baser & Morgan, 2008). The concept of capacity development appeared in the late 1980s and became a buzzword of development in the 1990s (Vincent-Lancrin, 2009). In this period there was a shift from traditional development aid to capacity development, emphasizing the need to build development on indigenous resources ownership and leadership; “give someone a fish and he eats for a day; teach someone to fish and he can feed himself for a lifetime” (Vincent-Lancrin, 2009).

Generally it is argued that capacity development is a social process that occurs within social networks. Although there are many views on what capacity development is and what its characteristics are, still little attention went to understanding underlying structural and content related patterns and dynamics in capacity development networks. The focus of previous research has been more on the output and outcomes of capacity development processes and on practical guidelines for effective capacity development, but a scientific basis oftentimes still lacks.
This section first analyses the concept of capacity development (2.2.1), after which is considered why capacity development occurs inherently in social networks (2.2.2). A closer look on social networks and how they can be analysed is presented at the end of this section (2.2.3), leading to the first step of the theoretical framework (2.2.4).

2.2.1 Capacity development

Within the context of this thesis capacity development is defined as changing a social system’s capacity, which is emerging from its members’ competencies and their collective capabilities, in such a way that it is better able to identify, understand and address its challenges.

There is no broadly accepted definition of capacity development. In general it is about changing the capacity of a social entity so that it is better able to address its challenges, but there exist as many definitions of the concept as there are contexts in which capacity can be considered (table 2.1). The definitions vary depending on whether the focus is on the substance itself, the sources or the effects of capacity development.

Within the context of this thesis capacity development is defined as changing the capacity of a social system, which is emerging from its members’ competencies and their collective capabilities, in such a way that it is better able to identify, understand and address its challenges.

<table>
<thead>
<tr>
<th>SOURCE</th>
<th>CAPACITY DEVELOPMENT DEFINITION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alaerts &amp; Kaspersma (2009)</td>
<td>Development of the capability of a society or community to identify and understand its development issues, to act to address these, and to learn from experience and accumulate knowledge for the future.</td>
</tr>
<tr>
<td>Baser &amp; Morgan (2008)</td>
<td>Developing that emergent combination of individual competencies and collective capabilities that enables a human system to create value.</td>
</tr>
<tr>
<td>OECD (2006)</td>
<td>The process whereby people, organizations and society as a whole unleash, strengthen, create, adapt and maintain capacity over time.</td>
</tr>
<tr>
<td>GTZ (2006)</td>
<td>The process of strengthening the abilities of individuals, organizations and societies to make effective use of the resources, in order to achieve their goals on a sustainable basis.</td>
</tr>
</tbody>
</table>

*These definitions are derived from definitions of the term ‘capacity’ (see Alaerts & Kaspersma (2009) for an overview) and interpretations of the term ‘development’.*
Table 2.2 contains the decomposed overview of the capacity development definitions by much-cited sources. Most definitions of capacity development include clarifications on what is understood by ‘capacity’, by ‘development’ and what is considered as the goal or purpose of capacity development. The following paragraphs analyses the differences and similarities between the definitions.

**Capacity**

The past decades many definitions for capacity in the context of capacity development were coined by authors from various disciplines. Overviews of this are made by several recent reviewers (e.g. Ubels et al, 2010; Alaerts & Kaspersma, 2009; GTZ, 2006; Baser & Morgan, 2008). The most extensive definition (not included in the table) is provided by Baser & Morgan (2008). They identified five central characteristics of capacity from a large series of capacity development case studies within the ECDPM framework:

- Capacity is inherently a **systems phenomenon**; it is an emergent property, or the effect of multiple interactions. It is the outcome of a complex interplay of attitudes, assets, resources, strategies and skills, both tangible and intangible, with technical, organisational and social aspects.

- Capacity has to do with **collective action**. Collective capabilities are what allows social (sub)systems to do something intentionally over a certain period of time and with effectiveness.

- Capacity is a **potential state**. It is about latent as opposed to kinetic energy, where actual performance of a social (sub)system could be considered as kinetic energy. This makes capacity hard to measure and to manage, since it is an intangible condition.

- Capacity is about **empowerment and identity**, properties that allow (part of) a social system to be aware of itself, to grow, survive and become more complex in a conscious manner.

- Capacity, in this developmental context, is about the **creation of public value**.

Ubels et al (2010) suggest that capacity is “the ability of a human system to perform, sustain itself and self renew”. They argue that capacity is a dynamic property, that it is about creating added value (perform), about staying alive and active (sustain), and about adaption and development over time (self-renew). Essentially this closely relates to Baser & Morgan’s (2008) overview.

Many capacity development definitions however try to clarify the term ‘capacity’ by differentiating between ‘competency’, ‘capability’ and ‘capacity’, often without going further into the exact meanings and differences of/between them. However, the combined use of these words emphasizes how capacity development is inherently a systems phenomenon.
phenomenon, as was concluded by Baser & Morgan (2008). Ubels et al (2010) adopt an interpretation of a relationship between these terms (after Morgan, 2006) in considering competencies and capabilities as components of capacity: “competencies are the specific abilities of individuals. Capabilities are specific abilities of the organisational (sub)system concerned. Both underpin and contribute to the overall capacity of a system. In other words, they can be considered as smaller sub-components of capacity that interact in complex ways”.

Furthermore it is worth noticing that the capacity development definitions in table 2.1 refer to different levels of analysis of the considered social system, by using the terms ‘society’/’community’, ‘individual’/’collective’, and ‘people’/’organizations’/’society’. This is more extensively discussed in section 2.2.3.

### Development

As can be observed from these definitions there are multiple interpretations of the term ‘development’ in ‘capacity development’. The term mostly refers to positive development (e.g. ‘improvement’, ‘enhancement’, ‘building’ and ‘strengthening’) and neutral development (e.g. ‘change’), but could theoretically even refer to negative development (e.g. ‘deterioration’, ‘decline’). Without further ado about the terminology, this thesis assumes that capacity development is about a social system’s intention to change towards a situation in which the set development goals can be addressed, or in other words: positive development.

<table>
<thead>
<tr>
<th>CAPACITY</th>
<th>DEVELOPMENT</th>
<th>GOAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alaerts &amp; Kaspersma (2009)</td>
<td>The capability of a society or community</td>
<td>Development</td>
</tr>
<tr>
<td>Baser &amp; Morgan (2008)</td>
<td>The emergent combination of individual competencies and collective capabilities</td>
<td>Development</td>
</tr>
<tr>
<td>OECD (2006)</td>
<td>Capacity of people, organizations and society as a whole</td>
<td>Unleash, strengthen, create, adapt and maintain</td>
</tr>
<tr>
<td>GTZ (2006)</td>
<td>The abilities of individuals, organizations and societies</td>
<td>Strengthening</td>
</tr>
</tbody>
</table>
**Goal**

Most definitions of capacity development suggest that capacity development is never considered without a goal for which it is needed to develop a social system’s capacity. Ubels et al (2010) emphasize the importance of never considering capacity without considering its objectives: “One can and should always ask: capacity for what? (...) The actual capacity that a system has simply expresses itself as the concrete level of performance, sustainability and renewal that it displays in its current reality and in its concrete area of activity”. The definitions in table 2.2 formulate such objectives as identifying, understanding and addressing the development issues, enabling a human system to create value, or to make effective use of resources. The goal that is considered in this thesis is related to the field of Water Resource Management: addressing wicked water challenges (see section 2.3).

**2.2.2 Applying a social networks perspective**

Considering the fact that capacity is the property of a social system and that it emerges from a synergy between the properties of the system’s parts (individual competencies and collective capabilities), it is very seductive to apply a social network’s paradigm to analyse capacity development processes.

As was mentioned in 2.2.1 capacity development literature distinguishes capacity on different levels by using terms that refer to different levels of the social system, such as ‘people’, ‘organizations’, ‘society’, ‘community’ or ‘individual’ and ‘collective’. However, a system’s capacity is not necessarily just about the competencies and capabilities as observed on these different levels, but also especially about the synergy between these various sub units of a social system; the capacity lives essentially between these actors, instead of within (Ubels et al, 2010). This is also emphasized by OECD’s (2006) use of the term ‘unleashing’, which indicates that a system’s capacity develops or emerges from a certain configuration of the individuals and relations within a social system. According to Alaerts & Kaspersma (2009), capacity development is a very complex process and full of interconnections between multiple individuals and groups of individuals. This complexity and interconnectedness results in the fact that a study about the nature of the parts (i.e. the individual competencies) does not necessarily lead to a correct understanding of the whole (i.e. the relational characteristics and/or collective capacities). The whole system’s capacity is more than just the sum of the competencies and capabilities of the parts; it includes some emerging properties that cannot be attributed to separate social entities.

Considering the fact that capacity is a social system’s property and that it emerges from a synergy between the properties of the parts (individual competencies and collective capabilities), it is very seductive to apply a social network’s paradigm to analyse capacity development processes.
The network perspective is also useful to look at capacity development as being a two-way interactive approach that requires some sort of coordination to effectively communicate knowledge through the system. After all, capacity development is about connecting all relevant actors within a social system for cooperation and coordination to achieve the development objectives (Luijendijk & Mejia-Velez, 2005). Ubels et al (2010) argue that no matter how skilled or knowledgeable individuals are, the capacity of the social system cannot be improved if these knowledge resources cannot be coordinated for the collective good. In the present complex world we live in it is not possible for one single (group of) actor(s) to arrange such coordination; cooperative interactivity in a social network is required for this. This interactivity for capacity development is also subject of Engels’s (1997:239) reportings. He states that one of the main problems constraining the development of sustainable solutions is the one-sidedness of many communication processes in cooperative contexts. Many traditional capacity development theories and practices promote linear and exclusive ways of thinking and one-dimensional ‘rationalization’. However, more recent insights offer the view that capacity development should be approached as a process of interplay among social actors from relevant social practices (Luijendijk & Mejia-Velez, 2005). This might lead to the gradual development of a pattern of more or less durable relationships among a number of social actors who perceive each other as relevant, or in other words: a capacity development network.

Within capacity development literature social networks are especially seen as a ‘social fabric’ or a ‘infrastructure’ for communication, knowledge sharing and learning. Section 2.4 elaborates further on this topic. However, from this view Creech & Willard (2001:150) summarize four fundamental drivers behind the interest in the network perspective for capacity development (as reported by Luijendijk & Mejia-Velez, 2005):

- The emergence of ICT in the 1980s and 1990s has made (global) networking much easier. Global information exchange and learning with people from different parts of the world has become accessible for large parts of the world.

- A sense of urgency: the growing complexity and inter-relatedness of major social, economic and environmental problems and the failure of some of the former approaches to solve issues like HIV/AIDS, environmental degradation and poverty alleviation makes multi-stakeholder and widespread learning unavoidable and highly needed.

- A sense of frustration: among public and academic actors because of the lack of impact that relevant research has had on public policy recently.

- Due to the private sector experiments with knowledge management and the impact on the private sector, the public sector and civil society organizations have also become interested in it.
2.2.3 Social networks defined

A social network is formally defined by Wasserman & Faust (1994) as ‘a set of network members that are connected to each other by one or more types of relations’. A social network perspective enables the possibility to analyse processes that influence capacity development on multiple analytical levels.

When referring to social networks, presently this term is often interpreted as an online platform, such as Facebook, LinkedIn or Twitter, that facilitates the building of connections among people who for example share interests, activities, backgrounds, or real-life connections. However, within the scope of this thesis the concept is viewed in a broader perspective. ‘Social network’ is formally defined by Wasserman & Faust (1994) as “a set of network members that are connected to each other by one or more types of relations”. Social networks are often visualized as ‘nodes’ representing the social actors (e.g. individuals or organizations) that are connected to each other by ‘ties’ representing the relations between them (see figure 2.5).

A social network perspective enables the possibility to analyse processes that influence capacity development on multiple analytical levels (see figure 2.6). On the lowest analytical level the individual actors with their competencies (i.e. knowledge, skills, attitudes, motivations, experience, etc.) are subject of analysis. One level up considers the properties of the relations that are established between those actors. These relational properties emerge (partly) from the combination of individual properties. The third analytical level puts a whole network (or cluster) under analysis to investigate the resulting relational structure and contents. Different network configurations with different relational and individual characteristics lead to a different capacity of the social system under study.
The science that analyses these multiple analytical levels of social networks and especially the interrelations and synergy between the network’s characteristics on those levels is called Social Network Analysis. The starting point of this practice is the premise that social life is created primarily and most importantly by relations and the patterns formed by these relations (Marin & Wellman, 2011). Furthermore it is argued that causation is not located in the individual, but in the social structure.

These assumptions fit very well to the perception that the capacity of a social system is more than the sum of the individual competencies. This could be illustrated by the game of Boggle, a word game that is played using a plastic grid of lettered dice, in which players attempt to find words in sequences of adjacent letters (see figure 2.7). Only when the dices show the right letters (when the actors have the right competencies) and when the letters are placed in the right configuration (when the right relationships are established among the actors), the right word can be found in the letter grid (the right capacity is developed to achieve the development goals).

Figure 2.6: The three analytical levels of social networks.

Figure 2.7: The game of Boggle. Only when the dices contain the right letters, and only when these letters appear on the right side of the dices, and only when the dices are located in the right way relatively to each other, ‘capacity’ emerges.
2.2.4 Theoretical framework

This section about capacity development leads to the first step is establishing the theoretical framework. For now a simple start is made, with ‘capacity development networks’ as the central concept of the theoretical framework (see figure 2.8). The next sections build the framework step by step until at the end of the chapter the full framework about the importance of network characteristics in capacity development networks is presented.

![Figure 2.8: The first step of constructing the theoretical framework.](image)

2.3 Wicked water challenges

This section describes the type of public value that is considered as the overall capacity development objective in this thesis: addressing wicked water challenges. This forms the context of the theoretical framework about the structural characteristics of capacity development networks.

![Figure 2.9: Relative positioning of this section within the research context, with a focus on insights that are related to wicked water challenges (indicated in blue).](image)

The previous section shed some light on the concept of ‘capacity development’ and on the fact that this process inherently takes place in social networks, where the synergy between the actor and relational properties cause the system’s capacity to emerge.

Ubels et al (2010) emphasized that it is not possible to consider capacity development processes without considering the capacity development objectives. Baser & Morgan (2008) described this objective very generally as ‘creating public value’, which was largely
Bonding and Bridging in Capacity Development Networks to address wicked water challenges

supported by the various definitions of capacity development in table 2.1. This section describes the type of public value that is considered as the overall capacity development objective in this thesis: addressing wicked water challenges. This forms the context of the theoretical framework about the structural characteristics of capacity development networks.

Section 2.3.1 defines the concept of wicked water challenges, arguing that three central characteristics cause water challenges to be wicked. The first one, complexity, is discussed in section 2.3.2. Section 2.3.3 describes the second characteristic, which is stakeholder diversity, closing off with uncertainty in section 2.3.4. At the end of this section the theoretical framework that was started in section 2.2 is extended with the results of this section about the framework context: addressing wicked water challenges.

2.3.1 Wicked water challenges defined

Many of the world’s problems in which water is involved could be labelled as wicked problems. ‘Wicked problem’ is a phrase originally used in social planning to describe a problem that is difficult or impossible to solve because of incomplete, contradictory, and changing requirements that are often difficult to recognize.

The demand for water gets increasingly higher every year, while the amount of available water in the World stays constant. Water Resources Management is the field that aims to maintain and improve the state of water resources (Pahl-Wostl, 2004) in a way that they can be used as effectively and efficiently as possible. “Management should guarantee services provided by the resource (e.g. water for irrigation, fisheries), prevent damages (e.g. flooding) and maintain the state of the resource for the use of future generations (e.g. preserve groundwater resources) but respect also the maintenance of the integrity of ecosystems as a goal in itself (e.g. maintenance of a good ecological state of rivers)” (Pahl-Wostl, 2004). Furthermore the water sector is also a sector of particular complexity because water is a bulky and fugitive resource that is not easily transferred to the right place at the right time (Alaerts & Kaspersma, 2009).

Many of the world’s problems in which water is involved could be labelled as wicked problems. ‘Wicked problem’ is a phrase originally used in social planning to describe a problem that is difficult or impossible to solve because of incomplete, contradictory, and changing requirements that are often difficult to recognize. The term ‘wicked’ is used, not having anything to do with ‘evil’, but rather referring to its resistance to resolution. Rittel & Webber (1973) originally created a list of ten characteristics of wicked problems within the social planning discipline. Later this list was generalized by Conklin (2005) to six universal aspects that also apply to other fields of practice:
The problem is not understood until after the formulation of a solution.

Wicked problems have no stopping rule.

Solutions to wicked problems are not right or wrong.

Every wicked problem is essentially novel and unique.

Every solution to a wicked problem is a ‘one shot operation’.

Wicked problems have no given alternative solutions.

Rittel and Webber (1973) coined the term in the context of problems of social policy, an arena in which a scientific (empirical) research approach cannot be applied because of the lack of a clear problem definition and differing perspectives regarding the problems and potential solution among stakeholders. In their words “the search for scientific bases for confronting problems of social policy is bound to fail because of the nature of these problems (...) Policy problems cannot be definitively described. Moreover, in a pluralistic society there is nothing like the indisputable public good; there is no objective definition of equity; policies that respond to social problems cannot be meaningfully correct or false; and it makes no sense to talk about ‘optimal solutions’ to these problems (...) Even worse, there are no solutions in the sense of definitive answers” (Rittel & Webber, 1973).

Combination of various literature sources that write about the difficulties in dealing with water related problems leads to the conclusion that there are three characteristics of water challenges that make them wicked: complex system interdependencies, high degree of stakeholder involvement, and high levels of uncertainty. Different sources from the Water Management field propose that therefore an integrated, participative and adaptive water management approach is required to address wicked water challenges (see figure 2.10) (Segrave et al, 2012:250). The next subsections elaborate on these three characteristics and the approaches that are required to address them.

### 2.3.2 Complexity of wicked water challenges

Dealing with the complex interconnectedness of water challenges could be done with a holistic integrated approach, adopting a systems orientation to address the challenges at hand. In such an approach problem solvers look further than only their challenge demarcation and check which changes occur in other parts of the water system when interventions would be implemented.

Traditionally water resource management has largely been approached from a purely engineering approach that treats the water system as if it were a mechanical system. Technological fixes seemed very efficient in solving a number of urgent water related
Bonding and Bridging in Capacity Development Networks to address wicked water challenges

problems, such as wastewater treatment, water level management by gates and weirs, design of irrigation systems, etc. (Pahl-Wostl, 2002). However, more and more dissatisfaction occurs with such technological end-of-pipe solutions that can be quite resource intensive and increasingly expensive (Pahl-Wostl, 2002). Moreover, often these engineered solutions do not even solve the whole problem, or induce other types of inconveniences in connected parts of the water system. Therefore, recently the emphasis in the Water Resource Management field has been put more and more on creating awareness for the need to take the complexity of water systems and the challenges that result from that fully into account.

Human actors typically tend to reduce the complexity and the amount of (uncertain) variables when they are confronted with a difficult challenge, to translate it into a well-defined problem with simple cause-effect relationships. However, it would be much more appropriate to handle such complex challenges as interdependent subsystems (Folke et al, 2002; Pahl-Wostl, 2004). In a water system almost everything is interrelated because water is a fugitive resource, because many people can influence the water system (in quantity as well as quantity) and because also many people are affected by it. If an intervention is implemented in one part of the system this has positive or negative effects in other parts of the water system.

Dealing with this complex interconnectedness of water challenges could be done with a holistic integrated approach, adopting a systems orientation to address the challenges at hand. In such an approach problem solvers look further than only their challenge...
As a working definition, we define the global water system as the global suite of water related human, physical, biological, and biogeochemical components and their interactions.

These components include:

1. **Human components** – These are the sum of water-related organizations, engineering works, and water use sectors. Society is both a component of the global water system and a significant agent of change within the system.

2. **Physical components** – These are the physical attributes and processes of the traditional global hydrologic or water cycle, including runoff, geomorphology, and sediment processes.

3. **Biological and biogeochemical components** – This category includes the sum of aquatic and riparian organisms and their associated ecosystems and biodiversity. These organisms are also integral to the geochemical functioning of the global water system and not simply recipients of changes in the physicochemical system. Hence we also include here the biogeochemistry of the global water system and water quality.

*(Framing Committee of the GWSP, 2004)*

demarcation (most of the times made for disciplinary or administrative reasons) and check which changes are expected to occur in other parts of the water system when interventions are planned to be implemented. In other words, challenges should not be addressed in the isolation of the sub system in which they appear, but in the context of the complexly interconnected sub systems, considering all aspects, consequences and emergent properties (Newell & Wassen, 2002; Dyball et al, 2005). These might refer to physical phenomena, such as animals, plants and rivers, or to conceptual ones, such as the various world views, attitudes, knowledge and beliefs held by different stakeholders (Keen et al, 2005). Keen et al (2005) state that the strength of a systems orientation is that both physical (as in the engineering approach) and social processes and concepts are integrated with the problem-solving framework, rather than approached in isolation from each other.
2.3.3 Diversity of wicked water challenges

The key to deal with the stakeholder diversity and resulting ambiguity is to take a participative water management approach. Participation to handle ambiguity in an inclusive way demands the integration of the various involved perspectives that might be very different in nature.

Mostert et al (2007) argue that “no single stakeholder has all the necessary information, legal competencies, funds, and other resources to manage a natural resource”. Stakeholders need to collaborate, put their knowledge, perspectives and problem demarcations together to develop capacity, especially when the complex interconnection within the water system as considered. Pahl-Wostl et al (2007a) argue that the need for stakeholder involvement in addressing water challenges is also based on democratic legitimacy. They emphasize that from this view “all those who are influenced by management decisions should be given the opportunity to actively participate in the decision-making process”, regardless of personal attributes such as knowledge, power, culture or social background.

With such a diversity of stakeholders engaged in a problem solving process, also many different sensible ways of understanding the problem and finding solutions are involved (Brugnach & Ingram, 2012). What one stakeholder (group) may define as a beneficial development may be perceived as detrimental by others. Brugnach & Ingram (2012) state that actors frame a challenge according to their backgrounds, experiences, societal positions, values and beliefs. These distinctive frames lead to different knowledge, viewpoints and preferences, resulting in different ways of addressing one and the same challenge. According to them this implication of having multiple sensible and valid ways to perceive a situation leads to confusion within a group of problem solvers, also referred to in literature as ‘ambiguity’. Table 2.3 shows in which categories ambiguity might show up when stakeholders from different backgrounds are involved in a problem solving process (from Ubels et al, 2010).

The key to deal with this stakeholder diversity and resulting ambiguity is to take a participative water management approach. ‘Participation’ has become a somewhat hollow term in the water management literature. This is the result of the fact that many stakeholders are often involved in problem solving processes, but without resolving the ambiguity in problem perception. This makes a participative approach difficult and futile. Participation to handle ambiguity in an inclusive way demands the integration of the various involved perspectives that might be very different in nature (Brugnach & Ingram, 2012). It is not just about translation of knowledge between stakeholders, or an accumulation of facts, but it requires the generation of new shared and agreed upon knowledge in the creation of which all stakeholders have actively participated and contributed.
To deal with uncertainty because of the limited possibility of predicting the water system’s external drivers and internal interdependencies, an adaptive water management approach is required that is characterized by flexibility and an innovative capacity.

Another main characteristic of water challenges that cause them to be wicked is uncertainty. Uncertainties in a water system exist partly due to the complex and often unknown interdependencies of interrelated water system components and partly because of the unpredictability of external factors that influence the water system, such as climate change, economic developments, etc. Pahl-Wostl (2007) states that dealing with such uncertainties and trying to take them into account is one of the major issues faced by the water sector, because the ability to predict future key drivers of the water system and the water system’s responses to those drivers and to each other is limited.

An adaptive water management approach is required to deal with uncertainty regarding the behaviour of a water system, characterized by resilience, flexibility and innovative capacity. High flexibility and high innovative capacity, together with an understanding of the water system’s context and vulnerability, lead to a high adaptive capacity of the system, which make it possible to react on unforeseen and unpredictable changes.

2.3.4 Uncertainty of wicked water challenges

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Adaptive water management is a well-known and often discussed term within the water resources management literature (e.g. Holling, 1978; Walters, 1986; Lee, 1999; Pahl-Wostl, 2007; Pahl-Wostl et al, 2007a). Generally it is argued that changes in the water system have become so pervasive, rapid and discontinuous that only the ability to adapt to these changes will enable progress and improvement of management practices (Baser & Morgan, 2008).

2.3.5 Theoretical framework

In section 2.2.4 the start was made of the theoretical framework that should be the result of this chapter. This section outlined the context of capacity development networks as considered in this thesis. Water challenges are often wicked because of the fact that they involve complexly interrelated processes, a great diversity of stakeholders with ambiguous perspectives, and a large amount of uncertainty because of the limited possibility of predicting the water system’s external drivers and internal interdependencies. Therefore the capacity developments networks should work towards an integrated (systems oriented), participative, and adaptive water management approach.

The identification of the context of addressing wicked water challenges results in a small but important extension to the theoretical framework, as shown in figure 2.11.

![Figure 2.11: The next step in constructing the theoretical framework, complemented with insights regarding wicked water challenges.](image-url)
2.4 Focus on social learning

This section focuses on a single but very important process in capacity development networks: social learning. Many authors of capacity development literature support that social learning is the most important and essential ingredient for capacity development networks.

Whereas section 2.2 discussed the central concept of capacity development networks, and the capacity development context of addressing wicked water challenges was outlined in section 2.3, this section focuses on a single but very important process in capacity development networks: social learning. The choice to consider just this single most important process is made following Baser & Morgan’s (2008:8) observation that a theoretical approach “based on the ideas that ‘everything must be taken into account’ or that ‘everything is connected to everything else’ can be disempowering and confusing. An attempt at comprehensiveness runs the risk of collapsing under its own weight and losing the focus on capacity as a distinct subject. On the other hand, focusing on a narrow range of subjects loses the systems perspective that we think is crucial to understanding what capacity is and how it comes about.”

In section 2.2 was already mentioned that learning and knowledge sharing processes play an increasingly important role in capacity development literature. The focus of most authors of capacity development literature is on the fact that capacity development cannot take place without learning and/or sharing knowledge. Corresponding to the findings of Luijendijk & Licklaen Arriëns (2009) and Luijendijk & Mejia-Velez (2005), Alaerts (2009) for example states that “knowledge and capacity are intricately related, and are essential for development”. He also notes that the absence of learning and knowledge sharing processes is the most important barrier (next to failure of administrative arrangements and lack of sufficient expertise) for development of other problem solving capacities. Alaerts & Kaspersma (2009) furthermore describe ‘learning’ as a meta-
competency for capacity development. According to them actors, organizations and society as a whole should develop their ability to learn together in order to also develop their technical, management and governance related abilities, which are all required for effective capacity development.

Many authors of capacity development literature support that social learning is the most important and essential ingredient for capacity development networks. However, much less attention went to the question which factors and processes influence social learning in capacity development networks. The latter is the focus of this thesis. Before zooming deeper in on the question of why social learning would be the main building block of capacity development networks for addressing wicked water challenges, the concept itself should be clarified first. This is done in section 2.4.1. Section 2.4.2 shows how social learning is described in Water Resources Management literature as the key for capacity development in the water sector, related to addressing wicked water challenges. Section 2.4.3 presents the different theoretical views on how the structure of capacity development networks facilitates social learning (from a communication network perspective, a knowledge network perspective, and a learning network perspective). Special attention to trust and reciprocity as boundary conditions for social learning in networks is given in section 2.4.4. The theoretical framework is extended according to these new insights in section 2.4.5.

2.4.1 Social learning defined

Social learning is essentially a socially embedded learning process with an input (the required conditions for social learning) and an output (the desired outcomes of social learning). It can be defined as the process of establishing a change in understanding that is situated in wider social units and happens through social interaction.

Recently ‘social learning’ has become a hot topic in natural resources management and, as is the case with the term ‘capacity development’ (see section 2.2), there exist almost as many definitions of social learning as articles about the topic (see table 2.4). Some definitions focus on the objectives of social learning, others on the learning process itself, or on the factors that influence social learning process. Some authors of social learning literature focus on a specific aspect or context of social learning, where others apply such a broad definition that it could encompass almost any social process in any situation. Considering existing social learning literature, there is still little consensus regarding its meaning or theoretical basis. Reed et al (2010) reviewed a number of social learning related articles published in Ecology & Society, which is used as the basis for this section.

According to Reed et al (2010) social learning is essentially a socially embedded learning process with an input (the required conditions for social learning) and an output (the desired outcomes of social learning). However, many definitions of social learning
confuse the input and output with the learning process itself. For example, stakeholder participation is sometimes identified as the input for social learning, sometimes as part of the learning process itself, and sometimes as the desired output of the learning process. Similarly concepts as ‘adaptive capacity’, ‘collective directed action’, and ‘improved management’, are confusingly identified by different authors as input and/or output (Reed et al, 2010).

Going back to the basics, Reed et al (2010) identified three main characteristics of social learning as a result from their extensive literature review. The first refers to the concept of ‘learning’, whereas the other two as interpretations of the concept ‘social’.

Social learning is about a change in understanding

Early learning literature defines learning often as the process that leads to a change in understanding (Reed et al, 2010). Although none of these early theories are specifically about social learning, they could provide a basic understanding of social learning processes. For instance, authors from the constructivist paradigm refer to learning as a process of constructing new knowledge out of previously constructed knowledge combined with reflection on new experiences (e.g. Kolb, 1984). Others suggest that learning can be instrumental (i.e. acquiring knowledge), communicative (i.e. understanding and reinterpreting acquired knowledge by communication with others)) or transformative (i.e. change in attitude or behaviour through reflection on underlying assumptions).

Table 2.4: Definitions of ‘social learning’.

<table>
<thead>
<tr>
<th>SOURCE</th>
<th>DEFINITION</th>
</tr>
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<tbody>
<tr>
<td>Pahl-Wostl et al (2008)</td>
<td>Developing new relational capacities, both between social agents, in the form of learning how to collaborate and understand others’ roles and capacities differently.</td>
</tr>
<tr>
<td>Keen et al (2005)</td>
<td>The collective action and reflection that takes place amongst both individuals and groups when they work to improve the management of the interrelationships between social and ecological systems.</td>
</tr>
<tr>
<td>Rist et al (2007)</td>
<td>A process where different actors can deliberate and negotiate rules, norms and power relations, which they facilitate through workshops with natural resource users.</td>
</tr>
<tr>
<td>Mostert et al (2007)</td>
<td>The process involves the development of trust, joint problem definition, joint fact finding, the development and assessment of different alternatives, joint decision making, and joint planning for implementation.</td>
</tr>
</tbody>
</table>
Bonding and Bridging in Capacity Development Networks to address wicked water challenges (e.g. Mezirow, 1995). This partly corresponds to the theory that learning may happen as single-loop (learning about consequences of specific actions), double-loop (reflecting on assumptions that underlie our actions) or triple-loop (challenging the values, norms and higher order thinking processes that underpin assumptions and actions) learning (Keen et al 2005, Reed et al, 2010). Whereas learning may occur at any of these levels and may or may not lead to changes in attitudes and behaviour and the building of trust, respect and shared goals (Reed et al, 2010), the common view is that learning refers to a change in understanding. However, learning is only considered social learning if this change in understanding takes place at a sufficiently broad scale through social interactions.

Social learning is situated within wider social units

Recent literature about organisational learning and communities of practice argues that social units (e.g. communities, organizations, institutions, etc) can learn collectively, as opposed to large numbers of individuals learning independently (Reed et al, 2010). There is evidence from scientific studies that collective learning, for example through collective reflection and problem identification, can perform better than the sum of individual learning (Senge 1990, Argyris & Schon 1996). This is also supported by recent literature about the concept of ‘wisdom of the crowd’ (e.g. Surowiecki 2004). Following these insights to build on the previous paragraph, social learning must demonstrate change in understanding that goes beyond small groups of individuals and diffuse to members of the wider social units or communities of practice to which they belong (Reed et al, 2010). This means that the change in understanding should reach further than e.g. the direct social boundaries of a workshop or meeting.

Social learning happens through social interaction

Next to considering the scale at which social learning takes place, Reed et al (2010) also argue that the interactive mode through which learning takes place is characteristic for social learning. A change in understanding within a wider social unit could only be considered social learning if the message is spread from person to person through a social network. Networks can influence people’s understanding, opinions and views through social interactions between related people, or through their larger structures (see section 2.4.3). Reed et al (2010) distinguishes between two types of social interaction in networks: information transmission (i.e. simple learning of new facts) and deliberation (i.e. a genuine exchange of ideas and arguments during which ideas and perceptions change through persuasion). They refer to Habermas’s (1981) concept of ‘communicative action’ in stating that a social space should be created or enhanced to allow communication between people that leads to changes in the wider social network. Reed et al (2010) note that it is important to consider the influence of power relations on social interactions, because power dynamics between knowledge holders influence the learning outcomes. They refer to Cundill (2010) in stating that “assuming that high levels of interaction between stakeholders in any given situation will lead to social learning is simplistic“. However, these power dynamics are left out of the scope of this thesis.
Summarizing the above insights social learning is defined as the process of establishing a change in understanding that is situated in wider social units and happens through social interaction. As mentioned earlier it is important to make a clear distinction between the input (required conditions) and output (desired outcomes) of social learning processes. For the purposes of this thesis, the desired outcomes for the network in which social learning takes place are defined as the three approaches that were identified for addressing wicked water challenges (section 2.3): an integrated systems orientation, stakeholder participation and adaptivity. This is further clarified in section 2.4.2. The required conditions, with special focus on social network structure, are the topic of section 2.5. This is visualized in figure 2.13.

![Figure 2.13: Schematic overview of the ‘social learning’ concept, with its definition in blue.](image)

**2.4.2 Outcomes: addressing wicked water challenges**

Social learning processes facilitate the outcomes that are required for addressing wicked water challenges. The fact that it involves a change in understanding, a wider social unit, and social interactions enables an integrated, participative and adaptive water management approach. This is one of the reasons why social learning is considered a key process in water related capacity development networks.

This section focuses on the question of how social learning, earlier defined as the process of establishing a change in understanding that is situated in wider social units and happens through social interaction, might cause the desired outcomes in the context of addressing wicked water challenges. As identified in section 2.3 capacity development networks should work towards a three-fold outcome to address wicked water challenges: an integrated systems orientation, stakeholder participation and improved adaptive capacity. A considerable amount of Water Resources Management refers to how social learning could be the means to achieve these outcomes.
The general idea of the benefits of social learning for water management is supported by Keen et al (2005). They refer to the old adage that claims that ‘it takes a community to raise a child’, and argue that the same is true for managing environmental systems, because no single individual could possibly give all the care and have all the knowledge that is required to deal with wicked water challenges (also supported by Mostert et al, 2007). The fact that social learning involves learning in wider social units enables this collective management of a water system.

Pahl-Wostl’s (2002) conclusions correspond to the above idea. She observes that social learning enhances actors’ understandings of the social system dynamics, including the perceptions of others, the role of the network relationships and the system’s interdependencies. This improved understanding enables actors and broader social units to view their challenges from a systems orientation. Moreover, Pahl-Wostl (2002) argues that social learning facilitates the joint creation of a shared problem perception among the stakeholders that are involved in the social learning process. In this regards social learning serves also as the source for generation of trust through the interactions, which in turn forms the base for critical reflection and recognition of one’s own and others’ mental frames and subjective assumptions and valuation schemes (also supported by Keen et al, 2005, in the context of multi-loop learning). These results of social learning lead to improved stakeholder participation and cooperation, including collective action, knowledge creation, compromise, decrease of ambiguity and conflict resolution, which are key to successful participation.

Social learning also leads to an increased adaptive capacity of a social system. A learning context that facilitates development and collective action is required to sustain water systems in a world of continuous change (Folke et al, 2003). Social learning processes within social networks create a continuous cycle in which knowledge and the ability to act upon new insights are continuously questioned, applied, and regenerated, which allows adaptation to changing circumstances (Pahl-Wostl et al, 2007a). Furthermore, the improved system understanding that is a result of social learning (Pahl-Wostl, 2002) leads to an improved adaptive capacity by enabling the opportunity to integrate stakeholders’ perspectives regarding future developments in the water system. Pahl-Wostl et al (2007b) state that actors need to learn to recognize how their own frames of reference influence and constrain their thinking and that other legitimate frames of reference exist to enable adaptive water management. Only by recognizing these different knowledge bases and mind frames, they can be integrated. That way more stakeholders, providing knowledge about different parts of the water system from their own perspectives, are better able to foresee future developments in the water system (due to interdependencies within the system and influences of changing external drivers) than one single stakeholder is. Also it enables innovation in the social system. The recognition of different knowledge bases and perspectives, combined with the trust that is generated by social learning, allows actors to bring their diverse ideas together while maintaining the system overview, possibly resulting in technological or social innovations that facilitate adaptation in case of rapid changes.
Summarizing the insights of this sub section, social learning processes facilitate the outcomes that are required for addressing wicked water challenges. The fact that it involves a change in understanding, a wider social unit, and social interactions enables an integrated, participative and adaptive water management approach. This is the reason why social learning is considered a key process in water related capacity development. The next sub section presents how the network perspective facilitates the analysis of social learning processes and their underlying mechanisms.

2.4.3 Social learning through social networks

Social networks are considered by many authors to be the infrastructure for social learning. Network characteristics influence the degree to which social learning takes place in capacity development networks. The insights that support this view come from the different backgrounds of communication networks, knowledge networks and learning networks.

Social networks are considered by many authors to be the infrastructure for social learning. Network characteristics influence the degree to which social learning takes place in capacity development networks. The insights that support this view come from the different backgrounds of communication networks (Monge & Contractor, 2003), knowledge networks (e.g. Luijendijk & Lincklaen Arriëns, 2009) and learning networks (e.g. Lave & Wenger, 1991).

In the context of social learning processes the terms ‘knowledge communication’, ‘knowledge sharing’, and ‘learning’ are used by authors from different backgrounds who apply different terminology to refer to a similar idea: the social network as infrastructure for social learning as it is defined in this thesis. However, these different fields of study (Communication, Knowledge management and Learning) do not cover exactly the same scope. This means that caution is required to make sure that the contexts of the different theories are compatible with the social learning perspective. The positioning of the fields relative to each other as considered for the purposes of this thesis was presented in section 1.4 (see figure 2.14). The following paragraphs discuss theories from the different perspectives that support the view of social networks as the infrastructure for social learning for capacity development.

Figure 2.14: Relative positioning of the concepts ‘communication’, ‘knowledge sharing’, and ‘learning’, and ‘social learning’ as overlap (see also the explanation in section 1.4).
Communication networks perspective

From the communications network perspective (Monge & Contractor, 2003) the social network structure facilitates the establishment of changes in understanding (or learning) through contagion. Communication networks are defined as “the patterns of contact that are created by the flow of messages among communicators through time and space” by Monge & Contractor (2003:3). Contagion theories seek to explain these networks as conduits for ‘infectious’ messages (including knowledge, attitudes and behaviour). They are based on the assumption that the opportunities for contact provided by communication networks serve as a mechanism that exposes people, groups and organizations to ideas, information, beliefs, attitudinal messages and the behaviour of others (Burt, 1980, 1987; Contractor & Eisenberg, 1990). This exposure to communication messages increases the likelihood that network members will develop knowledge, attitudes and behaviours that are similar to those of their network relations (Carley, 1991; Carley & Kaufer, 1993). This is referred to as the convergence model of communication by Rogers & Kincaid (1981). On the condition that the spreading of such ‘infectious’ messages reaches the wider social unit through chains of interactions, communication networks facilitate social learning.

Many theories that relate to social learning processes are based on the assumptions of a contagion model (e.g. social influence theory, structural theory of action, social cognitive and learning theories, etc). They share the core proposition that social network interactions produce patterns of shared cognitions and behaviours (Fulk, 1993). Erickson (1988) describes how various dyadic (relational) network measures, such as communication frequency and relation strength, can shape the extent to which actors influence others to which they are directly connected in the social network (contagion by cohesion). She also describes how contagion can even take place in an indirect way by ‘infecting’ others in the network that has similar structural patterns of relationships (contagion by structural equivalence). Most empirical research on contagion mechanisms has been done on contagion of attitudes and perspectives (social influence theory) and behaviour (Bandura’s social learning theory). However, the application of the contagion mechanisms on factual knowledge messages is not so much investigated. Heath & Heath (2007), writers of the popular scientific book Made to Stick, argue that there are six principles that make factual messages memorizable and ‘infectious’: simplicity, unexpectedness, concreteness, credibility, emotions, and stories. Although this is a highly interesting statement, for the purposes of this thesis this is not investigated further into detail.

Knowledge networks perspective

The next perspective that is considered to support the importance of social network structures for social learning comes from the field of Knowledge Management. Knowledge management is defined as the explicit control and management of knowledge within a social unit, aimed at achieving the social unit’s objectives (Liebowitz & Wilcox, 1997). This last part of the previous sentence is where the most significant difference is between
knowledge management and communication; whereas communication is about all forms of interaction, regardless of message content and collective objectives, knowledge management is specifically about communication of knowledge with the intentional goal of achieving certain objectives. The field of Knowledge Management distinguishes between two types of knowledge: explicit knowledge, which “can be expressed in facts and numbers and can be easily communicated and shared in the form of hard data, scientific formulae, codified procedures, or universal principles” (Nonaka & Takeuchi, 1995), and tacit knowledge, which “is highly personal and hard to formalize. Subjective insights, intuitions and hunches fall into this category of knowledge” (Nonaka & Takeuchi, 1995). Luijendijk & Mejia-Velez (2005) describe how tacit knowledge could be further separated into technical tacit knowledge (skills and know-how) and a cognitive dimension (mental models, beliefs, values and perceptions). Knowledge management has enjoyed increasing popularity and is already proclaimed as the most universal management concept in history (Takeuchi, 2001, as reviewed by Luijendijk & Mejia-Velez, 2005).

Luijendijk & Mejia-Velez (2005) argue that it is useful to take advantage of the theory and practices of Knowledge Management in the considered context, as knowledge plays a central role in capacity development. It is increasingly more recognized that knowledge (including information, skills, attitudes and experiences) can contribute to improving the performance and effectiveness of individuals and wider social units, provided that there is a basic capacity to manage knowledge as a resource in the social networks (Luijendijk & Mejia-Velez, 2005; referred to as the ‘learning competency’ by Alaerts & Kaspersma, 2009). Luijendijk & Mejia-Velez (2005) describe social networks as a critical ‘cortex’ of society that helps to channel the knowledge gained through local activities to other parts of the social network where the knowledge can be used for other applications (metaphor: the cortex is the part of the brain where information from different parts of the body is received, translated and interpreted to be sent to other parts of the body who need this information to function properly). This corresponds to the idea that the network structures facilitate capacity development in different parts of the network.

Knowledge networks are purpose driven, working networks, built on expertise (not just interest), and based on communication in networks to develop and strengthen capacity in all members (Luijendijk & Mejia-Velez, 2005). Essentially social networks bring together providers and consumers of knowledge (Luijendijk & Lincklaen Arriëns, 2009) and provide an opportunity to share knowledge among related network members. Luijendijk & Mejia-Velez (2005) argue that the strengthening of network relations leads to a faster flow of knowledge towards network members who need it, such as end users, practitioners, policy makers, etc. This is the case because strong social networks allows a social cycle of knowledge creation to start, in which the interplay between explicit and implicit knowledge lead to processes of knowledge conversion, expansion and creation, which are required to effectively reach individuals with different perspectives in the wider social network (a requirement to label it as social learning process). This is supported by Inkpen & Tsang (2005). They found evidence suggesting that knowledge transfer (especially of tacit knowledge) is facilitated by intensive social interactions and proposed that structural
network properties (e.g. relation strength, network configuration, network stability), influence the exchange of knowledge as resources between network members. This is discussed in more detail in section 2.5.

The model of cyclical knowledge creation, which is enabled by strong social networks (referred to in the previous paragraph), was developed by Nonaka and colleagues (Nonaka & Takeuchi, 1995; Nonaka et al, 2000). They found from extensive case studies that knowledge is created in a continuous social cycle of externalization, combination, internalization and socialization (see figure 2.15). Externalization is the process of converting tacit knowledge into explicit knowledge and leads to the articulation of conceptual knowledge. Combination involves the process of connecting multiple ‘pieces’ of explicit knowledge into more complex and new explicit knowledge. This knowledge can be converted again to tacit knowledge in the process of internalization (Luijendijk & Mejia-Velez 2005) call this ‘learning’). New tacit knowledge can be created out of existing tacit knowledge by socialization, e.g. through shared experiences. All these four components of the knowledge creation cycle involve a social interaction aspect, such as explicit knowledge sharing and combination, tacit knowledge sharing, interactive conceptualization processes for externalization and intensive training for internalization. These processes also refer to the establishment of a change in understanding through social interaction. Assuming that social networks allows these processes to happen in chains through the network, this knowledge management perspective provides very useful insights for the network processes that facilitate social learning.

Whereas much knowledge management literature considers the influence of network structure on social learning, Cross et al (2011) argue that the relation content is also a driver of knowledge flow through networks. The relation content refers in this case to the kind of information that is shared and to the characteristics of relationships that dictate who is selected to share knowledge with in the network. Cross et al (2011) identified five categories of information that is mostly looked for by network members in their social networks: solutions (know what and know how); meta-knowledge (pointers to databases or other people); problem reformulation; validation of plans or solutions; and legitimation from contact with a respected person. They found that each of these information benefits performs a unique function in helping network members to solve problems, and thus drives them to interact with other network members.
Learning networks perspective

Lastly, some learning theories with a background in psychology provide some insights in how social networks provide a social learning infrastructure. Also within the learning theories the focus moved from individual attributes to social attributes that influence learning processes. Since the 1970s the constructivist-learning paradigm has been challenging the traditional cognitive learning theories. The central proposition of constructivist learning theories is that knowledge is created inside a person by reflecting on experiences and fitting new information together with the knowledge that was constructed at earlier times. According to the social constructivists stream this reflection could also be on the experiences of other network members, which means learning from other people’s experiences. Through interaction with objects, events and people in their social network individuals discover and construct new complex information and conceptualizations of challenges and solutions. Again assuming that the social network allows such a change in understanding to reach via a chain of social interactions to wider social units, this refers to the concept of social learning.

Lev Vygotski (1978) is the main proponent of the social constructivism approach to learning. According to him social interaction plays a fundamental role in learning and development processes. His initial focus was on the development of children, but extended his insights to his ‘social development theory’, which is illustrated by the following quote: “Every function in the child’s cultural development appears twice: first, on the social level, and later, on the individual level; first, between people (interpsychological) and then inside the child (intrapsychological). This applies equally to voluntary attention, to logical memory, and to the formation of concepts. All the higher functions originate as actual relationships between individuals” (Vygotsky, 1978:57).

Vygotski’s social development theory states that learning, between and within people, proceeds development of capacities. According to this theory people can often complete tasks with the help of others that they could not have accomplished alone because their skills and/or understanding is not yet developed enough. Only after the task is completed a certain amount of times with peer collaboration from within the social network, the learner is able to perform the task on his own. The degree to which skills, behaviour and concept understanding are developed depends upon the degree of social interaction with a More Knowledgeable Other (refers to anyone who has a better understanding or a higher ability level than the learner with respect to the particular task, process, or concept) during the zone of proximal development. This is the time span that is required by the learner to master the knowledge. When the knowledge is mastered, the network members can function as a More Knowledgeable Other to his network relations. These insights emphasizes the importance of communication frequency, as a relational network characteristic, for social learning.

Another learning theory from the social constructivism paradigm that focuses on the importance of the social network as a learning environment is the situated learning theory, first proposed by Lave & Wenger (1991). They introduced their theory combined
with the concept of ‘communities of practice’, which refers to a social sub system (i.e. group of people, community, network component) in which network members use each other’s practical experiences as a learning resource and join forces in making sense of challenges they face and potential solutions. The situated learning theory argues that learning is not just the transmission and reception of abstract decontextualised knowledge between people. It is a social process that is situated in a specific context and embedded within a particular social and physical environment, whereby knowledge is co-constructed between/among people. However, according to our definition of social learning, this type of learning that happens in communities of practice can only be considered social learning if the change in understanding also crosses the borders of the community itself into the wider social network.

The community of practice perspective considers the effects of the network structure as well as the network content on learning. The network structure as the set of relations among the network members serves as the learning infrastructure, whereas the concept of ‘community’ specifically refers to the importance of the relational content (e.g. a shared identity or collective objective, and a shared intention for sustained learning within a specific domain). Wenger et al (2011) argue that by establishing and strengthening a network of connections among people within a common domain of interest, a social space is created in which the participants can discover and establish a learning partnership and develop their (collective) capacities. This once more emphasizes the importance of the network structure and strength for (social) learning in networks.

### 2.4.4 Theoretical framework

This section presented social learning as a key to capacity development for addressing wicked water challenges. Social learning was defined as the process of establishing a change in understanding that is situated in wider social units and happens through social interaction, resulting in an output that enables an integrated, participative and adaptive water management approach. This is the reason why social learning is considered a key process in water related capacity development networks. This section also clarified that a capacity development network may function as the infrastructure for social learning processes. Whether social learning can take place and to what degree it will lead to the desired outcomes depends on the social network’s characteristics. This is the topic of the next section (2.5).

These insights result in an extension to the theoretical framework, visualized in figure 2.16.
Social capital literature studies the influence of network structure on the social exchange of resources, such as knowledge, and distinguishes between two types of network mechanisms: bonding and bridging networks, which are respectively paradoxically closely related to proximity and diversity within social relationships.

2.5 Bonding and bridging

Social capital literature studies the influence of network structure on the social exchange of resources, such as knowledge, and distinguishes between two types of network mechanisms: bonding and bridging networks, which are respectively paradoxically closely related to proximity and diversity within social relationships.

Figure 2.16: An extended version of the theoretical framework, complemented with insights regarding social learning.

Figure 2.17: Relative positioning of this section within the research context, with a focus on insights on the effects of social network characteristics on social learning (indicated in blue).
Section 2.4 presented social learning as a key process for capacity development with the objective of addressing wicked water challenges. Furthermore, an investigation of theories from the fields of communication, knowledge management, and learning made clear that social networks could function as a social learning infrastructure in capacity development contexts. This section zooms deeper into the influence of social network mechanisms and characteristics on social learning processes.

Section 2.5.1 introduces the concept of social capital, around which a field of research is established that studies the influence of network structure on the social exchange of resources such as knowledge through networks. The social capital literature distinguishes between two relevant mechanisms for these social processes: bonding and bridging. Bonding mechanisms are strongly connected to proximity as a characteristic on the relational level, tending in extreme cases towards the emergence of dense tightly knit network structures. These concepts and their influence on social learning and capacity development is discussed in section 2.5.2. Bridging mechanisms are especially closely related to the relational characteristic to diversity and lead in extreme cases to loose and open social networks. Section 2.5.3 presents these concepts and their effects on social learning and capacity development. Both bonding and bridging paradoxically provide benefits (up to a certain level) for social learning, depending on the capacity development goals to be achieved. Should networks be one or the other, should they be balanced, or could they just add value to one another? This dilemma is presented in section 2.5.4. This overview of how social learning is influenced by network characteristics enables also a further development of the theoretical framework in section 2.5.5.

### 2.5.1 Social capital

The social capital of a capacity development network is the combination of values, trust (together resulting in goodwill) and exchangeable knowledge resources that resides in the network’s structure and content, and that enables the connected network members to effectively act together in order to pursue their capacity development objectives.

When considering social learning in social networks, as is done in the previous sections of this chapter, exploring the concept of social capital is inevitable. Eames (2010) refers to Pretty & Frank (2000) when suggesting that the combination of social capital and social learning are critical to the effective functioning of network-based resource management. Social capital is the term used for the values, trust and exchangeable resources that reside in social network structure and content, and that enable the connected network members to effectively act together in order to pursue their shared objectives (Eames, 2005; Patulny & Svendsen, 2007). Defining it as such and narrowing ‘exchangeable resources’ down to ‘knowledge resources’, this concept fits perfectly to the concept of capacity development networks as it is applied in this thesis. However, this is not done very often up to this day.
The social capital concept is the last decades used by sociologists, political scientists and economists to address social network related questions in their own fields (Adler & Kwon, 2002). The first one to analyse it in depth was Pierre Bourdieu in 1985, who referred to social capital as “the aggregate of the actual or potential resources which are linked to possession of a durable network of more or less institutionalized relationships of mutual acquaintance or recognition” (Bourdieu, 1985:248; quoted by Portes, 1998). According to Adler & Kwon (2002) social capital is roughly understood as “the goodwill that is engendered by the fabric of social relations and that can be mobilized to facilitate action”. They also provide a more comprehensive overview of social capital definitions and their implications to the meaning of the concept. Connecting the resources and goodwill that were mentioned by Bourdieu and Adler & Kwon to the activity of knowledge exchange, the social capital concept is very useful to zoom in on the processes behind social learning in capacity development networks (assuming that knowledge exchange in social networks leads to a change in understanding within a wider social unit by social interactions, as supported in section 2.4.3).

Since its conception the term social capital has become an umbrella concept, taking together multiple processes with distinct antecedents and various foci. This caused sceptics to characterize it as an elastic term that means many things to many people and that has taken a circus-tent quality (from the literature review of Adler & Kwon, 2002). Many authors define social capital as a resource with benefits for a single actor that lies in the external relationships that he/she establishes with other network members. However, this thesis follows the sociocentric and many of the ‘whole network’ (Marin & Wellman, 2011) variants of network sociology, where social capital is considered to be the characteristic of a greater social unit and results from the structure and contents of the linkages among its members (Adler & Kwon, 2002).

Figure 2.18: Visualization of the main concepts in this section on the three analytical network levels.
Arguing like this, the social capital of a capacity development network is the combination of values, trust (together resulting in goodwill) and exchangeable knowledge resources that resides in the network’s structure and content, and that enables the connected network members to effectively act together in order to pursue their capacity development objectives. The main question here is then which social network characteristics are most beneficial for developing capacities by social learning with the objective to address wicked water challenges (striving for integration, participation and adaptivity)?

Before continuing to answer this question it is important to gain some deeper insights into the different network characteristics on the multiple analytical levels. Social capital theorists differentiate between two ‘extreme’ network mechanisms: bonding and bridging (e.g. Patulny & Svendsen, 2007; Adler & Kwon, 2002; Portes, 1998). Bonding mechanisms tend to occur through proximity on the relational level, resulting in a very dense network with a very homogeneous member group, characterized by closure on the network level. Bridging mechanisms broker between diversity within social relationships and result in a very loose and open network with a very heterogeneous group of network members, characterized by structural holes on the network level. This is illustrated in figures 2.18 and 2.19. Paradoxically both extreme (proximity vs. diversity) mechanisms have important benefits for social processes within the network, depending on the network's objectives (e.g. capacity development to address wicked water challenges). The next to sub sections zoom further in on these bonding and bridging mechanisms.

Figure 2.19: The network structure scale, with a maximum relational proximity on the left side, leading to closure and bonding mechanisms, and a maximum relational diversity on the right side, leading to structural holes that require bridging mechanisms.
Networks in which bonding mechanisms prevail, characterized by high levels of geographical, cognitive, organisational and social proximity, have many benefits for social learning in capacity development networks. They result in high levels of knowledge sharing efficiency, quality and frequency, and enable social learning processes to take place. They mainly contribute to effective stakeholder participation for addressing wicked water challenges. However, too much bonding and proximity within a network is argued to be detrimental for effective social learning and capacity development.

Bonding mechanisms occur through proximity within social relations, i.e. in which the individuals share many similarities, resulting in a dense set of strong connections within a tightly knit group of network members on the overall network level. The term ‘bonding’ originates from social capital literature (e.g. Putnam, 2000). The network structure that emerges in cases of extreme bonding are referred to as ‘closure’ in social network analysis literature (e.g. Burt, 2000) and is strongly related to the concept of strong ties that is used by Granovetter (1973). Closure refers to the network’s high relational density, which is defined as the actual amount of relationships divided by the maximum possible amount of relationships among the network members. The concept of strong ties refers to close relationships within a bonding network (e.g. between good friends, or between colleagues sharing a long history). A ‘bonding network’ is thus assumed to consist of a homogeneous dense group of actors (Eames, 2005). Proximity, e.g. similarities in for example in gender, age, religion, culture, language, professional affiliation, perspective, vision, understanding, etc., generally strengthens the relations among network members and reinforces trust, loyalty and support within the group (Burt, 2000), which leads to various benefits for social learning.

**Bonding benefits**

Bonding in networks, associated with proximity and closure on the relational and network analytical levels has multiple benefits for social learning in capacity development networks. The general assumption is that proximate people have a tendency to form close collaboration networks because it is easier to communicate with people who are similar (Boschma, 2005). Improved communication facilitates knowledge sharing, which in turn enables social learning for capacity development. Burt (2000) adds to this that bonding affects access to information and efficiency of knowledge flows; closer networks contain more direct relationships, and thus shorter paths to other networks members, which implies that they suffer less from information quality deterioration through long chains of intermediaries. Moreover. Dense networks are moreover characterized by a high level of trust. Burt (2000) states that network closure improves the reliability of communication within the closed community, because it facilitates sanctioning that makes it less risky for people in the network to trust one another: “strong relations among a person’s contacts are argued to give him/her more reliable communication channels, and protect him/her from exploitation because he and his contacts are more able to act in concert against...
someone who violates their norms of conduct” (Burt, 2000:352). Patulny & Svendsen (2007) distinguish another type of trust to which they refer as particularized trust (as apposed to generalized trust). This the type of trust that exists specifically in a dyadic relation, mostly because of proximity.

Proximity as a relational characteristic and bonding as a characteristic on the network level also reinforce each other. The more proximate people are (e.g. in age, education or religion) and the greater the multiplexity of their relations (e.g. they know each other from work, sports, and nightlife) the stronger their relation gets. In other words, proximity within relations leads to a reinforced strength of those relations, which will only make the network closer, increase bonding, and increase its benefits for social learning in capacity development networks (up to a certain level, to be discussed later). Furthermore some authors found that the closer the relation between two people, the more similar they become (e.g Monge & Contractor, 2003); not in fixed characteristics such as gender and age of course, but in variable characteristics such as norms, beliefs, attitude, understanding, etc. This two-way interdependency illustrates how characteristics on the network and relational levels reinforce each other.

Focus on proximity

Different types of proximity result in different benefits for the network members, with the focus still on social learning in capacity development networks. Throughout the years many types of proximity have been defined. But, as Boschma (2005) puts it, “what unites the different dimensions of proximity is that they reduce uncertainty and solve the problem of coordination, and, thus, facilitate interactive learning and innovation”.

Authors from various backgrounds, but mostly related to organisational cooperation, have come up with a wide range of proximity categories with their own definitions and operationalisations (see figure 2.20). Two review papers of Knoben & Oerlemans (2006) and Boschma (2005) indicate that there is much overlap between those multiple definitions of categories of proximity that can be found in literature (Heringa et al, unpublished; Knoben & Oerlemans, 2006; Boschma, 2005).

![Figure 2.20: The (de)composition of the dimensions of proximity (Knoben & Oerlemans, 2006).](attachment:image.png)
For the purposes of this thesis we distinguish between four dimensions of proximity: geographical, cognitive, organisational and social proximity. To a large extent this is the division that was also made by Boschma (2005). Boschma however also identified a fifth dimension: institutional proximity, which refers to the institutional environment on the macro-level and entails elements that influence and structure political, social and economic interaction. This thesis focuses on the micro level, namely the network characteristics themselves, as opposed to the network environment. On this level the institutional differences can be considered as a part of the social and organisational proximity (Knoben & Oerlemans, 2006; Boschma, 2005; North, 1990). Therefore this fifth dimension is left out. The following paragraphs clarify the four proximity types that are considered and their effect on social learning and capacity development in bonding networks.

- **Geographical proximity**

Geographical proximity can be denoted as territorial, spatial, local of physical closeness (Knoben & Oerlemans, 2006). It can be measured as the absolute geographical distance between actors, as the travel time between actors (taking into account the means of transport), or as the perceived spatial distance.

Geographical closeness between people facilitates planned and serendipitous face-to-face interactions; network members can easily come together when they are spatially close to each other, which favours communication frequency. It facilitates explicit and specifically tacit knowledge sharing with a high level of information richness, which favours communication quality (Knoben & Oerlemans, 2006; Boschma, 2005). For explicit knowledge the many digital ways of communication made geographical proximity less important, but most authors argue that spatial closeness might still be important for transferring tacit knowledge that is required for interpretation and understanding of the codified knowledge (e.g. Howells, 2002). These two results (improved communication frequency and improved communication quality) of geographic proximity are beneficial for social learning in capacity development networks.

Furthermore social networks are not necessarily located or bound geographically, because there is nothing inherently spatial about the concept of social networks (Boschma, 2005). Geographical proximity may facilitate knowledge sharing between people, but it is not the main element that creates the connectedness between network members that is required. Knoben & Oerlemans (2006) suggest, based on their literature study, that constant geographical proximity might not be required for effective collaboration. Meetings, visits and temporary collocation could be sufficient in many cases, but only if other forms of proximity are present to facilitate understanding and sharing. However, empirical evidence for this seems lacking so far. Spatial proximity is likely to build on and strengthen other forms of proximity in relations, such as cognitive, social and organisational proximity. Thus, social learning may be facilitated by geographic proximity, but it is neither a necessary nor a sufficient condition; according to Boschma (2005) learning processes require at least a certain level of cognitive proximity besides geographic proximity.
• Cognitive proximity

Cognitive proximity is generally defined as the “similarities in the way actors perceive, interpret, understand and evaluate the world” (Knoben & Oerlemans, 2006, after Wuyts et al, 2005). This refers for example to a shared knowledge base, but also to similarities in the language and jargon that actors use to communicate with each other or to a shared definition of challenges at hand in the case of capacity development.

In order to communicate and share knowledge effectively and efficiently, actors need to have a certain level of cognitive proximity and thus have similar (but not necessarily identical) frames of reference, which are shaped by e.g. culture, experience, norms, affiliation, etc. (Knoben & Oerlemans, 2006). People tend to search for knowledge that is closely related to the knowledge that they already have at people who are cognitive proximate to themselves, which leads to the fact that knowledge creation is often cumulative (Boschma, 2005). This is related to an important concept in learning theories: the absorptive capacity. Network members can only learn (absorb) new things that connect in one way or another to knowledge that they have constructed at earlier times (according to the constructivist paradigm of learning), because only then can they communicate, understand and process the new knowledge successfully (Boschma, 2005). The more cognitive proximate network members are, the better they understand each other’s messages, the more efficient and meaningful becomes their communication, and the better their capacity to cooperate, jointly participate and act collectively to achieve their (capacity development) objectives. “In sum, actors need cognitive proximity in terms of a shared knowledge base in order to communicate, understand, absorb and process new information successfully” (Boschma, 2005). In other words: a certain level of cognitive proximity is an absolute requirement for social learning in capacity development networks.

• Organisational proximity

Organisational proximity is defined as closeness between people regarding (explicit or implicit) rules and routines of behaviour and a shared system of representations, values and beliefs, following Torre & Rallet (2005). On the current level of analysis of individual actors, their relations, and the network the form this also involves similarities in institutional background and in organisational culture. Moreover, it involves similarities in the level of autonomy and the degree of control that can be exerted by the actors within their social environment (Boschma, 2005), related to elements of relative power relations. Organisational proximity does not necessarily imply that network members are from the same organization, but that their (organisational) environments share some properties.

Organisational proximity facilitates social learning in capacity development because it results in mutual understanding regarding each other’s context and environment. This makes it easier to interpret each other’s messages and prevents misunderstandings. Organisational proximity enables cooperation and collective action in networks, because it increases the communication efficiency through this increased understanding between network members, just as cognitive proximity does. (Knoben & Oerlemans, 2005).
• Social proximity

Social proximity, sometimes referred to as personal proximity or as relational proximity (Knoben & Oerlemans, 2006), is defined as closeness in social context. It originates from embeddedness literature (Polanyi, 1944; Granovetter, 1985), which essentially suggests that the more socially embedded the relationships of actors (the more mutual friends, hobbies, activities, etc), the more social learning takes place (Boschma, 2005).

Relations between socially embedded actors involve trust, based on friendship, kinship, shared experiences, relation duration and mutual friends (Boschma, 2005). Trust positively influences knowledge sharing quality and frequency because it allows for vulnerability (discussed in more detail in section 2.6.1). Furthermore it facilitates sharing of tacit knowledge and encourages a social and open communicative attitude rather than the calculative attitude aiming towards cost minimization as many economics based knowledge management theories suggest (Boschma, 2005). These results of social proximity, based on trust, are beneficial for social learning in capacity development networks.

Negative bonding effects

Already from the very beginning that the social capital of networks was studied it was argued that too much bonding is as bad (or even worse) as a lack of it in social networks. Granovetter (1973) already investigated how the strong ties that are inherently found in bonding networks have a negative influence on the network’s performance. He suggests that strong ties within a closed social unit close off the contact with the wider group, and with that ways to improvement. This is destructive for an integrated systems orientation, effective stakeholder participation, and the system’s adaptive capacity.

A study of Svendsen (reported by Patulny & Svendsen, 2007) found that excessive bonding leads to widespread distrust, prejudices (about the ‘outer world’), nepotism, a lack of cooperation, group isolation, social poverty and neighbourly conflicts. Portes (1998) also found some negative results from too much bonding in networks during his literature study. He concludes that too much in-group bonding leads to complete exclusion of actors that do not belong to the closed network. This can end up as a “conspiracy against the public” and a complete stop of knowledge flow into and out of the closed network component, which leads eventually to a very subjective truth within the network and a complete blindness to what happens outside. Furthermore he states how bonding can also result in strong norms that prevent certain behaviours that are required for capacity development, such as finding new tasks or activities, negotiating with network relations, and lack of a critical attitude towards own and others’ work in the closed network. According to him such ‘negative’ strong group norms can prevent the development of autonomy, self-determination and initiative, which in turn might lead to decreased progress or even deterioration of the system.
The above stated findings are supported by Boschma (2005), who suggests from his critical literature review that too much cognitive proximity may be detrimental to learning and innovation, which are essential processes in capacity development networks. According to him cognitive proximity easily leads to cognitive lock-in, meaning that established routines with a social network obscure the view on new technologies or new possibilities, resulting in cumulative knowledge creation that leads to knowledge redundancy and inhibits innovation. He also concludes that too much social proximity leads to very high levels of loyalty, based on emotional bonds of friendship, which might lead to underestimation of opportunism. Furthermore too much commitment to other network members may lock actors into established ways of doing things at the expense of their own innovative and learning capacity (Boschma, 2005). Both consequences influence social learning for capacity development in the water sector negatively. Lastly, Boschma (2005) concludes that also too much geographical proximity may be harmful for interactive learning and innovation. Especially in the case of highly specialized geographical environments the capacity development networks may become too much inward looking, which weakens the innovative capacity and results in the inability to respond to new developments and thus a decreased adaptive capacity of the system. However, only when the overload of spatial proximity is accompanied by overload of other types of proximity will it really affect network learning negatively.

These insights show that social learning in capacity development networks require some sort of balance; whereas a lack of bonding prevents social learning to take place, an overload of it turns out to be detrimental to social learning for capacity development. The line between success and failure seems very thin.

**Conclusion**

From the previous paragraphs can be concluded that close networks with a high level of bonding, characterized by high geographical, cognitive, organisational and/or social proximity, have many benefits for social learning in capacity development networks. They result in high levels of knowledge sharing efficiency (high level of understanding leads to less effort to share more), of knowledge sharing quality (rich and non-deformed), and of knowledge sharing frequency (due to reachability). Considering this, bonding by proximity is mainly beneficial to capacity development because it enables effective social interactions (for social learning to take place) and because it contributes to effective stakeholder participation for addressing wicked water challenges. However, too much bonding and proximity is argued to be detrimental for effective social learning and capacity development (see figure 2.21).

*Figure 2.21: Theoretical framework addition related to the concepts of ‘bonding’ and ‘proximity’.*
2.5.3 Network characteristics related to Bridging

Bridging mechanisms are particularly beneficial for an integrated systems orientation and the network’s adaptivity, which are essential requirements for capacity development networks that address wicked water challenges, because they introduce novel and nonredundant knowledge into a capacity development network. Special attention should be given to bridging over disciplinary, sectoral, administrative and developmental boundaries. However, it must also be considered that too much bridging and diversity in networks is detrimental to social learning and capacity development.

High levels of bridging within social networks lead to a loose (low-density) set of relationships that result in a very open network structure, characterized by structural holes. It is called bridging because literally communicative bridges are formed between diverse people that normally do not find each other in networks. The concept of bridging originates from social capital literature, and is often referred to as ‘brokerage among structural holes’ in social network analysis literature. A structural hole occurs when for example two close network components are only very weakly connected to each other. As Burt (2000:353) states: “The structural hole between two groups does not mean that people in the groups are unaware of one another. It only means that the people are focused on their own activities such that they do not attend to the activities of people in the other group. Holes are buffers, like an insulator in an electric circuit. People on either side of a structural hole circulate in different flows of information”. To bring together people from opposite sides of the hole, brokerage needs to take place between them. Furthermore the concept of bridging is closely related to Granovetter’s (1973) concept of ‘weak ties’. Weak ties occur between diverse individuals and are assumed to be more fragile than connections in close ‘bonding networks’ (being strong and proximate ties) because this diversity, as opposed to proximity, result in less dyadic particularized trust (see also section 2.6 about trust) and less intense and efficient interactions.

Burt (2000:363) emphasizes the importance of bridging over diversity in a social network by citing John Stuart Mill (English philosopher and economist, 1806-1873) as follows: “It is hardly possible to overrate the value (...) of placing human beings in contact with persons dissimilar to themselves, and with modes of thought and action unlike those with which they are familiar. (...) Such communication has always been, and is peculiarly in the present age, one of the primary sources of progress”. Paradoxically (considering the contrast between proximity and diversity) bridging networks also have, just as bonding networks, important benefits for social learning in capacity development networks. Much literature is written about the strength of weak ties (e.g. Granovetter, 1973) and the benefits of structural holes that are present in bridging networks (e.g. Burt, 2000).
Bridging benefits

According to Burt (2000, 2005) bridging mechanisms facilitate a multi- or transdisciplinary problem solving approach that involves many (or in the best case all) stakeholders. Involvement of a diverse group of stakeholders provides the opportunity to bring together a diverse set of knowledge and perspectives from various backgrounds and disciplines, but all related to the same water system (see figure 2.22). Bridging thus prevents isolation, opportunism within the network, and blindness to the outside world (Boschma, 2005). It facilitates the possibility of considering the whole range of diversity with a cross-disciplinary view in a problem-solving situation, and could thereby lead to the integrated system’s view that is required in capacity development networks for addressing wicked water challenges (see section 1.3).

Figure 2.22: How bridging facilitates the establishment of an integrated system’s view.
(Or: how a lack of bridging does not facilitate this)
Next to that bridging is argued to be beneficial for social learning and capacity development because it provides access to new and nonredundant knowledge resources and with that an opportunity for innovation (Burt, 2005) and adaptation. As was stated in section 2.4.2, more stakeholders, providing knowledge about different parts of the water system from their own perspectives, can foresee future developments in the water system (due to interdependencies within the system and influences of changing external drivers) than one single stakeholder (see figure 2.23). The more diverse the stakeholders’ perspectives on the water system or challenge at hand, the more valuable it is to combine these into a set of shared future scenario’s (although there is a limit to this, see page 75 about negative bridging social capital). This positively influences the adaptive capacity of the social system. Next to this bridging is beneficial for the adaptive capacity because it breaks routines that tend to obscure the view on new possibilities and out-of-the-box opportunities and ideas. It enables actors to go out of the established channels within their own organisational or social communities, which provides a broader learning interface and more learning opportunities for innovation (Boschma, 2005). Wenger et al (2011) support that diversity within networks enhances the innovative capacity, “because networks characterized by diversity allow that information flows can be picked up, interpreted, and propagated in unexpected ways; they traverse networks with a high

Figure 2.23: How bridging facilitates the creation of a shared future scenario, a shared starting point, or shared knowledge. (Or: how a lack of bridging does not facilitate this)
level of spontaneity and unpredictability”, which would lead to a high innovative capacity and adaptivity. Furthermore Boschma (2005) finds that the benefit of distance between connected network members is that it facilitates the ability to create new knowledge, and with that innovative solutions that benefit the adaptive capacity of a water system. He states that knowledge development often requires dissimilar and complementary bodies of knowledge and refers to Cohendet & Llerena (1997) who suggest that new and alien knowledge sources trigger new ideas and creativity.

Focus on diversity

As we have seen in the previous paragraphs bridging over heterogeneity have benefits for social learning in capacity development networks, related to the flow of new and nonredundant knowledge to the advantage of an integrated systems orientation and the system’s adaptivity. However, various boundaries have be crossed to achieve different objectives. Snyder & Wenger (2004) illustrate this by stating that “a world learning system that can match the challenges we face must meet (...) cross-boundary representation that includes participants from all sectors – private, public, and nonprofit – and from a sufficient range of demographic constituencies and professional disciplines to match the complexity of factors and stakeholders driving the problem. The full potential of this learning process is only realised when it connects all the players at various levels who can contribute to it.”

- Crossing disciplinary boundaries

Problem-solvers from different disciplines (e.g. irrigation, drinking water, ecology, etc) tend to demarcate the challenges that they are addressing according to their own backgrounds and knowledge. Challenges are often simplified by disregarding variables that are outside these disciplinary demarcations. However, considering the interdependencies within the water system, such disciplinary boundaries should be crossed to facilitate an integrated systems view, with benefits for the whole system’s capacity to solve the interrelated problems.

- Crossing sector boundaries

Generally, people from different sectors (e.g. government, research, NGO, industry) have the tendency to cooperate mostly with others from the same sector (Wen, forthcoming). Scientists mainly talk to and work with other scientists, government officials discuss and develop policies mostly with other government officials, and industrial entities most easily solve their issues by involving their industrial counterparts. However, crossing these boundaries and connecting the different sectors of research, government, education, NGO’s and industry to each other would open the opportunity to establish a synergy between what happens within these sectors. Having all sectors of society collaboration towards a same direction leads to improved capacity development for addressing wicked water challenges. Hearn & White (2009) support this by stating that “the knowledge gained by research is often trapped at the point of origin, caught in the language of research, or simply isolated from those who actually apply that knowledge
–– the practitioners in the field. Likewise, tacit knowledge from the field rarely reaches the researchers or those making decisions. More effective bridges between knowledge, policy and practice are needed [to enable effective capacity development].

• Crossing administrative boundaries

Responsibilities related to management of the water system are generally divided between different administrative levels, such as municipalities, provinces, regions or states, countries, and international governmental unions. When these administrative levels only consider their own responsibilities and tasks, there will be a lot of friction and contradiction between them. Especially when lower levels have the responsibility of carrying out orders of higher levels, not considering each other’s perspectives, objectives, attitudes and benefits is detrimental (in both ways) for capacity development. Therefore also administrative boundaries should be crossed in capacity development networks in such a way that the actions on one level corresponds to the situation and circumstance on another level and administrative synergy is achieved.

• Crossing developmental boundaries

Luijendijk & Mejia-Velez (2005) emphasize the importance of bridging the boundary between developed and developing countries to enable application of global knowledge that is constructed in the developed world in local development situations: “(...) access to global information without knowledge of the local situation and context has little sense. Therefore creating international networks of professionals and communities of practice that share best practices and lessons learned from both the South and the North [i.e. the developing and the developed world (red.)] could be a very efficient way [to approach capacity development in the developing world]”. According to them such networks could provide suitable knowledge “just in time” and “just enough” and would provide the developing stakeholders with a much stronger sense of ownership. This means that a certain level of diversity in learning stage regarding the topic at hand should be present for stakeholders to learn from one another, which corresponds to the concept of the More Knowledgeable Other in Vygotski’s theory of social development (section 2.4.3). Another advantage of such global networks is that developing countries, which deal oftentimes with similar challenges, can learn directly from each other. “In this way the traditional ‘expert counterpart’ model assuming a one-way flow of knowledge from the North to the South will be replaced by the two-way flow of knowledge, which allow professionals in developing countries to ‘scan globally and reinvent locally’” (Luijendijk & Mejia-Velez, 2005, after Fukuda-Parr, 2002). At the same time it allows the developed North to become more responsive to the demands and knowledge flows in the developing South.
Negative bridging social capital

From the above paragraphs can be concluded that a certain level of bridging is very beneficial, if not essential, for social learning capacity development networks. However, some authors also focus on the fact that a too high level of bridging in a network has adverse effects.

The main ‘dangers’ of a too high level of bridging and diversity in networks can be divided into two major lines (e.g. Boschma, 2005). Firstly too much diversity within a bridging relationship limits the absorptive capacity of the network members. Due to too different mental models (i.e. ideas, perspectives, attitudes, knowledge, backgrounds) they are not able to understand each other anymore, which leads to a barrier for effective participation, which in turn influences the social system’s capacities to adapt and develop an integrated system view. Secondly too much bridging and diversity, implying long chains of weak ties, is expected to lead to fragmentation of the network, which results in a lack of coordination and the absence of an overview of what is happening within other parts of the social network. This is also not in favour of social learning and capacity development.

Conclusion

This overview suggests that characteristics related to bridging mechanisms facilitate the social learning process by introducing novel and nonredundant knowledge into a capacity development network. This enables the consideration of diverse knowledge bases and perspectives regarding a water system and/or specific challenge. Moreover, it positively influences the innovative capacity of the social system. This leads to the conclusion that bridging network structures are particularly beneficial for the establishment of an integrated systems orientation and the network’s adaptive capacity (see figure 2.24), which are essential requirements for capacity development networks that address wicked water challenges (see section 2.3). Especially attention should be given to bridging disciplinary, sectoral, administrative and developmental boundaries to achieve these benefits for capacity development networks. However, it must also be considered that too much bridging and diversity in networks is detrimental to social learning and capacity development.
Due the fact that both bonding and bridging mechanisms have outcomes that are essential for capacity development, it is important to conclude that capacity development networks should contain a careful balance between proximity and diversity. Whereas bonding by proximity benefits stakeholder participation, bridging over diversity has advantages for the establishment of an integrated systems view and increased adaptivity. Depending on the network’s specific water related objectives and the boundaries that need to be bridged, it should carefully be determined which types of proximity are required to establish the right balance for achieving the desired social learning outcomes.

As Eames (2005) state: “distinguishing between bonding and bridging social capital raises the question as to whether one is meant to be understood as better or more valuable than the other”. Where some authors argue that bonding social capital is more important, others believe that bridging provides more value to networks (Patulny & Svendsen, 2007). An interesting question in this regard is whether bonding and bridging mechanisms create, inhibit or decrease each other, because of the fact that they both turn out to have benefits for social learning in capacity development networks for addressing wicked water challenges, but are paradoxical in the sense that they are respectively connected to the network characteristics of proximity/closure and diversity/structural holes (see figure 2.25). However, not much evidence for this relationship between bonding and bridging can be found in existing literature. However, what can be concluded from previous scientific work is that capacity development networks should contain a careful balance between bonding (proximity) and bridging (diversity). This is supported by multiple authors of social capital, knowledge management and capacity development literature.

Nooteboom (2000) states that a trade-off needs to be made between proximity, for the sake of effective absorption and understanding, and cognitive distance (or diversity), for the sake of an integrated systems view, novelty and innovation: “information is useless if it

<table>
<thead>
<tr>
<th>Mechanism</th>
<th>Relational level</th>
<th>Ties type</th>
<th>Network level</th>
<th>Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>BONDING</td>
<td>Proximity</td>
<td>Strong ties</td>
<td>Closure</td>
<td>Knowledge sharing: - efficiency - quality - frequency</td>
</tr>
<tr>
<td>BRIDGING</td>
<td>Diversity</td>
<td>Weak ties</td>
<td>Structural holes</td>
<td>Knowledge novelty</td>
</tr>
</tbody>
</table>

*Figure 2.25: Overview of social network characteristics and outcomes that are related to bonding and bridging mechanisms.*
is not new, but it is also useless if it is so new that it cannot be understood” (Nooteboom, 2000:153 as quoted in Boschma, 2005). Boschma derives similar conclusions; too little proximity is harmful for a network because of a lack of trust, understanding and commitment, whereas too much social proximity leads to an overload of trust and blindness to outside influences, both barriers to social learning for capacity development. Burt (2000) refers to the importance of balancing bonding and bridging by stating that bridging over structural holes is an important source for new information and added value, but that network closure in the same network is also essential to realize the value that could be buried in the structural holes.

Baser & Morgan (2008) also adopted this way of thinking when they identified the capability to balance diversity and coherence as a core systems capability (among four others) to enable capacity development. This core capability includes according to Baser & Morgan (2008) the capabilities to communicate (closely related to bonding structures), to build connections, to manage diversity (closely related to bridging structures) and to manage the resulting paradox and tension. They argue that coherence, which is a result of proximity and leads to collective focus and action, and diversity, leading to the required integration of diverse perspectives and knowledge bases, are both essential to capacity development.

The story line of the first part of this thesis, leading to a theoretical answer to the central research question of this assignment, here comes almost to an end. Starting with an analysis of the concept of capacity development networks, which were defined as social networks, consisting of social actors and their relations, specifically aiming at addressing wicked water problems, the need for an integrated, participative and adaptive water
management approach became clear. With the focus on social learning processes in such networks, both bonding and bridging mechanisms (respectively closely related to proximity/closure and diversity/structural holes) turn out to provide benefits in quite different ways for the above social learning outcomes and capacity development to address wicked water challenges.

The above considerations ask for a well balanced capacity development network to address wicked water challenges. Too much proximity (or too few diversity) leads too lock-in and loosing contact with the outside world, whereas too much diversity (or too few proximity) leads to misunderstandings and fragmentations. This optimal balance required ‘just enough’ proximity (especially cognitive) in the network to enable interactions and facilitate understanding and collective knowledge creation, and thereby participation, and ‘just enough’ diversity (especially disciplinary and sectoral) to ensure enough novelty and innovativeness for an integrated system’s orientation and adaptive management. Referring back to the review on social learning of Reed et al (2010), they state that social learning “is most likely to occur if groups with different types of knowledge, share similar epistemological beliefs”. This underpins exactly what is meant in this case by balancing the effects of proximity and diversity. Depending on the specific water related capacity development objectives at hand, a systematic approach of crossing certain types of boundaries (disciplinary, sectoral, administrative, developmental) and at the same time facilitate proximity in other ways (geographical, cognitive, organisational, social) should be applied.

2.5.5 Theoretical framework

This section looked deeper into the effect of network characteristics that are associated with bonding and bridging mechanisms on social learning for capacity development aiming at addressing wicked water challenges. Bonding mechanisms tend to occur through proximity on the relational level, resulting in a very dense network with a very homogeneous member group, characterized by closure. Bridging mechanisms broker between diversity in a social relationship and result in a very loose and open network with a very heterogeneous group of network members, characterized by structural holes.

Both bonding and bridging have benefits for social learning in capacity development networks. High levels of geographical, cognitive, organisational and social proximity, result in high levels of knowledge sharing quality, quantity and efficiency, enabling social learning processes to take place and mainly contribute to effective stakeholder participation for addressing wicked water challenges. Bridging structures are particularly beneficial for an integrated systems orientation and the network’s adaptive capacity, because they introduce novel and nonredundant knowledge into the network. Special attention should be given to bridging disciplinary, sectoral, administrative and developmental boundaries.
However, it must also be considered that too much bonding/proximity or bridging/diversity in networks is detrimental to social learning and capacity development. Combining this with the fact that both bonding and bridging structures also have outcomes that are essential for capacity development, it is important to conclude that capacity development networks should contain a balance between the two. Depending on the network’s specific water related objectives and the boundaries that need to be bridged, it should carefully be determined which types of proximity are required to achieve the desired social learning outcomes.

With these results the theoretical framework can be extended again. This is shown in figure 2.27.

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**Figure 2.27**: The theoretical framework as it is after this section, complemented with the insights about the need for a balance between bonding and bridging and the effects of proximity and diversity on the relational network level.
Although a careful balance between bonding and bridging is argued to be key to social learning processes, the reviewed literature also describes some other social network characteristics on the individual and relational analytical levels that are essential ingredients for the emergence, development and strengthening of the network: trust & reciprocity, opportunity, motivation and ability.

The previous paragraphs zoomed step wise in on the effects of proximity and diversity in social relations, resulting in bonding and bridging mechanisms on the network level, paradoxically both with benefits for social learning in capacity development networks. Although a careful balance between proximity and diversity is key to social learning processes, the reviewed literature also describes some other social network characteristics that are essential ingredients for the emergence, development and strengthening of the network. This section highlights the importance of the concepts of trust, reciprocity (2.6.1) and opportunity (2.6.2) on the relational level of the network, and motivation (2.6.3) and ability (2.6.4) on the individual level of the network. This leads to the last addition to the theoretical framework, presented in its final form in section 2.6.5.

2.6.1 Trust and reciprocity

The concepts of trust and reciprocity are argued to play a key role in establishing network relations and in allowing interactions for social learning to take place between network members. It matters especially in problem-framing interactions because it allows for vulnerability by showing ignorance.
The concepts of trust and reciprocity are argued to play a key role in establishing network relations and in allowing interactions for social learning to take place between network members. As GTZ (2006) puts it: “trust is the basic lubricant for networking and sharing knowledge”. Trust can be viewed on different analytical levels in social networks. Patulny & Svendsen (2007) distinguish between particularized trust on the relational level, which refers to trust that exists between two individuals, and generalized trust, referring to a normative type of trust that is related to a general moral and faith in the ‘good’ intentions of other network members and that exists on the level of the whole network. Particularized trust is invoked through proximity within social relationships: people specifically choose whom to trust based on similarities they share with others. Generalized trust however is according to Patulny & Svendsen (2007) the main reason that diverse people can establish connection between them and thus the main reason that bridging networks exists.

Trust matters especially in problem-framing interactions (Cross et al, 2001). Pahl-Wostl et al (2007b) found that a minimum level of trust is required as a basis for transparent and efficient communication (a requirement for social learning) and of Cross & Borgatti (2004) about the fact that trust may contribute to the capacity of a social network by enabling its members to share valuable information with each other. They write that “trust and psychological safety have been associated with an ability to learn at both the individual and group levels of analysis. Thus one might also anticipate interpersonal trust or a perceived sense of safety to inform a model of information seeking” and/or social learning. They found that people are more willing to share useful knowledge in trusting relationships. Considering the receiving side of the learning interactions, people would also be more willing to listen to and absorb trusted other’s knowledge.

Trust might play such an important role because it allows vulnerability (Parcell, 2010): “human beings do not like to admit ignorance and inability to solve a problem. They are also naturally reluctant to share as they think their experience is not relevant or ‘good enough’. It takes trust and appreciation to share that vulnerability”. The above considerations lead to the assumption that trust plays an important role in social learning in capacity development networks that aim to address wicked water challenges.

Reciprocity is generally defined as the expectation that people will respond to each other in similar ways. This is also supposed to be an essential ingredient for any type of social interaction (Kolekofski & Heminger, 2003). Parcell (2010) states that people share knowledge best when they feel that their contributions are acknowledged and valued by the group: “people participate [in social learning processes] when responses to their queries are timely. They are then more willing to reciprocate”. He also proposes that as trust grows, people share more without expecting knowledge in return (sometimes also referred to as voluntary knowledge sharing). However, he finds that it is important that knowledge sharing is rewarded by reciprocal return of new knowledge when trust is still developing in a relationship.
2.6.2 Opportunity

A sufficient level of knowledge sharing opportunity within social network relationships is essential for social learning and capacity development. This level of opportunity is determined by the quality of the relationship (interaction frequency, intensity and multiplexity), know-who regarding network relations, and the accessibility of network relations.

The previous sections often mentioned the existence of ‘relationships’ between social network members, and how these function as a communication, knowledge sharing and social learning infrastructure. Section 2.5 described the influence of the total resulting pattern of these relationships on social learning for capacity development aiming at addressing wicked water challenges. However, according to Adler & Kwon (2002), there is another essential relational ingredient for ‘materializing the social capital’ in the network, e.g. for the benefits of social learning: opportunity.

‘Relationship’ stayed a very broad concept throughout this thesis. It was assumed that these relationships allow communication to happen between the related network members. However, having a relation in this context could mean that the network members have face-to-face meetings every day, but it could also be that their interactions are restricted to one phone call every year. It is clear that such differences in interaction frequency might have a significant impact on the degree to which knowledge is shared for social learning to take place. Thus, the ‘quality’ of the relationships requires, next to its structure and content, attention when analysing capacity development networks. This includes the interaction frequency (how often do the actors interact?), intensity (how ‘deep’/superficial are their interactions?) and multiplexity (in which different contexts do their interactions take place?). These three factors determine whether the actors in the relationship actually have the opportunity to engage in knowledge sharing processes, in a way that social learning can take place.

Pahl-Wostl & Hare (2004) raise another aspect that is also considered to belong to ‘opportunity’ for the purpose of this thesis. They state that actors, to engage in social learning for resources management processes, need to be aware of each other’s existence and perspectives. Without this know-who, network members don’t know who to turn to for specific knowledge, which implies that they don’t have the opportunity to learn. Borgatti & Cross (2003) add to this by writing that the act of information seeking is a function of the extent to which a person knows and values the expertise of another. A person’s awareness of the knowledge or expertise of their connections determines whether and for what kinds of reasons a connection will be consulted (Cross & Borgatti, 2004). According to them such know-who is perhaps the single most important variable in knowledge seeking. However, they also state that awareness of who knows what is not sufficient for interaction: “Knowing that someone has information or knowledge you need does not translate to actually utilizing that knowledge if the person is not accessible. In fact, in today’s time-constrained world, it is likely that access alone might be uniquely
influential in whether and how others are tapped for information or knowledge”. The easier it is to access new knowledge, the higher our quality and quantity standards. These standards fall when access to knowledgeable people gets harder. Cross & Borgatti (2004) summarize that “both knowing who to turn to and having access to them are important in pulling information from a network of contacts”.

In summary, a sufficient level of knowledge sharing opportunity within social network relationships is essential for strengthening of network relations, social learning and capacity development. This level of opportunity is determined by the quality of the relationship (interaction frequency, intensity and multiplexity), know-who regarding network relations, and the accessibility of network relations.

2.6.3 Motivation

Motivation enables network members to make use of the network’s social capital; a bonding or bridging structure may contain high levels of social capital in the form of goodwill and knowledge resources, but without the network members’ motivation to materialize this social capital and to commit to the network, no knowledge sharing or learning will take place.

Another factor that is of major importance for the occurrence of social learning in capacity development networks is ‘motivation’ (Adler & Kwon, 2002). Motivation is an individual characteristic that refers to the willingness of network members, e.g. to communicate, share their knowledge and learn from each other. For social learning this is required to happen in a wider social unit, i.e. across the social boundaries of the initial knowledge sharing activity. Adler & Kwon (2002) state that motivation enables network members to make use of the network’s social capital; a bonding or bridging structure may contain high levels of social capital in the form of goodwill and knowledge resources, but without the network members’ motivation to materialize this social capital, no knowledge sharing or learning will take place. Moreover, network members should be motivated to commit to the network and their colleague network members to enable network strengthening.

Different types of learning and sharing motivations that enable social learning and network strengthening are identified in social capital, knowledge management and psychological literature.

Social norm based motivation

Portes (1998) distinguishes between consummatory motivations and instrumental motivations. The first class is based on deeply internalized network norms, established through lifelong socialization or intense shared experiences. The second class of motivation is based on another type of norms, and relate more to theories of rational calculations (‘there is no such thing as a free lunch’) from an economic perspective (Adler
& Kwon, 2002). It can be based on the obligation that results from dyadic knowledge exchange (reciprocity), or on the situation where such general norms of reciprocity are enforced by the broader community.

Kolekofski & Heminger (2003) take another approach to motivation, but also related to relational and general trust and norms. They analysed motivational beliefs about information exchange using a framework based on the Theory of Reasoned Action (Ajzen & Fishbein, 1980). Through a literature study, they discovered a series of potentially relevant beliefs that appeared to influence knowledge sharing:

- **Beliefs about information**: Is the information believed to be personal ‘possession’ or belonging to the organization; perceived amount of information; perceived value of the information. Also the perceived information quality is important here, due to the fear that the information receiver will react in a negative way.

- **Interpersonal beliefs**: strength of ties between the persons involved; fear of providing wrong information; reciprocity, i.e. belief that others will also provide information to you. (Strongly related to relational trust and norms)

- **Beliefs about environment**: whether there are positive norms about sharing in the network environment; commitment to the network. (Strongly related to generalized trust and norms).

- **Beliefs regarding the activities**: extent to which the information is believed to be related to and relevant for the activities; extent to which the learning activities are believed to be useful, fun, effective, etc.

**Intrinsic vs. extrinsic motivation**

The last category of motivational beliefs that is suggested by Kolekofski & Heminger (2003) is related to the expected outcomes of knowledge sharing behaviour. This is strongly related to Deci & Ryan’s differentiation between intrinsic and extrinsic motivation. A learning activity is generally considered to be intrinsically motivating if an external reward is not necessary to start and continue that activity (Boekaerts, 2002). People who are intrinsically motivated find the activity itself or its outcome gratifying. Even in case of difficulties in completing the activity intrinsically motivated people will persist because the experience a feeling of self-determination (Boekaerts, 2002). Extrinsically motivated people expect to get some sort of reward (which can also be penalty prevention) after completing an activity; they value this reward and not the activity itself.

This source of motivation is also brought up by Andriessen (2006:28), who considers outcome-based motivation: “people are motivated to share (or withhold) knowledge because they value the outcomes. This could relate to incentive outcomes, such as reputation, acceptance or credits (extrinsic), or to the learning outcomes itself (intrinsic). In addition it is important that the person finds consistency in the outcomes: if sharing is appreciated one moment and condemned the other, people lose the motivation to share”.

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Self-efficacy based motivation

Another important influencer of learning and sharing motivations is self-efficacy (Deci & Ryan, 2002). Self-efficacy beliefs are opinions that people hold about their own ability in relation to a specific domain and about their ability to learn within this domain. People are more interested in participating in learning activities and tasks for which they think they have the necessary abilities. Bandura (1977) is a much-cited source when it is about the concept of self-efficacy. According to his social cognitive theory an individual’s efforts to complete an activity increase as his/her level of self-efficacy or mastery expectations increase. He describes how a person’s self-efficacy is influenced by feedback from his/her social environment. Ormrod (1999) applied the concept to a social learning environment such as a capacity development network. According to him self-efficacy levels reflect a persons’ understanding of what skills they can offer in a group setting.

2.6.4 Ability

Ability refers to the expertise of network members and their skills to communicate with their network relations, and is as important to enable social learning in networks as the concept of opportunity and motivation. Ability includes actors’ expertise, absorptive capacity, knowledge articulation skills, communication skills and self-efficacy.

Adler & Kwon (2002) also note that ability – defined as the competencies and resources at the network actors - occupies an ill-defined place in the current state of social capital theory, which focuses on structural relational characteristics. Mostly it is not taken into account because it is proposed to belong to the concept of human capital and not social capital (e.g. Burt, 1993). However, for social learning and capacity development the ability to share and absorb knowledge is not less important than the opportunities and motivations to do so. This is supported by Portes (1998), who perceives the positive effects of individual knowledge sharing ability as complementary to the relational characteristics in the context of relational interactions for learning.

Ability thus refers to the expertise of network members and their skills to communicate with their network relations. The concept of absorptive capacity that was discussed in section 2.5.2 about cognitive proximity is also closely related to the concept of ability. Absorptive capacity refers to the ability to construct new personal knowledge from received and absorbed messages. Moreover, for network members to absorb new knowledge, other network members should share their personal knowledge and expertise. To do this they should be able to articulate their internal (tacit) knowledge and to communicate it effectively to their relations (similarly to the externalization and socialization processes in the knowledge creation cycle of Nonaka & Takeuchi (1994) that was discussed in section 2.4). This requires a certain level of communication skills.
and self-efficacy; network members should believe that they are able to absorb and share knowledge in order to actually be able to do so. Here ability overlaps partly with motivation, where self-efficacy was also discussed.

2.6.5 Theoretical framework

With the recognition that there is more than only network structure (bonding and bridging) and relational content (proximity and diversity), the focus has been put in this section on the concepts of trust, reciprocity, opportunity, motivation and ability.

The concepts of trust and reciprocity are argued to play a key role in establishing network relations and in allowing interactions for social learning to take place between network members. It matters especially in problem-framing interactions because it allows for vulnerability by showing ignorance. The social learning opportunity is determined by the quality of the relationship (interaction frequency, intensity and multiplexity), know-who regarding network relations, and the accessibility of network relations. It enables network members to make use of the network’s social capital, just as motivation does; a bonding or bridging structure may contain high levels of social capital in the form of goodwill and knowledge resources, but without the network members’ motivation to materialize this social capital, no knowledge sharing or learning will take place. Moreover, to strengthen the network and improve interactions its members should be motivated to commit to the network and their colleague members. Thirdly, ability refers to the expertise of network members and their skills to communicate with their network relations. It includes actors’ expertise, absorptive capacity, knowledge articulation skills, communication skills and self-efficacy.

These results lead to the finalized theoretical framework, presented in figure 2.29. Section 1.7 presents the complete story line of the framework in its finished form.
Figure 2.29: The last addition to the theoretical framework contains concepts that are argued to also have benefits for social learning in capacity development networks, but are less directly related bonding and bridging mechanisms.
2.7 The theoretical framework completed

The results from the literature review that are described in sections 2.2 to 2.6 lead to the following conceptual framework about bonding by proximity and bridging over diversity for social learning in capacity development networks that aim to address wicked water challenges (figure 2.30).

![Diagram of the theoretical framework](image_url)

*Figure 2.30: The completed theoretical framework.*
CAPACITY DEVELOPMENT NETWORKS (section 2.2)

Although there are many views on what capacity development is and what its characteristics are, still little attention went to understanding underlying structural and content related patterns and dynamics in capacity development networks.

Within the context of this thesis capacity development is defined as changing a social system’s capacity, which is emerging from its members’ competencies and their collective capabilities, in such a way that it is better able to identify, understand and address its challenges.

Considering the fact that capacity is the property of a social system and that it emerges from a synergy between the properties of the system’s parts (individual competencies and collective capabilities), it is very seductive to apply a social network’s paradigm to analyse capacity development processes.

A social network is formally defined by Wasserman & Faust (1994) as ‘a set of network members that are connected to each other by one or more types of relations’. A social network perspective enables the possibility to analyse processes that influence capacity development on multiple analytical levels.

WICKED WATER CHALLENGES (Section 2.3)

The type of public value that is considered as the overall capacity development objective in this thesis is ‘addressing wicked water challenges’. This forms the context of the theoretical framework about the structural characteristics of capacity development networks. Many of the world’s problems in which water is involved could be labelled as wicked problems. ‘Wicked problem’ is a phrase originally used in social planning to describe a problem that is difficult or impossible to solve because of incomplete, contradictory, and changing requirements that are often difficult to recognize.

Dealing with the complex interconnectedness of water challenges could be done with a holistic integrated approach, adopting a systems orientation to address the challenges at hand. In such an approach problem solvers look further than only their challenge demarcation and check which changes occur in other parts of the water system when interventions would be implemented.

The key to deal with the stakeholder diversity and resulting ambiguity is to take a participative water management approach. Participation to handle ambiguity in an inclusive way demands the integration of the various involved perspectives that might be very different in nature.

To deal with uncertainty because of the limited possibility of predicting the water system’s external drivers and internal interdependencies, an adaptive water management approach is required that is characterized by flexibility and an innovative capacity.
SOCIAL LEARNING (Section 2.4)

This thesis’ focus is on a single but very important process in capacity development networks: social learning. Many authors of capacity development literature support that social learning is the most important and essential ingredient for capacity development networks.

Social learning is essentially a socially embedded learning process with an input (the required conditions for social learning) and an output (the desired outcomes of social learning). It can be defined as the process of establishing a change in understanding that is situated in wider social units and happens through social interaction.

Social learning processes facilitate the outcomes that are required for addressing wicked water challenges. The fact that it involves a change in understanding, a wider social unit, and social interactions enables an integrated, participative and adaptive water management approach. This is one of the reasons why social learning is considered a key process in water related capacity development networks.

Social networks are considered by many authors to be the infrastructure for social learning. Network characteristics influence the degree to which social learning takes place in capacity development networks. The insights that support this view come from the different backgrounds of communication networks, knowledge networks and learning networks.

BONDING & BRIDGING (Section 2.5)

Social capital literature studies the influence of network structure on the social exchange of resources, such as knowledge, and distinguishes between two types of network mechanisms: bonding and bridging networks, which are respectively paradoxically closely related to proximity and diversity within social relationships.

The social capital of a capacity development network is the combination of values, trust (together resulting in goodwill) and exchangeable knowledge resources that resides in the network’s structure and content, and that enables the connected network members to effectively act together in order to pursue their capacity development objectives.

Networks in which bonding mechanisms prevail, characterized by high levels of geographical, cognitive, organisational and social proximity, have many benefits for social learning in capacity development networks. They result in high levels of knowledge sharing efficiency, quality and frequency, and enable social learning processes to take place. They mainly contribute to effective stakeholder participation for addressing wicked water challenges. However, too much bonding and proximity within a network is argued to be detrimental for effective social learning and capacity development.
Bridging mechanisms are particularly beneficial for an integrated systems orientation and the network’s adaptivity, which are essential requirements for capacity development networks that address wicked water challenges, because they introduce novel and nonredundant knowledge into a capacity development network. Special attention should be given to bridging over disciplinary, sectoral, administrative and developmental boundaries. However, it must also be considered that too much bridging and diversity in networks is detrimental to social learning and capacity development.

Due the fact that both bonding and bridging mechanisms have outcomes that are essential for capacity development, it is important to conclude that capacity development networks should contain a careful balance between proximity and diversity. Whereas bonding by proximity benefits stakeholder participation, bridging over diversity has advantages for the establishment of an integrated systems view and increased adaptivity. Depending on the network’s specific water related objectives and the boundaries that need to be bridged, it should carefully be determined which types of proximity are required to establish the right balance for achieving the desired social learning outcomes.

**OTHER FACTORS (section 2.6)**

Although a balance between bonding and bridging is key to social learning processes, the reviewed literature also describes some other social network characteristics on the individual and relational analytical levels that are essential ingredients for the emergence, development and strengthening of the network: trust & reciprocity, opportunity, motivation and ability.

The concepts of trust and reciprocity are argued to play a key role in establishing network relations and in allowing interactions for social learning to take place between network members. It matters especially in problem-framing interactions because it allows for vulnerability by showing ignorance.

A sufficient level of knowledge sharing opportunity within social network relationships is essential for social learning and capacity development. This opportunity is determined by the quality of the relationship (interaction frequency, intensity and multiplexity), know-who regarding network relations, and the accessibility of network relations.

Motivation enables network members to make use of the network’s social capital; a bonding or bridging structure may contain high levels of social capital in the form of goodwill and knowledge resources, but without the network members’ motivation to materialize this social capital and to commit to the network, no knowledge sharing or learning will happen.

Ability refers to the expertise of network members and their skills to communicate with their network relations, and is as important to enable social learning in networks as the concept of opportunity and motivation. Ability includes actors’ expertise, absorptive capacity, knowledge articulation skills, communication skills and self-efficacy.
PART 2

CASE STUDY
In the first part of this thesis a conceptual framework was proposed that answers the central question of this thesis from a theoretical point of view:

Which social network characteristics, with a focus on bonding and bridging mechanisms, facilitate social learning in capacity development networks that aim to address wicked water challenges?

In the second stage of the research a case study was carried out in order to assess whether the proposed framework makes sense in real-world capacity development initiatives in the water sector (see figure 3.1) and evaluate to which degree the framework could be used as a basis to develop practical recommendations for capacity developers in the water sector (see section 1.2 for an overview of research objectives and questions). This chapter explains and describes the case study methodology, selection procedure and research instruments by means of which the case study results (chapter 4) were obtained.
Section 3.1 describes the case study objectives and clarifies why this methodology is chosen to assess the theoretical framework. The case that was selected is the UN-Water Safe Use of Wastewater in Agriculture project and is introduced in section 3.2, as is the justification for this choice. Section 3.3 presents the research methods and instruments that were developed to study the case, including the operationalisation of the theoretical framework.

3.1 Research methodology

“Which social network characteristics, with a focus on bonding and bridging mechanisms, facilitate social learning in capacity development networks that aim to address wicked water challenges?” This is the central research question posed in this thesis. A conceptual framework that proposes an answer to this question from a theoretical point of view was presented in chapter 2. The framework identified the interconnections between
the concepts of capacity development, social networks, wicked water challenges, social learning, and bonding and bridging social capital, based on literature from various research fields. The central objective of this thesis is to develop a basis on which practical recommendations for capacity developers in the water sector could be developed. However, before actual conclusions can be drawn it is required to check whether this theoretical framework makes sense within the context of real-world capacity development initiatives. In order to discover whether this is the case it was chosen to conduct a case study. This section presents the underlying motivations for this methodological choice as well as the implications of the proposed framework for the case study selection.

3.1.1 The case study as a methodology

This section aims to justify the choice to conduct a case study for assessing the theoretical framework that was developed within the research assignment. It focuses on the usability of the case study as a research methodology and explains how this methodology fits to the purposes of this research.

According to Swanborn (2010) a case study could be defined as an investigation of a social phenomenon

- in its natural environment,
- with special attention to social processes and how these are perceived by the social ‘carriers’ of the phenomenon,
- using diverse data sources to get a thorough view on the phenomenon,
- and aiming at extensive description of many variables, searching for explanation of the studied processes.

Essentially a case study is “an intensive analysis of an individual unit, stressing developmental factors in relation to environment” (Flyvbjerg, 2011). This individual unit, which can be a single individual, a community or an organization, can be studied in a number of ways, quantitatively or qualitatively. The methods are not so much decisive for a case study, but the demarcation of what belongs to the case and what is context is. ‘Intensive’ in Flyvbjerg’s definition means that the study comprises more depth (i.e. detail, richness, completeness, and variance) into the unit of study than does cross-unit analysis. ‘Developmental factors’ refers to the fact that case studies would be especially useful to study processes that are involved within the social unit. Flyvbjerg (2011) emphasizes that a case study should not be seen as subordinate to investigations of larger samples, but as a valuable in-depth research method for its own purposes.
Flyvbjerg (2011) comes to the important conclusion that in depth qualitative (case) research and wide (statistical) quantitative research are complementary instead of conflicting: “It is common sense to give up wars that cannot be won, like the methods war over quantitative versus qualitative methods, or the science wars, which pit social science against natural science. It is also common sense to finally acknowledge that case studies and statistical methods are not conflicting but complementary”. His overview of complementary value is shown in table 3.1. From the notion that case studies are not too often taken seriously by scientists he also identified and extensively describes five misunderstandings about the case study as scientific research methodology (shown in summary in table 3.2).

**Table 3.1: Overview of the complementary value of case studies and statistical methods (Flyvbjerg, 2011).**

<table>
<thead>
<tr>
<th>Case Studies</th>
<th>Statistical Methods</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Strengths</strong></td>
<td><strong>Weaknesses</strong></td>
</tr>
<tr>
<td>Depth</td>
<td>Selection bias may overstate or understate relationships</td>
</tr>
<tr>
<td>High conceptual validity</td>
<td>Weak understanding of occurrence in population of phenomena under study</td>
</tr>
<tr>
<td>Understanding of context and process</td>
<td>Statistical significance often unknown or unclear</td>
</tr>
<tr>
<td>Understanding of what causes a phenomenon, linking causes and outcomes</td>
<td>Establishing probabilistic levels of confidence</td>
</tr>
<tr>
<td>Fostering new hypotheses and new research questions</td>
<td>Weak mechanisms for fostering new hypotheses</td>
</tr>
<tr>
<td><strong>Weaknesses</strong></td>
<td><strong>Strengths</strong></td>
</tr>
<tr>
<td>Weak understanding of occurrence in population of phenomena under study</td>
<td>Conceptual stretching, by grouping together dissimilar cases to get larger samples</td>
</tr>
<tr>
<td>Statistical significance often unknown or unclear</td>
<td>Weak understanding of context, process, and causal mechanisms</td>
</tr>
</tbody>
</table>

Flyvbjerg (2011) comes to the important conclusion that in depth qualitative (case) research and wide (statistical) quantitative research are complementary instead of conflicting: “It is common sense to give up wars that cannot be won, like the methods war over quantitative versus qualitative methods, or the science wars, which pit social science against natural science. It is also common sense to finally acknowledge that case studies and statistical methods are not conflicting but complementary”. His overview of complementary value is shown in table 3.1. From the notion that case studies are not too often taken seriously by scientists he also identified and extensively describes five misunderstandings about the case study as scientific research methodology (shown in summary in table 3.2).

**Table 3.2: Summarizing overview of the most common misunderstandings about case studies (Flyvbjerg, 2011).**

<table>
<thead>
<tr>
<th>Misunderstanding No. 1</th>
<th>General, theoretical knowledge is more valuable than concrete case knowledge.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Misunderstanding No. 2</td>
<td>One cannot generalize on the basis of an individual case; therefore, the case study cannot contribute to scientific development.</td>
</tr>
<tr>
<td>Misunderstanding No. 3</td>
<td>The case study is most useful for generating hypotheses; that is, in the first stage of a total research process, while other methods are more suitable for hypotheses testing and theory building.</td>
</tr>
<tr>
<td>Misunderstanding No. 4</td>
<td>The case study contains a bias toward verification, that is, a tendency to confirm the researcher’s preconceived notions.</td>
</tr>
<tr>
<td>Misunderstanding No. 5</td>
<td>It is often difficult to summarize and develop general propositions and theories on the basis of specific case studies.</td>
</tr>
</tbody>
</table>
Like Flyvbjerg (2011), Swanborn (2010) concluded from his extensive review and synthesis that a case study is especially useful to obtain detailed knowledge about a social process in its natural environment. He finds that case studies are very valuable for getting insights into social interactions between individuals that act within the case context, and specifically in their various viewpoints and perceptions regarding (explanations and underlying patterns of) these interactive processes. This is exactly the objective of this second research stage, which aims to assess how the theoretical insights that resulted from the first research stage take place in a real-world environment. Especially due to the fact that social interaction (in capacity development networks) play a very important role in the topic of this thesis, the case study methodology appears to be a perfect fit to the purposes of this research.

3.1.2 Case study objectives and considerations

Referring back to section 1.2, the main objective of this thesis is to establish a framework that could serve as a basis for the development of practical insights and recommendations for water related capacity developers. The case study serves to assess the theoretical framework that was presented in chapter 2. The specific case study objectives are:

- To obtain insights into the meaning of the various theoretical framework variables in a real-life capacity development situation.
- To evaluate whether the conceptual relations that are present in the theoretical framework (e.g. between social learning and capacity development, between the various network characteristics and social learning) correspond to the processes that can be observed in a real-life capacity development situation.
- To explore a real-life context of a capacity development network to investigate any interesting extra insights that provide in-depth or extended understanding of the theoretical framework variables and connections.

The following paragraphs present various considerations that were done to select a case with which the above objectives could be achieved.

Minimizing specific contextual effects

When selecting a case it should be considered whether the preference goes to a single case or to a series of nested sub cases as part of a greater whole (Swanborn, 2010). Studying only one single case means that the influence of the specific case environment plays a big role in the case results, which could make it difficult to distil that context’s effects on the studied processes. When considering a greater whole in which multiple sub cases are nested it becomes possible to find out which effects on the investigated social...
interaction could be attributed to which environmental aspects. As Swanborn (2010) states: “Hoe meer cases, des te meer informatie; we kiezen liever voor twee cases dan voor één. En liever drie dan twee. (...) De onmogelijkheid om bij de bestudering van slechts één of een zeer beperkt aantal situaties te onderscheiden tussen algemene en situatiespecifieke trekken leidt tot de noodzaak van replicatie bij andere cases”.

Testing versus exploration

Another important consideration relates to the level of information that is expected to be obtained from the case study (Swanborn, 2010). The case study objective is not to test detailed hypothesis, but to explore the meaning, connections and any other interesting insights of the theoretical framework variables (that potentially lead to starting points of future research, see section 6.4). The case study should thus have a context in which the framework variables are expected to occur and it should offer the opportunity for such explorative research.

Selection criteria

Various practical considerations have led eventually to selection of the ‘Safe Use of Wastewater in Agriculture’ project. This project is a cooperation between UN-Water members and partners, coordinated by the UN-Water Decade Programme on Capacity Development (UNW-DPC), which is located in Bonn, Germany. The project aims at the establishment of an international capacity development network, with members from many developing countries, to promote safe use of wastewater in agriculture.

The following four reasons played a major role in this selection process:

- Connections were already established between KWR Watercycle Research Institute (which provided the opportunity to conduct this research) and UNW-DPC. This provided a pragmatic reason to engage with this UN-Water programme.

- A central focus of UNW-DPC is the development of capacity development networks, within UN-Water and among stakeholders in the member states of the United Nations. Their capacity development approach has much parallels with the concept of social learning as it was defined in section 2.4. Thus, also regarding the context and content opportunities were present.

- UNW-DPC had recently launched the Safe Use of Wastewater in Agriculture project. Being a UN-Water programme (and not an agency) their scope is very broad and inter-disciplinary. At the time of case selection already four UN agencies from various disciplinaru backgrounds committed to a cooperation within this project, guaranteeing the possibility of studying diversity and bridging mechanisms, as well as proximity and bonding mechanisms.

- Moreover, the Safe Use of Wastewater in Agriculture project was at the moment of case study selecting in the starting phase. The international Kick-Off workshop had just taken place and the main part of the capacity development project was just
about to start. Very seldom there is the opportunity to study a network from the very first moment it starts to emerge. For this reason the case provided a very interesting ‘playground’ to investigate network characteristics and networking mechanisms and their influence on the social interactions that take place in the network. However, this also implies that there is no evidence of social learning or capacity development that has taken place already, because the network is ‘new’. The case study is thus restricted to study the network potential instead of actual learning outcomes. However, the convenience of being able to study the network from the start of its emergence outweighs this limitation.

### 3.2 The case: Safe Use of Wastewater in Agriculture

This section presents the case that was selected to study bonding and bridging in capacity development networks from a social learning perspective: The Safe Use of Wastewater in Agriculture project, coordinated and initiated by the UN-Water Decade Programme on Capacity development. Section 3.2.1 outlines the context of the Safe Use of Wastewater in Agriculture project (UN-Water & UNW-DPC), after which the case is described in detail in section 3.2.2. The applicability of this case for the case study objectives (see section 3.1.2) is presented in section 3.2.3.

#### 3.2.1 Case context

The Safe Use of Wastewater in Agriculture project is a capacity development initiative, initiated and coordinated by the UN-Water Decade Programme on Capacity Development (UNW-DPC). In order to understand the case context the focus of this section is firstly on UN-Water, as a so called inter-agency mechanism of the United Nations, and UNW-DPC as one of its four specialized programmes (For more information about this case context: e.g. UNW-DPC, 2011).

**UN-Water**

UN-Water is established in 2003 by the United Nations (UN) High Levels Committee on Programmes as an inter-agency mechanism. It is intended to foster greater cooperation, knowledge sharing and coherency among existing UN members (the official UN agencies) and partners (the non-UN organization that work in formal and close cooperation with UN agencies) that are involved in fresh water related projects. The aim of UN-Water is to coordinate...
among organizations that do similar work or could add value to each other’s work by cooperation. A management team together with four specialized programmes (World Water Assessment Programme, Joint Monitoring Programme on Water Supply and Sanitation, and the two Decade Programmes on Capacity Development and Advocacy and Communication) form the UN-Water backbone. In this configuration it aims to develop its abilities to support action and promote solutions related to complex fresh water related issues, including water supply and sanitation as well as water resources management. The work is focused mainly on providing coordination and support for the UN-Water members and partners and other stakeholders to provide leadership and solutions to member states (the countries that are officially recognized by the United Nations) that are dealing with water related issues.

Box 3.1: The scope, objective and focus areas of UN-Water (From: A Guide to UN-Water, downloadable from http://www.unwater.org)

Scope

The scope of UN-Water’s work encompasses all aspects of freshwater and sanitation, including surface and groundwater resources and the interface between fresh and sea water.

Objective

UN-Water was established to promote coherence and coordination in UN System initiatives that are related to UN-Water’s scope of work and contribute to the implementation of the agenda defined by the 2000 Millennium Declaration and the 2002 World Summit on Sustainable Development.

Focus areas

- Integrated water resources management
- Drinking-water, sanitation and health
- Water scarcity
- Water quality
- Transboundary waters
- Climate change and disaster risk management
- Gender and water
- Financing and valuation
- Capacity building
- Africa: a region for priority action
UN-Water Decade Programme on Capacity Development

The Decade Programme on Capacity Development (UNW-DPC) is one of the four programmes operating under the UN-Water flag. Its broad mission is to “enhance the coherence, credibility and integrated effectiveness of UN-Water, by strengthening its capacity development programmes, particularly in developing countries and economies in transition”. UNW-DPC started to work in August 2007 with the objective of strengthening the activities of UN-Water members and partners and support their efforts in achieving the Millennium Development Goals, with a special focus on capacity development for addressing freshwater issues in UN members states. The capacity development goals are therefore two-fold: developing cooperative capacity within UN-Water to develop problem-solving capacities in the member states. Directed towards the member states UNW-DPC primarily focuses on decision makers (to develop countries’ institutional capacities), water professionals (to develop their individual capacities/human capital), academia (to develop countries’ training capacities) and media (to develop countries’ societal capacities).

UNW-DPC’s projects and activities are characterized by adding value to UN-Water members’ and partners’ joint activities by providing support and coordination, and/or by scaling up activities of UN-Water members and partners by greater involvement and cooperation within UN-Water. Value adding activities comprise e.g. activity mapping, capacity needs assessment, capacity gaps analysis, and development and implementation of capacity development methodologies. Scaling-up activities have to do with bringing the attention of UN-Water members and partners and member states to existing initiatives by e.g. workshops, publications, trainings and conferences, aiming for greater cooperation to develop capacities. All activities aim at contributing to the eight UN-Water key priority areas as presented in box 3.1 (see figure 3.3).
The case that was selected for the purposes of this thesis is the Safe Use of Wastewater in Agriculture project, initiated and coordinated by UNW-DPC, and developed into a still growing cooperative capacity development project in which already six UN-Water members and partners joined UNW-DPC: FAO (Food and Agriculture Organization), UNEP (United Nations Environmental Programme), UNU-INWEH (UNU Institute for Water, Environment and Health), WHO (World Health Organization), IWMI (International Water Management Institute) and ICID (International Commission on Irrigation and Drainage). The multiyear and multi-regional capacity development project aims to promote the safe use of wastewater in agriculture in developing countries and countries in transition. In order to address this broad issue the organizing partners were found in the various water related disciplines that are involved in this topic, being agriculture, health and environment. The project background and topic relevance are described in box 3.2.

Outline

Between November 2011 and halfway 2013 the Safe Use of Wastewater in Agriculture finds itself in the first project stage. This stage started with an international Kick-Off Workshop (Nov ’11), followed by five Regional Workshops for Francophone Africa (Feb ’12), Western Asia & Middle-East (May ’12), Anglophone Africa (Sep ’12), Latin-America (Nov ’12) and East-Asia (Feb ’13), and ending with a Wrap-Up Workshop halfway 2013. The cooperating UN members and partners take turns in organizing the two or three-day workshops, by finding a local partner in the workshop region to arrange the logistics and facilitate the organization.

The target group of the workshops are individuals in key organization and institutions who’s work is related to safe use of wastewater in agriculture. In practice this comes down to high-level civil servants working at relevant ministries and researchers from relevant university programmes and research institutes. Each project partner nominates participants from their international networks within the workshop region, which ensures that people from all relevant disciplines appear on the nominees list. Next a selection is made in such a way that from each country one, two or three participants are invited, preferably from different disciplines and backgrounds to promote cross-disciplinary cooperation within the countries.

The main objective of this initial stage is to enable the target group to increase their knowledge and skills on the topic and make them aware of the useful existing UN-materials (e.g. reports, movies, publications, training materials, etc.) that could support them in addressing the issue on country level, to eventually enable development action. This is done on one side by presentations from the organizing UN-Water members and partners and a field trip, and on the other side by interactive discussions and/or break-out sessions in which the workshop participants have the opportunity to share their knowledge with each other and learn from each other’s experiences.
Population growth and rapid urbanization are intensifying pressure on fresh water resources. The lack of quality water and high level of local water demand are leading to increasing water scarcity and stress and is consequently driving the use of non-conventional waters, such as (treated) urban wastewater. Agriculture irrigation is the greater wastewater user and is especially important in urban and peri-urban areas where wastewater can serve as a new source of water and fertilizer that have to be properly managed to minimize environmental and health risk. The total land irrigated with untreated, treated or partially treated wastewater, both directly and indirectly, is uncertain but estimations indicate that it can be as high as 10% of total irrigated land. In several developing countries raw sewage is still used for agricultural irrigation despite of the health risks.

Besides all benefits of wastewater use in agriculture, it can also have adverse impacts on health and environment depending on the treatment level, type of irrigation and local conditions. Serious health and environmental risks are for example posed by pathogens (many of which are capable of survival in the environment, on crops or in soil), chemical agents, salts and heavy metals. Managing these risks is a crucial issue that must be addressed from local and global perspectives.

To maximise opportunities and minimize risks related to the use of wastewater in agriculture a robust policy and institutional framework (which are often lacking in these contexts) has to be designed. Responsibilities and jurisdictions among public institutions (health, agriculture and water) have to be clear and coordination mechanisms should be created to come up comprehensive and effective policies. In addition attention should be paid to wastewater treatment and/or protection technologies and farmer guidance. Capacities to implement solutions on multiple levels are still lacking in many countries.

Partly taken over and summarized from the project’s concept note

(FAO, UNEP, UNU-INWEH, & UNW-DPC, 2011)
Before the Regional Workshops start, a country level capacity needs assessment is done in order to be able to fit the workshop contents to the participants’ contexts as well as possible. This is mainly done by requesting country reports from the participating countries. The participants (one, two or three from each country) are asked to send out Capacity Needs Assessments questionnaires to all stakeholders in their country that play a role related to wastewater use in agriculture. They are asked to collect the responses and use these to develop a national country report, which elaborates on the present situation regarding wastewater use in agriculture in their country and their capacity needs. This structure is chosen because the cross-disciplinary cooperation in developing the country report should at the same time function as the basis for a national cross-disciplinary (and maybe even cross-sectoral) capacity development network.

As mentioned before the series of Regional Workshops is planned to be closed off with an international Wrap-Up Workshop in 2013. The aim is to let the Regional Workshop participants present their national post-workshop developments, which hopefully have led by then to fruitful cooperations and projects at the country level. The full workshop series should lead to publication of a document in which all national reports, workshop results and best and worst practices are included in such a way that it could be used as a kind of action plan for capacity development to promote safe use of wastewater in agriculture in developing countries.

Where the first project stage hopefully leads to improved individual competencies that are capable of making a change on the organisational or national level, the project partners also envision a second project stage in which the project would aim to support the workshop participants by improving the national context (organisational capabilities and the system’s capacity) to enable them to make best use of their new competencies. This stage would therefore focus on the whole system of wastewater production, management and use, and all stakeholders involved. Special attention will be given to policies, strategies, laws en regulations and the relationships, interdependencies and interaction among involved stakeholders.

Case positioning

Summarized, the Safe Use of Wastewater in Agriculture project aims to focus on capacity development at two different levels. Firstly the Workshops in the first project stage focus on capacity development at the interface between the national (government officials) and global (UN experts) levels. The second project stage might focus more on capacity development at the interface between the national (government officials) and local (their national context) level in enhancing development action. However, this case study only considers the first focus on capacity development on the interface between the national and global level, where international experiences are globally exchanged within the network that is established during the Regional Workshops. Furthermore, the case study distinguishes between social learning determinants on the three different analytical social network levels that were introduced in section 2.1.3: the actor level, the relational level, and the complete network level. Figure 3.5 visualizes this positioning.
The sub cases: 1st and 2nd Regional Workshops

For the purposes of this research only the first project stage of the Safe Use of Wastewater in Agriculture project is taken into account where UN experts and country level stakeholders come together for capacity development on the national level. The first two (of totally five) Regional Workshops are considered as two nested sub cases.

The first Regional Workshop took place in Marrakech, Morocco, on 18 and 19 February 2012, and was attended by 31 participants (excluding UN delegates, workshop organizers and special guest who did the introductory speech) from 17 (mostly Francophone) African countries (see figure 3.6). The participants came from many relevant disciplines, such as water resources management, wastewater treatment, agriculture, health and environment. Most of them were government officials, with management and policy related activities as their daily work, but also researchers were present from public and private research institutes. Most of the participants were men, with only two women attending the sessions.
Figure 3.6: Overview of participating countries at the 1st Regional Workshop, with the number of participants per country in the graph.

Figure 3.7 a-d: Impression of the 1st Regional Workshop in Marrakech, Morocco.
The second Regional Workshop was held in New Delhi, India, from 16 to 18 May 2012. This workshop was attended by 20 participants from 10 countries in the West-Asian and Middle Eastern region, plus 9 participants from local Indian Research Institutes and NGO’s (figure 3.8). In total this summed up to 29 participants (excluding the UN delegates, two journalists and a special guest who opened the workshop). Also here a diversity of disciplines met each other, from governments, universities and research institutes and dealing mostly with management, policy and research. The presence of the local participants resulted in a relatively larger part of female participants than at the first Regional Workshop.

Figure 3.8: Overview of participating countries at the 2nd Regional Workshop, with the number of participants per country in the graph.
Differences and similarities

The workshops are considered as two ‘nested’ sub cases within one ‘main’ case: the Safe Use of Wastewater in Agriculture project. Both workshops had the same aim of bringing people from different countries, disciplines and sectors together to raise awareness, learn and share knowledge with other participants and UN experts, and encourage development action. Also the same procedure was applied to select participants (however, at both workshops the agricultural discipline – in relation to water management – was somewhat overrepresented.

However, there were also some differences between the two, which allow to investigate the effect of some of the workshops’ contextual factors. The most important five are described here and summarized in table 3.3:

• Programme

First of all, the workshop programmes differed somewhat, due to the fact that some valuable lessons were learned during the first Regional Workshop. Where the first workshop only lasted two days, the second was decided to be organized for three days, to allow more time for interaction between the participants while still spending half a day on a field trip. The first workshop was divided into six 1,5 hours sessions for expert presentations around relevant topics. The presenters (mostly UN delegates) were asked to leave some time for discussion, but in practice it was not enough to get the interactions between participants going. However, in the programme of the second workshop time was deliberately reserved for breakout sessions in which coordinated discussion in small groups could take place. The topic presenters had 15 minutes to set the scene for the whole group of participants, followed by more than an hour for the smaller break out groups and another hour for presentation and plenary discussions among the participants. Although most of the presenters took more than the planned 15 minutes, the opportunity for interaction was much higher during the second workshop.
• Workshop set up

Secondly the physical set up was different. The first workshop was set up in a classroom configuration, while the second was arranged into a double U-shape (see pictures). In both configurations the participants were seated together per country. During the second workshop the local participants that were present were mostly placed at the other side of the room from the international participants. At both workshops the UN experts mostly sat together in the back of the room.

• Language

Thirdly it is important to consider the languages that are spoken during the workshops. Whereas people at the second workshop had English as their second language, just as the UN experts and organizers, the participants of the first Regional Workshop had French mostly as their second language. While both dealing with the issue that participants could not communicate in their own language (except for the times when speaking with their country colleagues), language caused a greater barrier at the first workshop. At the first workshop professional translators translated the English presentations into French over the headphones, and translating the French questions back into English, switching again from English to French to answer the same questions. Especially when people are not comfortable with these headphones and speaking via translators, this raised a threshold for informal communication and social interaction (for which no translation was available).

• Timing

The fourth difference that might influence the case study outcomes is the fact that the two workshops were held three months after each other. In such a time span something might happen that changes people’s behaviour around a certain topic. In this case this could be e.g. a disaster with many casualties in which also wastewater fed agriculture was involved, or a major calamity at a wastewater treatment facility. However, at the time of writing this there is no reason to believe that this causes a significance difference between the workshops, but it is important to keep this in mind.

• Culture

Lastly culture is a major factor to consider in this case. Both workshops brought participants together from many different countries, which implies that cultural diversity within the groups was already present. However, generally could be concluded that the African culture is different from the South Asian/Middle Eastern culture, potentially resulting in different perceptions, different norms, different ways of interaction, etc. This difference is certainly relevant to keep in mind, because it could count for some of the differences in the research results that might be observed between the two sub case studies.
The previous two subsections presented the case to be studied, how it was selected and which considerations should be taken into account for case analysis. This section focuses on the applicability of the case for the purposes of this thesis.

The case study objective is to assess the theoretical framework about the influence of social network characteristics (especially related to bonding and bridging structures) on social learning in capacity development networks in a real-life case. This means that the case should meet some requirements. Most important is that is has to be an initiative in which a capacity development network is central, corresponding to the definitions and assumptions that were made in chapter 2.

Within the Safe Use of Wastewater Project ‘capacity development’ is defined as “the process through which relevant stakeholders, especially from sanitation, agriculture, environment and consumer sectors, improve their abilities to perform their core roles and responsibilities, solve problems, define and achieve objectives, understand and address needs, and effectively work together in order to ensure the safe and productive use of wastewater in agriculture”. The project also includes the view that individual competencies (determined by knowledge, skills, experience, motivation) and organisational capabilities (determined by mission, structure, procedures, infrastructure, culture, human and financial capital) make up or enable the social system’s capacity to address the complex issues around wastewater use in agriculture. This definition is compatible with the theoretical frame that is presented in chapter 2 of this thesis.

The Safe Use of Wastewater in Agriculture project is set up according to a typical UN capacity development strategy, consisting of a series of workshops in which various groups of people are brought together to develop a capacity development network. The processes that are encouraged in these networks correspond to what was defined in chapter 2 as social learning. Moreover, the fact that the actual processes can be studied and observed at the workshops provides good methodological opportunities.

<table>
<thead>
<tr>
<th>1st Regional Workshop</th>
<th>2nd Regional Workshop</th>
</tr>
</thead>
<tbody>
<tr>
<td>Much presentation time, less interaction opportunity.</td>
<td>Much interaction opportunity, less presentation time</td>
</tr>
<tr>
<td>Only plenary discussions</td>
<td>Break-out groups and plenary discussions</td>
</tr>
<tr>
<td>Classroom configuration</td>
<td>U-shape configuration</td>
</tr>
<tr>
<td>Barrier between French and English speakers (as second language)</td>
<td>All English speakers (as second language)</td>
</tr>
<tr>
<td>February 2012</td>
<td>May 2012</td>
</tr>
<tr>
<td>North-African culture</td>
<td>South-West Asian culture</td>
</tr>
</tbody>
</table>
3.3 Case study design

As was described in section 3.1 a case can be studied in a number of ways, qualitatively or quantitatively (Flyvbjerg, 2011). For a case study as methodology not the research methods and instruments are normative, but the case demarcation determines which research opportunities there are. Depending on these, methods and instruments should be chosen in such a way that a maximum amount of value can be obtained form the case in the given time frame. In order to make optimally use of the case opportunities it was chosen to apply two data collection methods: survey research with the workshop participants provided the major part of the data collection process, supported by observations during the two Regional Workshops of the Safe Use of Wastewater in Agriculture project. Sections 3.3.1 and 3.3.2 elaborate on the motivation, design and execution for/of these two methods. The timeline of this second research stage is shown in figure 3.10.

![Figure 3.10: Timeline of the second research stage, in which the moments that different research instruments were applied are indicated.](image)

3.3.1 Survey research

The majority of the data in this case study is collected by means of survey research. Oftentimes surveys are used to collect data for quantitative and statistical data analysis. However, there are some good reasons to use surveys for qualitative ends in this case study.

One of the goals of this case study is to collect data about the characteristics of the emerging social network to come to conclusions regarding relational proximity or distance, and moreover, information about how these characteristics...
influence social learning and capacity development is searched for. In order to be able to compare the participants’ answers regarding these network characteristics, their answers should be on similar levels. The convenience of survey research is that the questions are set, that all respondents answer to the same questions, and that they can be limited to choose their answer only from a given number of possibilities. This makes the data better comparable than in the case where all respondents would describe their characteristics in their own words. Swanborn (2010) emphasizes the value of questionnaires in a case study as an opportunity to describe perceptions, viewpoints, attitudes and behaviours of the involved participants in a reliable comparative way. Moreover, open survey questions allow respondents to provide in-depth explanations of their more restrictive answers. And last but not least, a survey gives the respondents some time to think about their answers (which they do not have in e.g. an interview) and to accurately shape their answers. This is an advantage in this case because people are asked to provide their opinions and perceptions on things that could find ‘difficult’, such as learning and capacity development.

Verhoeven (2007) provided a set of important considerations to develop a survey that were taken into account. She states that a survey should be usable, readable, unambiguous, complete, valid (measuring what you want to measure), neutral (not sending the participants in a certain direction), to the point, and as compact as possible.

**Approach**

Surveys were distributed among the workshop participants via an online system: FluidSurveys. The timeline in figure ... shows which surveys were sent out at which moments with respect to both Regional Workshops. The surveys were sent out in two parts, before and after the workshop, because of the large amount of questions and because of the fact that part of the response was required for the workshop preparations, and part of the questions reflected afterwards on the workshop. All surveys were complemented with extra questions for purposes of UNW-DPC. The same considerations as mentioned above were done for those questions to keep among others the neutrality in the survey, but are not considered in detail here.

Due to the fact that the questions for this research were still in development when the 1st Regional Workshop took place, the majority of the questions were asked in hind view. This was better balanced at the time of the 2nd Regional Workshop.

**Operationalisation**

The case study objectives (see section 3.1.2) are about assessing the theoretical framework in order to evaluate to which degree the frame could serve as a basis for deriving practical insights and recommendations for water related capacity developers. Therefore, framework (see section 2.7) served as basis for the survey design.

The survey questions could essentially be divided into three parts. The first part questioned the workshop participants about their individual perceptions regarding capacity development and social learning, and the general effect of the other framework
variables on these elements. Secondly, the respondents (i.e. the Regional Workshop participants) were asked to provide information about maximum three of their most relevant ‘external’ social relations for their work on Safe Use of Wastewater in Agriculture. The word ‘external’ refers to the fact these include relations with people that are not necessarily participating in the Safe Use of Wastewater in Agriculture project. This information regarded personal data (of the respondents as well as of their social relations), relational outcomes, and characteristics of their social interactions. The last set of questions referred to the ‘internal’ colleague workshop participants that are (or could be) most relevant to the participants’ work on Safe Use of Wastewater in Agriculture, including their intentions and reasons to stay in contact and the characteristics of their interactions during the workshop. A complete overview of all survey questions that provided valuable results for this research can be found in appendix B. This appendix also contains the information about which questions were contained in which survey (before/after the workshop). Table 3.4 shows the considerations that were done for the operationalisation of each of the theoretical framework variables. Not all variables from the theoretical framework get the same amount of attention in the survey, for reasons of survey length and relative relevance in the selected case.

Maximizing validity and reliability

The survey was pretested to increase the validity. Understanding and interpretation of the questions and multiple choice answers, as well as response time and question routing were tested with peers from Delft University of Technology. Furthermore it was tested whether the responses provided results that were valuable and usable for the case study objectives. After survey improvement, it was pretested another time with the UNW-DPC programme officer that leads the Safe Use of Wastewater in Agriculture project cooperation. His background is comparable with those of most Regional Workshop participants, which provided an even better measure for the survey validity. This second pretesting round was followed by another improvement of the survey, after which it was distributed among the respondents.

Special attention went to preventing socially desirable answers for reasons of reliability. In the introduction of the surveys, as well as during the workshops, it was emphasized by the researcher and the UNW-DPC programme officer that the survey responses were very important for improvement of following workshops. The respondents were told that their sincere answers (positive or negative) were very much welcomed to be able to serve them and the participants that would follow within the frame of the Safe Use of Wastewater in Agriculture project. The specific research objectives were not made clear to the respondents, contributing to the survey neutrality.

The surveys were developed with the online service of FluidSurveys, with the invitations sent out by email. The questions were developed in English and translated to French by a translation bureau for the majority of the 1st Regional Workshop participants. By using the services of professional translators the validity (regarding interpretation differences) is kept as high as possible. However, the translations, plus the fact that neither French or
English were the native languages of the workshop participants, cause some limitations and uncertainties regarding the validity. This was tried to be resolved by matching the survey results to the researcher’s observations at the workshops, to reach a certain level of intersubjectivity about the meaning of the responses.

Response

The survey response rate is presented in figure 3.11. The surveys were sent out to all participants of the 1st and 2nd Regional Workshops (respectively 31 and 29). Due to the fact that the surveys have been completed in an online system the respondents did not have the opportunity to skip some of the questions, which means that the response is the same for all questions within one survey.

Survey 1A was a very short one and mandatory for all workshop participants of the 1st Regional Workshop. This caused a very high response. Survey 1B was distributed approximately four months after the workshop. A reason for the lower response might be

<table>
<thead>
<tr>
<th>Theoretical framework variable</th>
<th>Operationalization considerations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capacity Development</td>
<td>(Q1 to Q3)</td>
</tr>
<tr>
<td>Social Learning</td>
<td>(Q4 to Q7, Q39 – Q40, Q42 – Q44)</td>
</tr>
<tr>
<td>Proximity and Diversity</td>
<td>(Q11 – Q19, Q29 – Q38, Q41)</td>
</tr>
<tr>
<td>Trust, Reciprocity, Opportunity, Motivation and Ability</td>
<td>(Q20 – Q28)</td>
</tr>
</tbody>
</table>

Table 3.4: Overview of the considerations that were done for the survey design.
the decreased level of commitment to the project. This does suggest something about the (lack of) emerging capacity development network, but no data is available to support such assumptions.

The 20 respondents of survey 2A are the same as those of survey 2B. The participants that did not respond are mostly the ‘local participants’ (see page 108), who were invited by the local workshop organizer, separately from the international participants.

Data analysis

Basically the surveys contained three types of questions that were analysed in different ways: open questions, statements and rating questions (with four or five point Likert scales), and various questions that specifically relate to the concept of proximity.

Due to explorative character of the case study many open questions were posed in such a way that the responses could be given in many directions. Depending on the content of the answers that were provided by the workshop participants the researcher developed categories according to which the responses could be classified. These response categories and their content provide in turn an important part of the insights that are presented in the next chapter.

The second type of questions involved four or five point Likert scales, e.g. from strongly disagree to strongly agree, or from very limited to very high, etc. Those were applied in order to make the responses comparable to each other. The response to these questions were mainly used to develop a graphical overview of the status of the various variables from the theoretical framework.

Lastly the data that was collected about the level of relational proximity/diversity was translated into proximity indexes before the were analysed. The indexes range from 0%, indicating as much diversity between the answers as possible, to 100%, indicating as much proximity between the answers as possible. The last column of the table in appendix B provides information on how the proximity indexes (PI) for the questions were calculated for the questions where this is applicable.
The two workshops were attended by the researcher to observe the participants’ behaviour and interactions, in order to be better able to interpret the results from the surveys.

A disadvantage of survey research is that the underlying arguments of the responses and the context in which the response is given remain unknown (Verhoeven, 2007). The great advantage of complementing data collection with observational methods is that it can increase the validity of the study (DeWalt & DeWalt, 2002), because observations might help the researcher to get a better understanding of responses that were collected by other methods such as surveys. DeWalt & DeWalt (2002) argue that observation of human behaviour and social interactions can be used to help answer descriptive questions and to build theory. Moreover, they believe that a main advantage of this research method is that it provides the researcher with a holistic understanding of the phenomena under study and a reference frame for data that is collected by means of methods in which the response context is unknown. Marshall & Rossman (1995) support this by stating that participant observation allows researchers to check definitions of terms that participants use in interviews (or open questions in surveys), to observe events that are relevant but not explicitly shared in another way by the participants, and to observe situations to which participants refer written or spoken language so that these description can be put in the right context by the researcher. Schmuk (1997) also explicitly states that observations provide researchers with ways to investigate interactions between people (although underlying mechanisms of these interaction have to be investigated by other means). Summarized it may be concluded that observational research is a valuable additional data collection method for purposes of this thesis.

Approach

Both Regional Workshops (in Marrakech, Morocco and in New Delhi, India) were attended by the researcher to observe the behaviour and interactions of/among the workshop participants. Observation in this case means very generally that the researcher watched and listened at what happened during the workshops.

The observations were done in a semi-structured way. The theoretical framework concepts served as focus. Whenever something was observed or heard that related to one of those concepts (capacity development, social networks, social learning, proximity, diversity, bonding, bridging, trust, reciprocity, opportunity, motivation and/or ability) was written down (see figure 3.12 for an example). Also other observations that seemed relevant for the study were noted. The observations were done in a participatory way; the researcher took part in the workshop as if being one of the UN-Water delegates.
Maximizing validity and reliability

The validity of the observation results was maximized in two ways. Firstly, much attention went to writing down the observations as objective as possible, keeping the actual observations and the researcher’s interpretations of those observations separate from each other. Secondly, it was tried to achieve the highest possible level of intersubjectivity. Observations during the workshops were carried out to be able to interpret and provide depth to the survey results. The survey responses reflect the subjective perception from the viewpoint of the participants, whereas the observations reflect the subjective perception from the viewpoint of the researcher. By combining and matching these two perspectives, a certain level of intersubjectivity is achieved. Moreover, intersubjectivity was achieved in another way by discussing the observations with some of the UN-Water delegates who also attended the workshops.

Figure 3.12: Fragment of observation notes of a discussion at the 1st Regional Workshop. Quotes and observations were noted as literally as possible, with interpretative notes in the comments (pink box).
Next to this the reliability of the observations was considered. In order to keep the observations as ‘neutral’ and ‘sincere’ as possible the researcher was not introduced specifically as observer to the workshop participants. This way it was aimed to prevent changed or exceptional behaviour of the participants due to consciousness about the fact that somebody was observing them closely.

**Analysis**

As described above the observations that seemed relevant to the research topic were written down in a notebook, after which they were digitalized in word processing software. Unfortunately, the written notes of the 2nd Regional Workshop were lost somewhere during the trip home, but most of them were preserved in digital format.

During the analysis of the survey results the observations were considered many times, to match both results for improved interpretations, but also for additional ‘in-depth’ insights to the survey responses. For the reason that the data was collected in two vary different ways (surveys and observations), they are kept apart throughout the next chapter, which present the results.
This chapter presents the results of the Safe Use of Wastewater in Agriculture case study. The Safe Use of Wastewater in Agriculture (SUWA) project is a UN-Water project that consists of a series of Regional Workshops (preceded by a global kick-off workshop and closed off by a global wrap-up workshop) to create awareness about the topic at the country level and to establish an international boundary-crossing capacity development network, both with the aim of encouraging and supporting the workshop participants to enhance capacity development processes related to this topic in their countries.

The case study was conducted to evaluate whether the theoretical framework that is presented in chapter 2 makes sense in a real-life capacity development context and could be used to derive practical insights and recommendation from for water related capacity developers. From literature was found that the characteristics of a social network, with a special focus on bonding and bridging mechanisms, could benefit social learning processes in various ways, such that capacity is developed for addressing wicked water challenges, specifically by establishing an integrated systems orientation, stakeholder participation and increased adaptivity (see section 2.7).

The results are presented in a step wise approach, corresponding to the development of the theoretical framework in chapter 2. Clear distinction is made between the survey results and the observation results. Each section and sub section first present the results
that were obtained from the survey responses, after which value adding observations and interpretations are presented. Figure 4.1 shows the icons that are used to indicate the different types of results. Furthermore, throughout this chapter small blue boxes with the framework variables can be found. They indicate that the results that are presented relate to that variable.

Firstly, section 4.1 shows the results about capacity development to promote SUWA in general, to which degree they could be identified as being wicked, and the approaches to address them. Section 4.2 presents the centrality of the concept of social learning to capacity development from the perspective of the Regional Workshop participants. Lastly section 4.3 shows the case findings regarding the influence of the network characteristics on processes that relate to social learning for capacity development.

### 4.1 Capacity development

This section presents the case study results that relate to characteristics of the challenges around Safe Use of Wastewater in Agriculture (SUWA) and potential needs and approaches to address them as perceived by the workshop participants.

The survey questions that provide the majority of the results in this section are questions 1 to 3 (appendix B), which relate to the theoretical concept of capacity development (in a context of wicked challenges) in general (see figure 4.2). Additional insights from the workshop observations are presented at the end of each sub section to add value to the survey results.

*Figure 4.1: These icons are used in this chapter to indicate whether the result were collected by survey or by observations.*

*Figure 4.2: Simplified schematic of the theoretical framework with the focus of this section in blue and the numbers of the survey questions that provided the results (see appendix B).*
A broad range of stakeholders and stakeholder groups is considered to be relevant in the SUWA capacity development process according to the workshop participants. An analysis of all responses showed that the relevant stakeholders could be categorized into different groups (this was done by the researcher), representing the whole wastewater chain, from wastewater producer, to wastewater utilities (e.g. collection, treatment, distributors), to direct wastewater users (i.e. the people who actually seal with the wastewater itself) and indirect users (the people who handle product that are produced with wastewater). Other often mentioned stakeholder groups are governmental institutes, who have the responsibility of providing a proper policy that regulates wastewater use, and a group labelled as ‘other’, which contains knowledge workers (e.g. researchers as knowledge creators, but also NGO’s, educators and media as knowledge intermediaries and disseminators), financiers, and the private sector in general. An overview is presented in table 4.1.

The workshop participants from both the 1st and 2nd Regional Workshops also provided descriptions of what they perceive as the barriers and needs regarding capacity development in their countries. Analysis of the results show that the participants focus on multiple aspects of the same broad issue: wastewater use in agriculture. Where some focus on the lack of technology (e.g. wastewater treatment plants, monitoring equipment, research labs), others focus on the lack of a proper policy and regulatory framework, the lack of financing, or the lack of water infrastructure (e.g. sanitation systems and wastewater distribution channels). Other aspects that are often mentioned by the participants as development barriers are a lack of knowledge and awareness at the multiple stakeholders (e.g. regarding the –negative– impacts of wastewater on health and environment, the know-how of wastewater treatment, awareness of the problems in general), a lack of social acceptance (among farmers and consumers) and a lack of participation and coordination among the involved stakeholders. The responses were categorized into relevant categories by the researcher. The overview of the various perspectives and foci that was derived in this way is presented in table 4.2, illustrated by quotes from the survey responses.
Table 4.1: Overview of categories of important stakeholders (groups) for addressing the Safe Use of Wastewater in Agriculture challenges as identified by the workshop participants.

<table>
<thead>
<tr>
<th>STAKEHOLDER CATEGORIES</th>
<th>STAKEHOLDERS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Wastewater producers</strong>&lt;br&gt;Should know their impact on health and environment</td>
<td>• Urban communities&lt;br&gt;• Industry&lt;br&gt;• Tourism</td>
</tr>
<tr>
<td><strong>Water utilities</strong>&lt;br&gt;Should comply to existing standards, know their best practices</td>
<td>• Sanitation services&lt;br&gt;• Treatment staff &amp; management&lt;br&gt;• Water delivery staff &amp; management</td>
</tr>
<tr>
<td><strong>Direct wastewater users</strong>&lt;br&gt;Should be aware of the risks and safety measures regarding use of untreated water, accept use of wastewater that is really safe, knowledge about applying best practices for risk reduction</td>
<td>• Farmers (women &amp; youth)&lt;br&gt;• Peasant associations&lt;br&gt;• Market gardeners&lt;br&gt;• Irrigation field specialists&lt;br&gt;• Irrigation system managers&lt;br&gt;• Golf fields irrigators&lt;br&gt;• Forest irrigators&lt;br&gt;• Agricultural extension officers&lt;br&gt;• Groups of agricultural development</td>
</tr>
<tr>
<td><strong>Indirect wastewater users</strong>&lt;br&gt;Should be aware of the risks and safety measures regarding use of untreated water, accept use of wastewater that is really safe, knowledge about best practices for risk reduction</td>
<td>• Produce consumers&lt;br&gt;• Rural communities&lt;br&gt;• Farmer families&lt;br&gt;• Crop handlers &amp; sellers&lt;br&gt;• Kitchen staff</td>
</tr>
<tr>
<td><strong>Government</strong>&lt;br&gt;To design standards, regulations, and strategies, divide roles and responsibilities, assess national situation, to get national attention to the topic</td>
<td>• Ministries (in the fields of water &amp; sanitation, environment, health, and agriculture)&lt;br&gt;• High level government officials&lt;br&gt;• Policy makers&lt;br&gt;• Local governments&lt;br&gt;• Municipalities</td>
</tr>
<tr>
<td><strong>Other</strong>&lt;br&gt;For support of other stakeholders, in doing required research, providing the required resources, and as communicators/educators, for national attention</td>
<td>• Scientists &amp; Researchers&lt;br&gt;• NGO’s&lt;br&gt;• Health professionals&lt;br&gt;• Environmental organizations&lt;br&gt;• Media&lt;br&gt;• Financiers&lt;br&gt;• United Nations&lt;br&gt;• Educators&lt;br&gt;• Private sector</td>
</tr>
</tbody>
</table>
Table 4.2: Overview of categories that reflect participants’ different foci and perspectives on the Safe Use of Wastewater in Agriculture challenges, accompanied by illustrative quotes.

<table>
<thead>
<tr>
<th>PERSPECTIVE CATEGORIES</th>
<th>ILLUSTRATIVE QUOTES</th>
</tr>
</thead>
</table>
| Wastewater treatment   | “We have a lack of water treatment and testing laboratories that are competent to prove the neutrality of the water after treatment.”  
“Our wastewater treatment plant does not have a lab, and wastewater is insufficiently treated to serve agriculture”  
“We need de-centralized low cost, environmentally sustainable wastewater treatment systems in place of centralized systems.” |
| Infrastructure         | “The use of wastewater in agriculture requires the existence of a highly effective and well managed wastewater collection system. Everything should be collected in a sewer for the necessary disposal of large quantities of water and sludge. (...) The low coverage of sanitation facilities and the disposal of sludge and effluent directly into the environment creates a worrying health situation.”  
“The challenges are the provision of treated wastewater to farmers through distribution channels, and the lack of financial and material resources for the high quality purification of wastewater.”  
“We need to segregate the sewage and industrial waste streams.” |
| Financial means        | “One of the main challenges is to seek fund suppliers to finance the projects and to be able to develop a national strategy.”  
“We need financial means for a wastewater treatment plant with a lab.”  
“The financial issue will be an important problem. The cost of the treated water for agriculture should be less than the cost of fresh water.” |
| Policy                 | “Our barrier is the lack of institutional capacity in assessing the problems and addressing them.”  
“We have a lack of policy directives and of a strategic implementation plan.”  
“We need to establish a legal and institutional frame relating to the reuse of treated wastewater (concerning quality standards for water reuse, defining the responsibilities of different stakeholders, cost sharing mechanisms, whether to use incentives or coerce use of this water, (...)” |
<table>
<thead>
<tr>
<th>PERSPECTIVE CATEGORIES</th>
<th>ILLUSTRATIVE QUOTES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Social acceptance</td>
<td>“(...) The second obstacle is purely cultural, since wastewater is considered unfit for use.”</td>
</tr>
<tr>
<td></td>
<td>“The obstacles are mostly socio-cultural. It is currently difficult to let rural people include (safe) wastewater use in their agricultural activities.”</td>
</tr>
<tr>
<td></td>
<td>“There is a lack of acceptance by farmers for irrigation with treated wastewater.”</td>
</tr>
<tr>
<td></td>
<td>“(...) There are also psychological and cultural barriers for consumption of produce that is grown with reused water.”</td>
</tr>
<tr>
<td>Knowledge &amp; Awareness</td>
<td>“Solving this challenge should begin with education and awareness building of people at key decision making position in the ministries dealing with irrigation, water supply and sanitation and environment to sensitize them.”</td>
</tr>
<tr>
<td></td>
<td>“A barrier is the lack of knowledge about how wastewater is used in agriculture (...) and its impact on the environment.”</td>
</tr>
<tr>
<td></td>
<td>“A main challenge is the current lack of awareness and skills of water utility staff and wastewater users, such as farmers, vegetable growers, consumers, etc.”</td>
</tr>
<tr>
<td></td>
<td>“The lack of knowledge and public awareness on best practices and solutions regarding safe use of waste water is a problem.”</td>
</tr>
<tr>
<td>Participation &amp; Coordination</td>
<td>“The need is to improve the coherence between different sections of the society including the general public, organizations, researchers, policy makers, industrialists and farmers”</td>
</tr>
</tbody>
</table>
The above mentioned barriers and needs that follow from the survey result analysis, including also the fact that a large amount of diverse stakeholders is or should be involved in addressing the SUWA challenge, all passed as a discussion topic during the two workshops. It could be observed however, that some of the topics got more attention than others.

Especially the need for stakeholder participation was emphasized many times and was received every time with much agreement and confirmation. Noteworthy is the event where one of the participants at the 1st Regional Workshop compared the need for synergy and participation among stakeholders to address the SUWA challenges with an orchestra playing a symphony. He used the metaphor to make clear that all involved stakeholders should work together as musicians in an orchestra; only when all musicians have the right parts of the same symphony on their music stands, play their instruments well, and keep an eye on whether their actions still benefit the whole, the concert will be a success. Like this, he emphasized, addressing the challenges would only be effective when the concerned stakeholders would act in synergy. From the first moment that this metaphor was mentioned, it was referred back to in many presentations and at many points in the discussion. Also when discussing financial/economical aspects or technological aspects the participants referred back to this metaphor, stating that all other needs could only be resolved when such participation could be established.

Another interesting thing that was noticed at both workshops is that even from countries in which wastewater treatment, financial resources and policy are quite developed, the participants still returned often to the topic of the challenges they face regarding stakeholder cooperation and coordination. This is for example illustrated by the following two quotes that are taken from a plenary discussion during each of the workshops.

- “This is something we need to work on; how to involve other parties? How to develop this mechanism with social and technical components we already established? We are thinking about this: maybe we need a coordinating agency that brings together all players.” (Participant of the 2nd Regional Workshop)

- “In our country we have done this [wastewater treatment] already for a long time. The involved ministries of agriculture, health, water, land use and urban development have the need more than before to work together on this topic; there should be coordination between ministries to put efforts together as regards wastewater reuse. Still, we are now together, not for the first time, with participants from multiple ministries, but we have not yet made an integrated report for our prime minister. Each of us should draw lessons from what we saw yesterday during the excursion
The need for stakeholder participation was thus relatively often referred to during the workshops, more than to the other categories that are presented in table 4.2. Sometimes mentioning this need of participation was followed by a discussion on how the required processes could be facilitated. However, the reasons why participation is required to address the SUWA challenge were considered much less. However, one of the participants outlined the issue as follows: “The first step [in addressing the SUWA challenges] is to have an overview of the whole system for all partners [i.e. stakeholders]. For example, in my country there is still a debate about how much water is actually used in agriculture to irrigate which crops. All ministries have different numbers to base their strategies on. In this way they will never come to a shared strategy of how much wastewater could be used at which times and which locations, because they rely on different types of information without being aware of it. Therefore we should share and be made aware of the different visions of all partners, so that we have a common starting point”. This mismatch of information and perspectives that different stakeholders apply was mentioned more often during the discussions at both workshops. However, it does not come back specifically as a capacity development barrier in the survey results, although one of the participants mentioned regarding this topic during the workshop discussions that his country deals with “a lack of participatory situation analysis in the field”, which might refer to the same issue.

Another capacity development issue that surfaced at the workshop, but was not referred to in the survey as a need or barrier, is the fact that addressing water related challenges as this one requires a perspective that considers more than only the local part of the water system where the problem is located. A participant at the 2nd Regional Workshop emphasized that the whole wastewater chain should be taken into account when developing a wastewater policy, by stating that “developing a strategy of reuse of treated wastewater has to be done in steps, trying to cover all aspects of the quality standards of wastewater reuse: ways of treatment, storage and distribution methods, types of crops, modes of irrigation and also social aspects related to this safe use of wastewater”. This connects to the stakeholder categories that were derived from the survey data analysis in table 4.1. Furthermore participants at both workshops remarked that a country’s wastewater also does not stop at the country border; it affects the situation in downstream countries, e.g.: “[My country] is the water tower of West Africa. From this point of view, we need to maintain the quality of our wastewater at a level that is suitable for different downstream water uses, such as agriculture” (Taken from the general comments in the survey response of a participant of the 1st Regional Workshop). During the 2nd Regional Workshop these system interdependencies were
topic of discussion too, in a discussion about economical aspects of SUWA, illustrated by the following quote: “Our problem is the high cost of upstream treatment, which does not allow wastewater producers to ensure good water quality downstream”.

4.2 Social learning

This section presents the results of the survey questions that relate to the importance of learning and the degree to which social learning is perceived as an important practice for capacity development. This was investigated by means of survey questions 4 to 7 (see appendix B), related to the theoretical concept of social learning. Additional insights from the workshop observations are presented at the end of each sub section to add value to the survey results.

The participants of the 2nd Regional Workshop were asked to rate how relevant the different workshop activities were to them, considering their work related to SUWA. They were also asked to provide the considerations behind their ratings to find out if processes related to learning, knowledge sharing and social interaction play a role in the perceived relevancy of the activities.

The following activities were distinguished:

- UN-Water presentations: 15 minute presentations (often longer) from UN faculty members, each related to a topic that is considered relevant to the SUWA challenge according to the WHO guidelines on wastewater use.
- Country presentations: an introductory session in which one participant from each country introduced the SUWA state in his/her country.
• Field trip: an excursion/field trip to a wastewater treatment plant in the Delhi region.

• Breakout groups: discussion groups related to the topics of the UN-Water presentations consisting most of the time of 7 or 8 workshop participants.

• Informal discussion: the moments of voluntary and informal discussion during break time or in the hotel.

Figure 4.4 shows to which degree the different workshop activities were perceived to be relevant for the participants’ work on SUWA. The next paragraphs present the reasoning that was provided behind these ratings.

Almost all participants considered the presentations from the UN-Water members and partners as very much relevant to their work on the topic, because they “learned from them”, by some participants elaborated as “because of getting the latest knowledge on wastewater”, “because they provided the perspectives of UN bodies on the issue”, and “because it provided [them] with general awareness about UN programmes on wastewater”. One person indicated that it was somewhat relevant for his work on SUWA, because “it only provided a general overall view on wastewater use”.

At the second place are the breakout groups, perceived as very much relevant by the great majority of the respondents, and as much relevant by the rest. Again the general reason of “because I learned from the discussions” was given a couple of times. Some participants provided reasons as: “because of the one-to-one interactions”, “because of the close interactions”, and “because it provided the opportunity for focussed discussion in a
“smaller group”, which suggests that they especially valued the personal social interactions for their work on SUWA. Moreover the participants indicated that they learned about the perspectives and experiences of other countries, and that a broad range of aspects of wastewater management could be discussed, depending on the interests of the group.

The country presentations were considered much or very much relevant by the participants for the reason that “they gave a general idea of the regional status of wastewater generation, problems, treatment, usage and possible solutions” and because “it gave the opportunity for experience sharing”. Some of the participants emphasize that they especially learned much “because wastewater disposal and use is a common problem among the participating countries”, which makes it possible that they “can learn from others’ situations”.

The informal discussions during break time were rated as very much relevant because they learned “many many things (...) during the breaks by the discussions with people from different countries”, and because “the discussions were beyond the issues that were looked in the formal sessions”. Participants also indicated that it was useful to network with the other participants and that it gave the opportunity to discuss “personal interests in specific areas and specializations”. Some participants indicated that the informal discussion were somewhat relevant to them because it gave them the opportunity to “clarify the points and issues” that were topic of discussion before the break.

The relevance of the field trip was rated very high to not at all. The reasons why it was considered very relevant to some participants are because “it was a practical demonstration of a wastewater treatment plant” and because it gave “an idea on how a sewage treatment plant works”. The reasons that were given why it was perceived as less or not at all relevant were that and the activity was “limited to observation of physical infrastructures and not much discussion possible on the services and processes” and because “we [i.e. the participants country] have many treatment plants as we have seen in Delhi”, which suggests that it was considered less relevant because it was not new.

The above results are summarized in table 4.3, showing a categorization of the reasonings that were provided, developed by the researcher. The motivations have different foci: processes, set up, and content. Some participants focused their reasoning on the processes that took place during the workshop and made the activities relevant for them. As can be observed, learning, sharing knowledge, social interaction and awareness creation are central themes in the participants’ reasons. Some special attention was given to the informal set up of some activities, which was considered very relevant. Lastly, some participants focused their reasoning on the content of the activities that they found relevant for their own work on SUWA.
Table 4.3: Summary of reasonings from the workshop participants about why the workshop activities were (less) relevant to them, divided into ‘process related’, ‘set up related’, and ‘content related’.

<table>
<thead>
<tr>
<th>PROCESSES</th>
<th>ILLUSTRATIVE QUOTES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Learning</td>
<td>“Because I learned from them”</td>
</tr>
<tr>
<td></td>
<td>“It gives the practical knowledge of treatment of wastewater; seeing is believing”</td>
</tr>
<tr>
<td></td>
<td>“Real world experience”</td>
</tr>
<tr>
<td></td>
<td>“Many many things we learn during the breaks by the discussions with people from different countries”</td>
</tr>
<tr>
<td></td>
<td>“Latest information and knowledge”</td>
</tr>
<tr>
<td>Knowledge sharing</td>
<td>“Sharing knowledge and skills”</td>
</tr>
<tr>
<td></td>
<td>“It gave opportunity for experience sharing”</td>
</tr>
<tr>
<td></td>
<td>“Sharing information”</td>
</tr>
<tr>
<td></td>
<td>“Getting the view of other country members”</td>
</tr>
<tr>
<td>Social interaction</td>
<td>“It made good mix up and to know each other in very informal way. “</td>
</tr>
<tr>
<td></td>
<td>“Networking”</td>
</tr>
<tr>
<td>Awareness creation</td>
<td>“We learned the importance of wastewater”</td>
</tr>
<tr>
<td></td>
<td>“General awareness about UN programmes on wastewater”</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SET UP</th>
<th>ILLUSTRATIVE QUOTES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Informality</td>
<td>“The discussions were beyond the issues that were looked in[to during] the formal sessions”</td>
</tr>
<tr>
<td></td>
<td>“Because of personal interests in specific areas and specialization”</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CONTENT</th>
<th>ILLUSTRATIVE QUOTES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relevant topic</td>
<td>“I got knowledge about liquid and solid disposal”</td>
</tr>
<tr>
<td></td>
<td>“Focus on treatment process”</td>
</tr>
<tr>
<td>General overview</td>
<td>“It gives general idea of wastewater generation, problems, treatment, usage and possible solutions”</td>
</tr>
<tr>
<td></td>
<td>“What is going on globally”</td>
</tr>
<tr>
<td></td>
<td>“Overall scenario of wastewater use”</td>
</tr>
<tr>
<td>Alignment with others</td>
<td>“It provided the state of practices in the context of participating countries”</td>
</tr>
<tr>
<td></td>
<td>“Because every country was given due consideration”</td>
</tr>
</tbody>
</table>
In addition to the survey results, the researcher spoke with people about the main benefit of attending the workshops for capacity development in their own countries. The majority indicated this to be the opportunity to share experiences with participants from other countries. Due to the fact that all countries deal with similar challenges regarding the workshop subject the participants perceived is as very valuable to discuss experiences and approaches from other countries. They suggested that learning from those experiences would enable them to also put a step forward towards addressing the challenges in their own countries. This corresponds to the reasons that were given for the relevancy of some of the workshop activities in the previous section.

This is supported by the answers that were provided by the participants of the 2nd Regional Workshop to survey questions regarding their expectations regarding learning and knowledge sharing during the workshop. The responses mostly referred to learning from other countries’ experiences, learning about ways to address these challenges, get updated knowledge related to SUWA, and sharing the experiences they had in their own country.

Another noteworthy observation relates to a speech that was held by one of those present at the 1st Regional Workshop. He remarked at the start of the workshop with great enthusiasm and conviction that those who participated in the workshop should seize the opportunity of sharing knowledge and learning from others with both hands, now that they were together from all sides of the North-African region in one workshop. Moreover he emphasized the importance of passing the newly obtained knowledge through to others in each one’s country who might be able to apply the knowledge to good ends. This 30-second speech was received by the other participants with a loud applause, indicating their agreement to what was said and emphasizing the importance of it.

### 4.2.2 Capacity development roles

Next, the workshop participants of both workshops were asked for the role that they see for themselves in capacity development for SUWA in their own country, to find out whether this would have anything to do with social learning.

The answers that were provided by the workshop participants to this open question were again divided into relevant categories by the researcher, to gain a general overview of the responses:
• As a **researcher**, creating new knowledge about e.g. wastewater treatment options, health and environmental impacts, beneficial irrigation methods for wastewater application on the field.

• As a **policy developer**, applying the new insights in national wastewater strategies, or in documents that would influence the wastewater policy formation.

• As a **project manager**, setting up and managing (pilot) projects in which wastewater is applied in agriculture in a safe way, e.g. to give a good example, to convince policy makers of the benefits, or to provide a study context for researchers.

• As a **knowledge disseminator**, sharing (new) knowledge with stakeholders to whom it might be relevant, through reports, discussions, workshops, media, etc.

• As a **connector**, bringing stakeholder groups together and providing coordination for collective action.

Some people see their role within one of these categories, whereas others consider themselves all-rounders, fulfilling multiple functions at the same time. Especially the roles of knowledge disseminator and connector (as identified by the researcher) were often mentioned as complementary to being a researcher, policy developer of project manager. This is illustrated by quotes that were taken from the responses of participants from both workshops in table 4.4.

These results are supported by the responses on the question to mention three capacity development actions that the participants could execute in their own country on their return home. 27 of 35 participants included one or more activities that relate to the overarching roles that many participants see for themselves labelled by the researcher as ‘knowledge disseminator’ and ‘connector’. The other activities relate to the roles of researcher, policy developer or project manager.

Activities related to the role of knowledge disseminator that result from the survey responses are e.g. to “select methods and materials to make stakeholders aware of wastewater use in agriculture”, to “give fair and positive information about reuse of wastewater”, “to share the knowledge among stakeholders through workshops”, to “send the final report of the workshop to the contact group on wastewater”, to “reach out to the organizations concerned with wastewater treatment in order to better promote the use of it” or to “educate people on how to reduce health risks associated with consumption of vegetables and fruits produced in urban and peri-urban zones [with wastewater agriculture]”. The workshop participants elaborated on their role as connector by describing the activities e.g. to establish “coordination between other sectoral organizations on my own capacity level”, “to volunteer to work in creating a knowledge hub for knowledge sharing on safe use of wastewater in agriculture”, to “start a multidisciplinary discussion”, or “to have transdisciplinary coordination meeting to address the issue”.

**Bonding and Bridging in Capacity Development Networks to address wicked water challenges**

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Table 4.4: Overview of overarching capacity development goals that the participants saw for themselves (next to more specific roles as researcher, policy developer, and project manager).

<table>
<thead>
<tr>
<th>OVERARCHING CAPACITY DEVELOPMENT ROLES</th>
<th>ILLUSTRATING QUOTES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowledge disseminator</td>
<td>“I am motivated to first raise awareness and also encourage decision makers to first develop infrastructure for the collection and treatment of wastewater, and then to use the treated water for agriculture.”</td>
</tr>
<tr>
<td></td>
<td>“To do advocacy with policy makers, writing articles in newspaper for awareness building, and showing best practices and local initiatives to the mass through TV media.”</td>
</tr>
<tr>
<td></td>
<td>“My role is to run different National and International funded projects on wastewater/sewage water use and impact on environment. The findings of these could be transferred to stakeholders through demonstration in field, seminars, workshops, brochures, electronic media etc.”</td>
</tr>
<tr>
<td></td>
<td>“(…) The results from research are translated and simplified and sent to professionals and policy makers to take necessary measures, such as increased enforcement of regulations related to pollution of water resources, correct and revise regulations and standards, allocate budgets for pilot studies, etc.”</td>
</tr>
<tr>
<td>Connector</td>
<td>“(…) Also I could raise coordination among different sections of the society including the general public, research and government organizations, industrialists and farmers.”</td>
</tr>
<tr>
<td></td>
<td>“I want to contribute to the identification of wastewater use in agriculture as a priority area in our national water sector and providing meaningful coordination among related national organizations.”</td>
</tr>
<tr>
<td></td>
<td>“(…) Being a neutral platform and network, we can also bring government and other concerned departments, industry, farmers, and policy makers together to discuss this important issue of wastewater use as a solution to the water security problem.”</td>
</tr>
<tr>
<td></td>
<td>“To meet the challenges related to the use of wastewater in agriculture in [my country], I can play the role of intermediary between the persons that are responsible for wastewater treatment and the users of this water in agriculture and also the organizations that want to popularize the use of wastewater.”</td>
</tr>
</tbody>
</table>
4.2.3 How social is social learning?

The responses that are considered in the previous section should, especially for the participants of the 2nd Regional Workshop who answered the question directly after the last workshop session, be considered as intentions; intentions to fulfil certain roles, and intentions to execute certain capacity development actions. The results from the survey that was sent to the participants of the 1st Regional Workshop, approximately three months after it took place, provide some insights in the actual degree to which knowledge is shared through the participants’ social networks. These answers show that the participants conveyed their (newly obtained) knowledge to approximately 10 to 200 people within their (extended) social networks, by means of reports, presentations, workshops, conferences, and discussions. This is illustrated by the following quotes:

“At least 5 people including fellow researchers, managers of wastewater use associations, people who are responsible for the water network, friends.”

“After returning home, I shared with a lot of people on the subject. They are among others: my colleagues, my department heads, intellectual friends, the cooperating market gardeners, and also religious groupings ... We talked about the problems associated with the use of wastewater, how other countries are developed in the treatment of wastewater before its reuse, and I spoke about the challenges our country faces in relation to wastewater (as in building treatment plants and other laboratories instead of a station that does not even cover all the capital with drinking water).”

“Over fifty people of various institutions and NGO’s were informed of the results of the workshop.”

“A CR was made to the minister in charge of water and sanitation and his colleague responsibles in the sector. In the face of drying water resources and climatic disturbances, the urgency must be about healthy reuse of wastewater. It should be the mother of all battles since it is the only one sure to be won, because of the resources provision.”

“At a meeting of the Directorate of Facilities and Development of Irrigation, the opportunity was offered to me to give a brief summary of work done during the workshop on the safe use of wastewater in agriculture. And several colleagues were able to discuss the theme of the workshop. The proposal to set up an experimental site using treated water from the sewage treatment plant in Ouagadougou has been suggested. The provisions are currently being taken with the structure responsible for the wastewater treatment plant.”
“Number of individuals exceeds twenty. The type of person contacted: my superiors, colleagues and other partners (external services)”

“20 people: colleagues and students. The discussion was about the valuation of treated wastewater in agriculture and how to use it in a safe manner”

“More than 200 people, researchers. About the wastewater situation in the country and particularly in Kinshasa, and about various solutions to our situation.”

“Back home, the workshop report was made for my supervisor. But we had much discussion with colleagues and friends about the advantages and disadvantages of using wastewater. How to promote the use of wastewater and minimize the risks associated with its use remains the main problem [to be discussed].”

“I was able to talk to ten people. Among them were colleagues, my director, and friends.”

“10 people: friends/colleagues and my supervisors, about the progress in our country and new technologies”

“I made a report of my mission for the Director General and I gave a presentation about the workshop to my Technical Director. Also I talk all the time with my colleagues my friends, and even with my family about the topic of the workshop”

“Few people. They are related to the topic, but from other institutes.”

“I facilitated two national meetings on water conservation, including the use of treated wastewater in irrigation, which was attended by over 60 people per session, composed of executives under my direction and the heads of directions of agricultural services managements of 48 wilayas.”

“I talked with my colleagues and submitted a report on the workshop and its activities to the Chairman of the Agricultural Resource Center as well as to the Ministry of Agriculture and Land Reclamation.”

“I talked to my superiors and my colleagues”
4.3 Social network characteristics

A significant part of the survey was dedicated to collecting data about the participants’ most relevant relations within their personal social SUWA network (survey questions 29 to 40, see appendix B), and within the SUWA project environment (questions 41 to 44, see appendix B). In total they provided information about 77 relations within their personal networks – independent from the workshop and/or project – and 59 (potential) relations within the workshop boundaries. From these network characteristics on the relational analytical level some interesting insights could be derived about the influence of social network characteristics on interactions within those networks.

4.3.1 A general overview

The participants were asked to rate how much they agreed to a series of statements regarding the influence of some of the theoretical framework variables on learning and knowledge sharing within the participants group in general (survey questions 8 to 28 in appendix B). The statements referred to proximity (similar knowledge bases, shared goals), diversity (in knowledge and perspectives), opportunity (know-who), motivation (engagement), and trust and reciprocity. The results provide information on the relative importance of the various aspects for learning and knowledge sharing according to the workshop participants.

Figure 4.6a presents the combined result of both workshops, whereas figures 4.6b and 4.6c show the differences between the two workshop groups. The first graph indicates that most of the participants agree to the fact that all aspects positively influence learning and knowledge sharing within the participants group. Only a small number indicated that they somewhat disagree with the positive impact of the proximity variables, and up to a maximum of 12% of the participants indicated to feel ‘neutral’ about this. The graph shows that the positive influence of trust is strongly agreed with by more than 60% of the participants, followed by knowledge diversity, reciprocity, motivation, know-
who, shared goals and similar knowledge bases. Interesting to note is the fact that the participants seem to agree to the fact that a shared knowledge and perceptions for a good understanding has a positive influence on learning and knowledge sharing, and even more that bringing together diverse knowledge has similar effects. This seems paradoxical.

As regards the differences in response between the participants of the 1st and 2nd Regional workshops, those are mostly related to the degree of agreement with the positive effects of reciprocity, knowledge diversity and trust. Looking at figure 4.7, which shows how the participants actually graded the presence of the various variables within their own workshop environment, it can be noted that here also the largest difference appears for trust; the participants of the 2nd Regional Workshop perceived a higher degree of trust within the group than the participants of the 1st Regional Workshop.

Figure 4.6: a) A general overview of how the workshop participants considered elements to be of influence on learning and knowledge sharing at the workshop. b) The same overview, but only presenting the responses of the 1st Regional Workshop participants in Marrakech. c) Idem, but only presenting the responses of the 2nd Regional Workshop participants in New Delhi.
Figure 4.7 could be complemented with some interesting observations, especially regarding know-who, engagement, and trust.

‘Trust’ was operationalised in the survey as ‘a high level of trust and an open atmosphere’. From the researcher’s observations at both workshops the atmosphere would be considered a lot more ‘open’ and ‘trustful’ at the 2nd Regional Workshop. Both workshops showed similar starting situations in which discussion came down to an accumulation of facts and experiences from the participants’ own expertise and experience. While the countries that were more developed with respect to SUWA could ‘show off’ their best practices, the less developed countries did not contribute much at the beginning. This difference in participation between knowing and not-knowing countries was even more visible during the 1st Regional Workshop than during the 2nd Regional Workshop. The emphasis at the first couple of sessions at both workshops was on the participants’ own expertise, instead of on their own ignorance, which might be considered the ‘natural starting point’ of an interactive group process. However, as the workshops progressed, the participants of the 2nd Regional Workshop started to adopt increasingly more fragile attitudes, asking more questions, showing their ignorance, and allowing for more in-depth discussion by reacting on each other, instead of only sending out one’s own messages, and with that a more free, open and trusting atmosphere. This showing of vulnerability was much less the case at the 2nd Regional Workshop, where the fear of saying things that would be perceived by others as ‘stupid’ might have overruled the desire to ask questions, potentially reinforced by comments of the more developed
countries about the fact that they already knew the basic outlines of the challenge as presented during the workshop and practiced these things for a long time already, and their questions of what the UN could do for them in their ‘more developed’ phase. From the observations of the workshops a potential explanation for this difference in atmosphere might be the higher degree to which personal interaction took place at the 2nd Regional Workshops, which allowed for trust building, and/or the good example of emphasizing ignorance that was given by one of the participants (in the spirit of “we have no system, did never do anything about wastewater use, and know nothing about it”) at the start of the 2nd Regional workshop, which was well received by his co-participants. This explanation would support the difference in figure 4.7, and might explain the difference between graphs 4.6b and 4.6c; because of experiencing this more open atmosphere participants might have realized that it does influence learning and knowledge sharing positively.

Secondly, the results regarding the rating of ‘engagement’, operationalised as ‘a high level of engagement and positive energy’, can be complemented with some insights from the workshop observations. The differences between the ratings of this variable between the participant groups of the 1st and 2nd Regional Workshops are almost nonexistent. However, the researcher would rate this level of engagement and positive energy at the 2nd Regional Workshop much higher than at the 1st Regional workshop. In contrast with the 2nd Regional Workshop, at the 1st Regional Workshop participants came in often late after breaks, made phone calls or had bilateral not-so-silent discussions during the presentations, and did not hide their tiredness by extensive yawns. This puts some question marks with the results and their interpretations of these questions.

Lastly, the difference in rating of the know-who, operationalised as ‘knowledge about the other participants’ contexts, challenges, approaches and barriers related to wastewater use in agriculture’, might be explained by the fact that part of the participants at the 2nd Regional Workshop were invited separately to the workshop, being local stakeholders from the country in which the Workshop took place. This group of participants only attended some of the sessions and did not participate in the session where all ‘international participants’ introduced themselves to each other. This supports the result that the know-who is rated somewhat lower at the 2nd Regional Workshop.

With a focus on network stability (required for strengthening and consolidation of the network, for improved social learning and/or knowledge sharing on the longer term), the participants were also asked to what degree they agreed with statements regarding the
power of the same variables as above to encourage them to stay in contact with other participants. Graph 4.8a presents the combined results of responses from both workshops, with the differences between them highlighted in graphs 4.8b and 4.8c. These differences are even less than for the responses to their influence on learning and knowledge sharing. The positive effect of knowledge diversity and relation reinforcement is least commonly agreed on, whereas also here trust and reciprocity are most strongly agreed on to encourage the participants to stay in contact with others. More insights regarding this intention or behaviour to stay in contact with co-participants follow from the next paragraphs.

Figure 4.8: a) A general overview of how the workshop participants considered elements to be encouraging for staying in contact with other participants. b) The same overview, but only presenting the responses of the 1st Regional Workshop participants in Marrakech. c) Idem, but only presenting the responses of the 2nd Regional Workshop participants in New Delhi.
4.3.2 Reasons to stay in contact

The participants were asked to indicate whether they planned to stay in contact with the other workshop participants whom they had labelled as (potentially) most relevant to their work on SUWA and to provide the reasoning behind their answer (Q43 in appendix B). Table 4.5 presents the results, illustrated by some representative quotes.

Table 4.5: Overview of reasons why the workshop participants (do not) intend to stay in contact with each other.

<table>
<thead>
<tr>
<th>1st Regional Workshop</th>
<th>2nd Regional Workshop</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Intention to stay in contact:</strong> NO (30%)</td>
<td><strong>Intention to stay in contact:</strong> YES (70%)</td>
</tr>
<tr>
<td><strong>PROXIMITY / OPPORTUNITY</strong></td>
<td><strong>PROXIMITY / OPPORTUNITY</strong></td>
</tr>
<tr>
<td>The travel costs are not in our favour.</td>
<td>We are in the same contact group</td>
</tr>
<tr>
<td>Lack of time.</td>
<td>We work at the same organization</td>
</tr>
<tr>
<td>We did not exchange contact information.</td>
<td>We live in the same city</td>
</tr>
<tr>
<td>I wrote down his address with an error.</td>
<td>He is my friend</td>
</tr>
<tr>
<td>Because of the availability of everyone.</td>
<td>Mutual views</td>
</tr>
<tr>
<td>This is a time that we do not communicate well, because I wrote a lot and his email no longer passes. I wonder why.</td>
<td><strong>KNOWLEDGE / SUPPORT</strong></td>
</tr>
<tr>
<td><strong>KNOWLEDGE / SUPPORT</strong></td>
<td></td>
</tr>
<tr>
<td>He helped me very much</td>
<td></td>
</tr>
</tbody>
</table>

It shows that the contact in 30% of the most relevant within-workshop relations that were specified by the participants of the 1st Regional Workshop is not (expected to be) continued after the workshop. In contrast to this, the participants of the 2nd Regional Workshop expect to stay in contact with 100% of the most relevant relations that they identified within the workshop environment.
The reasons that the participants provide why they do not intend to stay in contact with their colleague participants whom they identified as most relevant to their work on SUWA relate to the concepts of geographical proximity and opportunity. This is exemplified by the quotes that were taken from the responses in table 4.5, such as “the travel costs are not in our favour”, indicating that the geographical distance is too large to have physical meetings, and “we did not exchange contact information”, referring to the lack of opportunity to contact each other. The participants from the 1st Regional workshop who do intent to stay in contact with their most relevant counterparts indicate that this is mostly because of geographical proximity and thus easy opportunity for interaction (“work at the same organization” or “live in the same city”). Some reasonings relate to being friends or sharing mutual views, indicating an effect of respectively social and cognitive proximity, and one states that this person “helped [him] very much”.

It can be noted that the participants of the 2nd Regional workshop generally provide different types of reasons why they intend to stay in contact with co participants. Instead of referring to reasons of proximity and opportunity (which they also do, but to a lesser extent than the other participants group), they state reasons related to the goals for which they want to ‘use’ the contacts (outcome based motivations), especially because of the knowledge that the other is expected to have (“he has a good experience about many subjects”, “for information exchange”), and/or because of the support and cooperation that the other would be able to provide (“I want his help for reviewing our discharge standards”, “He can assist and be helpful to us”).

These results show that different types of proximity and the value that people could contribute (e.g. knowledge and/or support) increases the chances of social network consolidation. However, geographical distance and the lack of opportunity to contact each other are likely to negatively affect this.

The reason for this contrast in the intention to stay in contact between the responses from the two workshops might have to do with the fact that they were collected at different moments with respect to the workshop dates. The participants of the 1st Regional Workshop responded approximately four months after the workshop, whereas participants of the 2nd Regional Workshop responded on the last day, or within two weeks after the workshop (see figure 3.10).

As the results show in table 4.5, within two weeks of the 2nd Regional Workshop the participants intent to stay in contact with all co participants whom they identified as most relevant to their work on SUWA, whereas four months after the 1st Regional Workshop...
the participants might have found out that due to practical reasons it turned out that the contact would not be continued after the workshop (while the intention might have been there in the first place, but this remains uncertain).

Furthermore, a closer look at the data shows that difference in types of responses (regarding proximity/opportunity versus knowledge/support) might be caused by the type of relation. In the majority of the cases, the relations that are intended to be continued for reasons of knowledge or support are with the workshop convenors: the UN-Water people, whereas the reasons of proximity and opportunity mostly refer to relations with colleague participants. Considering the fact that the organizers from the different UN-Water agencies might be assumed to be experts in the field and to have access to many resources and other benefits, it makes sense that this explains the difference in types of responses to a large extent. The participants of the 2nd Regional workshop would provide in that case more of the knowledge/support type of reasonings, because they identified the UN-Water delegates much more often as most relevant relations compared to the 1st Regional Workshop participants. This can be explained by the language barrier (lack of cognitive proximity), through which French speaking participants at the 1st Regional Workshop did not interact much with the English speaking UN-Water delegates, except for the plenary sessions that were simultaneously translated.

Staying with the collected data regarding the (potentially) most relevant relations within the workshop environments, another interesting parallel can be found between the topics of communication between the workshop participants and the fact regarding whether they already knew each other before they met at a SUWA workshop (related to social proximity). These results are obtained from Q42 – Q43 in appendix B.

It was found that within the identified relations in which the participants did not know each other before, the discussed topics relate to the content of the workshop and comes down to a quite superficial exchange of impersonal facts. In contrast with this, participants who identified relations with people they already had known for some years before the workshop responded that at least one (of three) topic of communication was about how to join forces to start a wider social process outside the workshop context. Table 4.6 illustrates the difference between these factual (technical?) communication topics and cooperative (organisational?) communication topics.

4.3.3 Relation duration versus interaction content

Staying with the collected data regarding the (potentially) most relevant relations within the workshop environments, another interesting parallel can be found between the topics of communication between the workshop participants and the fact regarding whether they already knew each other before they met at a SUWA workshop (related to social proximity). These results are obtained from Q42 – Q43 in appendix B.

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These results suggest that social proximity, in the form of knowing each other for a longer period of time or duration of the relationship, influences the interaction content. They suggest that the fact that people know each other for a longer period of time increases the chances that knowledge finds its way into a wider social unit through joined forces.

It should be noted that participants and their reported relations who indicated that they had known each other already for some years are in all cases from the same country. In two cases communication topics related to cooperation and joint intentions were reported within relations between participants that had never met before the workshop started, but who were from the same country and both from governmental institutions. This could be an indication of the fact that also geographical, but also cognitive proximity play a role here; participants from the same country have similar goals, because they both aim to solve the challenges as present in the country that they share. However, in other cases where relations within the same country were reported this communication topic of joining forces and cooperation did not surface, which would be an indication that just coming from the same country is not a sufficient condition for future/extended social learning.
For the 77 relations that were reported between the workshop participants and their personal social network’s most relevant relations (for their work on SUWA), data was collected about the geographical location (country and city), organisational background (organization and sector), daily work type, discipline, managerial position and expertise (technical, management or governance related knowledge) of both the ego and the alter of the relationship (Q29 - Q38 in appendix B). Indexes were developed (see last column in appendix B) to rate the relational proximity on all these variables, and compared with (among others) the communication frequency between the workshop participants and their most relevant ‘external’ relations (Q39 in appendix B).

The results show that the proximity on average increases with the communication frequency in the reported social relations; when participants have reported a higher communication frequency, the chances are higher that they are also more proximate in their geographical location, organisational background, daily work type and discipline (figure 4.9). This does not count for proximity in age, managerial level, relation duration or in type of knowledge (Figure 4.10). Only for two relations a communication frequency was reported of less than once per year. For reasons of representativeness this data is disregarded.

*Figure 4.9: Positive relations between proximity indexes for geographical location, organisational background, daily work type and discipline (vertical axis) and communication frequency (horizontal axis).*
Figure 4.10: No apparent relations between proximity indexes for age, managerial level, relation duration or in type of knowledge (vertical axis) and communication frequency (horizontal axis).

HORIZONTAL AXIS: COMMUNICATION FREQUENCY

1. Less than once per year (2x)
2. Multiple times per year (16x)
3. Multiple times per month (32x)
4. Multiple times per week (17x)
5. Every day (10x)
4.3.5 Proximity versus relational outcome

The workshop participants were also asked to indicate the (expected) outcomes of the relations that they had identified as most relevant to their work on SUWA within their personal social network (Q40 in appendix B). They were allowed to pick any number of a list of potential outcomes of a professional social relationship: new contacts/network extension, joint publications such as reports/books/scientific articles, joint projects/cooperations, new products/technologies, new policy, access to valuable knowledge, access to financial resources, access to tangible tools such as software/labs, or they could add another outcome.

Figure 4.11 shows the results regarding the expected outcomes. Apparently relations within a social network that are considered as ‘relevant’ have in most cases an (expected) outcome of joint projects/cooperation, access to valuable knowledge, joint publications, and network extension. The workshop participants expect outcomes such as new policy, new products/technologies, access to tangible tools and financial resources to a lesser degree. Furthermore, in the cases where the latter outcomes are expected, it is always combined with one or more of the four most expected outcomes mentioned above. This corresponds to the results that were for example presented in section 4.3.1: analysis of the barriers and needs regarding capacity development around SUWA showed that the challenge could be viewed from many perspectives, but participation and coordination among stakeholders (explicitly including knowledge sharing) seems to have a separate overarching role in capacity development.

![Graph showing expected outcomes](image)

*Figure 4.11: (Expected) outcomes for all social relations that were identified ‘external’ of (i.e. independent from) the SUWA workshop/project environment.*
For the four most common (expected) outcomes, related to participation, cooperation and interaction within the social network, it was sorted out how they relate to the different types of proximity. Tables 4.7 to 4.8 present the results. Again the proximity indexes (calculated as described in section 3.3.1) for similarities in age, geographical location (country, city), organisational background (organization, sector), managerial position, daily work, discipline and knowledge type were applied. The average proximity indexes and relation duration are calculated for the whole set of identified relations, to serve as reference points, and the proximity index averages are determined per expectation/no expectation. For example, the 31% in table 4.7 (under ‘Organization’) should be read as follows: 31% of the relations in which access to new knowledge is (one of) the outcome(s) is between people who work at the same organization. Below, it can be read that 66% of the relations in which access to knowledge is NOT (one of) the outcome(s) is between people who work at the same organization. Since the average proximity in organization of the total amount of identified relations is 44%, the data suggests that relations in which access to valuable knowledge belongs to the (expected) outcomes have a higher chance of being diverse (instead if proximate) as regards the organizations people work at.

The pink columns indicate the suggestion of a light preference towards proximity for the considered (expected) outcome, and the blue columns indicate the suggestion of a light preference towards diversity for the considered (expected) outcome. In the cases where the proximity index percentages deviate less than 6% from the total average (upper or lower boundary) the difference is not considered relevant. From a statistical point of view the amount of available data is not sufficient to do an extensive quantitative analysis with the possibility to tell which conclusions regarding proximity and diversity could significantly be drawn. However, the data does suggest that there might be a connection between the (expected) relational outcomes and the different types of proximity.

Summarized, access to new knowledge is an outcome of relations that tend to be more proximate in geographical location and managerial position, and more diverse in organization, sector and daily work. Joint projects and cooperation is an outcome of relations that tend to be more proximate in managerial position and daily work, and more diverse in discipline. New relations and network extension is an outcome of relations that tend to be more diverse in organization and sector. Regarding the outcome of joint publications no conclusions can be drawn, because the differences in proximity index average are to low.
proximity and diversity could significantly be drawn. However, the data does suggest that there might be a connection between the (expected) relational outcomes and the different types of proximity.

Summarized, access to new knowledge is an outcome of relations that tend to be more proximate in geographical location and managerial position, and more diverse in organization, sector and daily work. Joint projects and cooperation is an outcome of relations that tend to be more proximate in managerial position and daily work, and more diverse in discipline. New relations and network extension is an outcome of relations that tend to be more diverse in organization and sector.

Regarding the outcome of joint publications no conclusions can be drawn, because the differences in proximity index average are too low.

Table 4.7: Average proximity indexes for relations of which knowledge sharing IS versus IS NOT an expected outcome.

<table>
<thead>
<tr>
<th>Duration</th>
<th>Age</th>
<th>Country</th>
<th>City</th>
<th>Organization</th>
<th>Sector</th>
<th>Managerial position</th>
<th>Daily work</th>
<th>Discipline</th>
<th>Knowledge Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowledge Sharing</td>
<td>8.96</td>
<td>60%</td>
<td>96%</td>
<td>90%</td>
<td>31%</td>
<td>56%</td>
<td>70%</td>
<td>49%</td>
<td>49%</td>
</tr>
<tr>
<td>No Knowledge sharing</td>
<td>9.00</td>
<td>55%</td>
<td>97%</td>
<td>76%</td>
<td>66%</td>
<td>69%</td>
<td>50%</td>
<td>61%</td>
<td>55%</td>
</tr>
<tr>
<td>TOTAL AVERAGE</td>
<td>8.97</td>
<td>58%</td>
<td>96%</td>
<td>82%</td>
<td>44%</td>
<td>61%</td>
<td>57%</td>
<td>54%</td>
<td>51%</td>
</tr>
</tbody>
</table>

Table 4.8: Average proximity indexes for relations of which cooperation IS versus IS NOT an expected outcome.

<table>
<thead>
<tr>
<th>Duration</th>
<th>Age</th>
<th>Country</th>
<th>City</th>
<th>Organization</th>
<th>Sector</th>
<th>Managerial position</th>
<th>Daily work</th>
<th>Discipline</th>
<th>Knowledge Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cooperation</td>
<td>9.19</td>
<td>60%</td>
<td>96%</td>
<td>83%</td>
<td>45%</td>
<td>62%</td>
<td>71%</td>
<td>60%</td>
<td>47%</td>
</tr>
<tr>
<td>No cooperation</td>
<td>8.48</td>
<td>54%</td>
<td>96%</td>
<td>88%</td>
<td>42%</td>
<td>58%</td>
<td>44%</td>
<td>40%</td>
<td>61%</td>
</tr>
<tr>
<td>TOTAL AVERAGE</td>
<td>8.97</td>
<td>58%</td>
<td>96%</td>
<td>84%</td>
<td>44%</td>
<td>61%</td>
<td>57%</td>
<td>54%</td>
<td>51%</td>
</tr>
</tbody>
</table>

Table 4.9: Average proximity indexes for relations of which networking IS versus IS NOT an expected outcome.

<table>
<thead>
<tr>
<th>Duration</th>
<th>Age</th>
<th>Country</th>
<th>City</th>
<th>Organization</th>
<th>Sector</th>
<th>Managerial position</th>
<th>Daily work</th>
<th>Discipline</th>
<th>Knowledge Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Networking</td>
<td>9.67</td>
<td>61%</td>
<td>93%</td>
<td>93%</td>
<td>21%</td>
<td>46%</td>
<td>64%</td>
<td>51%</td>
<td>47%</td>
</tr>
<tr>
<td>No networking</td>
<td>8.58</td>
<td>57%</td>
<td>98%</td>
<td>80%</td>
<td>57%</td>
<td>69%</td>
<td>61%</td>
<td>55%</td>
<td>54%</td>
</tr>
<tr>
<td>TOTAL AVERAGE</td>
<td>8.97</td>
<td>58%</td>
<td>96%</td>
<td>84%</td>
<td>44%</td>
<td>61%</td>
<td>62%</td>
<td>54%</td>
<td>51%</td>
</tr>
</tbody>
</table>

Table 4.10: Average proximity indexes for relations of which joint publications IS versus IS NOT an expected outcome.

<table>
<thead>
<tr>
<th>Duration</th>
<th>Age</th>
<th>Country</th>
<th>City</th>
<th>Organization</th>
<th>Sector</th>
<th>Managerial position</th>
<th>Daily work</th>
<th>Discipline</th>
<th>Knowledge Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Joint publications</td>
<td>9.74</td>
<td>56%</td>
<td>95%</td>
<td>85%</td>
<td>44%</td>
<td>62%</td>
<td>64%</td>
<td>60%</td>
<td>56%</td>
</tr>
<tr>
<td>No joint publications</td>
<td>8.19</td>
<td>61%</td>
<td>97%</td>
<td>84%</td>
<td>45%</td>
<td>61%</td>
<td>61%</td>
<td>47%</td>
<td>47%</td>
</tr>
<tr>
<td>TOTAL AVERAGE</td>
<td>8.97</td>
<td>58%</td>
<td>96%</td>
<td>84%</td>
<td>44%</td>
<td>63%</td>
<td>62%</td>
<td>54%</td>
<td>51%</td>
</tr>
</tbody>
</table>
As presented in section 4.3.1 participants of both workshops indicated that a broad diversity of stakeholders are, or should be, involved in addressing the SUWA challenge. The need to bridge this diversity was emphasized at many points during both workshops. This was done by the successful symphony metaphor (discussed earlier in this chapter), which was coined by one of the participants at the 1st Regional Workshop and used over and over again by many other participants and UN delegates. Also the fact that bridging is required over the various different problem perspectives that exist, to have a common starting point for collective action was described in section 4.3.1.

The importance of bringing diverse stakeholder groups together to develop capacity for addressing the SUWA challenges surfaced at multiple other points in the discussions at the workshops and was mentioned in the survey fields for general comments. This is illustrated by the following quotes.

In the survey responses:

“The mismanagement between related agencies related to water quality, agricultural and water distribution” as a barrier for capacity development.

“I believe that any strategy should be built on a precise understanding of the general characteristics of the society” as a comment related to the fact that governmental policy development should depend on the needs and requirements of the people in the field.

“Urgent establishment of a consultative committee between state authorities and stakeholders for a better understanding and awareness of the importance of safe use of wastewater” as a need for capacity development.

“Farmers are the most important stakeholder group to reach. The challenge is about who can represent them. Water User Associations are still very weak and normally farmers don’t trust government or governmental persons a lot” as a concern related to how to bridge between the various stakeholder groups (in this case government and farmers).
At the workshops:

“There are so many stakeholders to involve and there are so many objectives to reach. (...) The whole situation should be looked at in an organized way; like a proper symphony with a timeline. Policy is first made according to a vision from the government. Then the policy should be adapted to what is possible in the actual situation. Knowledge about these possibilities should be shared among all levels, up to the last user; the human being.” (Participant at 1st Regional Workshop)

“The sales people [of fertilizer products to farmers] should also be communicated with [by governments and policy makers]. By cooperation and communication between all involved parties you will get a better product eventually.” (UN delegate in reaction to one of the participants at 1st Regional Workshop)

“We, as technical people and professionals, should definitely meet, because we can influence and/or convince our minister or other supervisors. However, you should also start from the top: involve heads of states on international level. Only then the full governments will be involved. Collection and wastewater treatment are very important, so we should organize a summit with all ministers, decision-makers, etc. Anyway, still we as professionals should keep meetings to exchange knowledge, to be able to apply it when needed.” (Participant 1st Regional Workshop)

“There are two issues: 1) we professionals fail to communicate our message in an easy and understandable way, and 2) We professionals are too narrow-minded to show a real, truthful, honest and complete image to decision-makers. We should take into account all involved factors. (...) At the technical level we should present honest and complete data, in such a way that it gives a correct picture. That would make the data better accessible and understandable for decision-makers. We should use simple language, about relevant topics such as ‘what are the impacts’; that is understandable for politicians.” (UN delegate, summarizing a discussion between participants of the 1st Regional Workshop)

“Multidisciplinarity is important. Ministries cannot address this wastewater issue alone. They should work together. Otherwise wastewater will not be used at all, while it could be a valuable resource, or it is wrongly used with accompanying health and environmental hazards.” (UN delegate, summarizing relevant workshop outcomes in the closing session)
As was observed, and confirmed by two of the UN delegates, the participants from more developed countries (regarding the SUWA challenges) are more active during plenary discussions than participants from less developed countries. This was especially the case at the 1st Regional Workshop. Those ‘more knowledgeable participants’ seemed to be eager to share and show everything they know about the topic. One of the UN delegates supposed that this difference in degree of interaction is quite logical from the ability perspective. He stated that it is often the case that participants with more knowledge, and thus in a sense with a (perceived) higher ability to contribute purposefully to the workshop, are more active at workshops such as these. Moreover he emphasized the fact that it is difficult to ask questions when one knows very little about a subject, especially when there are others present who are perceived to be on a much higher knowledge level.

From the observations at the workshops also the role of leadership became clear for encouraging/facilitating social interactions and knowledge sharing among workshop participants. Some participants only contributed to the (plenary and break-out group) discussion when they were directly asked something. One of the participants indicated that he found it difficult to know what kind of contributions he could make would be relevant for the others, and thus tended to only provide his knowledge to the group when he got a question from a colleague participant. Opposed to this, some participants tended to act like a metaphorical waterfall, seemingly putting everything they knew on the table, just in case another participants might find this knowledge useful. Generally it was observed that discussions and social interactions went more smoothly when a ‘good’ discussion leader was present, asking the right questions, giving everybody an opportunity to contribute, and facilitating the interactive processes. Although this leadership was formally expected to come from the UN delegates, some of the participants filled in this leaders role in a very natural way.

The different roles that network members adopt in these social processes (regarding voluntary knowledge sharing, questioner, discussion leader, etc.) seem to be important for the quality of the outcomes.
Lastly, the survey responses to the questions about the participants’ most relevant (potential) relations within the SUWA project environment provided some interesting extra insights regarding determinants of network emergence. Some people that attended the workshop (both UN and non-UN attendees) take a very central place within the (potential) SUWA social network. All these central actors share some similarities:

- Visibility during the workshop. They all had a prominent role in the workshop in which they were identified as a very relevant person, by being one of the UN delegates/organizers, giving a presentation during one of the workshop sessions, and/or participating in a very active and constructive manner in the formal and informal discussions. This might be related to a relational opportunity that is established by someone’s high visibility and approachability.

- Sharing knowledge on a very concrete and practical level. Their contributions to the workshop (e.g. plenary presentation, but also discussion input) were on a very practical level for the other workshop attendees, some of which could be directly applied in any of the participants’ contexts. This might have emphasized the relevance of the knowledge of these central individuals to the others.

- Originally from the region in which the workshop was held. All of them originally come from the country, or otherwise the region, in which the workshop was held. For the local organizers and participants this is obvious, but especially for the differences in centrality among the UN delegates this can be noted.

- Speaking the same (second) language as the participants. This is especially visible from the differences in (potential) relevance of the UN delegates. At the 1st Regional Workshop only those UN delegates/experts/organizers were identified to be (potentially) relevant to the workshop participants that spoke the same (second) language as themselves, which was French in this case.
PART 3

CONCLUSION
Looking back at the research objectives, this thesis set out to develop a theoretical framework that explains the role of bonding and bridging social network characteristics as underlying mechanisms of social learning in capacity development networks that aim to address wicked water challenges. Such a framework could form the start of a scientific basis to develop practical insights and recommendations for capacity developers in the water sector. To evaluate the theoretical frame that was the result of Part 1, Part 2 focused on the UN-Water Safe Use of Wastewater in Agriculture capacity development project as a case study. The main research question was posed as follows:

Which social network characteristics, with a focus on bonding and bridging mechanisms, facilitate social learning in capacity development networks that aim to address wicked water challenges?

This chapter puts forward the conclusions that can be derived from the research results presented in chapters 2 and 4, synthesized per sub research question, and representing insights from both theory and practice.
5.1 Addressing the sub research questions

1. How could capacity development networks be defined and what should be their outcomes, considering the focus on addressing wicked water challenges?

From a theoretical point of view it was argued that applying a social network approach is very appealing to gain insights in the underlying capacity development mechanisms. Considering both concepts of capacity development and social networks, capacity development networks were defined as ‘social networks, consisting of actors and the relations that connect them, which aim towards changing their collective capacity in such a way that they are better able to identify, understand and address their collective challenges’.

From the literature review it was synthesized that Water Resources Management often comes down to solving wicked water challenges, characterized by a high systems complexity, involvement of a large amount of stakeholders with many different objectives and perspectives, and a high degree of uncertainty due to unpredictable external drivers and unknown internal system interdependencies. To address these, capacity development processes should enable effective stakeholder participation, construction of an integrated view on the complete water system, and a high level of adaptability.

The challenge of promoting Safe Use of Wastewater in Agriculture that was addressed in the case study appeared to have some of the wicked problem characteristics that were derived from the literature review. The respondents indicated that a large amount of stakeholders is or should be involved in addressing the challenge and that there exist many different starting points, foci and perspectives with which the challenges are defined, demarcated and addressed. Furthermore they perceived the complex interdependencies within the water system, especially related to the upstream effects on downstream consequences of water use and more specifically to the effects within the wastewater chain, from wastewater producers to (waste)water utilities and wastewater users, which are again wastewater producers for downstream actors. The respondents indicated that their capacity barriers mostly relate to the lack of financial resources, technology and infrastructure (treatment plants, labs, sanitation and distribution systems), governance (policy and regulations), expertise (knowledge, awareness), and social acceptance.

Indications were obtained that the respondents perceive stakeholder participation, cooperation and coordination as an overarching capacity development need, as a starting point to address the above barriers. Furthermore, from the survey responses and observations at the Regional workshops was found that the respondents consider it a need to take careful note of the various stakeholder perspectives and interconnections within the water system, or corresponding to the theoretical framework: to establish an integrated systems orientation. Although the case study did not find any support for the relevance of adaptivity for capacity development to address the Safe Use of Wastewater in Agriculture (wicked) water challenge, the need for an integrated and participative approach was thus confirmed.
2. What is the role of social learning in capacity development networks?

The theoretical framework identified social learning, defined as ‘establishing a change in understanding within a wider social unit through social interaction’ as a key process in capacity development networks. The concept of social learning, integrating theories from communication, knowledge management and learning backgrounds, could explain underlying social network mechanisms for capacity development. The literature review showed that this is especially the case in the context of wicked water challenges, because social learning is argued to facilitate an integrated, participative and adaptive management approach. Social networks could be interpreted as the infrastructure for stakeholders’ social interactions, such as communication and exchange of knowledge, which are essential processes for social learning.

The results of the case study support that social learning plays an important role in capacity development.

Firstly, the importance of learning for capacity development was identified. The respondents indicated that the workshop activities were specifically relevant for capacity development and their own work related to that because they enabled learning, sharing of information, updates, experiences, and social interaction with knowledgeable others. They indicated that the social interactions they had were especially relevant to learn about topics that were of specific interest to them, about the global situation around the considered topic, and about others’ detailed experiences (providing the opportunity to align one’s own situation with that of others).

Secondly, the case study also focused on the ‘social’ part of social learning. It showed that the respondents see passing on knowledge within their own personal network (knowledge disseminator role) and coordination among stakeholders (connector role) as an overarching role for themselves to contribute to capacity development, next to fulfilling their roles as scientists, policy makers or project managers. The majority mentioned as contributions to capacity development in their countries a minimum of one action that relates to knowledge sharing (e.g. through reports, workshops, discussion, presentations, etc) or stakeholder coordination to improve cooperation and participation, next to raising funds, doing research, developing new policies or stricter regulations, or starting new (pilot) projects.

Thirdly, it was found that formulating these actions related to social learning did not necessarily end up as just intentions, but actually developed into a social learning behaviour. The participants of the 1st Regional Workshop responded to have shared their (newly obtained) knowledge with 10 to 200 people in their (extended) personal networks, by means of reports to supervisors, informal discussions among colleagues and friends, facilitation of national meetings with colleague professionals, and student education in university.
From these results it could be concluded that the case study supports the theoretical framework in stating that social learning is key to capacity development. Furthermore, a strong indication was found that social learning processes are closely related to stakeholder participation, cooperation and coordination, corresponding to the theoretical reason for which social learning was argued to be important in capacity development networks.

3. How do bonding and bridging mechanisms, including the social network characteristics with which they are associated, facilitate social learning processes in capacity development networks aiming to address wicked water challenges?

The theoretical frame identified bonding and bridging as two important social capital mechanisms. Bonding mechanisms tend to occur through proximity on the relational level, resulting in a very dense network with a very homogeneous member group, characterized by closure on the network level. Bridging mechanisms broker between diversity within social relationships and result in a very loose and open network with a very heterogeneous group of network members, characterized by structural holes on the network level. Following the social capital theories, with a focus on the exchange of knowledge (and disregarding exchange of other resources, such as money, power and status), both extremes of proximity and diversity have paradoxically benefits for the social network, depending on its objectives.

Considering social learning for capacity development to address wicked water challenges, proximity (distinguishing between geographical, cognitive, organisational and social proximity) was argued to facilitate knowledge sharing efficiency, quality and quantity. Summarized this means that people who understand each other better (e.g. due to similar experiences, backgrounds, use of language and jargon), are socially embedded in the same groups and are geographically located close to each other, need less words to share more (efficiency), are less likely to interpret and pass on knowledge flows wrongly (quality) and communicate more often (quantity). These elements specifically enhance stakeholder participation. Diversity however is also argued to be advantageous to capacity development networks for addressing wicked water challenges. Crossing boundaries (especially disciplinary, sectoral, administrative and developmental boundaries) within social relations in a capacity development networks enables to inflow of fresh, new and yet unconsidered, knowledge in the form of information, skills, experiences or attitudes. Theoretically this should enhance the network’s capacity to establish an integrated view on the water system, and to adapt to rapid and unpredictable system changes.

The literature review however also showed that too much proximity or too much diversity within networks will also be destructive to effective capacity development. A too high level of proximity might cause (cognitive, social or geographical) lock-in within the network, leading to ignorance of the ‘outer world’, and thus inhibiting an integrated systems orientation. Too much diversity within a capacity development network leads to fragmentation, misunderstandings and incomprehension, opposing effective participation.
Within the Safe Use of Wastewater in Agriculture case, respondents generally agreed (somewhat or strongly) to the fact that having shared developmental goals and similar knowledge bases for increased understanding, as well as the act of bringing diverse knowledge together, both positively influence learning and knowledge sharing within a social environment. Moreover both factors were also identified as encouraging for staying in contact with others. This already provides a general indication that both proximity and diversity are perceived to have benefits for social learning and consolidation (in the sense of strengthening) of the capacity development network.

Furthermore, a lack of geographical proximity and/or opportunity for interaction turns out to be reasons for the respondents not to stay in contact with others whom they identified as relevant to their work on Safe Use of Wastewater in Agriculture. Social and cognitive proximity were indicated as reasons why people did (or intent to) keep contact. Moreover, important reasons to (intent to) stay in contact with relevant people that were reported by the respondents are relational expectations of extended learning and support/cooperation. These findings, with geographical distance identified as a major barrier and cognitive and social proximity as important facilitators of network consolidation and sustainability, argue that it might be extra important to facilitate interaction opportunities in geographically wide capacity development networks to enable social learning to take place. This focus on strengthening/consolidation of the capacity development before social learning can take place might be a relevant addition to the theoretical framework.

The case study also hinted that social proximity, considering specifically the duration of the social relation, might affect the content of the interactions at the workshop. Participants who had never met before the Safe Use of Wastewater in Agriculture workshops communicated mostly about facts related to the workshop topics. In contrast, participants who knew each other also from other contexts than the workshops reported about communication related to cooperations and joining forces to enhance capacity development initiatives. This partially supports the positive relationship between proximity (only social) and knowledge sharing efficiency; participants that know each other from other social environments and had the opportunity to communicate about the topic previously seem to advance easier to more complex topics of communication.

Moreover, the analysis results of the characteristics of relevant social relations about which the respondents reported show that on average proximity increases (or diversity decreases) in location, sector, daily work and discipline with increased communication frequency. This might be indication for a positive relationship between proximity and knowledge sharing quantity, as proposed in the theoretical framework. This relationship was not found between communication frequency and proximity in managerial position, type of knowledge (related to technology, governance or management), age, or relation duration.

Regarding the respondents’ expectations of their reported relevant social relations the case study also shows some interesting results. Relations of which knowledge sharing is an expected result tend to be relatively more proximate in geographical location and
managerial position and relatively more diverse in organization, sector and daily work. Relations that are expected to yield cooperation and joint projects tend to relatively more proximate in managerial position and daily work, and relatively more diverse in discipline. Relations with the expectation of network extension tend to be relatively more diverse in organization and sector. For proximity in age and type of knowledge, as well as for relation duration, no hints for a causal connection to the expectations of knowledge sharing, cooperation and networking could be identified in the case study. Although these conclusions cannot significantly be quantified with the present research, they are preliminary indications that knowledge sharing might be facilitated by geographical and professional positional proximity and by organisational, sectoral, and daily work diversity. Continuing this argument, cooperation among stakeholders might be facilitated by proximity in professional position and daily work activities and by disciplinary diversity. Network extension seems to take place especially in cases of organisational and sectoral diversity. No specific support could be obtained for the reasons why proximity and diversity in these elements might be prevailing for the various relational contents of knowledge sharing, cooperation or network extension (such as understanding and opportunity for proximity or ‘newness’ for diversity as proposed by the theoretical framework.

Both the survey results and the observations showed some clue about the perceived importance of bridging over diversity. Especially the fact that coordination among different sectors (e.g. government, society, research) is required surfaced in the case study results. Moreover, multi-disciplinarity was mentioned as a capacity need, and discussions were held about the establishment of overarching coordinating agencies for effective water management, procedures to get various stakeholders together to address challenges, etc. However, the importance of bonding mechanisms shows up much more in the case study results than the importance of bridging mechanisms.

Combining these conclusions regarding the effects of proximity (bonding) and diversity (bridging) on social learning related aspects, the case study supports the theoretical framework in emphasizing the importance of a balance between certain types of proximity and diversity, depending on the processes that should take place and the objectives that need to be achieved in capacity development networks. Indications for the fact that too much proximity and diversity are destructive to capacity development were not found in the case study. However, geographical, cognitive and social proximity can be considered the have positive effects on social learning, whereas organisational diversity (in organization, sector, daily work or discipline) might be beneficial depending on the boundaries that need to be crossed to achieve the network’s objectives. No extensive evidence was found for the importance of bridging administrative and developmental boundaries, although the identification of the broad range of involved stakeholders (from many administrative levels) and the value that respondents attach to learning from experiences from other countries could be considered an indication that this is indeed the case.
4. Which other network characteristics, apart from those related to bonding and bridging mechanisms, should be taken into account in this context of social learning in capacity development networks for addressing wicked water challenges?

The theoretical framework identified some variables that are, according to the literature review, relevant influencers of the capacity development network strength/stability/consolidation, which is required for social learning to take place. On the relational level these are trust and reciprocity (to allow vulnerability and the power of showing ignorance) and opportunity (to let the social processes actually take place), complemented on the individual level with the motivation and ability to share and absorb knowledge (i.e. information, skills, experiences and attitude) and commit to the capacity development network and its objectives.

The roles of trust and opportunity were supported by the results of the case study, whereas no clear indications were found for the importance of motivation and ability on the individual level. The workshop observations that were done during the workshops suggested that increased trust (through an increased level of personal interactions and the good example of a few participants showing ignorance that was well received by others) led to an increased knowledge sharing quality, meaning less accumulation of dry facts and more real interaction by addressing each others questions and involving in more intense discussion. As concluded in the previous paragraph, the role of opportunity mainly manifested itself when it was absent, being a barrier for development of a social relation and inhibiting social interactions that might otherwise be part of a social learning process.

Furthermore, from the observations, four extra variables were identified that might play an important role in social network development. All are on the individual level and relate in some way to the variables that were defined in the theoretical framework:

- The level of knowledge of participants that engage in the network (the more knowledge they have the more confident they seem to engage in a social learning process).
- Leadership (leadership of some network members seems to result in social learning opportunities at the workshop).
- Visibility of participant in the network (relates to opportunity, the more visible network members are, the better accessible they seem to become).
- Sharing knowledge on a very concrete and practical level (‘knowledge translation skills’, relates to ability; the degree to which network members are able to present their knowledge in a way that connects to other members’ backgrounds seems to affect their centrality in the network).
**5.2 Addressing the central research question**

The answers to the sub research questions that were concluded in section 5.1 serve as the basis to answer the central research question that was posed in chapter 1:

**Which underlying social network characteristics, with a focus on bonding and bridging network mechanisms, facilitate social learning in capacity development networks with an objective to address wicked water challenges?**

The following statements present the most important findings from the literature review and case study:

- Social learning, being described as the process of establishing a change in understanding within a wider social unit through social interaction, is a key process in capacity development networks for addressing wicked water challenges, facilitating stakeholder participation, establishment of an integrated view on the water system, and improved adaptivity.

- Proximity (distinguishing between geographical, cognitive, organisational en social proximity) within social relationships benefits knowledge sharing efficiency and frequency through understanding, particularized trust and reciprocity, and interaction opportunity in the capacity development network, facilitating stakeholder participation through social learning.

- Diversity within social relationships (crossing disciplinary, sectoral, administrative and developmental boundaries) benefits the introduction of fresh, new, innovative and unconsidered information, skills, experiences and attitudes into the capacity development network, facilitating establishment of an integrated view on the water system and an increased adaptivity through social learning.

- A careful balance should be found between proximity and diversity among the network members to let the perfect capacity development network emerge (from the social learning perspective), emphasizing the various types of proximity, depending on which boundaries need to be bridged and which objectives need to be achieved in addressing specific (wicked) water challenges.

Figure 5.1 presents an adapted version of the theoretical framework is it was developed in chapter 2, showing in solid red which findings are supported by both the literature review and the case study, in dashed red the findings that are supported by the case study, and in blue the findings that were obtained from the literature review but remained unreveiled in the case study.
Figure 5.1: Adapted schematic of the theoretical framework as it was developed in chapter 2. It shows the main research findings, as supported by the literature review (in blue), by the case study (in dashed red), or by both literature review and case study (solid red).
With the full story of this research concluded, this chapter discusses the applied methods, the obtained results, and their practical value for the scientific fields that were the starting point of this thesis: Water Resources Management and Science Communication (TU Delft). The reliability and validity of the research methodology and the research instrument design is presented in section 6.1, whereas a reflection on the research results and their interpretations is discussed in section 6.2. Section 6.3 highlights the potential practical value of this research for capacity developers in the water sector. Recommendations for future research are presented in section 6.4, and lastly, a reflection on the Water Resources Management and Science Communication fields is done in section 6.5.
6.1 Discussion of methods

This research assignment was conducted in two stages. The first stage consisted of a literature review, combining insights from different backgrounds into one theoretical framework to answer the central research question from a theoretical perspective. This framework was assessed in a real-life capacity development situation by means of a case study: the Safe Use of Wastewater in Agriculture project. Data was collected with surveys and observations at two Regional Workshops within the project. This section discusses the limitations, reliability and validity of the research methods and provides a reflection on the choices that were made.

![Structure of the research project]

Figure 6.1: The structure of this research project.

6.1.1 Literature review

Focus

A study background in Water Resources Management and Science Communication, and a graduation internship within the KWR Knowledge Networks and Futures Studies department, led to the focus of this thesis: Capacity development networks in the water sector.

Step by step the fields of wicked water challenges, social networks, social learning, social capital were discovered to understand how social network characteristics could benefit capacity development process. This resulted in a ‘round’ story line, from head to tail. However, it should be kept in mind that from the beginning choices were made for the research focus, and that thus everything else was left out of the scope.

As Alaerts & Kaspersma (2009) suggested, the (social) learning competency is only one part of capacity development, next to technical, management and governance competencies. Eventually this also appeared as a result from the case study. However, the focus on social learning seems to have been a convenient one, since the case study...
results suggest that the other ‘capacity needs’, related to technology, management and governance, are subordinate to needs that have to do with social learning as it was defined in this thesis. Social learning appears to be an overarching process that might facilitate the process of addressing other needs. This corresponds to the fact that much water-related capacity development literature specifically focus on the role of knowledge, knowledge sharing, learning, social interactions, etc (e.g. Luijendijk & Mejia-Velez, 2005; Baser & Morgan, 2008; Ubels et al, 2010). However, clearly the other aspects of capacity development should not completely be disregarded, since these are mostly the directly perceived problems stakeholders have to deal with, and important bottlenecks for development and cooperation.

Similarly, the choice was made to focus within social learning mostly on knowledge sharing as a resource exchange, to be able to investigate capacity development networks and the consequences of their characteristics from a social capital perspective. This implies that e.g. attitude and behaviour change, which could also be achieved by social learning, are left out of the scope of the theoretical framework. This turned out to be convenient during the second research stage, because considering the time frame of this project it would not have been possible to investigate the longer term attitudinal or behavioural changes. However, the concepts of knowledge sharing, knowledge communication and learning provided more opportunities.

Summarized it is important to note that the literature review provides by no means a complete overview of the whole capacity development concept. However, when looking back it can be concluded that the focus points of the theoretical framework turn out to be indeed very relevant ones, with the potential to gain a significant overview of capacity development processes and their facilitators and bottlenecks.

**Literature quality: validity and reliability**

Within the demarcation of this research, the literature review strategy that was recommended by Van der Sanden & Meijman (2004) was applied to increase the quality of the literature review. Literature was searched for in various consecutive rounds, centring on the different key words, and ranging from scientific articles to research reports workshop proceedings. The above mentioned foci were chosen as the review process developed. These focus points, together with an assessment of the literature quality, determined which sources would be included in the development of the theoretical framework and which would be left out. The majority of the sources on which the framework is based are scientific articles from well-known and peer reviewed journals and articles or chapters from books that were published by scientific publishers (such as Taylor & Francis and Sage) or university presses. An overview of this is presented in Appendix 1.

Furthermore, to assess the validity of the framework it is important to consider the background and context of the used literature. The framework brings together literature from various backgrounds. The majority of the sources that are referred to regarding capacity development, the wickedness of water challenges and the need for social learning
relate to the Water Resources Management field, or more generally to the field of Natural Resources Management. This means that the theoretical insights are considered within their original context. However, all theory that relates to social network characteristics and how they could benefit social learning, is not specifically derived from literature with a Natural Resources Management context, because this is a yet undiscovered part of the field. For that part of the framework much attention went to the question whether the insights could be translated to this Water Management context. For example, the findings of Nonaka & Takeuchi (1995) about the SECI model of knowledge management (section 2.4) are originally developed in a car-industry context. However, their insights are supported from various other context, resulting in the assumption that they also possibly make sense in the context of this thesis. Such considerations were done throughout the literature study.

6.1.2 Case study

The combination of the literature review and case study turned out to be very valuable in answering the central research question on this thesis. The main topic of capacity development is so extensive, that it would not be possible to gain useful insights regarding the effects of network characteristics by means of one (or two, but not more considering the time frame of this assignment) case study. The theoretical framework provided thus a convenient basis to focus only on some parts of capacity development processes in the case. However, as described above, a large part of the used insights did not originally stem from the Water Resources Management field. The case study in turn provided a means to evaluate whether the theoretical framework indeed made sense in the context of this research. As presented in figure 5.1, combining the results from both the literature study and the case study provides an insight into the relative importance of the various framework variables. Some of them are supported by both literature and case results, whereas others did not appear in the case study, or turn out to be results of the case but did not surface in the literature review.

Case study methodology: validity and reliability

Assessing the reliability and validity of qualitative research methods is often an issue under discussion. The main indicator for reliable qualitative research, such as a case study, is trustworthiness of the study (Verhoeven, 2007). Is the level of subjectivity kept as low as possible? Is the research replicable or are the methods and results justified in such a way that it is clear which interpretations have led to which conclusions? Were the research instruments designed in such a way that random errors are kept as low as possible? Several measures were taken to keep to reliability of the study as high as possible.
Two sub cases with differences in setup, programme activities, attending countries/cultures were studied to make the effects of the workshop context on the case study results visible and transparent. However, not many outstanding differences were found between the responses from the two sub cases that might be related to the workshop context (some differences were found due to the different points in time of study). Furthermore, it was chosen to combine two data collection methods in the case study: survey research (with the main reason to make the data comparable, especially regarding the relational characteristics) and observations at the Regional Workshops (to support the questionnaire results and provide deeper insights and colour to the survey data). Matching the results of both data collection methods to get a deeper understanding of the processes under study increases the reliability of the research. A state of intersubjectivity was also aimed to achieve by discussing the collected data and interpretations, especially from the observations, with peers (UN-Water delegates) that were also present at the two Regional workshops. The last measure that was taken to keep the reliability as high as possible was that the research instruments were designed with a close eye on the theoretical framework, to provide a clear focus for the survey questions and observations.

Very important to keep in mind is that this research has quite an explorative character. The results can not be considered as hard proof, but they do provide a strong indication of the importance and effects of the studied concepts. The results provide a good basis for further (quantitative or qualitative) research into the interdependencies between the various network characteristics that are argued to positively influence social learning and capacity development, and for the design of practical interventions that can be implemented to enhance capacity development networks for water management purposes (see also section 6.3 for these practical insights and section 6.4 with recommendation for future research).

Although it was tried to keep the effects of the workshops themselves as low as possible, it is not possible to see the case study results regarding social learning mechanisms in capacity development networks completely independent from the workshop structure (e.g. the workshop programme, the degree to which interactivity is promoted, the fact that the participants were selected by a specific strategy and might thus have very specific characteristics that influence the processes under study, the effect of the cultures in the various regions). Considering the fact that the Safe Use of Wastewater in Agriculture project is set up according to a typical United Nations capacity development approach, the results might be generalizable to a certain degree, within the United Nations. However, complete different capacity development projects/networks, might result in different, but not necessarily contradicting, insights.

A last remark about the case study as a whole refers to balancing between qualitative and quantitative approaches. As presented in chapter 3.1 a qualitative case study approach was chosen in order to gain deeper insights into the social network mechanisms behind social learning in the context of capacity development to address wicked water challenges. However, when it came to the stage where the influence of relational characteristics was
researched, it was recognized that a quantitative approach would also be valuable. In the end a consensus was reached in which influences of both quantitative and qualitative approaches were visible. The reasons to make this balance come down on one side to the realization that an explorative qualitative approach would be more fitting to the demarcation of the project, whereas on the other side the was a strong interest into combining the ‘harder’ quantitative approach with the ‘softer’ sciences. Reflecting on this, this combination was valuable to gain broader insights in the advantages of the completeness that could be achieved by combining both type of results, but on the other hand, considering the boundaries and demarcation of this specific project it might have yielded more thorough conclusion when a clear choice would have been made.

Survey research: validity and reliability

The reasons to have survey reasons as the main data collection method of the case study was provided in section 3.1. A couple of measures were taken to keep the validity of the surveys as high as possible.

Firstly, the survey questions were designed in close relation to the theoretical framework to be sure that the results would be consistent with each other and with the research questions. The theoretical framework functioned as the demarcation of the survey research, and as a guide to the operationalisation of the variables to be studied. Secondly, the chance on socially desirable answers was tried to be lowered by emphasizing the importance of honest answers for improvement of the workshops and for UN-Water to be able to match the workshop output to the demand of the participants. From the critical answers to some of the survey questions, but even more from the critical comments on the feedback forms that were mostly handed out at the same time as the surveys, it seems that this action was successful. Thirdly, the survey was pretested by two university peers and two colleagues at UNW-DPC who come from a similar background as the participants of the Regional Workshops, to test whether the interpretation of the survey questions matched the intended meaning. Next to this the pretest survey results enabled a check to the usability of the data for the purposes of this thesis.

Some limitations of the survey design should be considered. In the first place, the surveys have the implication that the case study results are based on self-reporting. Especially regarding the questions that relate to behaviour (e.g. social learning, social interactions, knowledge sharing) and to the characteristics of the participants’ most relevant social relations, it is important to consider that the data represent the views and perspectives of the participants themselves. And, as the proverb indicates, words and behaviour do not always go hand in hand. When it is about behaviour at the workshops the results could be checked with the observations. However, for reportings about the world outside the workshop there is no way to check their reliability within the frame of this project. Secondly, a less developed version of the theoretical frame was used as guidance for the questions. This causes some questions to be less ‘to the point’ as the present theoretical framework would allow. This especially applies to the questions that were posed to provide a general overview of the effects of the considered variables (trust, reciprocity,
proximity, diversity, motivation/engagement, see questions 8 to 28 in appendix B and section 4.3.1 for the actual results). The statements that were used to collect data about the influence of these variables on learning and knowledge sharing and on the sustainability of the network could have been formulated in a way that the concepts better match the theoretical framework, and the answering possibilities (strongly disagree to strongly agree) could be developed in such a way that the results would have been more meaningful. Thirdly language could be a source of misinterpretations in this case. For both groups of participants the languages of the workshop and the surveys (French and English) were not their native languages. This might cause misinterpretations at the side of the respondents, and again at the side of the researcher. Furthermore, at the 1st Regional workshop the researcher was totally dependent on the translator. Also the survey questions were translated to French by a professional translator, whereas the researcher’s own basic level of French (supported by Google Translate) served to translate the responses to the open questions back to English. Lastly, some attention should be given to the fact that the surveys were distributed at different points in time with respect to the workshop; whereas the participants of the 2nd Regional Workshop all responded within two weeks after the workshop, the participants of the 1st Regional Workshop received the majority of the questions approximately four months after their workshop. This influenced on one side the response rate, and at the other side it most probably affects the participants’ memories of the workshops. However, no indications were found that this had major effects on the data.

Observations research: validity and reliability

As mentioned above, the validity of the observation results was tried to keep as high as possible by achieving a state of intersubjectivity regarding the interpretations. A researcher’s observations are very personal and closely related to cultural background, focus, prior knowledge, mind frame, etc. The interpretations that are connected to the observations are even more influenced by those elements. To decrease the level of subjectivity that comes with such personal observations, the observations and interpretations were discussed with some of the UN-Water delegates that also attended the workshops. This way the observation results can be considered an intersubjective reflection on the phenomena that were observed at the workshop.

Next to the fact that observations form valuable complementary insights to the survey results, there are also some limitations involved with this mode of research. The first limitation relates to the intersubjectivity mentioned above. Although the observation results and interpretations were discussed with peers who also attended the workshops, it is still the case that some of the observer’s characteristics are likely to influence the results. An example of this is the event where the combined behaviour of yawning, calling and discussing through others’ presentation was identified as an indication of not being engaged with the workshop activities. However, this identification of behaviour is strongly related to the observer’s culture. In other cultures yawning might not be a signal of disinterest at all, and a public that discusses your presentation at the moment you are still
speaking might mean a very high interest in the topic which should be topic of immediate
discussion. In the events where the interpretations from the observations and the survey
responses do not match, there would be a need for further investigation. Furthermore
the replicability of this part of the research is questionable, due to the fact that the
observations were only semi-structured to gain a wide overview of potentially relevant
processes, and because there were no means available to record the informal discussions
and behaviours at the workshops for a any reliability checks. However, notes were made
with much attention to keeping the objective observations separate from the researcher’s
interpretations.

6.2 Discussion of results

This section highlights and discusses some limitations and interesting insights that
developed during the course of the research project. Section 6.2.1 starts with discussing
some important limitations of the results. Next the interplay between the theoretical
and case study results is focused on in section 6.2.2, followed by a reflection on the most
important concepts of this project (capacity development, social learning, bonding, and
bridging) in section 6.2.3.

6.2.1 The concept of time: investigating intentions

One of the limitations of this research project is the available time. The ‘development’ part
of the concept of ‘capacity development’ suggests that this is a process that takes place
over time. Actions at a certain point in time do not necessarily lead to immediate changes
in capacity. Rather, generally it is expected that years pass while addressing such ‘wicked’
and large-scale challenges as for example the Safe Use of Wastewater in Agriculture
case that was studied for this thesis. The same counts for the concept of social learning.
Knowledge sharing behaviour and learning intentions could be present at one point in
time, but this does provide any proof of actual learning within the network. In this line
of thought it is important that this research project measured mainly perceptions and
intentions, and to a lesser degree actual behaviour during the workshops (by means of the
observations), but disregarding the actual learning or capacity development effect on the
longer term. However, the fact that the survey was sent out to the participants of the 1st
Regional Workshop four months after it was finished was used to ask a question about the
‘social learning’ behaviour in the time between the workshop and the survey distribution.
However, referring back to section 6.1, the results obtained in this way are a form of self-
reporting and do not necessarily reflect actual behaviour.
6.2.2 Survey versus observation results

It was chosen to use two different research instruments to increase the intersubjectivity of the study results: surveys and observations. For most variables in the theoretical framework the results from both methods support each other. However, some variables that were part of the theoretical framework did not appear during the observations at the workshop. On the other side, some interesting observations were done that do not directly fit within the variables as defined in the theoretical framework. In this way, the combination of surveys and observations provide a certain relief or depth to the framework, making clear for which variables more support was found and for which other less support was found. Figure 5.1 presented the overview of this.

Interesting to note is that the observation results did sometimes not match the survey results. This was especially the case for the ‘general’ results that were presented in section 4.3.1. As reported in this section, the participants of both workshops indicated that a high level of almost all variables (engagement, trust, shared knowledge base, knowledge diversity, etc) was present. This did not correspond to the observations that were done at both workshops. Independent from labelling the workshops as having a ‘high’ or ‘low’ level of engagement, trust, etc, it was noted that the levels were quite different for the 1st and the 2nd workshop, while this difference could not be found from the survey results. This discrepancy does say something about the quality of the survey results. Apparently the participants did not interpret the situation in the same way as the researcher. Reasons for this could be that the statements were interpreted differently, that the participants provided socially desirable answers, or that there were not enough answering possibilities to let this diversity show up. If ‘very much agree’ or ‘somewhat disagree’ do not fit to the participants’ feelings about the statements, the only option is to choose ‘somewhat agree’, while within this option there might still be much variability in the participant’s way of judgement and interpretation. This was already discussed in section 6.1.2 (in the ‘survey’ paragraph).

6.2.3 Indirect relations among variables

This research focused on the conceptual relations between capacity development and social learning and between network characteristics (related to bonding and bridging mechanisms) and social learning. The results that were presented in chapter 4 mostly focus on these specific relations. However, between the lines of what is written in the results chapter, many potential indirect relationships between the various variables can be recognized.

Reed et al (2010) already referred to the issue that it is sometimes difficult to distinguish between the input and output of processes such as social learning. During this research it appeared that this is not only the case for social learning, but for the majority of the
theoretical framework variables. The variable ‘trust’ is for example a very complex one in this regard. The theoretical framework went as far as stating that trust (closely related to reciprocity) is very important for social learning to take place. However, from the different sections in chapter 2 becomes clear that trust could also be an outcome of various types of proximity, is required for bridging, is a result from bonding, but also a result from social learning. The true complexity of the ‘real world’ surfaces here. Mapping such complex interrelations between variables is a complex challenge, but very worth while to try, because it would clarify a lot. Also indications were found for interrelations between proximity and opportunity and between social learning motivation and ability. Furthermore all observational insights, although not directly included in the framework variables’ definitions, related in some way to the concept of opportunity, motivation and ability.

There are two things to consider in this case: From one side it could be argued that the framework concepts were not defined strictly enough, which could cause much confusion about exact meaning and about whether some observed events could or could not be attributed to the theoretical framework variables, or should be defined separately. At the other side there are still some open ends in the framework. As mentioned in the previous section the topic of capacity development in the water sector was demarcated to make it manageable, while the case study shows the process in its full glory. This difference implies that some observations are just at the point of crossing the framework’s demarcation. Within this thesis this complexity was not taken into account, but it would be very interesting to investigate such interrelationships within and across the theoretical framework in more detail (see also section 6.4 with recommendations for future research).

6.2.4 Bonding versus bridging

Although bonding and bridging mechanisms in social networks form the central line throughout this thesis, the practical focus was more on their associated relational characteristics: proximity and diversity. The framework went as far as concluding that a balance between both mechanisms is required in a capacity development network, since both of them paradoxically have benefits for social learning. Bonding can occur through various types of proximity and bridging is required over various boundaries. A certain level of diversity is thus required in a network to allow inflow of knowledge from all backgrounds, but also a certain level of proximity is required to enable actual knowledge sharing and creation processes.

This implies that some bonding is required (through proximity) to enable bridging mechanisms to take place. When there is too much diversity, a durable bridge will probably never be established between two (groups of) individuals when there is no ground of proximity at all. This research provided no explicit indications for this (since it was outside the direct focus of both research instruments). However, is does provide an interesting recommendation for future research. This closely relates to clarifying interrelations between the other framework variables, as discussed in section 6.2.3.
Referring back to figure 2.18, bonding and bridging mechanisms relate to various network characteristics on three identified analytical levels: the actor/individual, the relations, and the whole network. The similarities or differences between personal characteristics of individuals determine the degree to which social relations are proximate or diverse. High levels of proximity then leads to closure on the network level, whereas high levels of diversity leads to structural holes on the network level. Normally, capacity development network members are never 100% proximate or 100% diverse, which means that some complex middle ways between bonding and bridging are present, and potential interdependencies between the two.

The case study results provide some interesting discussion points in this line of reasoning. From the case study was observed that individual characteristics (that do not necessarily relate to proximity or diversity might also have the potential to directly influence bonding and bridging mechanisms. For example, the workshop attendees that were relatively visible and showed their leadership abilities (as regards facilitating social learning processes at the workshop) seemed to have a capacity to create bridges over diversity that is present in a network and close structural holes that are present. Such ‘connectors’ are essential for bonding and bridging in capacity development networks, just as a balanced level of proximity and diversity, and the presence of closure as well as structural holes. This is an interesting topic for future research, also presented in section 6.4).

6.3 Implications for capacity developers

The main objective of this graduation assignment was to develop a basis from which practical insights and recommendations can be derived for capacity developers, with a focus on bonding and bridging in the social networks in which capacity should be developed.

Water related challenges are everywhere. To address these, capacity has to be developed within the social system that needs to deal with them. People, or organizations, that aim to initiate or enhance such processes are the capacity developers. For example, the initiator of the Safe Use of Wastewater in Agriculture project, UN-Water Decade Programme on Capacity Development (UNW-DPC) is such a capacity developer. Guidelines with best capacity development practices in the water sector are available, and they provide tips and tricks that follow from previous successes. However, a scientific base to derive such insights and practical recommendations from is still not available. This thesis aimed to make a first step in the development of such a framework.

Capacity development projects will probably never be ideal; there will always be limitations to what can be achieved with the available means, and choices will always have to be made regarding how many and which stakeholders to involve (disciplines, sectors, etc.), what kind of platform to use to bring them together (online, in workshops, in teleconferences, etc.), and which steps would lead to the best results (activities,
content, etc.). The extent of this range of considerations becomes clear from this research. For capacity development to happen the right individuals should engage in the right relations, together establishing the right network that enables social learning, cooperation, coordination and most important: problem solving. The following paragraphs consider three stages of a general capacity development process as it is often organized by capacity developers, the choices that have to be made at those moments, and the implications they have for the rest of the process.

N.B.: These practical insights are based on the researcher’s broader experience within UNW-DPC, their projects, and on research that was partly conducted separately from this thesis within a Cooperation of Framework between KWR Watercycle Research Institute and UNW-DPC.

- **Stakeholder selection: the basic ingredients**

The selection of stakeholders that is involved in a capacity development project is key to its success or failure. Attention should go firstly to the question of which boundaries have to bridged to establish an integrated view of the challenge situation and context. These considerations determine to which degree and what kind of diversity within the capacity development network is required. Depending on this, capacity developers should focus on which types of proximity could balance the diversity within the network and enable network emergence and strengthening, and with that effective social learning and participation. Without involving enough diversity their will be a lack of views and perspectives on the challenge, inhabiting the process of finding solutions that are considered ‘proper’ by all stakeholders that are involved in the real-life challenge. However, to achieve effective capacity development, the network members should also have some things in common, be proximate to a certain degree. A careful balance is thus required.

- **Relation building for social learning**

Getting the right people together is by no means a guarantee for capacity development; it only provides a certain potential for capacity development, or a certain level of social capital that is available in the network. To mobilize this social capital and enable social learning, relations between the individuals should be built as a communication infrastructure. The natural thing that will happen is grouping of proximate people. Exactly here lies the crux: specific attention should go to use the various types of proximity that are available between the different network members to build bridges among diversity. This will not happen automatically.

This implies that the activities within a capacity development project should not only focus on the content of the challenges at hand (which often is the case). Building the right (bridging) relations does not happen automatically, and requires at least as much attention of the capacity developer as the content does. An explicit and well organized ‘networking activity’ for example could support such relation building. Elements such as motivation to
learn, to share and to commit to the network, and skills to share and absorb knowledge and expertise with/from other network members should actively be enhanced to let a functional knowledge infrastructure emerge from a group of individuals.

- Establishing an enabling network

Building the required social learning infrastructure would be a good step towards actual capacity development. However, also on the network level the circumstances should be ‘right’. The network as a whole should be an enabling environment for capacity development. Whether it concerns incentives, opportunities, or the level of trust; the social context should support social learning among the network members. Furthermore, on the network level capacity developers should keep an eye on the balance between bonding and bridging mechanisms. Does bridging occur where it was considered important in the first place? Does the network not become too fragmented, or too closed, leading respectively to disintegration or lock-in of the network. Continuity seems here a very important concept: bringing people together and investing in relationships once appears not to do the magic, but continuous involvement of the capacity developer might be required until a strong and solid network has developed that is able to address the challenges for which the project was initiated.

6.4 Recommendations for future research

Lastly, since this assignment was identified as an ‘explorative’ research and considering everything that was presented, concluded and discussed before, this section presents some recommendations for future research.

Social learning as an overarching capacity development enabler

The results of this study suggest that participation, cooperation and coordination (by means of social interactions/social learning) are on a kind of ‘higher level’ as other capacity needs that are related for example to policy development, financial means, social acceptance, expertise building. While social learning was the focus of this research, it turned out that this process would have an impact on other capacity needs. The respondents suggested that if effective social learning related processes were in place, it would be easier to address the other barriers. However, this study did not present evidence for these interrelationships between such capacity development ‘competencies’.

Various communication theories exist about how social interactions lead to acceptance, change of behaviour, and change of attitude, potentially also opening ways to expertise, material resources and other requirements. It would be valuable to investigate, in relation to solving wicked water challenges, how social learning is connected to addressing other typical capacity needs for addressing wicked water challenges.

Solving the discrepancies within the framework
As figure 5.1 showed, not all framework variables were supported by both the survey results and the observation results. The results of this research can be interpreted as an indication, a first hunch, a general overview, of network characteristics as enablers of social learning for capacity development in the water sector. Gaining more insights into the exact roles of these network characteristics could be done through a thorough extensive quantitative research, with a tighter focus on the separate framework variables, enabling statistical analysis and providing a clearer view on the roles that these characteristics fulfill in capacity development networks.

Interconnections among the framework variables

This study focused on the direct connections between the framework variables, as indicated in the final theoretical framework. However, the results have shown that it is expected that many of these variables are also indirectly interconnected in quite a complex way. Individual network characteristics determine whether a relationship between two people is proximate or diverse, resulting together with other relations in a certain network configuration, but there appears to be more: certain individual abilities, for example related to leadership, outgoing personal character (visibility) and motivation seem to directly influence how a social network is emerging or evolving. A closer look at the various interconnections between the network characteristics on the analytical individual, relational and network levels would provide deeper insights in how exactly bonding and bridging mechanisms are enabled by those various characteristics.

Bonding to bridge, or bridging to bond?

Although this thesis is centred on bonding and bridging mechanisms, the practical focus more towards the specific relational characteristics of proximity and diversity. However, in the end, bonding and bridging are the mechanisms that enable (effective) capacity development in social networks. The results of this research suggest that a certain amount of bonding (by proximity, enabling understanding, facilitating participation, etc.) is required to build bridges over for example sectoral or disciplinary boundaries. Bonding and bridging mechanisms are expected to be related to each other. One of the recommendations for future research would be to investigate this relation, potentially as an overarching activity of the previous recommendation.

Longitudinal research into capacity development networks

One of the limitations of this research project is that it focuses on one point in time. Capacity development and learning are not processes that take place overnight. It could take weeks, months or years before effective change appear in social networks. Essentially the concepts that are studied in this thesis are intentions, and not the actual behaviour. It would be very interesting to compare the results of this study to another (case) study of a network that is further developed (so that there is a history of actual behaviour to look back on), or to start a long term research project which has the opportunity to study a network for a longer time, to see whether the same conclusions could be drawn.
6.5 Reflection on the scientific fields

For both fields of research that served as a starting point for this graduation thesis (Water Management and Science Communication) the research process and results have led to some new insights at the researcher’s side. This section discusses the most interesting ones.

6.5.1 Relative positioning (revised)

Referring back to section 1.4, some reflection could be done on the relative positioning of the Water Management and Communication fields. Considering the major role of social interactions in addressing complex water challenges, as was demonstrated in this study, Communication might be better positioned as a module that can be implemented in other fields of research (see figure 6.2). From this new perspective, the field of communication studies is perceived as standing alone and independent from other field (of course closely related however to the fields from which it originates). Communication ‘drops’ can be split from the greater whole, while they still stay ‘on communicating terms with each other’ with each other about important advances in the field. These drops then could be integrated into other (applied) scientific fields, to add valuable insights regarding the social process that influence the (natural) world around us. This approach is different from the one that was proposed by figure 1.5, because the overlap that was presented there hinted at a mutual integration benefits. However, on second thoughts, it would mainly be the communications field that can serve as a toolbox to understand relevant social processes that are inseparable from many applied sciences.

Figure 6.2: A revised vision on the relative positioning of the fields of Science Communication and Water Resources Management (see also figure 1.5).
Section 1.5 presented how this research project adds value to the fields of Water Resources Management and Science Communication. This section shortly looks back on these reasonings and provides more specific insights in how this thesis could be relevant for the specific fields at Delft University of Technology.

**Water Resources Management**

Firstly, for Water Resources Management the relevance of this thesis is a very practical one. Many capacity development initiatives are being conducted to address complex (or so-called ‘wicked’) water challenges. The capacity developers leading those projects have access to some practical guidelines (e.g. GTZ, 2006), based on best practices or previous experience, stating that social networks and social learning are essential ingredients for the success of their projects. However, a scientific base on HOW social networks and their characteristics and mechanisms, such as bonding and bridging, could benefit such social learning for capacity development. This thesis could provide the first step to the development of a capacity development toolbox for the network management within such projects.

At TU Delft, Water Management is a track of the Civil Engineering programme. The focus is significantly different from water related programmes at other universities. As perceived by the researcher, a large part of the curriculum in Delft is about designing (from irrigation systems, to sewers and treatment plants), whereas other universities have focused their programmes more on physical and social geography, ecology, geoscience, or human-earth system interaction. Considering the TU Delft background this technical applied approach is a very logical and valuable one. However, since the social sciences turn out to provide a very interesting extension to Water Resources Management, mainly as regards stakeholder management, it might not be a very strange idea to allow the ‘free space’ that students have in their study programmes (only a maximum of 10 ECTS) to be filled up with relevant courses from other programmes, e.g. accompanied by an essay on how courses from other disciplines are relevant to the Water Management field. This would enhance a broader development, a better view on what other disciplines could contribute to water management, leading to more inter- and transdisciplinary professional approaches in the future.

**Science Communication**

Secondly, this thesis provided a structured way to look at social interaction processes. Considering characteristics of (communicating) individuals, the emerging characteristics of the relation that develops between them, and those of the whole network, ensures that the full social context that could be of influence on science communication processes is taken into account. Such relational characteristics such as proximity and diversity, and their influence on communication processes, are especially relevant for the field of...
Science Communication to consider. An often returning issue in communicating science is that people from different backgrounds, with different interests, and various levels of education, etc. do not understand each other, don’t want to listen to each other, or cannot find each other to exchange their messages. Balancing proximity and diversity in such cases could provide the right circumstances to create effective communicative bridges between people.

More specifically, the researcher perceived the TU Delft Science Education and Communication track to have a stronger focus on the psychological side of Science Communication, centred more on the characteristics of senders and receivers (e.g. motivation, attitude, ability, etc.) than on the emerging characteristics of their relations or the network that develops from these. However, the role of such emerging social characteristics on the various network levels, and especially also potentially uncertain interdependencies between those has turned out to be of major importance on the communication processes that take place. Although it would be more confusing than explanatory for students to include this complex approach in the curriculum, it might result in a higher consciousness of the fact that not everything can be planned in the field of science communication, because of the complex social system’s emerging characteristics and their interconnections. It would for example emphasize and support the need to include multiple layers and ‘plan B’s’ in communication strategies, because what to do if the emerging social circumstances do not match the expectations that were created initially? More emphasis on such dynamics might increase the students’ awareness that the design of communication processes is not a matter of a simple trick that can be repeated; it requires a thorough consideration of each specific social system under focus.
References


Andriessen, J. H. E. (2006). To share or not to share, that is the question: conditions for the willingness to share knowledge. Delft Innovation System Papers (IS-2006-02).


Bonding and Bridging in Capacity Development Networks to address wicked water challenges


Bonding and Bridging in Capacity Development Networks to address wicked water challenges
Quality of literature

This figure presents the most relevant sources that were used in the literature review (chapter 2). The literature quality is also shown in this figure. The majority of the reviewed articles that resulted in input for the framework were found in scientific journals and books. The articles from various scientific journals are of course peer reviewed, and the articles the books were all published by a scientific or university press. However, the research report of Baser & Morgan (2008) and the workshop proceedings of Luijendijk & Maria-Velez (2005). Both provided leading insights for the development of the theoretical framework although they were not peer reviewed and/or scientifically published. However, by means of the literature review guidelines of Van der Sanden & Meijman (2004) these reports were considered valid and reliable enough to use. Interesting to note is that the case study results of this research support the findings from these two sources.
## Operationalisation of framework variables

This table contains all survey questions that have provided results for this thesis. The first column contains reference numbers to which is referred in chapter 4 when the survey results are described. The second column shows to which theoretical framework variable the question relates. The actual question that was posed in the survey is stated in the third column, as operationalisation of the framework variables. All questions that were multiple choice or that involved Likert scales provide information on the answering possibilities (printed in italic behind the questions in the third column). Lastly, the fourth column contains any extra remarks, including among others the numbers of the survey(s) (1A, 1B, 2A, 2B) in which the question were stated, and information about how the Proximity Index was calculated for data analysis where applicable.

<table>
<thead>
<tr>
<th>Qst #</th>
<th>Variable</th>
<th>Operationalisation</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td><strong>PART 1: INDIVIDUAL PERCEPTIONS</strong></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Capacity Development</td>
<td>What are the hindrances/barriers for safe use of wastewater in your country?</td>
<td>1A, 2A</td>
</tr>
<tr>
<td>2</td>
<td>Capacity Development</td>
<td>What is needed in your country to develop a national strategy for the safe use of wastewater in agriculture?</td>
<td>1A, 2A</td>
</tr>
<tr>
<td>3</td>
<td>Capacity Development</td>
<td>What are the most important stakeholders related to safe use of wastewater in agriculture in your country?</td>
<td>1A, 2A</td>
</tr>
<tr>
<td>4</td>
<td>Social learning</td>
<td>What could be your role in addressing the challenges related to wastewater use in agriculture in your country?</td>
<td>1B, 2A</td>
</tr>
<tr>
<td>5</td>
<td>Social learning</td>
<td>Please think of three concrete actions that you are able to take to enhance your country’s capacities to address the challenges related to wastewater use in agriculture.</td>
<td>1B, 2B</td>
</tr>
<tr>
<td>6</td>
<td>Social learning</td>
<td>With how many people did you talk about (the results of) the Safe Use of Wastewater in Agriculture workshop after you returned home? With whom?</td>
<td>1B</td>
</tr>
</tbody>
</table>
| 7     | Social learning               | Please indicate how relevant the following activities were for your work related to wastewater use in agriculture, and please let us know why the activities were (ir)relevant for you. *(Not at all, Somewhat, Much, Very much)*  
  • The country presentations on the first day  
  • The presentations from the UN-Water delegates  
  • The break-out discussion groups  
  • The field trip on the second day  
  • The informal discussion you had (e.g. during breaks) | 2B            |
<p>| 8     | Reciprocity                   | There was a good balance between “giving and taking” within this participants group; we all learned and shared. <em>(Strongly disagree / Somewhat disagree / Neutral / Somewhat agree / Strongly agree)</em> | 1B, 2B        |</p>
<table>
<thead>
<tr>
<th>No.</th>
<th>Category</th>
<th>Description</th>
<th>Agree Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>Reciprocity</td>
<td>A good balance between ‘giving and taking’ within the participants group positively influences relevant learning and knowledge sharing. (Strongly disagree / Somewhat disagree / Neutral / Somewhat agree / Strongly agree)</td>
<td>1B, 2B</td>
</tr>
<tr>
<td>10</td>
<td>Reciprocity</td>
<td>A good balance between 'giving and taking' encourages me to stay in contact with the other participants. (Strongly disagree / Somewhat disagree / Neutral / Somewhat agree / Strongly agree)</td>
<td>1B, 2B</td>
</tr>
<tr>
<td>11</td>
<td>Proximity (cognitive)</td>
<td>All participants share a similar knowledge base and perceptions regarding Safe Use of Wastewater in Agriculture; we understand each other. (Strongly disagree / Somewhat disagree / Neutral / Somewhat agree / Strongly agree)</td>
<td>1B, 2B</td>
</tr>
<tr>
<td>12</td>
<td>Proximity (cognitive)</td>
<td>Being 'on the same level' as the other participants positively influences relevant learning and knowledge sharing in the participants group. (Strongly disagree / Somewhat disagree / Neutral / Somewhat agree / Strongly agree)</td>
<td>1B, 2B</td>
</tr>
<tr>
<td>13</td>
<td>Proximity (cognitive)</td>
<td>Sharing similar knowledge bases and perceptions encourages me to stay in contact with the other participants. (Strongly disagree / Somewhat disagree / Neutral / Somewhat agree / Strongly agree)</td>
<td>1B, 2B</td>
</tr>
<tr>
<td>14</td>
<td>Proximity (cognitive)</td>
<td>All participants share similar goals related to wastewater use in agriculture in our countries. (Strongly disagree / Somewhat disagree / Neutral / Somewhat agree / Strongly agree)</td>
<td>1B, 2B</td>
</tr>
<tr>
<td>15</td>
<td>Proximity (cognitive)</td>
<td>Having similar goals related to wastewater use in agriculture positively influences relevant learning and knowledge sharing in the participants group. (Strongly disagree / Somewhat disagree / Neutral / Somewhat agree / Strongly agree)</td>
<td>1B, 2B</td>
</tr>
<tr>
<td>16</td>
<td>Proximity (cognitive)</td>
<td>Having similar goals as the other participants encourages me to stay in contact with them. (Strongly disagree / Somewhat disagree / Neutral / Somewhat agree / Strongly agree)</td>
<td>1B, 2B</td>
</tr>
<tr>
<td>17</td>
<td>Diversity</td>
<td>As a group we brought together a highly diverse set of knowledge. (Strongly disagree / Somewhat disagree / Neutral / Somewhat agree / Strongly agree)</td>
<td>1B, 2B</td>
</tr>
<tr>
<td>18</td>
<td>Diversity</td>
<td>A high knowledge diversity within the group positively influences relevant learning and knowledge sharing in the participants group. (Strongly disagree / Somewhat disagree / Neutral / Somewhat agree / Strongly agree)</td>
<td>1B, 2B</td>
</tr>
<tr>
<td>19</td>
<td>Diversity</td>
<td>A high knowledge diversity encourages me to stay in contact with the other participants (e.g. because they have knowledge that I don’t have). (Strongly disagree / Somewhat disagree / Neutral / Somewhat agree / Strongly agree)</td>
<td>1B, 2B</td>
</tr>
<tr>
<td>20</td>
<td>Motivation</td>
<td>There was a high level of engagement and positive energy within this participants group. (Strongly disagree / Somewhat disagree / Neutral / Somewhat agree / Strongly agree)</td>
<td>1B, 2B</td>
</tr>
<tr>
<td>21</td>
<td>Motivation</td>
<td>A high level of engagement and positive energy positively influences relevant learning and knowledge sharing in the participants group. (Strongly disagree / Somewhat disagree / Neutral / Somewhat agree / Strongly agree)</td>
<td>1B, 2B</td>
</tr>
<tr>
<td>22</td>
<td>Motivation</td>
<td>A high level of engagement and positive energy encourages me to stay in contact with the other participants. (Strongly disagree / Somewhat disagree / Neutral / Somewhat agree / Strongly agree)</td>
<td>1B, 2B</td>
</tr>
<tr>
<td>23</td>
<td>Trust</td>
<td>There was a high level of trust and good atmosphere within this participants group, which enabled effective discussion. (Strongly disagree / Somewhat disagree / Neutral / Somewhat agree / Strongly agree)</td>
<td>1B, 2B</td>
</tr>
<tr>
<td>24</td>
<td>Trust</td>
<td>A high level of trust and open atmosphere positively influences learning and knowledge sharing in the participants group. (Strongly disagree / Somewhat disagree / Neutral / Somewhat agree / Strongly agree)</td>
<td>1B, 2B</td>
</tr>
<tr>
<td>25</td>
<td>Trust</td>
<td>A high level of trust and open atmosphere encourages me to stay in contact with the other participants. (Strongly disagree / Somewhat disagree / Neutral / Somewhat agree / Strongly agree)</td>
<td>1B, 2B</td>
</tr>
<tr>
<td>26</td>
<td>Opportunity (know-who)</td>
<td>I learned much about the other participants’ contexts, challenges, approaches and barriers. (Strongly disagree / Somewhat disagree / Neutral / Somewhat agree / Strongly agree)</td>
<td>1B, 2B</td>
</tr>
<tr>
<td>Question</td>
<td>Description</td>
<td>Rating</td>
<td>Notes</td>
</tr>
<tr>
<td>----------</td>
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<td>--------</td>
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</tr>
<tr>
<td>27</td>
<td>Opportunity (know-who)</td>
<td>This knowledge about each other’s context positively influences learning and knowledge sharing in our group. (Strongly disagree / Somewhat disagree / Neutral / Somewhat agree / Strongly agree)</td>
<td>18, 2B</td>
</tr>
<tr>
<td>28</td>
<td>Opportunity (know-who)</td>
<td>This knowledge about the other participants’ contexts encourages me to stay in contact with the participants after the workshop. (Strongly disagree / Somewhat disagree / Neutral / Somewhat agree / Strongly agree)</td>
<td>18, 2B</td>
</tr>
</tbody>
</table>

### PART 2: A MAXIMUM OF THREE ‘EXTERNAL’ RELEVANT RELATION

(Partly adopted from the KWR ‘vakantiecursus’ survey – Heringa et al, forthcoming)

<table>
<thead>
<tr>
<th>Question</th>
<th>Description</th>
<th>Rating</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>29</td>
<td>Proximity (geographical)</td>
<td>In which location do you/does this person spend most of the time presently – Country? City?</td>
<td>18, 2A</td>
</tr>
<tr>
<td>30</td>
<td>Proximity (organizational)</td>
<td>Please state the name of the organization you are/this person is working for at this moment.</td>
<td>18, 2A</td>
</tr>
<tr>
<td>31</td>
<td>Proximity (organizational)</td>
<td>In which of the following categories does your/this person’s organization fit? (Industry / Government / Research &amp; Development / NGO / Other)</td>
<td>18, 2A</td>
</tr>
<tr>
<td>32</td>
<td>Proximity (organizational)</td>
<td>Are you/is this person in a managerial position? (Yes, part of the management team, director, professor, etc. / Yes, leading teams, projects, groups, etc. / No)</td>
<td>18, 2A</td>
</tr>
<tr>
<td>33</td>
<td>Proximity (organizational)</td>
<td>In which of the following categories does your/this person’s daily work fit? (Management or strategy / Policy / Research &amp; Development / Administration, finance, human resources / Production or operation / Marketing or public relations / Other)</td>
<td>18, 2A</td>
</tr>
<tr>
<td>34</td>
<td>Proximity (organizational)</td>
<td>In which of the following disciplines does your/this person’s daily work fit? (Water resources management / Wastewater treatment or management / Water infrastructure (supply or sanitation) / Irrigation / Agriculture / Environment / Health / Outreach, awareness or education / Other)</td>
<td>18, 2A</td>
</tr>
</tbody>
</table>
| 35 | Proximity (cognitive) | Please rate your/this person’s expertise in the following subjects, related to wastewater use in agriculture.  
- Technical knowledge – e.g. about treatment technologies, irrigation technologies, water infrastructure, health stanards, environmental consequences, modelling skills, design skills, best technology practises, etc. (Very limited / Limited / High / Very high)  
- Management knowledge – e.g. about management styles, decision-making processes, knowledge management, project management, financial management, best management practices, etc. (Very limited / Limited / High / Very high)  
- Governance knowledge – e.g. about involved stakeholders, existing policies and regulations, multidisciplinary working, stakeholder participation processes, policy formation skills, etc. (Very limited / Limited / High / Very high) | 18, 2A |
<p>| 36 | Proximity (social) | How would you describe your relation with this person? (client / contractor / organizations are partners / organizations are competitors / cooperate on project, idea, product, etc / members of same association / colleague / student / teacher / friend / education together / ex-colleague / other) | 18, 2A |
| 37 | Proximity (social) | For how long have you known this person (in years)? | 18, 2A |</p>
<table>
<thead>
<tr>
<th>Page</th>
<th>Section</th>
<th>Question</th>
<th>Options</th>
<th>Codes</th>
</tr>
</thead>
<tbody>
<tr>
<td>38</td>
<td>Proximity (social)</td>
<td>This person is ... (Much younger than I am / Younger than I am / Approximately my age / Older than I am / Much older than I am / I don’t know)</td>
<td>1B, 2A Pi: 0% for much ..., 50% for younger/older, 100% for same age</td>
<td></td>
</tr>
<tr>
<td>39</td>
<td>Social learning</td>
<td>How often do you communicate with this person about the topic ‘wastewater use in agriculture’?  (Every day / Multiple times per week / Multiple times per month / Multiple times per year / Once per year / Less than once per year)</td>
<td>1B, 2A</td>
<td></td>
</tr>
<tr>
<td>40</td>
<td>Social learning</td>
<td>Please indicate which of the following are (expected) results of your relation with this person, related to wastewater in agriculture. (New contacts, network extension / Joint publications, such as reports, books, proposals, articles, etc / Joint projects, cooperations / New products, processes, technologies / New policy / Access to valuable knowledge / Access to financial resources / Access to tangible tools, such as software, technologies, labs, etc / Other)</td>
<td>1B, 2A</td>
<td></td>
</tr>
<tr>
<td>41</td>
<td>Part 3: A maximum of two ‘internal’ relevant (potential) relations (Partly adopted from the KWR ‘vakantiecursus’ survey – Heringa et al, forthcoming)</td>
<td>Did you know this person already before the workshop started?  (No / Yes, for so many years :)</td>
<td>1B, 2B</td>
<td></td>
</tr>
<tr>
<td>42</td>
<td>Social learning</td>
<td>How would you summarize the subjects of your communications with this person in 3 key words/sentences?</td>
<td>1B, 2B</td>
<td></td>
</tr>
<tr>
<td>43</td>
<td>Social learning</td>
<td>Do you intend to stay in contact with this person?</td>
<td>1B, 2B</td>
<td></td>
</tr>
<tr>
<td>44</td>
<td>Social learning</td>
<td>Please indicate which of the following are (expected) results of your relation with this person, related to wastewater in agriculture. (New contacts, network extension / Joint publications, such as reports, books, proposals, articles, etc / Joint projects, cooperations / New products, processes, technologies / New policy / Access to valuable knowledge / Access to financial resources / Access to tangible tools, such as software, technologies, labs, etc / Other)</td>
<td>1B, 2B</td>
<td></td>
</tr>
</tbody>
</table>
'I beg your pardon,' said the Mole, pulling himself together with an effort. 'You must think me very rude; but all this is so new to me. So--this--is--a-- River!'

'The River,' corrected the Rat.

'And you really live by the river? What a jolly life!'

'By it and with it and on it and in it,' said the Rat. 'It’s brother and sister to me, and aunts, and company, and food and drink, and (naturally) washing. It’s my world, and I don’t want any other. What it hasn’t got is not worth having, and what it doesn’t know is not worth knowing. Lord! the times we’ve had together! Whether in winter or summer, spring or autumn, it’s always got its fun and its excitements. When the floods are on in February, and my cellars and basement are brimming with drink that’s no good to me, and the brown water runs by my best bedroom window; or again when it all drops away and, shows patches of mud that smells like plum-cake, and the rushes and weed clog the channels, and I can potter about dry shod over most of the bed of it and find fresh food to eat, and things careless people have dropped out of boats!'

From: The Wind in The Willows (Ch 1: The River Bank), by Kenneth Grahame