Reciprocity in wind farm development

An applied and theoretical approach

Robin Vermeij

Technische Universiteit Delft

TU Delft Delft University of Technology

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Challenge the future

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MASTER OF SCIENCE THESIS

RECIPROCITY IN WIND FARM DEVELOPMENT

AN APPLIED AND THEORETICAL APPROACH

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Robin Vermeij BSc

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Student number: 1357263

	Science Communication		*Aerodynamics & Wind Energy*	
Supervisor:	Dr. M. C. A. van der Sanden	TU Delft	Dr. ir. W. A. A. M. Bierbooms	TU Delft
Thesis committee:	Prof. dr. M. J. de Vries,	TU Delft	Prof. dr. G. J. W. van Bussel,	TU Delft
	Dr. M. C. A. van der Sanden,	TU Delft	Dr. ir. W. A. A. M. Bierbooms,	TU Delft
	Dr. ir. S. M. Flipse,	TU Delft	Dr. ir. E. J. L. Chappin,	TU Delft
	Dr. ir. W. A. A. M. Bierbooms,	TU Delft	M. K. Arah	NWEA
	M. K. Arah	NWEA		

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"Altruism is always self interest in disguise."
Oren Harman

PREFACE

We, as a species, are sometimes referred to as *Homo Reciprocans*. Human beings have ideas about what they deserve, or what others deserve. These ideas can be about something big, like a salary, or about something small, like a smile to a stranger. But no matter the size, they all share the characteristic that they are responsible for how people relate to each other. People also have their own ideas about new technologies. I am particularly interested in wind energy and what I found is that some people see wind turbines as a solution to problems while others see it as threatening and creating problems. I have the feeling that the conflicts that arise from this are largely dealt with in a technocratic manner, which leaves little space for expressing ideas we have. The text in this thesis is about the Homo Reciprocans in the wind energy socio-technological system. And although the thesis project required my full-time attention, it represents only a tiny fraction of the last two years of my life. The project was a journey of learning the scientific method, and learning about many new topics. It was all the more fun than the courses I followed during the first years of my study, because I could choose my own directions. This could sometimes feel like juggling because the individualistic nature of the project also gave additional challenges like dealing with uncertainty, freedom and responsibility. Nevertheless I enjoyed writing this thesis because it made me more aware of my own behavior as a *Homo Reciprocans*. I hope you will also enjoy reading it.

The vast majority of new things in the world are actually not very new but the combination of stories we read in books and hear around us from friend. Two texts in particular have put their mark on this thesis. In the earlier phases of the thesis project I realized I was up against, what Robert M. Pirsig calls, *"the great unknown, the void of all western thought"*. Being stuck at, let's say, working out the theoretical foundation of a research project, can lead to frustration, fear, and even anger and it is one of those moments where the scientific method will not point you in the right direction. Using Pirsig's *Zen and the Art of Motorcycle Maintenance* I managed to not fall for the gumption traps that were alway waiting around the next corner of the graduation process. Whereas *Zen* kept me on track from a process point of view, Oren Harman's *The Price of Altruism* gave me a intellectual road map on the topic of kindness. The fundamentals of reciprocity are difficult to grasp but the excellent book by Harman makes the matters very accessible. Having a deeper understanding about this proved indispensable because it made me more comfortable in researching social processes and helps putting my findings into perspective.

Of course more important than books written by people I do not know personally are my family and friends. I would like to thank my family and in particular my parents, Ton and Carla Vermeij, and my girlfriend Dong Dong for their inexhaustible support during all my years of study. This thesis would furthermore not have been possible without my daily supervisors Maarten van der Sanden and Wim Bierbooms. I'd like to thank Maarten for pushing me to bring my work to a higher level. Wim deserves many thanks for sharp comments during the interesting meetings about a slightly unconventional thesis at the Wind Energy department. I have the impression that this was a learning experience not only for me but also for them, and I truly hope they enjoyed it as much as I did. The rest of the thesis committees, Gerard van Bussel, Steven Flipse and Émile Chappin, deserves as many thanks for their valuable comments, feedback and critics. I am also grateful to the Dutch Wind Energy Association (NWEA). During my thesis work I had contact with Marije Arah, Maiken Larsen and Marijn van der Pas on a regular basis. I would like to thank them for their comments and the passionate discussions. They were very defining for the early phase of the project. Other acknowledgements are given to Wander Jager and Rolf Künneke for their scientific input during the project. And if the contribution of the former people are not enough to prove that you do not graduate alone, then take a look in the graduation room at Science Education & Communication. All my fellow students that I shared the room with are thanked for their critical reviews of my concept texts and enjoyable discussions on the process. The interviewees deserve a big thanks, without them doing research is simply impossible. Finally, I would like to thank the many wind energy professionals that shared their insights and opinions with me during the preliminary research phase and the workshop and, last but certainly not least, Aafke Fraaije for her support during the workshop.

ABSTRACT

AN APPLIED APPROACH TO RECIPROCITY IN WIND FARM DEVELOPMENT

Onshore wind farm development in the Netherlands faces challenges concerning community acceptance and process participation. Scholars point out that participation should focus on procedural justice and acceptability of the outcome. Wind energy can be seen as a socio-technological complex system. Characteristics of such a system are the multitude of actors, highly specialized information and large uncertainties in the long process. Establishing positive personal contacts could have favorable effects on the wind farm development process.

Part II of this thesis presents a practice oriented research that aims to gain insight in process participation by analyzing the informal social interactions between key stakeholders. The research question reads as follows: *What is the role of reciprocity in the origination and propagation of the relationship between the wind farm developers and the involved residents during the wind farm development planning phase?*

Reciprocity between actors means that actors reward kind behavior by being kind, and punish unkind behavior by being unkind. Positive reciprocity between actors creates commitment and trust. The formal framework used in this thesis to interpret reciprocity is Social Exchange Theory, or SET. SET describes interactions as the transfer of social resources between actors which leads to cognition and affection between them. The resources are, in order of increasing particularism, information, status and love. If actors embedded in social networks engage in exchange, complexities arise and a redistribution of social resource through social exchanges can lead to stability of the system.

To increase our understanding on this social stability in wind farm development a case study is conducted using a multiple data-collection method. The case study is wind farm Spuisluis (six to eight wind turbines) in the province of Noord-Holland, The Netherlands. Eight semi-structured interviews, two structured and non-participatory observations, a document analysis and the collection of visual material provide the data for this case study. Using the data, a reconstruction of the social interactions between developers and involved residents during the early planning phase is made. Initially, the developers engage in communication through a series of presentations in the community. Eventually a working group of residents is formed. This working group is involved in the process through an excursion during which the research reports are shared. The working group is critical towards the wind farm development.

An analysis of the interactions during the development process unveils a pattern of reciprocal exchanges between the developers and the involved residents. The project only slowly gained momentum among the residents. Although the communication comes about in good atmosphere and there are several reciprocal exchanges of information and status, tension between the actors in the network cannot always be released due to remaining doubts by the residents about the process and the intentions of the developers. Inconsistent exchanges, social exchanges which are perceived differently by the actors, are always perceived more negative by residents.

The role of reciprocity in the planning phase of wind farm development is therefore essential but limited. In the case study the actors involved achieve the shared objective of open information. Exchange of status and love are increasingly difficult because increased interdependence goes hand in hand with feelings of exploitation by both the residents and developers. Noise acting on the social network is a source of mistrust and uncertainties in the process hamper consistent exchanges. The relationship between developers and the working group is somewhat resilient.

A table named the 'typology of exchanges' is proposed as an extension of SET and reciprocity theory. It serves as an analytical tool to interpret the different kinds of perceptions of exchanges. It's symmetry in terms of actor dependency and interaction atmosphere serves as a pillar in understanding social interaction.

A THEORETICAL APPROACH TO RECIPROCITY IN WIND FARM DEVELOPMENT

Wind farm development is complex and contingent, leading to large uncertainties in the communication process between key actors. Social network analysis is a means to gain insight into these complexities. In Part II the role of reciprocity between key actors in wind farm development is qualitatively researched. Part III of this thesis aims to give insight in the social network conditions for which mutual advantage between key actors is likely to occur by simulation of reciprocity between wind farm developers and involved residents who are embedded in a network. The research question that is answered is: *how can a network model of reciprocity which is tailored to simulate the social exchange process between key actors in wind farm development be used to gain insight in this process?*

Reciprocity between actors means that actors act kind towards those who act kind towards them, and actors act unkind towards those who act unkind towards them. This mechanism of social interaction is modeled using psychological game theory, where actors can give points to each other and the outcome is defined by both actors' strategic behavior. In specific, a theory of reciprocity that incorporates perceptions of fairness is applied to the moonlighting game and extended for use on networks. The moonlighting game allows for positive and negative reciprocity, meaning that actors can gain mutual advantage, mutual disadvantage or unilateral advantaged (in terms of points, or material payoff) following a social exchange. Actor heterogeneity is introduced by specifying a propensity to reciprocate for every actor. If this propensity is high, an actor responds strongly to perceived (un)kindness. Actors furthermore behave according to their perceptions, or expectations, of other the behavior of actors. These perceptions in turn are based on the earlier behavior of neighboring actors.

The behavior of the resulting network model of reciprocity is investigated using Monte Carlo Simulation. This allows for determining the distribution of outcomes as a result of actor heterogeneity and network structure. When wind farm developers and residents engage in exchange, there is a probability that their perceptions are not based on previously experiences behavior, but are randomly assigned instead. In this case, as found in Part II of this thesis, they are assigned such that residents expect being disfavored and developers expect being favored. This results in actor specific behavior and represents influences from outside the network such as media exposure, policy (change) and other real-world phenomena. These combined effects of external forces is referred to as noise.

The simulations are performed on a dyad (one resident and one developer) and a network consisting of two fully connected groups of 10 actors (a group of developers and a group of residents), with a defined fraction of connections between the groups between them. Actor heterogeneity, the amount of noise and number of connections between groups are subsequently structurally varied. An analysis of the dyad shows that noise can lead to an equitable outcome when the developer is a less reciprocal actor than the resident. An analysis of the network case indicates that a number of connections between the groups can have favorable effects on the outcome equity, but at the same time increases the probability of a mutual disadvantageous outcome.

A network model of reciprocity that simulates interaction between wind farm developers and residents is presented. It is based on existing theories of reciprocity and extended in a network fashion. Actors are assigned behavior according to the empirical data of Part II. The model simulates interaction between wind farm developers and residents based on perceptions of fairness and. Outcomes of the model indicate that social interaction between residents and wind farm developers is a trade off between an equitable outcome and total payoff. Actor specific behavior (noise) can lead to a more equitable distribution of payoff. At the same time a few connections have a big difference on the outcome of the system, but increasing the number of connections has incrementally less effects. Too many connections increases the probability of a mutually disadvantageous outcome. The model therefore shows that in some circumstances it is favorable for actors to invest in existing relationships in order to decrease the effects of noise and increase resilience, and other circumstances to invest in creating new relationships with actors from the other group in order to decrease the network complexities. Although the representativeness of the model is limited, it shows some similarities with empirical data. Further research is needed to increase the representativeness of the actor heterogeneity and network structure as well as to validate the results.

CONTENTS

GLOSSARY

LATIN SYMBOLS

A	network adjacency matrix
c	convergence criterion
CI	95% confidence interval
f	end node or end move of a game
h	history profile
i	initiating actor
j	responding actor
k	a third actor
n	node (move) of a game consisting of f nodes
N	number of actors in a network
s	strategy
s'	first order belief
s''	second order belief
S	strategy set
SD	standard deviation
t	time step
U	utility

GREEK SYMBOLS

δ	probability of connections between groups
Δ	outcome term, difference in material payoff
ε	pure outcome parameter
θ	intention factor
ν	noise
π	material payoff
Π	material payoff set
ρ	reciprocity parameter
σ	reciprocation term
ϕ	kindness term

SUBSCRIPTS AND SUPERSCRIPTS

c	converged
d	developer
i	actor i
j	actor j
k	actor k
l	lower boundary
r	resident
u	upper boundary

ACRONYMS

BB	Bonacich and Bienenstock reciprocity model
FF	Falk and Fischbacher reciprocity model
MCS	Monte Carlo Simulation
MG	Moonlighting game
MM	Gallucci and Perugini reciprocity model
PD	Prisoners' dilemma
SET	Social Exchange Theory
SNA	Socal Network Analysis
TFT	Tit-For-Tat

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I

THESIS INTRODUCTION

1

INTRODUCTION TO RECIPROCITY IN WIND FARM DEVELOPMENT

Wind turbines, such as the one in Figure 1.1, are build in the Netherlands to ensure a sustainable, reliable and affordable supply of electricity. Implementing this technology however often leads to conflicts of interest among stakeholders in wind farm development processes. In this light, Wüstenhagen et al. (2007) distinguishes between socio-political acceptance, market acceptance and community acceptance. Community acceptance is commonly viewed as one that is often not satisfied when wind farm development is concerned (Devine-Wright, 2005, 2007). No simple explanation can be given to why community acceptance does or does not exist (Ellis et al., 2007). Therefore the wind energy research community stresses the importance of long-term societal acceptance and acceptability of wind energy technology (Kuik et al., 2016).

Figure 1.1: A modern solitary wind turbine in the open landscape of the province of Noord-Holland (photo: Bosch & Van Rijn).

Perceived procedural justice is one of the subjects in wind energy communication research that is related to acceptance of a wind energy project by a community (Zoellner et al., 2005; Ottinger et al., 2014). Involving the community in the development process in order to increase the perceived procedural justice can indeed lead to a higher acceptance (Agterbosch et al., 2007). In order to encourage wind farm developers to involve communities, the Dutch Wind Energy Association (NWEA) launched a *code of conduct* which prescribes early communication and financial participation (Nederlandse Windenergie Associatie et al., 2014). At the same time, in explaining community acceptance the formal institutional settings are less important than social conditions such as informal personal contacts (Agterbosch et al., 2009).

This leads to the suggestion that establishing positive personal contacts between actors in wind farm development can have favorable effects on community acceptance. This thesis indeed focuses on relationships based on *reciprocity* between the involved actors of a wind farm development. Due to the many layers in the concept of reciprocity, scholars often refrain from a precise definition (Gouldner, 1960; Perugini et al., 2003; Cropanzano, 2005). In somewhat general terms, reciprocal behavior means that one acts kind towards others that act kind, which leads to unspecified obligations towards each other (Cropanzano, 2005; Molm et al., 2000). Relationships based on reciprocity are, amongst others, characterized by positive aspects such as trust, commitment and solidarity (Lawler, 2001; Molm, 2010). Social Exchange Theory (SET) is used to make reciprocity between actors explicit through a series of interdependent reciprocal exchanges.

1.1. PROBLEM STATEMENT

Opinion polls are suggestive for high public support for renewable energy (>70%) in western societies (Ek, 2005; Warren et al., 2005; Kaldellis and Zafirakis, 2011). Many projects in development are however not realized. Of the projects that are realized, many suffer very long development times of up to ten years (van der Horst, 2007; Aitken et al., 2008). Not seldom communication plays an important role in this. One of the characteristics is that communication in wind farm development is highly contingent: there are no clear cut directions how to do communication because every project is different and faces unique challenges. There are furthermore many stakeholders involved, introducing a rich palette of perceptions and interests. Information dealt with by these stakeholders is often highly specialistic and technocratic, resulting in the meanings being open for interpretation (Zoellner et al., 2008). The development process is iterative and development times are long. Additionally, over the last decade wind farm opposition groups have proven to be able to be well organized and effective in delaying projects. All these factors make a wind farm development process highly complex and very sensitive.

Below is a short delineation on the preliminary research that is conducted which serves as a further exploration the problem. The findings of this preliminary research are then compared to scientific literature. This section ends with explaining why and how an approach to the problem described above is selected.

1.1.1. PRELIMINARY RESEARCH

A preliminary research is carried out to obtain more insight in the communication problems during wind farm development. To this end, conversations with eight experts working in the wind energy industry are done. The people talked with are two employees of the Dutch Wind Energy Association, one consultant, one manufacturer, and five wind farm developers (belonging to four different companies) of which one is a local energy cooperation. Specific attention is given to why and how the developers engage with communities. The experts are asked to give their view on the role of communication and to talk about examples from the field, their own experiences and expected future developments.

The main finding is that the experts see a shift happening right now in wind farm development style: from the old school approach orbiting around the application of permits and community involvement through formal channels towards the new school approach orbiting around early communication and community involvement through participatory means. The industry is forced to do this because of otherwise decreasing wind farm implementation rates. With current communication efforts being primarily based on gut feelings, there seems to be a demand for more understanding of communication during wind farm projects.

Mentioned barriers for successful wind farm development are (organized) community opposition which stems from fear and uncertainty as well as low trust in authorities, developers and scientists. Some experts mentioned that about every wind farm in the Netherlands is confronted with some degree of organized opposition. It is furthermore mentioned that developers are usually willing to think about solutions that take public concerns into account, and that this searching for a solution should not stop until it is found (although this 'sweet spot' is not always reached). Initial plans for wind farms are therefore 'aimed high', because the final project is always reduced by one or more wind turbines. Moreover, experts mention that opposition reduces after wind farm construction. In practice, having the right person to do communication, educating the community and managing expectations are key success factors mentioned by the experts. This should ideally lead to 'reasonable' debate and mutual understanding. It is however perceived impossible to satisfy the wishes of all residents. Matters are increasingly difficult for developers because every project is different. For large

companies, their image plays an important role in their motivation to commence communication. Developers can be thought as making calculated decisions (benefits must be greater than the costs) to engage with the community.

1.1.2. VIEWS FROM SCIENTIFIC LITERATURE

Findings of social scientist partly resonate with the expert's statements. Literature also mentions the old school approach, characterized by the *decide-announce-defend* paradigm, as one that is likely to invoke opposition because it is based on criticism rather than support (Bell et al., 2005; Burningham et al., 2006). There is also confirmation on the fact that many wind farm projects are confronted with opposition (Jobert et al., 2007; Jones and Eiser, 2009; Kaldellis and Zafirakis, 2011) and many are rejected because of that (Bell et al., 2005). The effects of educating the community (the 'deficit model' type of thinking) has however been contested since educating a community does not address real concerns of residents (Burningham et al., 2006; Aitken, 2010). Studies confirm that every wind farm project is different (Warren et al., 2005; Wolsink, 2007a; Jobert et al., 2007; Toke et al., 2008) and also the decrease of opposition after construction is consistent with literature (Krohn and Damborg, 1999; Wolsink, 2007b). The preliminary research obviously did not provide an representative view of the range of perspectives from professionals in the industry, indeed literature suggest that other views (on communication) exist (Wolsink and Breukers, 2010).

The conclusions from scientific literature on the topic of wind energy communication should however be taken with caution. Aitken (2010) reveals that the body of literature takes *"a largely uncritical approach in accepting and reinforcing (...) assumptions"* (p.1834). They key assumption that opposition is deviant results in research goals that aim to understand opposition in order to overcome it. Ellis et al. (2007) mentions that research questions on this topic should change in order to solve the problems that implementation of wind energy is facing. My personal observation is that the wind farm developers are research subjects only in a fraction of the published papers. The scientific body of literature on wind energy communication is heavily biased.

1.2. APPROACH OF THE PROBLEM

To approach the problem of wind energy implementation from a communication point of view a neutral perspective must be taken. The view of Oosterlaken (2014) helps to obtain this perspective. She argues that the use of 'acceptance' as a motivation to decide for wind farm construction is too narrow minded. This view could *"contribute to maintaining and legitimizing a top-down planning approach"* because people tend to accept unwanted developments. They for example feel that they cannot change anything. In contrast, planning processes should focus on ensuring ethical *acceptability* in order to create long term support for wind energy. Indeed, a neutral perspective should take into account the subjective acceptability by the various actors during the development and decision process. Scientific research should not take as a premise that a successful wind energy project is one that results in construction of a wind farm.

Focusing on reciprocity to gain insight in wind energy communication helps in taking this neutral perspective. Reciprocity happens *between* actors, with both actors putting effort in building and maintaining the reciprocal relationship. In other words, this thesis focuses on *relationships* between actors rather than on the actors themselves. It will be explained later that by asking the right research question and by choosing suitable theory I further intend to obtain this neutral perspective.

Concluding, communication processes in wind farm development are highly complex and sensitive. There is a paradigm shift from the *classic approach* towards the *romantic approach* [1] of communication. But what this romantic approach should exactly look like is unknown because every project is different and current communication efforts are largely motivated by feelings of what is right and what is wrong. The scientific body of literature does not provide a clear cut answer, partly due to the bias in the research papers.

[1] My notions of the *classic* and the *romantic* approach of communication are inspired by Pirsig's *Zen and the Art of Motorcycle Maintenance*. I feel that these wording invokes the right atmosphere of communication.

2

READER'S GUIDE

This report that you are reading now is the result of a research conducted for a double degree master program. The two master programs are Science Education and Communication, track Science Communication, and Aerospace Engineering, track Aerodynamics & Wind Energy, both at the Delft University of Technology. The thesis orbits around one central theme: reciprocity in wind farm development. By doing both master tracks I allowed myself to take two distinct approaches to one and the same problem. The research that is presented first, in Part II, takes the applied approach. A case study is conducted where reciprocity between key actors in wind farm developers is investigated 'in the field'. The subsequent Part III presents a theoretical approach. Here a reciprocity model is developed and applied to a network of actors. This order of first presenting the applied approach and then presenting the theoretical approach is not arbitrary. Insights that are obtained in the applied approach are used as modeling inputs in the theoretical approach. Despite this overlap, efforts have been made to make Part II and Part III readable on their own. The reader can therefore immediately jump to the topics that he/she is most interested in.

The decision to have a thesis structure like this is not without reason. This integrated project has an added value (and added difficulties) over single degree thesis projects. A big challenge for the branch of computational social science is to have accurate models that are representative for real world situations. The results of this thesis are, thanks to the double degree, a step in the direction of models with these qualities. A reflection on the added value (and added difficulties) that the integration of both projects offers can be read in Part IV. It is recommended to have read at least the introduction and conclusion chapters of both Part II and Part III before turning to this integration part.

Another challenge in integrating the social and computational sciences, and something that the readers specifically interested in the integration of both parts must be aware of, is the fact that conventions and definitions differ between different branches of science. In this thesis I intended to stay as close as possible to the existing conventions. And although this makes the reading of separate parts easier, it might make the reading of both parts together somewhat confusing on some points. Below the differences are described.

Social Exchange Theory stands at the basis of both the applied and theoretical approach of this thesis. When interpreting SET for both disciplines, the following discrepancies have appeared (tabulated in Table 2.1). SET defines social interaction as (a series of) *exchanges* during which *resource* is transferred from one actor to the other, and back. This results in an *exchange outcome*. The applied approach distinguishes between *economic* and *social* resources, while in the theoretical approach these resources are simplified into the non-dimensional *points*. The outcome of a social exchange in reality is somewhat difficult to grasp, which is why in Part II will take into account *change in relationship*. The advantage of a computational approach to social exchange is that the difference in real outcome and feelings of fairness necessarily have to be separated. This is why Part III distinguishes between *material payoff* (amount of points after an exchange) and *social payoff* feelings of inequality which actors intend to balance. The most important thing to remember is that economical and social exchange resources are not equal to material and social payoff.

Furthermore the idea of *perception* will be introduced in Part II. This is an actor's expectation or experience of

Table 2.1: Differences in definitions concerning Social Exchange Theory in parts II and III.

	exchange resource	**exchange outcome**
Part II	- economical - social	- change in relationship
Part III	- points	- material payoff - social payoff

a specific social exchange. Psychological game theory (which is used in Part III) also recognizes this variable as one that has an effect on how social exchanges take place, but it is referred to as *beliefs*. Whenever this thesis mentions either perceptions or beliefs, practically the same thing is meant.

There are two instances of *noise* used in this thesis. The first one is the notion of noise being sound emitted from a wind turbine itself (often related to noise annoyance experienced by residents). The second one is the notion of noise being some force from outside the social system that influences the actors within the system. This latter type of noise is often introduced in social network models where it functions as a modelization of media exposure, campaigning, random changes in actor behavior, etcetera.

Finally, there are the notions of *communities* and *groups*. In wind energy research, a community is usually referred to as a group of people living one and the same neighborhood nearby a wind farm (development). In network theory, a community is specifically defined as a group of actors who have a higher density of connections between them, while they have a lower density of connections with actors outside of this group. According to this definition, developers can also form a community. In order to not conceptually mix these two terms up, a community is referred to as residents living nearby a wind farm development and a group is a number of actors within a network who have a relatively high density of connections between them.

II

SCIENCE COMMUNICATION

AN APPLIED APPROACH TO RECIPROCITY IN WIND FARM DEVELOPMENT

3

INTRODUCTION TO AN APPLIED APPROACH TO RECIPROCITY IN WIND FARM DEVELOPMENT

Part II of this thesis report presents the Science Communication research that takes an applied approach to reciprocity between key stakeholders in wind farm development. It includes a case study, wind farm Spuisluis in the province of Noord-Holland, The Netherlands, which is researched using multiple data collection methods allowing for triangulation.

This chapter starts with an introduction of the research objective and research questions in section 3.1. The research relevance and scope ar covered in section 3.2. This chapter ends with a short explanation of the research context (section 3.3) and the contents of Part II (section 3.4).

3.1. OBJECTIVE AND RESEARCH QUESTION

In the light of the problem statement, the objective of this research is not to find causes of opposition in order to overcome them. Instead, this research is process oriented and does not take the outcome of the process as a premise. Furthermore, to obtain a balanced view on the problem multiple actors are explicitly taken into account. The research objective therefore is to gain understanding of wind farm development process participation by analyzing the informal social interactions between key stakeholders.

Wind farm development process participation is any activity during which actors other than the developers are involved in the process. Stakeholder participation can be seen as a process that emphasizes empowerment, equity, trust and learning among stakeholders, ultimately leading to comprehensive information inputs to environmental decisions (Prell et al., 2009). Informal social interactions are those interactions which are not prescribed by formal planning procedures. An example of a formal interaction is the mandatory public voicing. An example of an informal interaction is a public information evening organized by the project developer. Key stakeholders are those who are affected by the outcome of the process. A local community is therefore a key stakeholder.

As mentioned in the thesis introduction in chapter 1, there are indications that positive personal contacts are key in issues related to community acceptance of wind energy technology. Since community acceptance is critical and the wind farm developer is responsible for process participation, the relationship between these key stakeholders is considered in this research. The contents of this report provide a perspective that enables the promotion of harmony between the key stakeholders, potentially leading to meaningful stakeholder engagement and mutually supported outcomes.

The idea that the concept of reciprocity, characterized by unspecified obligations, plays a role in wind energy communication in the planning phase is substantiated by the fact that there are, prior to the application of the permit, no formal occasions for community involvement. The period of time between choosing a suitable

location until application of the permits necessary for construction is, according to the Dutch spatial planning regulation, called the *planning phase* (Rijksdienst voor Ondernemend Nederland, 2015). An important aspect of this planning phase is that detailed research reports are compiled which serve as supporting documents for the permit application. Process participation in this phase is not institutionally embedded. Process participation of the residents then starts from the benevolence of the wind farm developer. The main research question is therefore:

What is the role of reciprocity in the origination and propagation of the relationship between the wind farm developers and the involved residents during the wind farm development planning phase?

The developers and the residents are in the remainder of this thesis referred to as *actors* who have the ability to *exchange resources* with each other. *Reciprocity* is a "repayment in kind" (Cropanzano, 2005), and a *reciprocal exchange* is one that does not include explicit bargaining (Molm et al., 2000). This is formally described by social exchange theory and is in scientific literature also compared to giving gifts to each other (Emerson et al., 1976; Cropanzano, 2005). The basic premise of reciprocity is that perceived kindness will be answered with kindness. This means that actors are interdependent: the behavior of actors is depending on their expectations of the other actor's behavior in response (Molm, 1994). For example, imagine a wind farm developer who distributes information with the expectation that this leads to a higher understanding by residents. In the light of this theory, Foa (1971) distinguishes between three kinds of social resources that can be exchanges between actors. These are, in order of increasing particularism: information, status and love. With this theory in mind, the following subquestions are formulated:

1. What are the prevailing procedural, cultural and personal norms of reciprocity dictating and influencing social exchanges between the wind farm developers and the involved residents in the case study?
2. What pattern of social exchange can be discerned in the case study?
3. What perceptions do interviewed actors hold towards the social exchanges?
4. Which cognitive and affective characteristics of the relationship between the involved residents and the wind farm developers in the case study emerge from the reciprocal exchanges?

The research question and the subquestions will be answered in the conclusion in chapter 8. The norms of reciprocity describe the actor's propensity to act in a reciprocal way towards others. In a relationship actors engage in a multitude of encounters. The theory of social resource would suggest the existence of a pattern of exchange where actors engage in repeated exchanges characterized by increasingly particular resources. It is of interest whether such a pattern exists. Furthermore, all actors have different ideas, interests and personalities. Hence it is expected that different perceptions on social exchanges exist. The third subquestion therefore aims to elucidate the existence and the character of these different perceptions. Finally, answer to the fourth subquestion gives insight in the resulting relationship in terms of cognition (to what degree do actors have a common goal, understanding etc.) and affection (positive/negative emotional intensity towards each other).

The consecutive steps that are taken to answer the research questions and reach the research objective are visualized in a *research framework*. The research framework of this thesis is shown in Figure 3.1.

The first three elements in this research framework are *scientific literature on social exchange and reciprocity*, *scientific literature on wind energy communication* and the *preliminary research*. The scientific literature on wind energy communication has been treated in the form of a literature review (Vermeij, 2014). The three elements are synthesized into a conceptual model, which contains the key concepts and the relationships between them. The conceptual model thus contains the variables that are researched in order to answer the research questions. This conceptual model will be *confronted* with the research object, the wind energy project case study which was mentioned in the beginning of the introduction. This confrontation of the conceptual model and the case study leads to conclusions. These conclusions are used to gain insight in the social aspects of wind energy development and consequently reach the research objective.

3.2. RESEARCH SCOPE AND RELEVANCE

The research scope is limited to the development process of an onshore wind farm in the Netherlands consisting of 6-8 modern day horizontal axis wind turbines. In specific, the informal interactions (not embedded in

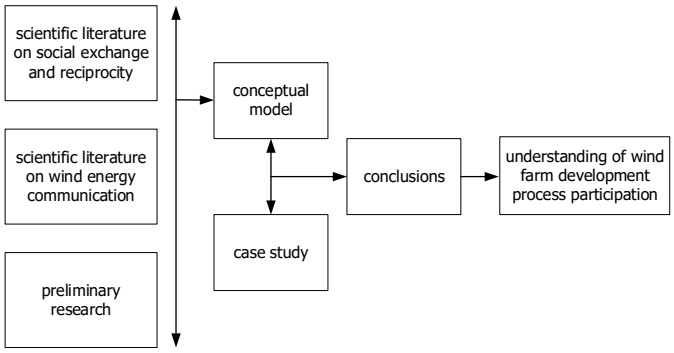


Figure 3.1: The research framework in which the consecutive steps of this thesis are visually shown.

policy or forced through contracts) between wind farm developers and residents during the planning phase of the project are studied. The study does therefore not cover the complete development process. Instead it spans time between first contact between the involved actors up till about 16 months after.

By limiting the scope to the *involved* residents rather than the community as a whole, including the 'silent majority', the role of the residents who are not involved are not explicitly taken into account. This is not to say that the relationship between the wind farm developers and 'silent majority' is non-existent. The role and function of this relationship are explored in the concluding chapter of this part.

The scientific relevance of this research is twofold. In the first place, the research will add to the body of scientific knowledge on the social aspects in wind farm development. This research field is relatively new and biased in favor of the developers. This thesis presents an approach to reduce this bias by using a more firm theoretical foundation and by aiming to understand how communication has an effect on relationships instead of what communication must be done. Second, this thesis aims to apply social exchange theory and reciprocity to a socio-technological system. This theory is before mostly applied in the research of workplace environments. The main difference between these two situations is that socio-technological systems revolve around a specific technology, in this case wind energy. Furthermore it can be expected that in a workplace environment the actors have higher similarities, for example they share a goal.

The knowledge from this thesis also has practical relevance. There is, from the developers side, a demand for more understanding about communication with residents. This thesis could furthermore help residents who are confronted with a wind farm development by giving understanding why and how the communication takes place. Ideally, developers and residents with knowledge about the contents of this research should be able to become closer to each other in order to obtain a shared view of what is an acceptable development (which does not necessarily exclude the possibility of *not* constructing the wind farm).

3.3. TYPE AND CONTEXT OF RESEARCH

The present research is of a *practice-oriented* and *diagnostic* nature. The main goal is to analyze a case with existing tested theory rather than theory development. Within the branch of practice-oriented research there exist several more types, ranging from problem analysis, diagnosis, design and intervention to evaluation. This research is diagnostic because diagnosis *"always concerns the background and causes of a dysfunctional disorder"* (Verschuren and Doorewaard, 2010) (p.76).

This research is conducted for the Science Communication Thesis (course code SL3581) and Research Methodology in the Social Science 2 (cource code SL3481) in order to obtain the master's degree of Science Communication and Education (SEC) at the faculty of Applied Sciences of the Delft University of Technology, The Netherlands. The research is carried out in collaboration with the Dutch Wind Energy Association (NWEA).

3.4. STRUCTURE OF PART II

The following chapter covers the conceptual research design explaining the theoretical background of reciprocity and social exchange and introducing the conceptual model. Chapter 3 elaborates on the used methodology to collect the data. A detailed account of the results of the case study is presented in chapter 6. The case is analyzed using the conceptual model in chapter 7. In the conclusion & discussion chapter, chapter 8, the research questions are answered and the research results are discussed. Also recommendations for future research are given.

4

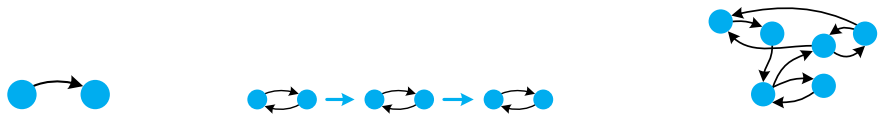
CONCEPTUAL RESEARCH DESIGN

This chapter presents the research design phase and will explain how the conceptual model for this thesis is developed from preliminary research and scientific literature, and how the concepts are operationalized. During the research design phase us is made of Verschuren and Doorewaard (2010) to structure the design process. According to this source, *"a conceptual model consists of a set of assumed causal relationships between the core concepts of a research project"*(p.267). It therefore helps to demarcate the research and provides a possibility to make use of existing theory. The conceptual model will serve as a 'mirror', to which the case will be *confronted* (see also the research framework in Figure 3.1). This confrontation will happen in the analysis (chapter 7).

This chapter begins with a review of the theory that is used in this thesis (section 4.1). The theory is used to design the conceptual model, which is is presented in section 4.2. Finally, the concepts are operationalized in section 4.3.

4.1. THEORY

This aim on this section on theory is to provide the background knowledge for combining both the ideas of Social Exchange Theory (SET), reciprocity and social networks. The figure below visually represents the three theories. SET is a description of interaction between actors and will be reviewed in subsection 4.1.1. Reciprocity is a type of social exchange and is reviewed in subsection 4.1.2. When considering a multitude of actors, a social network is obtained. The literature that covers social networks and social capital is reviewed in subsection 4.1.3. In the next section, section 4.2, it will be argued that the theories of SET, reciprocity and networks are complementary. The theory is subsequently used to construct the conceptual model.



Social Exchange Theory | Reciprocity | Social networks and social capital

4.1.1. SOCIAL EXCHANGE THEORY

Social exchange theory (SET) is a theory to model interaction between actors. The origins of SET are traced back to 1920 combining research from the field of anthropology, sociology and psychology. Since then different branches have evolved within SET, each with their own characteristics and applications (Cropanzano, 2005). This is why Gouldner (1960) observes that SET is a *frame of reference* rather than a theory itself.

A concise description of what SET encompasses is given by Emerson et al. (1976): *"The exchange approach in sociology might be described, for simplicity, as the economic analysis of noneconomic social situations"*. This notion of social exchange implies that we can see it as actors engaging in an exchange with each other during

which resources are transacted as to fulfill both actors' needs. SET is a dyadic theory, meaning that it describes interaction between two actors.

Literature generally distinguishes between four types of exchange. These are *negotiated exchange*, *reciprocal exchange*, *generalized exchange* and *productive exchange* (Lawler, 2001; Molm, 1994; Emerson et al., 1976). The scope of this research is the analysis of reciprocal exchange. However, the differences compared to negotiated exchange will be outlined in subsection 4.1.2.

The reason that actors engage in social exchange and establish relationships is that, similar to economic exchange, they provide benefits and costs for each other. Foa states: *"If expressions of friendship, admiration, and knowledge are commodities, then a party is no less a marketplace than is the stock exchange"* (Foa and Foa, 2012). In practice this means that if someone expresses friendship, he is likely to receive back the same signals. And if someone's property is purposely broken, it is more likely that he breaks the offenders property instead of thanking him. Noneconomic exchange is more difficult to define than economic exchange.

In his review article, Cropanzano (2005) distinguishes between three variables within the concept of SET. These are *rules and norms of exchange*, *resources exchanged* and *emerging relationships*. These concepts will be reviewed in detail below.

RULES & NORMS OF EXCHANGE

According to Emerson et al. (1976), rules of exchange form a *"normative definition of the situation that forms among or is adopted by the participants in an exchange relation"*. Cropanzano (2005) mentions these rules and norms being the 'guidelines' of an exchange process. Significant research has been conducted by Molm (1994) who, building upon the work of Emerson et al. and Markovsky et al., uses the notion of *dependence* to characterize the basis for exchange and connected individuals' perception of risk with the exchange process.

As Molm (1994) puts it, *"the concept of dependence is the cornerstone supporting all structural analyses of social exchange."* Dependence between actors is *"created by actors' differential access to others who control resources they value."* Three types of relations can be distinguished between actors A and B. These are: A is *dependent* on B, A is *independent* of B and A and B are *interdependent*. In the first situation, the outcome of a situation affecting A is completely depending on the behavior of B. The second situation describes that the outcome for A of a situation is merely depending on the behavior of A itself. A and B can therefore also be *mutually dependent* if they both value the other actor's resources. The last relationship, interdependence, describes that the outcome of a situation is depending on the behavior of both A and B.

An example of dependence from wind energy is the following: When residents know there is a wind farm development going on, they want to obtain more information about the details of the proposed wind farm. The developer has conducted research and has this detailed information. The residents are in this case dependent on the developers.

Early scholars assumed that motivations for actors engaging in an exchange relationship were based on their goal of maximizing their benefits. Later insights show that avoiding risk and maximizing the probability of the exchange partner behaving reciprocal are also motivations for engaging in exchange (Molm, 2003). Whatever individual motivations are, mutual dependence results in actors exchanging resources, but is also the cause of power inequalities and tensions (Molm, 1994). The perception of risk of engaging in an exchange is therefore important variable with respect to mutually dependent exchanges because one characteristic of a (reciprocal) social exchange is that it is often unknown whether and when an initial transfer of a resource will be returned. Expectations are often not made explicit in social exchange. One of the early findings of SET is that trust is a mediating variable: the higher the trust in an exchange relation, the lower the perceived risk (Blau, 1964a). Interdependent relationships encourage cooperation between actors. This is because actors are depending on each other, making the relationship less susceptible to defection of one of the two actors.

EXCHANGE RESOURCE

The second variable of social exchange theory is the exchange resource. A resource is defined as anything that can be transmitted from one person to another (Foa and Foa, 2012). Like Emerson, also Foa makes a distinction between economic and non-economic resources. However, whereas Emerson merely uses an

analogy by stating that SET is an economic analysis of non-economic situations, Foa says that there exists the phenomenon of exchange, and that economical and non-economical are two subsets of exchange (Foa, 1971). The main differences between economical and non-economical is that the former is finite, whereas the latter can be *"given to others without reducing the amount possessed by the giver"*.

Foa and Foa mention six categories of resources. Love, status and information are the non-economic resources and money, goods, and services are the economic resources. Love is an expression of affectionate regard, warmth or comfort. Status is an expression of evaluative judgment which conveys high or low prestige, regard or esteem. Information includes advice, opinions, instruction, or enlightenment, but excludes those behaviors which could be classed as love or status. An exchange works both in a positive and in a negative way. This means that resources can not only be given, but also taken away. Actor A can say 'I love you' to actor B, hence giving love. But when Actor A hurts actor B, by saying 'I hate you', love is taken away.

Different resources have different characteristics. These characteristics have been elucidated in a series of experiments and are the degree of *concreteness* and the degree of *particularism*. Particularism is *"the extent to which the value of a given resource is influenced by the particular persons involved in exchanging it and by their relationship"*. Concreteness *"suggests the form or type of expression characteristic of the various resources"*. This ranges from symbolic to concrete and is thus the degree to which the resource actually consists of matter. The six resources are plotted in Figure 4.1 according to their characteristics. The lower right half contains the economic resources, the upper left half contains the non-economic resources.

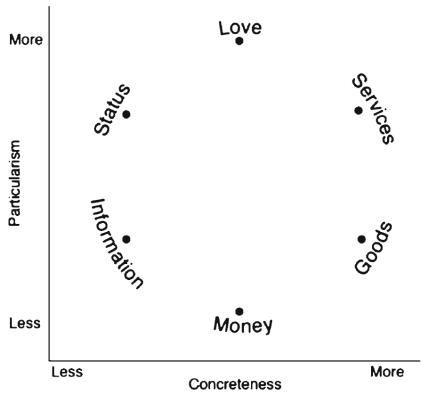


Figure 4.1: The six neighboring resources plotted according to their particularism and concreteness (Foa and Foa, 2012).

EMERGING RELATIONSHIP

The third variable of SET is the emerging relationship between actors. A social exchange leads to an emerging relationship, and in turn a relationship allows for a successive social exchange and so on. This definition is different from some other research fields, for example psychology, where the exchange itself defines the relationship (Cropanzano, 2005). SET treats social exchange and relationship as a separate variables.

Conceptualization of the emerging relationship has been, due to the many branches within SET, divergent. Trust has always been a concept of interest because it is seen that *"the gradual expansion of exchange transactions promotes the trust necessary for [the exchange partners]"* (Blau, 1964b). In general terms it means that an interdependent exchange relationship has the potential to generate high-quality relationships and unspecified mutual obligations (Cropanzano, 2005). Much evidence for the applicability of SET in understanding detailed social relationships is found in applied organizational research, for example (Shore et al., 2009; Lau and Cobb, 2010). In this research it is found that commitment and trust are the two main concepts that propel an interdependent exchange relationship. Experiments confirm the importance of these concepts (Lawler and Yoon, 1996; Molm et al., 2000; Lawler et al., 2008).

4.1.2. RECIPROCITY

As explained in the introduction, reciprocity can be thought of as a *"repayment in kind"* (Cropanzano, 2005), and a *reciprocal exchange* is one that does not include explicit bargaining (Molm et al., 2000; Molm, 2003). An

example is a family situation, where family members love each other and be loved in return. Another example considers the workplace environment, where expressions of respect by an employer are answered with respect in return by an employee. Literature distinguishes between *positive* and *negative* reciprocity (Perugini et al., 2003) (the former examples are all positive reciprocity). Negative reciprocity, also known as *retaliation*, occurs when both actors take a social resource from each other. An example of negative reciprocity is a person who's being insulted and, in return, insults the other person. Research, like the work of Molm (1994), sometimes exclusively focus on positive reciprocity. Foa, on the other hand, takes into account both giving and taking of social resources.

An reciprocal exchange therefore starts with a *unilateral exchange* of one actor towards another (Emerson et al., 1976; Lawler and Yoon, 1996; Molm, 2010). This actor makes a calculated decision that this unilateral exchange will be answered, resulting in a mutual benefit from the exchange (the 'cost-to-benefit ratio' has to exceed one (Nowak, 2006)). This unilateral exchange the creates the unspecified obligation for the other actor to give a return in kind. The time it takes until this unilateral exchange is reciprocated is called the *payoff time*. A successful reciprocal exchange leads to trust and commitment among the actors.

In terms of Foa's classification of resources (explained in subsection 4.1.1), symbolic resources (love, status) generally have a longer payoff time than concrete resources (goods, services). Furthermore, actors who are not very similar are unlikely to engage in exchange where love (very particular) is the exchange currency. This is because love and status are very particular, hence the value of the resource is depending on the person who provides the resource. Repeated interactions between nonsimilar actors can however result in the actors becoming more similar, which in turn enables the exchange of love. This is comparable with meeting new people. When meeting somebody new, the main social resource that is exchanged is information (where do you work, what films do you like etc.), which can change to compliments (I like your jacket) and eventually affection.

Back in 1960, Gouldner wrote an deepening article explaining the role of reciprocity in the stability of social systems and social relationships. What this stability exactly entails is not precisely explained in this article. Between 1960 and today, reciprocity has gained much attention and scientists have been performing interesting network simulations to show how trust and cooperation between actors can evolve, like in Macy and Skvoretz (1998). Amongst others, game theoretic approaches aim to find the fundamental cause of cooperation. In these models it is found that reciprocity can function as a starting mechanism of cooperation (Axelrod and Hamilton, 1981; Axelrod and Dion, 1988). It is shown that in certain situations the ratio between actors who act reciprocal and actors who don't act reciprocal remains constant over time and a stable social system is obtained (Nowak, 2006).

RECIPROCITY VERSUS NEGOTIATION

Molm (1994) conceptually splits reciprocity and negotiation. This is done because the two types of exchanges lead to two different kinds of relationships. It has been shown that, *"reciprocal forms of exchange, in which actors individually provide benefits to each other without knowing what returns they will receive, provide a more fertile ground for the development of trust than negotiated exchanges with binding agreements"* (Molm et al., 2000) (p.1422). Commitment and trust, the two variables that are often seen as characterizing the emerging relationship, are more strongly affected for reciprocal exchanges than for negotiated exchange. Experiments have shown that reciprocal exchanges can produce more stable relationships than negotiated exchange (Lawler et al., 2008; Molm, 2003). The difference between negotiation and reciprocity between actors A and B is schematically viewed below:

negotiated exchange	**reciprocal exchange**
$[A \rightleftarrows B] \Rightarrow [A \rightleftarrows B] \Rightarrow [A \rightleftarrows B]$	$A \rightarrow B \rightarrow A \rightarrow B \rightarrow A \rightarrow B$

Negotiated exchange is a joint decision process and has one outcome. Both actors agree on terms of exchange at one single moment, during which the benefits and costs are clear and discrete. Negotiation is therefore characterized by low risk, but is susceptible for deception of exchange partners and power differences play a large role as well. Reciprocity, on the other hand, has two individual decisions as its basis and therefore has two outcomes (as perceived by the two actors). Reciprocity is also more risky than negotiation, since it is uncertain whether, when and how much an act of benevolence will be reciprocated. Payoff times are also not clear, because it is more difficult to discretize the process of subsequent unilateral exchanges.

4.1.3. SOCIAL NETWORKS AND SOCIAL CAPITAL

People are embedded in extensive webs of relationships or, in other words, *a social network*. The branch of science dealing with processes on social networks is *Social Network Analysis* (SNA) (Wasserman and Faust, 1994). The quality of relationships in complex social networks is described by social capital theory. The following two subsections give more background information on social networks and social capital and the use in this research.

SOCIAL NETWORKS

"A social network is a set of people or groups of people with some pattern of contact or interaction between them" (Newman and Park, 2003) (p.174). Another, similar, definition is given by Wasserman and Faust (1994): *"A social network consists of a finite set or sets of actors and the relation or relations defined on them"* (p.20). Actors can be thought of as individuals or groups and relationships can be friendship, kinship, status, sexual, business, political and so on (Borgatti et al., 2009; Borgatti and Halgin, 2011). A network thus has two main ingredients: actors and relationships. But combining these two automatically adds a new third variable: *structure*, or *topology*. SNA looks at the structure of a social network *"because structure always affects function. For instance, the topology of social networks affects the spread of information and disease"* (Strogatz, 2001)(p.268).

The fact that an actor embedded in a network can only 'see' the actors that it is connected to has some important implications. Interactions are limited to only these neighboring actors. The state of an actor is therefore only influenced by exactly these neighboring actors. This is the cause of complexity: each individual behaves as a function of the other individuals it is connected to, but not according to some 'overall network state'. This accounts for complex and non-linear emergent behavior of the network. Complexity is difficult to define, but a complex social system can be considered as a system being *"composed of interconnected parts which display some properties that are not obvious from the properties of the individual parts"* (Estrada, 2012)(p.9). A classical example of this emergent behavior is a flock of birds. Each bird has adjusts its speed and flight direction only according to the neighboring birds, resulting in complex and dynamic flock shapes.

Structural properties of networks have an effect on the network behavior. Although there are many different kinds of network structures (Newman, 2003) only the concept of communities will be discussed here. For this thesis the notion of communities is important because *"behavior, opinion, and information, broadly conceived, are more homogeneous within than between groups"* (Burt, 2004)(p.353). Communities in a network can be understood as a subset of actors such that there is a higher density of connections within this subset than between subsets (Boccaletti et al., 2006). In practice, communities are formed by people or organizations sharing an opinion, skill, belief etc.

Actors on a network are furthermore exposed to noise. Noise can be seen as a force from outside the network that works on actors or connections and thereby influences the state of the actors within a network. This is often included in social network models because *"any modelization of social agents inevitably neglects a huge number of details"* (Castellano et al., 2009). This noise can therefore account for social complex processes such as media exposure and random changes in actor behavior.

Network stability is a measure of the network being able to deal with noise (Castellano et al., 2009). Will the state of the actors be heavily influenced? If yes, will the network return to its original state or to another state? And will there be big shifts, like communities being destroyed and new communities being formed? A stable system therefore indicates a converged system, a system which is 'stationary'. An unstable system is characterized by patterns of continuously changing actors, like a disease indefinitely 'traveling' through a network of people (Vespignani, 2011).

An information differential, different opinions, different interests etcetera can be viewe as *tension* between actors. Actors alleviate this tension by exchanging information of convincing the other actor of their opinion. The dynamics of actors engaging in social exchange and thereby reducing the tension leads to stability (Castellano et al., 2009). The actors within a community are more homogeneous and therefore low tension exists within a community. Within a community there exists a certain degree of order because the actors copy each others opinion, behavior etc. Maybe the best example of the mechanism of noise resulting in stable communities is given by the cultural dissemination model of Axelrod (1997). The notion of tension is, although in a less formal way, also used by wind energy communication research (Cass and Walker, 2009;

Maillé and Saint-Charles, 2014), socio-technological transitions (Geels and Schot, 2007) and social exchange theory (Lawler et al., 2008).

SOCIAL CAPITAL

For a description of the quality of relationships following a social exchange between actors, the literature of *social capital* is employed. A broad definition is that *"social capital is the web of cooperative relationships between citizens that facilitates resolution of collective action problems"* (Brehm and Rahn, 1997). Social capital is therefore, analogous to financial and human capital, the potential that is embedded in relationships. The idea of social capital has been applied to many fields of science, including wind energy (van der Horst and Toke, 2010), and, as such, there exist a wide range of interpretations. The links between social exchange, reciprocity and social capital has been recognized (Molm, 2010).

Common for interpretations of social capital theory are the inclusion of *structural*, *cognitive* and *affective* dimensions (Inkpen and Tsang, 2005; Cots, 2011). The structural dimension refers to the network, and is a measure of how easily information, opinions etc. can flow through the actors in the network. The cognitive dimension basically describes a degree of similarity of two actors (Inkpen and Tsang, 2005; Lawler et al., 2008). This is an important notion because similar actors have a higher probability of interacting, while an interaction makes actors more similar (Axelrod, 1997). The cognitive dimension consists of a shared objective (or goal) and shared vision (or understanding) among actors, but not necessarily common interests (Inkpen and Tsang, 2005; Cots, 2011). The link between social exchange, reciprocity and social capital becomes explicit when looking at the affective dimension of social capital. The affective dimension of an emerging relationship is by both SET and social capital described in terms of trust and commitment (Lawler and Yoon, 1996; Cots, 2011). Basically, trust reduces the risk associated with reciprocal exchanges and commitment has to do with actors continuing the exchange relationship. Lawler and Yoon has a more social capital like definition of commitment, and describes it as the individual's attachment to a community.

4.2. CONCEPTUAL MODEL

The conceptual model integrates the theories from SET, reciprocity and SNA as to be able to capture both the details of social interaction between wind farm developers and residents and the complexity of the social system. Wind farm developers and residents are interdependent actors without specified obligations embedded in a social complex network. SET allows for a discretization of their interaction, with every exchange becoming explicit. When these exchanges are reciprocal, such that information is reciprocated with information and status is reciprocated with status etcetera, a relationship based on trust and commitment evolves. To take into account the complexities in wind farm development, a social network perspective is used. Prell et al. (2009) show that social network analysis can help improve stakeholder participation and increase perceived procedural justice. In fact, there is a recent tendency that SET and social capital are merging (Molm, 2010), giving a network interpretation of Social Exchange Theory. The conceptual model uses the concept of reciprocity on a social network and discretized social resource exchange according to Social Exchange Theory.

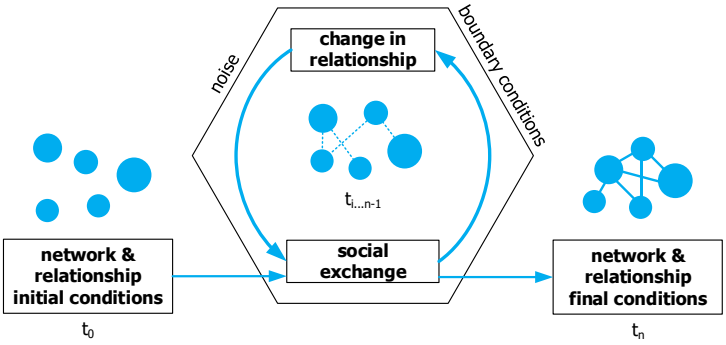


Figure 4.2: The conceptual model incorporating discretized Social Exchange Theory on a network. When the social exchanges are reciprocal, relationships of trust and commitment emerge.

In Figure 4.2 the conceptual model is shown with discrete communication steps $t_0 ... t_n$. The initial conditions,

t_0, are a definition of the network and relationships prior to any exchanges. In accordance with the theory of the former section, the network is described in terms of communities, stability and tension. The relationship is comprised of a cognitive and affective description. Then, the developers and residents engage in a series of social exchanges $t_1 ... t_{n-1}$, in which each exchange results in a change of relationship, and the redefinition of the relationship affects the successive exchange. The exchanges are however excited and limited by noise and boundary conditions. Every wind energy project is different, therefore these limitations are unique for every wind energy project. The eventual final network state and relationship at t_n is again a definition of the network and relationships. The model forms a process description, rather than a stationary parameter description. It therefore enables the researcher to make a discretization of the communication process and create understanding about the stability of the system and resulting relationships.

4.3. OPERATIONALIZATION

"An operationalization is a translation of abstract concepts into indicators, instruments and instructions" (Verschuren and Doorewaard, 2010). In this section I will explain how the concepts of Figure 4.2 are transformed into measurable indicators. There are three main elements in the conceptual model of the former section, these are the network, the exchanges between actors and the relationship between actors. The boundary conditions put constraints on the possible exchanges, and will therefore also be defined more precise.

4.3.1. OPERATIONALIZING THE CONCEPT OF NETWORK

A two actor network system is considered, with the actors having the property *resident* or *developer*. Since not all, but merely the involved residents are of interest, residents are further characterized by the organized entities that they refer belong to. Two types of ties are considered: social flows (social exchange) and relationships. These concepts will be further elaborated in subsection 4.3.3 and subsection 4.3.4.

The network is considered stable when successive exchanges are not any longer characterized by new resources, when actors do not engage in exchanges with new actors and when actors not change their perception of the wind energy in general and the wind farm in specific after an exchange. Tension is any actors' expression of impotence to change undesired dependencies or, in other words, a feeling of inability to change an unwanted social situation.

4.3.2. BOUNDARY CONDITIONS AND NOISE

The boundary conditions are in this research defined as any constant political, geographical or economical factors that limit the possibilities for social exchange between actors. One must think about political demands for wind farms, spatial limitations due to other land use and limited financial resources to engage in the exchange. For this research, noise is defined as anything that changes the dependency between actors, but which is not an exchange between the actors itself. Noise is therefore a force from outside the system that acts on the actors' state. Examples are media and exchanges with actors other than residents or developers by which more information is obtained.

4.3.3. OPERATIONALIZING THE CONCEPT OF EXCHANGE

As explained in section 4.1, a social exchange consists of the variables *rules & norms* and *resources*. These variables are subsequently split into measurable indicators, see Figure 4.4 for the taxonomy tree. Exchanges are furthermore characterized by a date and a location. The former is necessary to unravel the pattern of exchanges.

Exchange rules and norms the directives along which exchanges are taking place. These consist of procedural rules, cultural norms and dependence. Procedural rules state any mandatory exchanges (for example obligatory by policy). Cultural norms define the degree to which behavioral norms encourage reciprocal behavior. This is related to personality of actors and the 'social environment' that actors belong to. Finally dependence is a nonuniform distribution of resources or, in short, a power difference between actors.

In this research, different types of exchanges are distinguished. A reciprocal exchange is characterized by an initial unilateral exchange being which is then being answered by the receiving actor by transferring back the same resource. Retaliation is the opposite of reciprocity: taking away a resource is answered by taking back that same resource. Reciprocity (and retaliation) are furthermore not always equal, or balanced (like in an financial transaction). In a network of actors, the resources are not uniformly distributed, which is the

Figure 4.3: Exchange between actors.

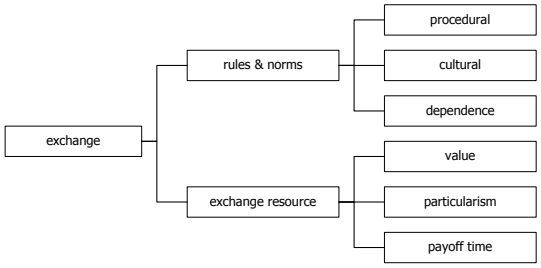
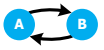
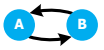
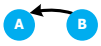


Figure 4.4: Taxonomy tree of the concept exchange.

cause for dependencies. A transfer of a resource from an independent actor to a dependent actor reduces dependencies, and the receiving actor might not feel the need to reciprocate because that would again increase his dependence and disturb the 'equity'. Such a one-directional exchange is known as a unilateral transfer (Cots, 2011; Molm, 1994). Unilateral transfers come in a positive and a negative form. Positive transfers happen when an actor *gives* or *receives* a resource. Negative transfers happen when an actor *takes* another actor's resource or is *deprived* of a resource by another actor (Foa and Foa, 2012). Finally, when no exchange is occurring, there is *dissociation*, which can be interpreted as a neutral and balanced exchange. These are therefore the types of exchanges of interest: reciprocal and unilateral exchange, both viewed from a negative an a positive perspective, and dissociation. The exchanges are tabulated in Table 4.1.

Table 4.1: Types of exchanges between actors A and B and associated roles actor of actor A. In the balanced exchanges *reciprocity*,*retaliation* and the absence of exchanges *dissociated*, A and B fulfill the same role.

	reciprocal	**unilateral**	
		active	passive
positive	 *reciprocity*	 *giver*	 *receiver*
negative	 *retaliation*	 *taker*	 *deprived*
no exchange	 *dissociated*	-	-

In this research, an exchange is defined as a social resource, being information, status or love which is being exchanged with that resource being characterized by value and a reciprocal response characterized by a payoff time. The social resources are not only on a personal level (shaking hands, expressing appreciation) but also on a project level (decision power, participation) since it is known *"that 'the public' could have some influence on the artifact of [renewable energy technologies] on the material form of the technological objects"* (Walker et al., 2010). Social resources are inexhaustible, it's value can therefore not be measured by the amount that is transferred. Instead the value of a resource is depending on the subjective perception of actors participating in the resource exchange.

4.3.4. OPERATIONALIZING THE CONCEPT OF RELATIONSHIP

As explained in subsection 4.1.1 a relationship consists of an affective and a cognitive variable. For this thesis, these variables are further deconstructed according to the indicators in Figure 4.6.

In line with the theory of social capital, cognition is a degree of similarity and is for the purpose of this study characterized by the degree to which the roles of the residents and developers are clear to each other, and the similarity of both actors' objectives and vision on wind energy. The similarity in vision on wind energy is added because this wind energy is a socio-technological system and how people behave and respond to each

Figure 4.5: Relationship between actors.

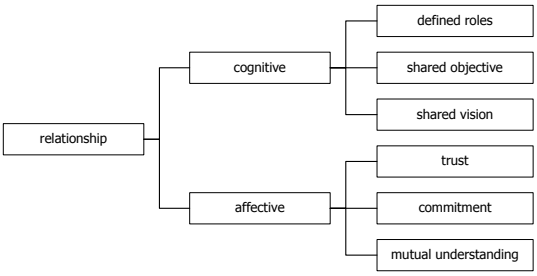


Figure 4.6: Taxonomy tree of the concept relationship.

other is partly depending on the difference in vision towards wind energy as a result of their identity and place attachment (Devine-Wright, 2009).

In this thesis, affection is characterized by the degree of trust between developers and residents and commitment to engage in exchanges, as well as mutual understanding of each others' behavior and perceptions. It is explained that trust and commitment are results of reciprocal exchange relationships in subsection 4.1.1. Mutual understanding has not been an indicator in SET research but it is included nonetheless because its importance is pointed out in the preliminary research. In terms of SET, mutual understanding is related to the degree to which actors understand each others strategies of exchange. This is however loosely related to the idea of solidarity which is "an actor's assessment of the relationship with the partner as one of unity and harmony, a partnership that is mutually beneficial to both " (Molm, 2010). Having a shared opinion is explicitly not an indicator of affection. Social capital and the SET network models take differences in opinion as a premise. According to the experts talked to during the preliminary research, a shared opinion is not necessary as long as there is *mutual understanding* of each others' opinion and behavior.

5

METHODOLOGY

This research makes use of a case study. It considers one wind farm project in which developers and residents engage in communication. The selection of a case study allows for an in-depth, intensive data generation using multiple qualitative research methods (Verschuren and Doorewaard, 2010). The methods used in this thesis are interviews, observations, document analysis and the collection of visual material.

This thesis basically presents a cross-sectional study since data is collected in a time span that is much smaller than the complete communication process. To answer the question how the relationship changes as a result of reciprocity, a longitudinal research would be preferable. This is however due to time constraints not feasible.

However, the power of a case study is that data from different sources allow for a rich palette of opinions, perceptions and relationships in which the similarities and contradictions become evident. The use of multiple data collection methods therefore allows for triangulation. Triangulation is used in an attempt to increase the validity of the data. The different data collection methods are furthermore complementary, meaning that they all provide a unique insight in certain aspects of the communication process.

This makes that the data collection methods are each more or less suitable to provide an answer to the research subquestions presented in chapter 3. An overview of the data collection methods and for which research subquestion(s) they provide the relevant information is given in Table 5.1. The data acquired from the interviews forms the core of this research as it provides information for all research questions. Observations allow for a direct measurement of exchanges, and therefore information can be inferred about the norms & rules of exchange and the resulting relationship. This method is less suitable to provide information on the pattern of exchange (subquestion 2) because only a limited number of observation is made. Documents, such as policy documents and newspaper articles, provide data that contributes to answering subquestions 1 and 2. Mandatory social exchanges dictated by policy are a rule of exchange, while newspaper articles provide a information to make a recollection of the pattern of events that happened in the past. Finally, information from documents and visual material is used to provide contextual information on the case study.

	interviews	**observations**	**documents**	**visual material**
subquestion 1 (norms & rules of exchange)	✓	✓	✓	
subquestion 2 (pattern of exchange)	✓		✓	
subquestion 3 (perceptions of exchange)	✓			
subquestion 4 (resulting relationship)	✓	✓		
context			✓	✓

Table 5.1: The different data collection methods are used to answer the set of research subquestions. A check mark means that the data collection method is the main source for answering the subquestion.

Most research questions are answered using multiple data collection methods, which allows for triangulation. Interviewees' reported relationships and expectations are compared with observational data. Analyzed documents give additional information on certain exchanges between actors in the past, and this data is therefore

be compared to the personal recollections of the interviewees. Visual material gives, in essence, an objective view of the landscape. How a wind farm relates to this landscape is of course subjective and can therefore not be deducted from this visual material. Different perceptions of the landscape are put in perspective using the photographic material. Only subquestion 3, regarding the perceptions of exchange, is uniquely answered by interview data. Every data collection method thus has its own strengths and weaknesses.

The remainder of this chapter explains the details of the used data collection methods. It covers the interviews (section 5.1), observations (section 5.2), document analysis (section 5.3) and visual material (section 5.4). In the sections it is also explained how the data is handled. At the end of the chapter, in section 5.5 some ethical considerations concerning this thesis are discussed.

5.1. INTERVIEWS

The interviews conducted are semi-structured. The semi-structured nature allows the interviewees to elaborate on their experiences during the communication process and allows the researcher to ask deepening questions on specific topics of interest. Development of the interview protocol is done according to Mortelmans (2007). The different parts of the interview are: drop-off questions, opening of the interview, introductory questions, transition questions, key questions, and wrap-up questions. Measurement of the indicators of section 4.3 happens during the key-questions. This thesis' focus on relationship and the use of a network perspective requires as little discrimination between developer and resident as possible. Therefore the same interview protocol is used for all interviewees.

A strategic sample of interviewees is used. The aim is to have interviewees who are both involved and diverse. Involved means that the interviewees must be engaged in communication with each other. Diversity means not only that both developers and residents will be interviewed, but also that within the group of developers and withing the group of residents I aim on highest diversity. In practice this means that from all involved developers and districts at least one person is interviewed. The use of a strategic sample allows for a minimum number of interviews while obtaining a maximum number of perceptions. By interviewing the core actors, the people who are most involved, the bigger picture of exchanges can be reconstructed.

The developers are contacted through email with a request for an interview. In this particular case study, a handful of residents are involved in the process through a *working group*. Contact information of these involved residents is acquired through the developers. A first request for interviewing the residents (through email) received three responses, after which additional targeted requests (to fulfill the requirement of interviewing at least one person of all districts) resulted in two more responses. After a few interviews an additional resident was contacted because this resident proved to play a key role in the process (this residents was initially not contacted because he was, at that moment, not directly involved in the communication process). The order of interviews is also chosen strategic. In order to keep a balanced view on the case study, the residents and project developers are interviewed alone and one-by-one, rather than, for example, first all residents and then all developers.

Appendix B contains the final interview protocol (Dutch). The first three interviews were conducted using a slightly different protocol. The remaining 5 interviews are conducted using an improved protocol. The differences in the interview protocols are not of a fundamental nature, but rather apply to the way of questioning. During the interviews a map of the area and an empty timeline are used to support the interviewees with answering of the question. The events that the interviewees mention are written down by me on the timeline. The timeline and map can be found in Appendix C. The interviews are conducted in Dutch, the native language of both the interviewer and the interviewees.

The interviews are audio-recorded. The recordings are subsequently transcribed using the transcription software F4 (Audiotranskription.de, 2015a). Coding of the relevant parts (the key questions of the interviews) is done using F4ANALYSE (Audiotranskription.de, 2015b). The coding consists of two parts: bottom-up coding, to find emerging topics, and top-down coding with a coding scheme developed from the conceptual framework and the emerging topics from the bottom-up coding (Saldaña, 2009).

5.2. OBSERVATIONS

Two meetings where residents and project developers come together are attended for observation. Observation allows for direct measurement of exchanges between actors as well as the communication atmosphere, but is less suitable to measure individual perceptions and emotions. The data from the observations is compared with the interview data.

Table 5.2: Dimensions of descriptive and focused observation used during data collection.

descriptive	**focused**
place	rules & norms of exchange
actors	social exchanges
objects	cognition
activities	affection
atmosphere	

To this end structured and non-participatory observation is used. In accordance with (Mortelmans, 2007), structured observation starts with a *descriptional observation*. It concerns a description of the setting, the actors, the objects in the setting, the activities that the actors engage in and the atmosphere. The next step will be *focused observation*, during which special attention is given to reciprocity between actors and the relationship. Table 5.2 is used during the observation to take structured field notes. Field notes are taken for each activity within the meeting (opposed to observe in fixed time periods or continuous recording) (Bryman, 2012). This is done because every activity can be associated to an exchange (like presentation, exchange of ideas and information, cooperating, debating...). The observation is non-participatory to ensure as little influence on the process as possible. The raw data consists of field notes in the form of a description of the observed variables. A short observation report is drawn up as soon as possible after the observation has been conducted. Structured and non-participatory observation allows to obtain the most relevant information while having as little disturbance of the process as possible.

5.3. DOCUMENTS

The document analysis serves two goals. The first goal is to give more case contextual information, the second goals is to make a comparison with the interview and observation data. Four types of documents will be considered, these are:

- demographics
- policy documents (provincial and municipal)
- newspaper articles
- other documents such as presentations and minutes of meetings

The data from demographics and policy documents serves to give more contextual information on the case. Demographic data on the residents gives a better understanding on the type of people that are involved with and affected by the development. Policy documents give information on the formal procedures and the requirements for wind farms and therefore contain boundary conditions of the exchange process. Newspaper articles and other documents, like presentations and minutes of meetings, are a description of the communication process and are therefore compared to the interview data.

All the documents analyzed in this research are publicly available and not produced as a part of this research. Due to time limitations the content of the documents is not coded. Authenticity is one of the criteria to assess documents Bryman (2012). Authenticity is ensured by obtaining the documents from the authors themselves. Credibility and meaning are other criteria of documents. These are subjective and will be assessed in combination with the interview data.

5.4. VISUAL MATERIAL

Photos are taken in-situ to get more details on the landscape characteristics of the wind farm development. The character of the landscape, and the value that residents attach to it, is important in infrastructural projects since different landscapes are perceived to have different suitability for wind farms (Vorkinn and Riese, 2001; van der Horst, 2007; Wolsink, 2006, 2007a; Cass and Walker, 2009). Photographic material is easily collected since it concerns public area. Part of the dike on which the wind farm is planned is fenced, but access is requested from the land owner. The role of these research-generated photographs is illustrative and serves to provide contextual information (Bryman, 2012).

5.5. ETHICAL CONSIDERATIONS

This research does not pose big ethical challenges. Bryman (2012) is consulted to deal with the following ethical points of interest during this research.

In the email requesting the potential interviewees to participate in an interview I gave complete information about the goals of the research, the content of the interview and the fact that this research is conducted in collaboration with NWEA. People voluntarily applied after this request. The first observation was arranged according to a similar procedure (the second observation was a public event). Prior to the interviews the interviewees were asked whether they had any objection to the conversation being recorded. They were informed about how the data was treated and stored.

However, communication during wind farm developments can contain sensitivities. The interview data might contain sensitive information and could pose privacy issues. The data in this report is therefore made anonymous by using fictional names for interviewees and the companies. The interview data will be digitally stored on a secured server. Prior to publishing this thesis report the interviewees are asked to review the used quotes.

6

CASE STUDY DESCRIPTION: WIND FARM SPUISLUIS

The data is presented in this chapter. First, a description of the samples for each of the data collection methods is given. Subsequently the context of wind farm Spuisluis is presented, including visual material and a communication timeline (section 6.2). Finally the communication between residents and developers are described in detail in section 6.3 until section 6.7. Sections 6.4, 6.5 and 6.6 only contain the descriptions of the most important events. A description of all the events during the three phases can be found in Appendix E.

6.1. DATA COLLECTION METHOD SAMPLE DESCRIPTIVES

The conducted interviews and observations, as well as the documents and the collection of visual material are separately discussed here. It gives an overview of the data that is collected, while the actual details of data are presented in integrated form from the next section onwards.

6.1.1. INTERVIEWS

A total of eight interviews are conducted for this research. The interviews are conducted in the period from 02/04/2015 until 13/05/2015. It is important to note that the wind farm development process is still happening at this time. However, during this period no major communication events took place. The interview duration varies from 48 minutes to 1 hour and 27 minutes, with an average interview duration of 1 hour and 10 minutes. Seven interviews are conducted at a location familiar to the interviewees, at their home or company workplace. One interview is conducted in a meeting room at Delft University of Technology.

THE INTERVIEWEES

The interviewees are two developers, five residents and one municipal civil servant. Of the interviewees three are female and five are males. The average age of the is 59 years, with a minimum age of 34 and a maximum age of 74 years. The residents who are interviewed are distributed over three different districts within the municipality (see also Figure 6.2 later on). The interviewed developers belong to two different wind farm development companies. Of these interviewees four residents and the civil servant belong to the *working group*, through which they are involved in the development process. The interviewees and their details are tabulated in Table 6.1. Also a short description of the interviewees and their vision on the project is given below.

Table 6.1: Interviewees' actor types, districts where they reside and their affiliation. Interviewees marked with a * are member of the working group.

interviewee	actor type	district	affiliation
Lara	developer	n/a	E-Power
Ivo		n/a	WindForceSea
Ellen*	resident	IJmuiden-Noord	district platform
Jake*			
Laurens*		Velsen-Zuid	n/a
Anthony			Stationsweg Association
Vince*		Velsen-Noord	municipality councilman
Jessica*	municipality	n/a	municipality civil servant

Lara (34, ♀), developer	**Ivo (74, ♂), developer**
Since the beginning of July 2014 project developer onshore wind at the national energy company E-Power and involved in the communication with residents. Beliefs in the *romantic* style of wind farm development. Feels very responsible for the way a wind farm is developed and likes engaging with local residents. Lara speaks of a prime location since the farm can be integrated with existing industry and it is very windy. *"I am used to be in a vulnerable position, towards a community. And also I like to collaborate, and I just truly want to know what keeps them going."*	Ivo is one of the partners of the local developer WindForceSea. He used to have a well-known company in the area and is nowadays very engaged with sustainability. He was initially more of the 'classic' style when considering communication with the community. Ivo considers all aspects of location Spuisluis suitable for a wind farm and quotes the recommendation of the municipality Velsen: *"If turbines will be build here, then that will be a dynamic counterweight with respect to the dominance of Tata on the background".*
Jake (69, ♂), resident	**Laurens (56, ♂), resident**
Resident of IJmuiden-Noord for 43 years and member of the district platform and the working group. Retired and very active in collecting information and contacting other people and organizations. Engaged in sustainability: he has solar panels on his roof. Also *"wind energy is fine, provided that... you do not experience any annoyance as a resident."* Jake's residence is *"in the heart of the whole thing"* and considers the location *"unsuitable"*.	Lives in Velsen-Zuid and raised in IJmuiden. He is not a member of the district platform but is a member of the working group. He works in a research institute for energy and therefore he has a higher than average technical knowledge enabling him to better understand and interpret reports regarding wind farm Spuisluis. Laurens considers the location suitable. *"I consider the integration of wind energy in those kind of areas very good."*
Ellen (49, ♀), resident	**Jessica (55, ♀), civil servant**
Lives in IJmuiden-Noord for about 16 years in a residential which is among the closest to the proposed wind farm. Member of the district platform and very concerned with the local environmental issues. Due to her demanding job and unpredictable working times she cannot attend all events. About the suitability of Spuisluis as a location for a wind farm, Ellen says: *"I think it can continue minus those two [eastern wind turbines], (...) but yes, then those people over there will experience the annoyance".*	Employee of the Environmental Service IJmond since the 1^{st} of January 2014. Earlier working experience concerned the expansion of wind farm Reyndersweg and a large wind farm development in the north of the province. Jessica is furthermore a member of the board of the North-Holland Energy Cooperation. She considers location Spuisluis suitable: *"It is suitable in an industrial landscape. We are close to sea, so we have quite some nice wind. (...) Sustainability, my task, that is what you show with this".*
Anthony (68, ♂), resident	**Vince (63, ♂), resident/councilman**
Retired judge who lives in the northwestern point of district Velsen-Zuid already for 25 years. He is a member of the Stationsweg Association which aims to represent the interest of the residents of the Stationsweg. Anthony is active in collecting and sharing information in the community. He did not apply for the working group but he intends to participate in the process through the area studio. According to Anthony, the is location unsuitable because he feels *"that an area that is already highly burdened, there should not be an extra burden in the form of a bunch of windmills".*	Retired entrepreneur residing in Velsen-Noord and currently a municipality councilman. In the past he started an neighborhood interest group (which does not exist any more). He aims to obtain a balance between well-being and well-fare in the municipality of Velsen. Vince has many connections and although he is not a member of the district platform, he often visits their meetings. Vince is a member of the working group. *"Those windmills are fine, but they may not have any negative impact on the residing and living environment. Because over here we are just already very heavily burdened."*

CODING SCHEMES

The first two interviews (one developer and one resident) are coded in a bottom-up fashion to elucidate any emerging topics. Emerging topics are the *governments and policy, local culture of residents, financial participation* and the *area studio*. The remaining interviews are coded using a coding scheme which is build up from the concepts of the conceptual model and the emerging topics from bottom-up coding (the first two interviews are coded a second time with this new coding scheme). Both the bottom-up and final coding scheme can be found in Appendix D. The coding schemes are in Dutch because translation only took place after the data handling and analysis.

6.1.2. OBSERVATIONS

Two observations are conducted. The observations took place after the interviews. One is a closed meeting between the members of the working group and the developers. The second one is a public meeting called the 'area studio' organized by the province to inform the public about wind farm Spuisluis. A short general description of the observation is given here. Relevant details of the observations in relation to the other data will be discussed in section 6.7.

The first observation took place on the evening of 26/08/2015 at the E-Power office in IJmuiden. The developers and working group came together with goal to discuss the latest developments and to prepare the area studio. This meeting was attended by seven interviewees (only Anthony was not there since he is not part of the working group) and one additional resident of the working group. The meeting took place in a typical business meeting room. I was sitting with among the attendants at a long table.

The second observation was the area studio on 28/09/2015 in Velsen-Zuid (the same venue as the first province presentation). Province, developers, companies and about eighty residents attended the area studio (totaling about 100 people). The main goal was to inform the residents, to listen to their concerns and answer the questions. The evening consisted of a plenary session followed by two parallel sessions. For the observation I was sitting at the back of the meeting room.

6.1.3. DOCUMENTS

The documents collected and analyzed during this thesis are tabulated in Table 6.2 including authors and publication dates. This thesis distinguishes between demographics, policy documents, newspaper articles and other documents such as presentations and minutes of meetings. None of the documents listed are produced as a part of this research and all are publicly available. The documents are further elaborated in the remainder of this chapter.

6.1.4. VISUAL MATERIAL

Visual material was collected on 02/04/2015 on a nice sunny day in the early afternoon. The material will be presented in subsection 6.2.1 as a part of the illustration of the context of the case.

6.2. CONTEXT OF WIND FARM SPUISLUIS

Project wind farm Spuisluis consists of the proposed construction of six to eight multi-megawatt horizontal axis wind turbines on the northern dike of the Spuisluis locks in the town of IJmuiden, province Noord-Holland. Two companies are collaboratively developing the wind farm, these are one local company named WindForce-Sea and one national energy provider and wind farm developer named E-Power.

Both the municipality of Velsen (to which IJmuiden belongs) and the province of Noord-Holland consider location Spuisluis suitable for wind energy. The province is the authority, meaning that they are in charge of issuing the necessary permits. During the time of the research, policy for onshore wind energy was still being developed on a provincial level and developers were not able to submit permit applications yet.

Despite the uncertainties concerning the permit applications the developers already started communicating with the community about wind farm Spuisluis. This communication was initially channeled through the district platforms, but later a so-called working group is initiated. This working group enables residents to become involved in the wind farm development.

Table 6.2: Overview of the documents analyzed during this research.

document type	document title	author	publication date
demographics	Gemeente op maat Velsen	Deerenberg et al.	2011
	CBS in uw buurt	Centraal Bureau voor de Statistiek	2015
policy documents	Aanvulling op beleidsplan windturbines (2005)	Gemeente Velsen	17/06/2008
	Herstructurering Wind op Land Noord-Holland, Notitie Reikwijdte en detailniveau, milieueffectrapportage	Runia et al.	21/05/2014
	Ontwerp beleidskader wind op land	Provincie Noord-Holland	21/09/2014
	Wijziging structuurvisie	Provinciale Staten Noord-Holland	15/12/2014
	Beleidskader wind op land 2014	Provincie Noord-Holland	15/12/2014
	Amendement geluidsbelasting turbines voor omgeving	Provincie Noord-Holland	15/12/2014
	Kaart 9: duurzame energie	Provincie Noord-Holland	15/12/2014?
	Beantwoording vragen van de raad	Vince (pseudonym)	09/01/2015
	Kaart 9: duurzame energie (gewijzigd)	Provincie Noord-Holland	17/02/2015
	Statenvoordracht Provinciale Staten	Provinciale Staten Noord-Holland	02/03/2015
	Windturbineregeling PRV wijziging	Provincie Noord-Holland	02/03/2015
	Bestemmingsplan Zeezicht	Gemeente Velsen	26/03/2015
newspaper articles	'Provincie vraagt aanpassing bestemmingsplan 'Zeezicht' Velsen'	Provincie Noord-Holland	27/02/2013
	untitled	Haarlems Dagblad	04/07/2014
	'Windturbines IJmuiden van Spuisluis tot pont'	Haarlems Dagblad	12/09/2014
	'Spandoeken en windmolengeluid bij emotioneel debat'	Noordhollands Dagblad	12/12/2014
	'Angst voor grote blazers'	IJmuider Courant	17/01/2015
	'Geluid turbines speelt in IJmond geen rol'	IJmuider Courant	03/03/2015
	'Windturbines langs het Noordzeekanaal'	Jake (pseudonym)	30/04/2015
	untitled	Noordhollands Dagblad	09/10/2014
	'Windpark breekijzer?'	Noordhollands Dagblad	09/10/2015
other documents	Nieuwe opgave Wind op land (presentation)	Bond	24/06/2014
	Presentation wijkplatform IJmuiden-Noord (presentation)	E-Power (pseudonym) and WindForceSea (pseudonym)	10/09/2014
	Verslag Presentatie Windpark Spuisluis	Wijkplatform IJmuiden-Noord	10/09/2014
	Notulen vergadering (minutes)	Wijkplatform Velsen-Noord	01/10/2014
	herstructurering Wind op Land (presentation)	Bond	08/10/2014
	Algemeen verslag informatieavonden wind op land (report)	Provincie Noord-Holland	08/10/2014
	Windmolens in Velsen aan de kant van het Noordzeekanaal? (presentation)	Anthony (pseudonym)	04/03/2015
	Verslag gebiedsatelier Windpark Spuisluis (report)	Provincie Noord-Holland	04/11/2015

The remainder of this section provides more information about the landscape and community characteristics (subsection 6.2.1), the communication and policy development process (subsection 6.2.2) and a detailed illustration of all communication in the form of a timeline (subsection 6.2.3).

6.2.1. LANDSCAPE AND COMMUNITY CHARACTERISTICS

LANDSCAPE

A visualization of wind farm Spuisluis is given in Figure 6.3. Figure 6.1 shows a map of the Spuisluis area with the proposed wind turbines indicated on it. The three western wind turbines are existing machines. Figure 6.2 shows this same map, but additionally the locations where photos were taken are indicated (see section 5.4). Also the different residential districts (see Figure 6.2.1) and the locations where the interviewees reside (see subsection 6.1.1) are shown.

The landscape has an industrial character. North of the canal is heavy industry in the form of steel factory Tata Steel, a cement factory, a paper factory and a transshipment company. Big freighters pass the canal daily. South, south-east and north-east of the locks are the residential districts IJmuiden-Noord, Velsen-Zuid and Velsen-Noord respectively. All districts belong to the municipality of Velsen.

Figure 6.5 shows photos taken in the area from four different viewpoints. The viewpoints 1 till 4 correspond with the numbered locations in the map of Figure 6.2. Amongst others, visible are the heavy industries at the northern bank of the canal, the residential areas at the southern bank of the canal and wind farm Reyndersweg.

Figure 6.1: The location of wind farm Spuisluis (adapted from Google Maps). The black, lilac and red wind turbines belong to the proposed wind farm. The red wind turbine was included in the initial proposal but was rejected after the provincial acceptance of the amendment in March 2015 (which will be explained in section 5.3). The eastern lilac position is the most controversial among residents, the western lilac position appeared in May 2015 as a back-up position. The three most western wind turbines, indicated in blue, are the existing 3 megawatt machines of wind farm Reyndersweg.

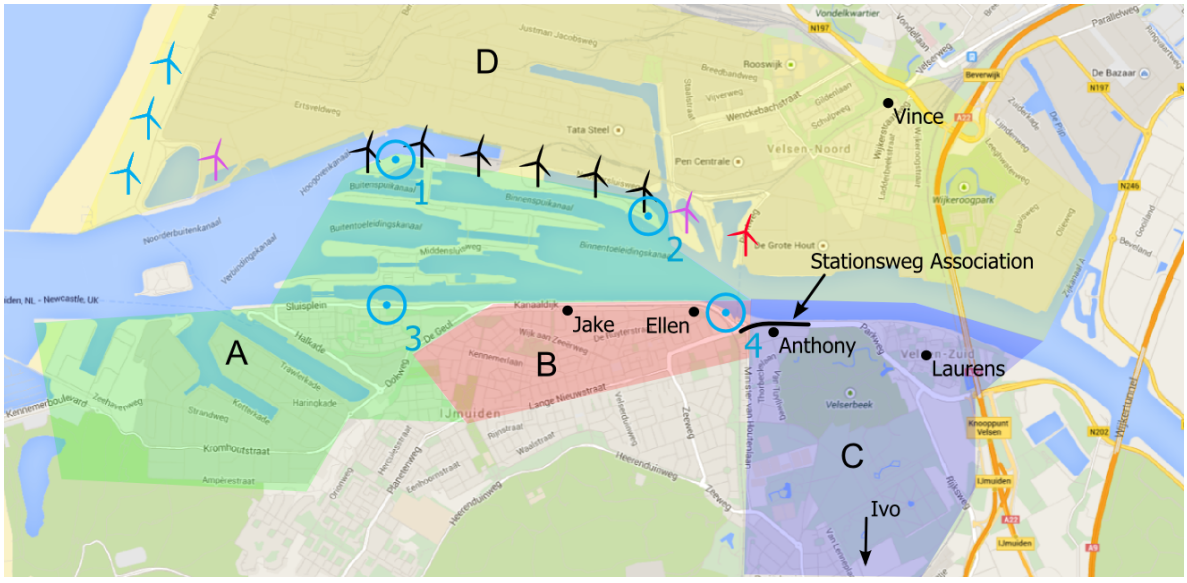


Figure 6.2: The same map as Figure 6.1 with numbered locations (1-4) where visual material is collected, lettered areas that indicate the districts IJmuiden-West(A), IJmuiden-Noord(B), Velsen-Zuid(C) and Velsen-Noord(D) (details of which will be presented in Figure 6.2.1), and named locations where some of the interviewees reside.

Figure 6.3: Visualization of wind farm Spuisluis (Haarlems Dagblad, 2014b).

(a) Viewpoint 4, direction northwest

(b) Viewpoint 3 (approximately), direction northeast

Figure 6.4: Visualizations of wind farm Spuisluis made by the developers. Note the industrial background, the height of the wind turbines and the water of the canal separating the residential area and the wind farm. These visualizations became available at the date of the area studio (28/09/2015).

(a) Viewpoint 1, direction northwest

(b) Viewpoint 1, direction south

(c) Viewpoint 2, direction north

(d) Viewpoint 2, direction south

(e) Viewpoint 3, direction northwest

(f) Viewpoint 4, direction north

Figure 6.5: Photos taken in the area. Visible are the steel factory Tata Steel (6.5a), residential area of IJmuiden-Noord at a distance of 600-700m from the proposed wind farm (6.5b), the cement factory (6.5c, residential area of IJmuiden-Noord at a distance of about 600m (6.5d) and the locks and the three currently existing 3 megawatt wind turbines of wind farm Reyndersweg (6.5e). Photo 6.5f shows, from left to right, the transshipment company, the conventional power plant, the ferry and the paper factory (behind the ferry).

DEMOGRAPHICS

Demographic information about the residents is shown in Table 6.3. The labels A up till D correspond with the districts in Figure 6.2. Note that Velsen consists of more districts than only the ones presented here, so the populations do not add up.

The population density of the districts IJmuiden-West and Velsen-Noord is relatively low. This is because there is also much industry in these districts. Also the population density of Velsen-Zuid is lower than average since this district houses a large park. There are clear differences between Velsen-Zuid and the other districts. Velsen-Zuid has a lower share of immigrants among the residents, the average house values are almost double compared to Velsen's average and house ownership is almost 30% higher. The average household size is also slightly larger.

Table 6.3: Demographic data of the population of Velsen and the relevant districts. The district labels are corresponding to the letters used in Figure 6.2. Columns marked with a $*$ are 2010 data (Deerenberg et al., 2011), the other values are 2013 data (Centraal Bureau voor de Statistiek, 2015).

label	district	population	population density [$/km^2$]	households	average household size	immigrants	house value* (€1000)	house ownership*
A	IJmuiden-West	3 935	960	2 015	1.9	17%	187	44%
B	IJmuiden-Noord	8 950	7 927	4 115	2.2	16%	184	51%
C	Velsen-Zuid	4 835	1 337	2 015	2.4	10%	405	79%
D	Velsen-Noord	5 130	589	2 440	2.1	30%	170	37%
-	Velsen total	67 120	1 499	29 930	2.2	17%	252	53%

6.2.2. PROJECT COMMUNICATION AND POLICY DEVELOPMENT FROM A BIRD'S EYE VIEW

Communication between the developers and the community started in June 2014 after the first announcements of the province to develop new policy for onshore wind energy. The old policy did not allow for construction of additional wind turbines. In the following months, the developers did a series of presentations at the already existing district platforms to inform residents about the new policy and wind farm Spuisluis. In October the idea of initiating a so-called *working group* was raised. Residents applied for this working group and became involved in the development of the wind farm.

In December 2014 the province made the *interim decision* to designate location Spuisluis for wind energy. Wind farm developers in the province are obliged to submit so-called *principal requests*, which had to be supported by preliminary research reports. As a consequence, the developers organized an excursion to a wind farm with the working group to inform them about the events and share the research reports. In March 2015 the definite decision to designate location Spuisluis was made.

On September 28^{th} 2015, the province organized and *area studio* in which all actors become involved in the development process. Prior to that, the developers organized another meeting with the working group to prepare for this area studio. This meeting took place on the 26^{th} of August. Both this meeting and the area studio were the subject of observation, see section 5.2. It is expected that early 2016 the permit applications for wind farm Spuisluis will be submitted at the province.

POLICY

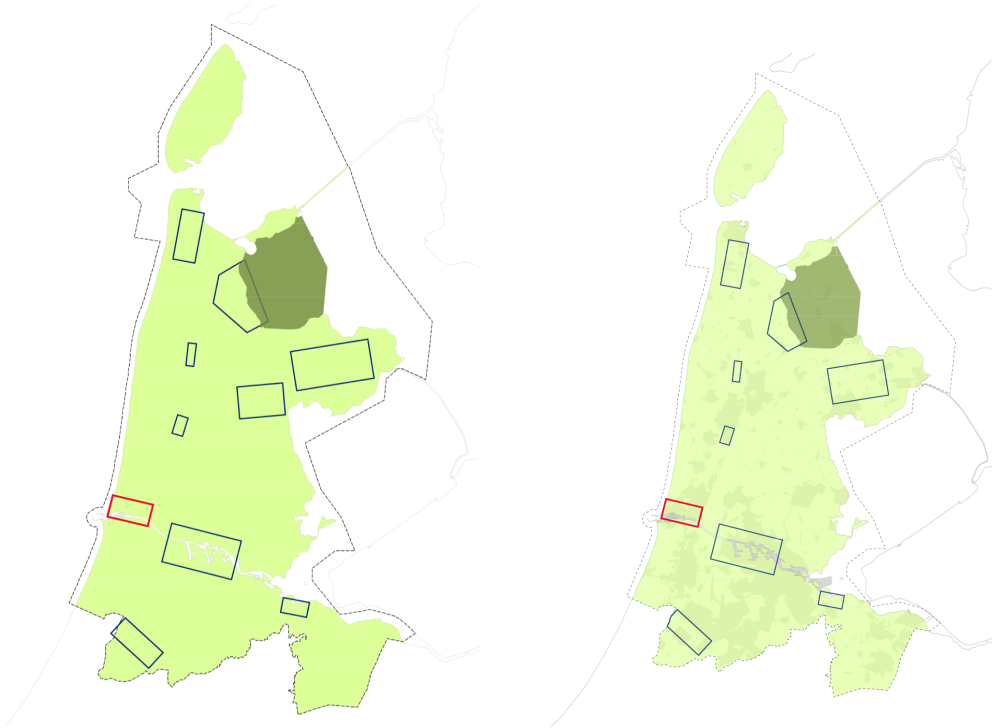
Wind farms should comply with the local policy regulation. What was explained before is that the provincial policy was still under development during this research. To give more insight into this matter, a short descrip-

tion of the different steps in the policy development is given below.

The first step in developing provincial policy for onshore wind energy in order to comply with the national policy (agreed upon in Sociaal Economische Raad (2013)) is to publish a *starting notice*. This starting notice is published in May 2014 and mentions location Spuisluis as one of the ten possible locations for onshore wind energy, see Figure 6.6a (Runia et al., 2014). A period of six weeks is scheduled for the legally mandatory *public voicing*. During public voicing anyone can submit their *vision* on the published document after which the document will or will not be adapted accordingly by the responsible authority (in this case the province). Meanwhile, the municipality of Velsen, although being in favor of wind energy (Gemeente Velsen, 2015), was forced to delete wind energy from their policy with the result that the province is in control of any further decisions concerning onshore wind energy.

After publishing the starting notice there was a period during which research is conducted which led to the publishing of the *draft policy framework* in October 2014 (Provincie Noord-Holland, 2014f). This publication was again followed by six weeks of public voicing. In December 2014 the interim policy framework is accepted (Provincie Noord-Holland, 2014b). The main requirements of a new wind farm are now established: six to eight wind turbines positioned in a line with a hub height between 100 and 120 meter (Provincie Noord-Holland, 2015a). In conjunction with this policy framework an amendment was accepted as a result of the visions submitted during the public voicing. This amendment concerns additional regulation on wind turbine noise (Provincie Noord-Holland, 2014a).

Following the acceptance of the amendment, a change of the policy framework was established in early March 2015, increasing the minimum distance between wind turbines and residential areas from 500 meters to 600 meters. This resulted in one of the 10 locations being rejected, see Figure 6.6b. The new onshore wind energy policy is formally written down in the *spatial regulation* and becomes effective as from the 15^{th} of January 2016 (Provincie Noord-Holland, 2015a). From this date wind farm developers can apply for permits necessary to construct a wind farm.



(a) (b)

Figure 6.6: Maps showing ten the areas originally designated for wind energy development (a) (Provincie Noord-Holland, 2014c), and the adapted version after the implementation of the amendment in March 2015 in which one location is rejected (b) (Provincie Noord-Holland, 2015b). The maps are adapted versions of the original. Location Spuisluis is indicated in red.

6.2.3. COMMUNICATION TIMELINE

The introductory information from the former three sections are integrated and presented in the form of a communication timeline. This is done to give a complete view of the communication process and help the reader to understand the interrelations between the factual events and the interviewees' perceptions which will be presented later. See Figure 6.7 and Figure 6.8 for the communication timeline.

The timeline for project Spuisluis covers the period 2012 until October 2015. To increase the clarity of the different types of events, they are divided into a *policy*, a *project* and a *local* layer. The policy layer consists of all events that are initiated or commended by the province. The project layer consists the core of this research and includes the communication between the developer and residents with respect to wind farm Spuisluis. The local layer consists other (communication related) activities, mainly occurring within the community, such as newspaper articles being published. Three communication phases are indicated above the communication timeline. At every beginning of each phase new information is available and social exchanges are advanced. The significance of the phases will become apparent in the following sections and in the chapter: Analysis of the social exchange relationship.

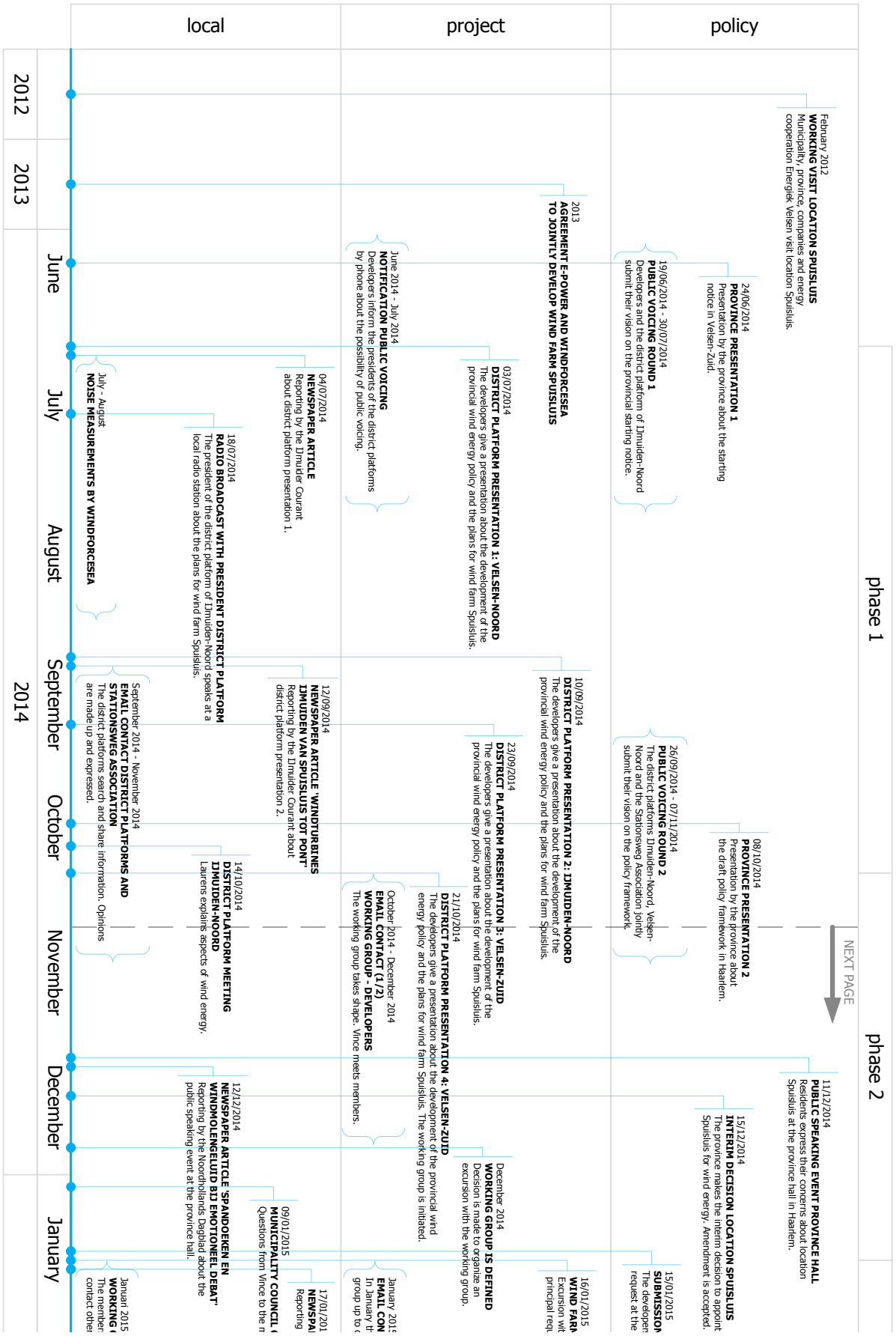


Figure 6.7: Timeline (1/2) indicating the events on a policy, project and local level during the three phases.

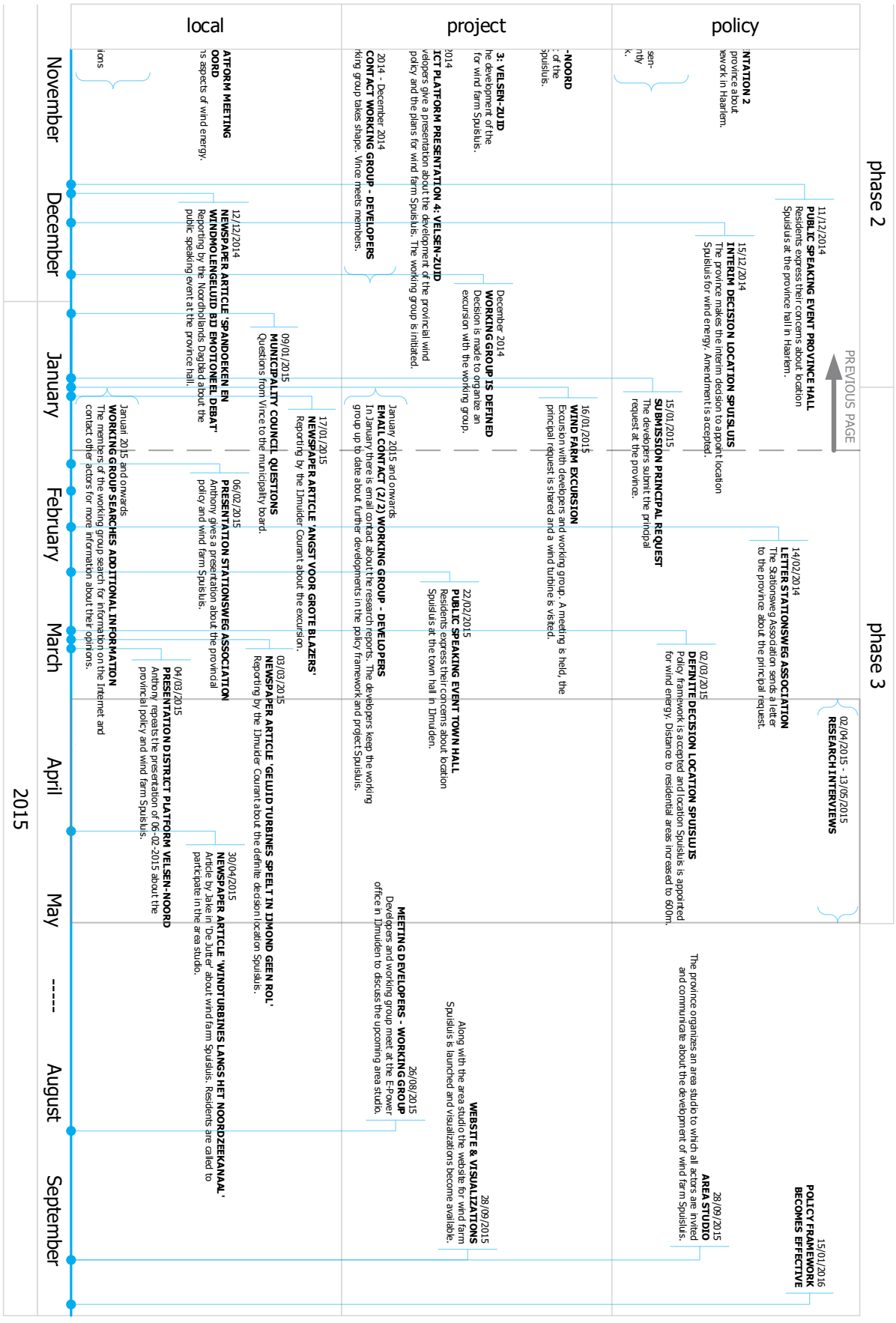


Figure 6.8: Timeline (2/2) indicating the events on a policy, project and local level during the three phases. The interviews are conducted in the months April and May of 2015. The observations took place on the August 26^{th} (meeting developers-working group) and September 28^{th} (the Area studio).

6.3. PRIOR TO PHASE 1: HOW IT ALL STARTED

The origin of project Spuisluis and the first attempts by the province for communication with the community through a presentation are described below. All information in the remainder of this chapter is interview data, except when explicitly stated otherwise.

6.3.1. THE ORIGIN OF PROJECT SPUISLUIS

Some ten years ago the plans for more wind energy in Velsen appeared in a *Wind turbine policy document* when the municipality announced the intention to become energy-neutral. An update of this document in 2008 shows location Spuisluis as a potential area for a wind farm (Gemeente Velsen, 2008). The municipality asked the local entrepreneur Ivo and his companion to develop the wind farm and in that way the company WindForceSea was born. Initially, WindForceSea attempted to develop three wind turbines as an extension of the three existing wind turbines along the Reyndersweg (see Figure 6.1 and Figure 6.5e). All research reports were compiled and the application for the necessary permits was submitted. Then the 2011 provincial elections took place and the new government did not allow for any further onshore wind energy developments. Project Reyndersweg did eventually not succeed due to this intervention by the province. WindForceSea started to put their efforts on wind farm Spuisluis.

Despite the province's attitude towards onshore wind energy, the municipality's goal to become energy neutral and intention to have more wind energy on their territory remained unchanged. In order to gain more political momentum for location Spuisluis a field trip was organized by the municipality civil servant Jessica in 2012 (Jessica was, by this time, not yet working for the Environmental Service IJmond). Municipality, nearby companies, the province and local energy cooperation Energiek Velsen attended this field trip.

Meanwhile, the duo of WindForceSea started to realize that they are unable to develop wind farm Spuisluis by themselves due to the complexity of the project and their lack of experience with legal procedures. Therefore they started looking for a partner which eventually led to an agreement being signed between the national energy company E-Power and WindForceSea in 2013.

In 2013 also the national targets for renewable energy were established and the province was forced to allocate space for future onshore wind energy (Sociaal Economische Raad, 2013). It looked like wind farm Spuisluis became a serious option again. The province started to prepare the development of new policy for the expansion of onshore wind energy.

The municipality of Velsen still holds on to location Spuisluis for wind energy, since this was formally established in their zoning scheme policy (Gemeente Velsen, 2015). The province, however, forced the municipality through a legal process to remove wind energy from their policy (Provincie Noord-Holland, 2013). In that way the province would stay in control of the permit applications regarding any wind energy development.

Consequently, in early summer 2014 the media reported location Spuisluis being rejected. But the reality was that the province was still working on a new policy regarding onshore wind energy on a higher level in which location Spuisluis also plays a part. The role of the municipality of Velsen is thereby reduced to "legal advisor" (Jessica). The body responsible for execution of the municipal policy is the Environmental Service IJmond, of which Jessica has become an employee by this time.

6.3.2. 24/06/2014: PROVINCE PRESENTATION 1

The first concrete step in the communication from the province with the community of Velsen was a presentation by the province on the 24^{th} of June 2014 about the *starting notice*, a formal document essentially stating how this new policy will be developed (Runia et al., 2014). This first province presentation was held at a venue in Velsen-Zuid. Discussed were the provincial targets for renewable energy and the process to create new policy as well as an explanation that research reports are yet to be compiled in order to support the new policy framework (Bond, 2014).

This presentation was the first time that the province formally communicated with the residents. There was only one problem: there were, despite the developers announcing the presentation to some members of the district platforms, no residents present. This was disquieting for the developers because they want the

residents to be well-informed about developments in their neighborhood.

"So that is somewhat alarming for us, because if nobody's there then you also don't know what's happening."
Lara

"It had been in the newspaper or something, but [the residents] did not really think 'that has something to do with us'."
Jessica

Interviewees mentioned possible causes for the absence of residents of Velsen. One explanation is that in the announcements the date number did not correspond to the actual day in the week. Another explanation is that residents were not motivated enough to attend since they thought it had nothing to do with them. Who did attend the presentation are the developers. E-Power just attracted a new employee, Lara, for onshore wind farm development. This presentation by the province was therefore the first time that Ivo of WindForceSea and Lara of E-Power met each other.

The province presentation (and the absence of the residents) in June marked the start for the communication between the developers and the residents. Phase 1 is from July until October 2014 and includes three presentations of the developers at the different district platform meetings and two rounds of public voicing. Furthermore two newspaper articles were published, the project had been on the radio and the district platforms started to communicate with each other about the wind farm. In this phase, the plan still consisted of eight wind turbines. The most eastern wind turbine was not rejected yet and the western back-up wind turbine was not yet in the picture (see Figure 6.1). There were also no research reports available yet.

The developers started communication with the community to inform them about the development of the provincial policy and the plans for wind farm Spuisluis. Developer Ivo initially saw only drawbacks in communicating with residents because it takes time and money, and it would only result in residents submitting objections at the mandatory public voicing rounds. However, it is E-Powers' company policy to start communication as early as possible. To begin with, a series of presentations was given at the district platforms to inform the community about the development of the provincial policy on wind energy and the plans for wind farm Spuisluis.

"You want that the community is informed about what is going to happen."
Lara

The district platforms, originally set up by the municipality as a communication instrument, are groups of volunteering residents who gather on a monthly basis to discuss issues at hand such as safety in the neighborhood and well-being of the residents. The districts of Velsen-Noord, Velsen-Zuid and IJmuiden-Noord (corresponding to the districts D, C and B in Figure 6.2) have an active district platform. The district platform of IJmuiden-West (corresponding to district A in Figure 6.2) is not active. Three presentations were given at Velsen-Noord, IJmuiden-Noord and Velsen-Zuid respectively. These presentations were the first time that residents and developers had direct contact.

6.4. PHASE 1: JULY 2014 - OCTOBER 2014

The recollections of the interviewees presented in subsection 6.1.1 are presented in the next few sections. Phase 1 is characterized by the residents becoming informed, deliberating and taking position. There are furthermore two rounds of public voicing, during which stakeholders can file their vision towards the new policy at the province.

In the early phases of communication are mainly illustrated by quotes from E-Power developer Lara. This is the case because she was the main driver behind this communication.

6.4.1. 03/07/2014: DISTRICT PLATFORM PRESENTATION 1, VELSEN-NOORD DISTRICT

The first presentation of the developers was held at the district platform meeting of Velsen-Noord. Of the interviewed residents none was attending this presentation. The presentation titled *'Information Wind Farm*

Spuisluis' (E-Power (pseudonym) and WindForceSea (pseudonym), 2014) started with an explanation of the provincial policy and the designated wind energy areas (the map in Figure 6.6a was also shown to the attendants). Then a short video on wind energy facts was shown after which they elaborated on the details of project Spuisluis and an excursion to another wind farm is offered to provide more information. Finally, the developers informed the attendants of the meeting (as well as the presidents of the other district platforms, by phone) about the possibility of *public voicing* on the starting notice for the development of the provincial wind energy policy. The last slide poses a question to the public and aims to start the discussion: *'What do you think about it? When are we a good neighbor?'*.

> *"We especially translated very much from the province, what would otherwise not have reached the residents."*
>
> *"We also used that first [presentation] to say: 'Guys, now you can still share your views with the province. You can complain or submit a vision.' So we really stimulated that so to speak."*
>
> *"Our belief is actually that when you engage residents with such an initiative, or make them have an active attitude, that opposition will turn up more easy and that you gain trust."*
>
> Lara

Next to informing the residents about the wind farm and the provincial policy (which was largely unknown by the residents), the developers intended to engage the residents with the project. The gathered residents presented noise as one of the main objections. Ivo who was not at all fond of the idea of communicating with the community in the first place, remembered this discussion as *"uncontrolled protests"*.

As a consequence of this first platform district presentation, a short article was published in the newspaper Haarlems Dagblad. It mentions that *"many attendants at the meeting of the district platform were surprised by the speed at which the province wants to achieve the plans"* (Haarlems Dagblad, 2014a).

Because the residents expressed concerns about to the possible noise disturbance, WindForceSea developer Ivo decided to conduct noise measurement along the southern bank of the canal the following months (*"Then you know what you're talking about!"*). In the rest of the community however, not much was happening yet, but the first seeds of what would become a lengthy communication process were planted.

Councilman and Velsen-Noord resident Vince was not present at this evening but he claims to have a good relationship with the president of the district platform of Velsen-Noord. His view on the presentation is illustrated by the following quotes:

> *"That was the first official step."*
>
> *"You cannot, as a normal citizen, visualize what kind of consequences you could probably have from it. So you cannot directly, within one hour of presentation, you cannot react. Or react in depth".*
>
> *"It is one-sided communication. It is communication aimed at, that you are actually not allowed to oppose because the fossil fuels deplete and we have to, must do other things."*
>
> Vince

Vince, in short, started to doubt the intentions of the developers. He points out that he understands why the developers start communicating through the district platforms, but he warns not to overestimate the effects of this communication.

6.4.2. 10/09/2014: DISTRICT PLATFORM PRESENTATION 2, IJMUIDEN-NOORD DISTRICT

After a period of summer holidays Ivo and Lara gave the same presentation at the district platform meeting of IJmuiden-Noord. Because of the vision and the radio broadcast, there was already some contact between the developers and the president of the district platform. Residents Jake and Ellen (the latter one responsible for drawing up the minutes) are both member of this district platform and attended the presentation. Their responses to the project and the developers' presentation are:

> *"Otherwise I would never have known this. Nothing else is told about it."*
>
> Ellen

"The question of Lara what should be done to make the wind farm acceptable and how she will engage in conversation with us is not clearly answered yet. About this we have yet to deliberate internally."
Wijkplatform IJmuiden-Noord

"The district platform is merely a group of ten people, so not representative for whole IJmuiden-Noord. So that, I think, is a bit of a problem."
Jake

"The municipality of Velsen wanted to built wind turbines here in the first place. (...) And that was not allowed by the province, forbidden. And less than half a year later the province said: 'We designate this location to built windmills' So how inconsistent can they be?"
Jake

"We perceive this as very confusing. We would almost like to use the words 'improper governance'."
Wijkplatform IJmuiden-Noord

"And then you see them like: 'yeah, province, what are they doing? What a strange administrative level.' So you kind of somewhat sense the resistance to the province."
Lara

The developers are, at this moment, the only source of information for the residents. This presentation also left the residents confused because the municipality had removed wind farm Spuisluis from their policy plans earlier. Many residents thought that the project was rejected, while in fact the authority was transferred to the province. After this presentation, Jake noted, *"everything kind of started to roll"*. He however felt wary towards the developers, since they seem to only aim their communication efforts at the non representative district platform. Also at this presentation noise disturbance was coined as a concern by the residents. This plays a larger role for IJmuiden-Noord than for Velsen-Noord because this district is closer to the proposed wind farm (see also the photos in Figure 6.5b and Figure 6.5d).

A report of the meeting was published on the website of the district platform. It says that *"the province as well as E-Power attach a high value to develop this farm in deliberation with the environment"* (Wijkplatform IJmuiden-Noord, 2014). How this deliberation must take shape is not yet known (This is similar to Vince his observation that the presentations do not provide for a proper in-depth reaction). The report furthermore confirms that residents mentioned the objection of noise.

The presentations at the district platform meetings seem to attract journalists, as also this one was visited by the press. An article was published in the Haarlems Dagblad stating that *"especially the [eastern] wind turbine appeared to excite the most opposition during the presentation"* (Haarlems Dagblad, 2014b). Indeed, as can be seen in Figure 6.2, this is the wind turbine closest to residential area and Ellens' house.

Slowly more information became available in the community. Jake and other residents started searching for information through the Internet and contacts other parties like Tata Steel. Also more communication between the district platforms started to appear during the run-up to the next round of public voicing in the form of email contact. During this communication information is exchanged and common interests are searched.

"So when this was planned here I started to search like, yeah, what kind of possible negative effects could there be? Not that there are, but there could be."
Jake

"Everyone started to dig, and Jake in particular is tremendously active."
Vince

6.4.3. 23/09/2014: DISTRICT PLATFORM PRESENTATION 3, VELSEN-ZUID DISTRICT

A similar third presentation was given at the district platform meeting of Velsen-Zuid in September 2014. Velsen-Zuid resident Laurens usually does not attend these meetings so he was absent. Anthony (member of the Stationsweg Association, an interest group consisting of residents of the Stationsweg, which is a main road in Velsen-Zuid, along the southern bank of the canal, see Figure 6.2) heard that wind energy would be one of the topics but did not feel any incentive to attend this meeting. None of the interviewed residents were attending this meeting.

"There were some contradictory rumors back then. (...) Yeah, bit vague, so I did not have many reasons to go there."
Anthony

"Velsen-Zuid, there lives sort of the intelligentsia."

"Sensible questions were sometimes asked over there."
Ivo

Whereas Ivo experienced the discussion during first presentation as *"uncontrolled protests"*, he left this meeting with a somewhat better feeling. Velsen-Zuid resident Laurens got to know about the project through his personal contacts. Also Anthony eventually heard about the details of project Spuisluis through other members of the Stationsweg Association who did attend the district platform meeting. They talked about their findings to Anthony. He characterizes the developers behavior as *"sneaky"*:

"The district platform is just a club of benevolent citizens who get some money from the municipality and organize meeting in return, and say: 'come along, and do something'."
Anthony

"My first point of critique on E-Power is: instead of stalking those district platforms, [the developers] should have put a page-size advertisement in the local newspaper (...) in June last year, and say like: 'This is our plan. You are welcome to respond, you can leave your remarks here'. I think it is somewhat strange indeed if you do that via those district platforms. Because although these agendas are read, but are they read thoroughly, and does everybody understand what is going on, that it is important to drop by?"

I think that, if you want to play a fair game with everyone from the beginning, that you first should make public your plans. (...) Those district platforms only advertise that in their agenda, that does not attract people. I mean, people do not wake up then. And I think that this kind of information, if you are going to affect somebody's environment, is not take-information, but bring-information."
Anthony

By this time there were presentations given at all of the three district platforms and the actors had shaped their views. The interviewed residents often talk about E-Power, when actually both E-Power and WindForceSea are meant (some interviewees only mentioned WindForceSea after being explicitly asked about it).

"[Ivo] can name things very hard and say: 'what you are saying is just nonsense!', and that is nice. And I choose more of a mediating, the more quite role. And I think that, if I say something about wind energy, that it has more value, because I say it from E-Power."
Lara

"He is not that important in the whole picture, because miss Lara is in charge there, and not Ivo. (...) I think that because Lara shouts all kind of things and leads the conversation at all the events. Ivo joined those district platforms but he, as I understood it, did not say too much."
Anthony

"I don't really fully understand that combination [of E-Power and WindForceSea]."

"[Ivo] has a lot of leisure time and he spends it like this, by being busy with wind energy. (...) And he... E-Power was looking for partners, to help developing this project."
Jake

"No opposition groups are formed, no enormous questions came to us, also not at the district platforms, while it had all been in the newspaper."

"The advantage of this municipality is that the people are very direct. And very transparent and that suits very well how I am, and that is very pleasant. Like with Jake, (...) I can honestly tell him what's going on, and he can critique me in a direct manner. And we can have that from each other. That is very nice and then you get to know everything."
Lara

The cooperation between the two developers is not well understood by the residents and E-Power is perceived as being the driving force behind the project. Lara and Ivo have different roles during the presentations, with Lara more active and mediating, and Ivo more passive and direct. The residents on the other hand are by the

developers seen as direct and transparent.

This time the topic was the explanation of the draft policy framework and the supporting research reports (Provincie Noord-Holland, 2014d). It became known that initiators of wind farms have to submit a *principal request* at the province in the beginning of 2015. What this request exactly should contain was at this moment not known yet. It was also announced that so-called 'area studios' will be organized in the future for each of the designated wind farm locations in the province, as is illustrated by the following quote:

> *"During the area studios the province, municipality and initiator will join the conversation with residents, district platforms, stakeholders. In this manner it is attempted to give public support a role at the front-end of the process."*
>
> Provincie Noord-Holland (2014e)

The residents present at the presentation responded with the known concerns about noise and presented a new concern: the possible negative influence of wind turbines on the particulate matter issue in the area (the municipality is known to have relatively high levels of particulate matter). Additionally they mentioned the culmination of (heavy) industry being a reason not to designate location Spuisluis for wind energy. For the developers started a period of waiting for the establishment of the policy framework.

The next steps of the province are again a period of six weeks for public voicing, where residents could submit their vision on the proposed draft policy framework, and a public speaking event on the 11^{th} of December where residents could react on the proposed policy framework during a committee meeting at the province hall.

6.4.4. OTHER EVENTS IN PHASE 1

Other events that occurred between July and October 2014 are two rounds of public voicing on the provincial policy (19/06/2014 and 26/09/2014), a radio broadcast (18/07/2014) and a presentation by the province (08/10/2014). The detailed descriptions of these events can be found in Appendix E.

6.4.5. PHASE 1 SUMMARY

In the period of June 2014 till October 2014 three presentations were given by the wind farm developers to inform the residents about the development of wind farm Spuisluis. This period is also characterized by the province making progress in establishing new policy for onshore wind energy. Two rounds of public voicing allowed residents to share their vision on the proposed policy.

Also several newspaper articles were published. Project Spuisluis did however only very slowly gain momentum among the residents. There was little incentive for the residents to attend the district platform meetings. Eventually only the district platform of Velsen-Zuid refrains from taking position. While much is still unknown about the details of the wind farm and many uncertainties still exist in the process, the communication between the developers and the district platforms is in full gear. The district platforms know each other's positions but only a few individuals are seriously engaged with the project and the resident's interests. As Vince pointed out: *"There is only a small group of people that feel responsible to act and to monitor the interests of a town or region"*.

6.5. PHASE 2: OCTOBER 2014 - JANUARY 2015

The provincial policy for onshore wind energy was well on its way by now. Location Spuisluis is favored by both the municipality and the province, but not yet definitely designated. The developers continued the communication, because soon it would become known what kind of research had to be carried out as a part of the submission of the principal request.

Phase 2 in the communication process is from October 2014 until January 2015, see Figure 6.7. It started with a presentation at the district platform meeting of Velsen-Zuid where the initiation of a working group was agreed upon. This was followed by e-mail contact between the developers and potential members of the working group. Furthermore, there was a public speaking event at the province hall, where residents could give additional information concerning their vision submitted during the second round of public voicing, and

there have been questions to the municipality of Velsen by the council. The principal request for wind farm Spuisluis was eventually submitted on January 15^{th}.

A small event happened before the fourth district platform presentation. Laurens, the Velsen-Zuid resident who gave explanation about noise during the third presentation, went to the district platform meeting of IJmuiden-Noord to give more information on wind energy on the 14^{th} of October.

6.5.1. 21/10/2014: DISTRICT PLATFORM PRESENTATION 4, VELSEN-ZUID

As a direct result of the developments in the provincial policy framework, the developers decided to give a second presentation (fourth presentation in total) at the district platform meeting of Velsen-Zuid. The communication process gained more momentum since residents from all the districts attended this meeting. Of the interviewees Lara en Ivo were attending, as well as Laurens and Jessica.

Presentation and discussion An explanation of the provincial policy framework and the details of wind farm Spuisluis were again illustrated during a presentation. Then a discussion followed which is similar to those during the other presentations. Additionally, Ivo shared the results of his noise measurements here and the formation of a working group was decided upon.

> *"So I try to make them more realistic. (...) Look for a way how you can handle it."*
> Lara

> *"They listen to it, but yeah, I have an interest, so I am not official."*
> Ivo

The concern that there is already much industry and that therefore wind energy is unsuitable is not directly countered by the developers. Lara tried to explain that the province and the municipality consider Spuisluis a suitable location for wind energy, but the interviewed residents showed no clear change in attitude. Lara considers this communication *"difficult"*. The developers however feel strengthened by the municipalities' landscape architect who, according to them, concluded that wind farm Spuisluis could *"provide a dynamic counterweight to the dominance of Tata in the background"* and invite the residents to handle the issue. The main message of Ivo's noise measurements was that background noise is very high and it will predominate the wind turbine noise. Ivo realizes he is not independent, and that therefore his statements about noise might not be believed by the residents.

However, two Velsen-Zuid residents, of which Laurens was one, confirmed the claims about noise of the developers by some example calculations. Also Jessica of the Environmental Service IJmond confirmed the low impact of noise in this particular situation.

> *"[The effects of] water you can clarify with a very simple example, that is about a factor two, especially with the low tones. yes, they understand that, and then they are immediately happy."*
> Laurens

> *"And then [Laurens] said like: 'well, you know, what it comes down to' (...), he did that by heart, I really love that, if you can calculate that instantly, and he said like: 'Well, listen bla bla bla... there will not be more than a 14 decibel-A increase.' He is on the side of the residents, and then he silences many of them, you know. So they do not dare to tell him that he does not know."*

> *"At some point they just dropped that noise, they thought: 'We will never win with that'."*
> Ivo

> *"That noise, well, those concerns are taken away to a large extend."*
> Jessica

Ivo felt strengthened by Laurens confirming his ideas about noise. According to the interviewees, the gathered residents then changed their view on the issue. Particulate matter has been mentioned by the residents in the former district platform presentation. During this evening, the residents and developers also discussed the issue of particulate matter.

"Next came suddenly, out of the blue I think, that the fumes would be blown to the surface level, that there could come more particulate matter."
Jessica

"There will not be more particulate matter, but the distribution can change. I indeed think that it will change, but I do not think that this change will be big. (...) The blades do not rotate that fast."
Lara

This surprised especially civil servant Jessica. The developers did not have a direct answer to this concern, since the influence of wind turbines on air pollution is not a very common topic. Lara thinks that the effects will be negligible.

Working group After the discussion the decision is made to form a working group through which residents can be involved in the process. It is proposed to organize an excursion to a wind farm. Also a sounding board is formed, the members of which will be kept informed by the developers about the progress.

"That is according to the procedures of E-Power, (...) they proposed it, a working group so you can join the conversation."
Ivo

"I was kind of stimulated by Lara, like: 'isn't that something for you?', you know. (...) Also because I am a woman, I think. Because otherwise there might be too many men and... and maybe also to make sure there will be some kind of click with the biggest opponent, I do not know that."
Ellen

"Laurens is in, thank God. He can tame much of the nonsense. (...) That man knows what you are talking about."
Ivo

"It is our job to look how we can become more sustainable, so we are glad to cooperate and make sure there is sufficient public support for onshore wind energy."
Jessica

There is some discrepancy in the interviewees recollection of how this working group came about. Lara states that the formation of the working group was a joint decision among the developers and the district platforms. Other interviewees, including developer Ivo, point at E-Power being the initiator of this working group. Interested residents could apply for the working group. Lara is happy with how this went, E-Power does not always gets positive response on these kind of requests: *"Luckily there was enough interest"*. Ivo saw that many residents did not feel like joining the working group: *"If they have to join something, then it becomes less, the enthusiasm"*. Next to a general request Lara personally asked Jessica and Ellen to become part of the working group. Jessica is very content with this gesture. For Ellen it is less clear why Lara asked her, but she suspects that they consider her one of the 'big opponents'.

Perception Velsen-Noord Velsen-Noord resident and councilman Vince did not attend this presentation but the president of the district platform Velsen-Noord did. Through this contact he heard about what happened during the event.

"I have very good contacts with the president of the district platform. So I heard the story. It was told then in Velsen-Zuid, that Velsen-Noord was okay, or hardly had any remarks or comments. (...) [It is] quite easy to already tell that Velsen-Noord in any case does not have any problems."

"With ordinary citizens, you cannot expect that you get back substantive remarks. Well, if you then also assume that the few remarks which were made [during presentation 1] are a positive signal, and you translate that to the next district platform, yes, then you are not doing well."

"After that everything came into motion."
Vince

> *"The president attended the presentation of E-Power at the district platform Velsen-Zuid. During this presentation E-Power claimed that the residents of Velsen-Noord did not have any objections against construction. The president indicated over there that this claim is not true."*
> Wijkplatform Velsen-Noord (2014)

Both Vince and the district platform of Velsen-Noord have their concerns about the integrity of the developers because they mentioned that their district would not have objections to the plan. This was the starting point of more focused communication between the developers and the residents in the working group.

6.5.2. EMAIL CONTACT (1/2) EN START WORKING GROUP

After the fourth district platform presentation the (potential) working group members and the developers e-mailed each other. *"The Spuisluis working group got more viability"* (Jake). No concrete steps were taken with the working group yet, because the policy framework was still in development and location Spuisluis was yet to be confirmed.

Seven residents (from all the districts), and Jessica from the environmental service eventually joined the working group. Five of these, Jake (IJmuiden-Noord), Ellen (IJmuiden-Noord), Vince (Velsen-Noord), Laurens (Velsen-Zuid) and Jessica (Environmental Service) are interviewed as part of this research. Not all members, for example Laurens, are part of one of the district platforms. The interviewee's views on the working group are the following:

> *"There is no objectivity or fairness. (...) That is why I am in the working group, because I want to just taste all the sides. Like how do these things actually work."*

> *"I have the idea, but... that will not be confirmed, that [Lara] consciously worked towards [the working group] to create as much public support as possible, and say to the province: 'Look, I am already talking with residents' and so on. But she does not talk with residents, she talks with a few people from the district who are in the district platform and who try... but a district platform does not have a official status, is not a official body."*

> *Luckily the people who are in are all critical... eh... Initially I made those appointments with them. I all got... I want to get to know them all (...) First, I just contacted them. Like, how are you into this, how do you look at it?"*
> Vince

> *"At some point it is decided, you know, the district platform cannot manage this. You know, this is not something of the district platform, that has to be separated. The district platform is not legal. So if shit is happening and we have to go to the court or something, if we have to become legal, then there really must be a working group."*

> *"There are some people in Velsen-Zuid, yes. There at the ferry. They think that we do too much with E-Power. They are scared that we will be surrounded by E-Power, and persuaded, and I don't know what. And Velsen-Zuid says: 'we won't join that, we make our own plan, we are not doing it'. So... there is some truth in that, because I am also a bit scared for that."*
> Ellen

> *"We thought about it whether we wanted to join [the working group]. Never, ne-ver we said then. (...) So [E-Power] tried to show: 'Province look, we have so much public support, because we already made a working group.' While the province was constantly shouting like: 'No, we will make a area studio later, and everybody can say something there'."*

> *"I will not be part of a working group, of E-Power, that already tries to gain some public support (...) I do not consider that fair play."*
> Anthony

> *"There is, let's say, kind of a good mix of proponents, and critical people. So I kind of like that"*

> *"For us it is important that they [the members of the working group] are an actual representation of the community. (...) I am very happy that these platforms exist, because otherwise it is just more difficult to approach those residents. But I do not have the illusion that [the residents] are being highly informed by those platforms. That is of course not the case."*
> Lara

The reason for residents to join the working group is mainly to obtain more information. The president of the district platform of IJmuiden-Noord, who contacted Lara about the vision and the radio broadcast, did not become a member of the working group because of personal reasons. Anthony did not want to become a member of the working group because the formal decision for the location was not made yet, and it is the province that will organize formal communication in the future. Many of the people in the working group were not acquainted with each other yet, so in addition to the email contact between the members of the working group, Vince decided to meet all the members in person.

Next, in November 2014, the province again made a move. It became known what the principal request would have to include. Moreover, the residents had a chance to further illustrate the vision that they submitted at the second round of public voicing after which the province would make an interim decision to designate location Spuisluis for wind energy. The public speaking event and the implications of the provincial decision will be discussed next.

6.5.3. OTHER EVENTS IN PHASE 2

Other events that occurred between October 2014 and January 2015 are a public speaking event at the province hall (11/12/2014), the interim decision of the province to appoint location Spuisluis for wind energy (15/12/2014), council questions to the municipality of Velsen (09/01/2015) and the submission of the principal request by the developers (15/01/2015). The detailed descriptions of these events can be found in Appendix E.

6.5.4. PHASE 2 SUMMARY

Phase 2 is characterized by the policy framework nearing completion and the developers continuing efforts to inform and engage the community members. A working group is formed, but by doing this the distance between the Stationsweg Association and the developers is increased. The principal request is written and submitted at the province. Although location Spuisluis is only designated in an interim decision, the developers prepare an excursion for the working group.

6.6. PHASE 3: JANUARY 2015 - MAY 2015

Phase 3 is from January 2015 till May 2015, this is shown in Figure 6.8. This phase starts with an excursion during which the working group sees its first action. Another event is Anthony who gives presentations about wind farm Spuisluis and the development of the policy. These, and a few other events, will be discussed in this section. The phase ending in May 2015 is somewhat arbitrary. The main reason for this is that the last interview is conducted in May. Phase 3 contains more serious and less open-ended communication. This is because the formation of the working group creates expectations of more community involvement and the research reports supporting the principal request provides a basis for discussion.

6.6.1. 16/01/2015: WIND FARM EXCURSION

As proposed at the earlier district platform presentations the working group was invited to join an excursion to a wind farm owned by E-Power. Just like when Lara notified the district platforms about the possibility of public voicing, Ivo was skeptical to do this:

> *"Lara, would you really do that? I say, because... where does that lead to? It has totally nothing to do with the process of permits and the like."*
>
> Ivo

The excursion eventually took place on a Friday. The visited wind farm has slight similarities with wind farm Spuisluis, since there is water between the three wind turbines and the residential area. Two interviewees were unable to attend the excursion. Jessica (Environmental Service IJmond) was ill and Ellen (resident IJmuiden-Noord) had other obligations. Councilman Vince form Velsen-Noord did attend and this was the first time he met the developers. Anthony, member of the Stationsweg Association but not a member of the working group, did not attend the excursion because he intended to avoid contact with the developers.

The day consisted of a kick-off in a local restaurant during which the attending people had the opportunity to get know each other better. Research reports that support the principal request were shared. There was

furthermore a visit to a wind turbine and a conversation with local residents about their experiences. These events and the interviewees' perceptions will be discussed in more detail below.

Kick-off meeting During the kick-off the attendants had the opportunity to meet each other in person and to express their expectations, interests and goals. The developers explained how they envision the continuation of the process. They want to involve the residents, and the residents want to keep an eye on the developments and influence where possible. Finally the intention is expressed to share all the information available among the working group and developers, but nothing concrete is agreed upon yet. Also the upcoming area studio was discussed, but neither the developers nor the working group knew when this will be organized and what the content will be.

> *"I kind of guided it, the conversation and the presentation etcetera, because it is our wind farm. I sense that the division of roles between Ivo and me is that I can contact the residents easier. I am somewhat... I listen a bit more to them [laughs]."*
> Lara

> *"If it gets to hot... and emotional, then they do not think clear anymore."*
>
> *"E-Power's point of view is that everybody should be involved."*
> Laurens

> *"My goal was (...) to be close to the source and to know what is all about to happen, and whether I can influence."*
>
> *"My only objective is that we will not get annoyance because of it."*
> Jake

> *'[We] explicitly talked about the fact of 'guys, we are not the area studio, when does the area studio come?' That is explicitly asked over there."*
> Vince

E-Power developer Lara took the lead during this day. The atmosphere is reported good and easy-going by the interviewees. All interviewees appreciated the openness and good intentions of the participants of the excursion. Lara mentions it a *"very useful conversation"*. There is, however, a sense among the working group that the excursion is not the 'real' participation, because that would commence at the area studio.

Principal request research reports Since the principal request and the supporting preliminary research reports were submitted one day before the excursion, the developers shared these. These preliminary research reports are 'quickscans' on the topics of noise, safety, shadow flicker and impact on flora and fauna (detailed research reports will be compiled in a later stage, prior to the permit application). The developers also gave additional information about safety in the canal area. Subsequently the working group got an opportunity to ask questions about this. There are many research reports, so there was no possibility for an in-depth discussion. Next to this, the working group insisted extra research reports being compiled on the effects on particulate matter and cumulative noise effects (these are not standard required for application of a permit). Furthermore, the developers offered the working group the possibility to choose the companies that will conduct the research required for the permit application.

> *"The very limited environmental research that is submitted with the principal request, yes that is far from sufficient for the possible placement here. So we insisted, and that is also promised now, [research on] the influence of the turbulence on the (...) pollution issue."*
> Vince

> *"Everybody may have the right to protest, I think. But you can fall into absurd demands (...) because now a protester can enforce the other party to make gigantic expenses, by saying: 'report!' (...) But do not have to pay anything, so that works out nicely for them."*
> Ivo

> *"I had somewhat higher ambitions, I wanted that they also became co-researchers in the whole process."*
>
> *"I want that, if I conduct research for example for noise, that those residents then also know what is researched, how it is researched, (...) on a basic level, because it is extremely complex. (...) [And] that they can explain it to their environment, and especially that they trust what is being researched.*

"I want that those research reports are accepted."

"That was a step further than they expected. Not like they are super enthusiastic and applaud, but more like: 'Oh, ok!'"
Lara

'If there are more technical questions then I try to give an answer to that."

"So we [the working group] can indicate who we would like to have to conduct, for example, the study of noise of the wind turbines, so which company will do that. And the same holds for safety and air pollution. So we have a voice in who can carry out that [research]."

"[The working group] is positive about that, yes. (...) That gives more trust."
Laurens

"We know what will be the outcome of the report, we already know that. (...) As long as it is not within 300 meters, such a [wind turbine] from a chimney, then it doesn't do anything with it. (...) Of course we already have contacts about that, I just know how it will turn out. But yes, again, then we are at the point of: I can say that, but I am nothing. It's that simple."

"There is only one company who can do [the research], so that is where you end up. (...) I do not feel like to discuss about that, we will end up at [company] anyway."
Ivo

The preliminary research reports and the future detailed research reports are perceived by the working group as being insufficient. Additional research on particulate matter and cumulative noise is demanded for the application of the permit. Ivo expressed a critical attitude towards the residents insisting on more research, but the developers consent with this request without bargaining. The residents furthermore get the possibility to become 'co-researchers', meaning that they can choose who will conduct the research. Of the interviewed residents, only Laurens recalls this and he indicates that this gives more trust. WindForceSea developer Ivo was more critical towards this gesture because it will not change the outcome of the research, but agreed nonetheless. During this session, Laurens took a mediating role and could help in answering the more technical questions.

Wind turbine visit After the kick-off and the discussion about the research reports the working group got the opportunity to experience wind turbines from nearby. Because the farm is owned by E-Power, there was also the possibility to enter the base of one of the turbines. It was windy that day, so the turbines were operational. The participants of the workshop could especially experience the wind turbine noise:

"You couldn't really hear the wind turbine, so that was positive. (...) The only thing that you heard here was mainly if you opened the door, the inside, that is what you do hear. But you won't hear that from a distance."

"So I had the impression that, about noise, the residents were quite at ease."
Lara

"What I noticed that it indeed made much less noise than older turbines. You could just stand underneath, and you could hear each other very well."
Laurens

"We could experience that, like, how much noise such a thing makes. Well, that is substantial."
Jake

The noise that the wind turbines made was perceived differently by the interviewees. The developers recall that the noise was not very much. Laurens had experienced (older types of) wind turbines from, nearby before through his work as a renewable energy researcher. Jake however mentions the noise made by the wind turbine being *"substantial"*.

Meeting the local residents At last, the working group got to meet the local residents of the visited wind farm for about an hour. It must be noted that this was explicitly requested by the working group members prior to the excursion. There were five local residents who talked about their experiences.

> *"They organized that very properly, so you have to give them credit for that."*
> Jake

> *"We got really clear from residents, from people who actually experienced annoyance from those windmills that are there, I heard the actual story."*

> *"I considered that approach, the objectivity, during the excursion correct. It was not a polished story, with solely people who said like 'Oh, we are so happy with those mills'."*

> *"It strengthened our view [on particulate matter] also a bit, that we have to be very alert."*
> Vince

> *"If there are so many complaints, where the government says like 'everything is within the norms', then I say: either those complaining people do not have any right to speak, or I say, the norm is not correct. One of those two. Well, that all those people complain, that is, in my opinion, justified. So I say: 'the norm is not correct', and that fear, that's what I have here."*
> Jake

> *"Somebody who wants to hear something (...) shall always hear it."*
> Ivo

> *"I think that a large part is psychological, the people who experience annoyance form wind farms. And I do not want that I fuel that psychological craziness with my actions."*
> Lara

Meeting the local residents was, as one interviewee mentioned, *"very emotional"* (Jake). This meeting with the local residents was the most impressive part of the excursion according to the interviewees. Although the local residents are not positive about the wind farm, the working group perceived this meeting as very positive. The working group got more wary and critical towards possible adverse effects after the excursion. The existing norms for noise are explicitly questioned by the residents, although Laurens is more reserved in his opinion towards disturbance from wind turbines. Ivo and Lara point at the individual perceptions of wind turbine noise instead of criticizing the norms.

After the excursion Both the interviewed residents and the developers experienced the excursion itself as positive. The residents concerns about wind farm Spuisluis were however not alleviated. The following quotes are illustrative for the interviewees positions:

> *"There is absolutely no hate and grudge. (...) You do not have to be mad at each other. I do respect them, but I also know that they are wolves dressed up like sheep."*
> Vince

> *"I already had that image, because of my search on the Internet."*

> *"They could not take away the complaints about noise annoyance, they rather have increased."*
> Jake

> *"I am sure that, because of that carrying effect of the water, that we will experience double the annoyance."*

> *"The amplification of noise over water, that is our biggest worry."*
> Ellen

> *"The residents let us know that noise was the main complaint, but [the working group] was clearly not that scared of that."*
> Lara

> *"E-Power says: 'our turbines comply with the legal norms'. (...) E-Power wants to place those minimum six anyway. If they can do it legally, they will do it."*
> Jake

"Look, if we are able to build something here [points at eastern position], then we would do that. Because we think that is responsible, those 500 meters."
Lara

Still some feeling of mistrust from the residents towards the developers remains. The developers also apparently wrongly assume that the residents do not think that noise is a concern. The working group furthermore realizes that the norms and regulation concerning wind turbine noise are still leading for the developers. Lara explains that it is *"exciting"* what the members of the working group will do with their newly acquired knowledge and experience. Jessica of the Environmental Service IJmond did also not attend the excursion and reported that she did not exactly know how the other members of the working group experienced the excursion.

The day following the excursion a newspaper article was published in the local newspaper titled 'Fear for big blowers'. The text is accompanied by a large photograph of the Velsen residents. The text resembles the interview data.

"The Velsen residents are curious, because they are worried about the possible construction of wind turbines at the north side of the Noordzeekanaal."

"If the levels of particulate matter are within the norms, then it is possible."

"If the residents connected to the district platforms do not express public support for the mills, and the province decides for construction, then a legal procedure will be considered."
IJmuider Courant (2015b)

The worries of the residents are clearly outlined, including the 'fan-effect' which could have negative effects on particulate matter. The article however does not mention the existence of a working group and developer WindForceSea. Lara's name is explicitly mentioned with the statement that wind turbines can be build if they comply to the norms. At the same time, Lara has limited knowledge about the communication between the working group and the district platforms:

"They report [their findings] to the district platforms. But how that is received... no idea."
Lara

The excursion also made Anthony of the Stationsweg Association more curious about the possible adverse effects of wind turbines on the local environment. He therefore visited the three turbines along the Reyndersweg (blue in Figure 6.1).

"There are three windmills here along the Reyndersweg. (...) I drove there myself one day, I just stood underneath them. There I have a much better understanding than from that Ms. E-Power, who is only constantly selling her club."

"That noise is not that bad, but I think the shadow flicker is tremendously annoying."
Anthony

6.6.2. E-MAIL CONTACT (2/2) AND INTERPRETATION OF RESEARCH REPORTS

In the period following the excursion the working group and the developers kept in touch through e-mail. A new date for a next meeting was not yet set because the definite decision to designate location Spuisluis was not yet made by the province.

"We play with our cards fully open."

"The atmosphere is, in general, good and open. Also just because of the attitude of those people."
Lara

"We pass on all the information."
Vince

"We communicate very pleasantly and nice. And if I ask her a question, I get a neat answer. And she stays friendly. (...) They did not choose a wrong one for that."

"The only contacts that E-Power has with the community is through the [working group], and there are only two, three from every district platform involved. So, what kind of opposition do they experience?"
Jake

"I think that she is very open in the emails that she sends, concretely elaborates on all questions in a good way, and is also very open in... just pass on all the information that they have one-on-one, and takes the people very seriously."
Jessica

"They can say, we will do everything in order to [have] a good relationship but, you know, they do also do not disclose everything."

"I think Lara tries very hard and does her job well. (...) But Lara is just a pinhead of the whole E-Power."
Ellen

"I rather talk with the people instead of mailing like a deaf person. I hate that."
Ivo

"The nuances disappear, if you communicate through email. (...) Then it is not any more about how you understand things. Then it is, right away, somewhat absolute. (...) Then it is better to just see each other."
Jessica

The interviewees say that they convey all information to each other and that the atmosphere of communication is good. Lara informs the members of the working group about developments and decisions by the province and updates them on meetings that they had with provincial agencies. The residents inform the developers about news from the neighborhood, such as the existence of the residential boats close to the locks. Despite this open communication the members of the working group remain suspicious towards the developers. Jake still feels uncomfortable with the communication only going through the working group. Also there is critique on using e-mail as a means of communication. Ivo does not appreciate communication through e-mail and also Jessica indicates that communication through email is not optimal. E-mail contact between the district platforms is reported good, and although Anthony still does not directly engage in communication with the developers there is still some indirect information exchange:

"I have email contact with IJmuiden-Noord, with Velsen-Noord and with, of course with my own club, the Stationsweg Association. With Velsen... with the district platform of Velsen-Zuid i don't have contact because I cannot do anything with them because they do not take position. (...) And with the developers I do not have contact at all, and I also would not like to have that."
Anthony

"Anthony, yes he is a jurist, so he follows everything very carefully. So we all communicate very clear with each other like 'guys, what do we have to keep an eye on...'"
Vince

"Every advantage has its disadvantage. Of course I can say like: I do not contact those developers, but the people in the working group do got all the papers, all reports, which supported the principal request. Well, I also have them here. [laughs] Because they are passed on. (...) Through my contacts with everyone I also get them, and some interesting things were in there."
Anthony

Perception and discussion of the research reports Also the research reports that are given to the working group during the excursion are discussed through e-mail. It is mainly Jake who reads through the reports to come up with questions. Plowing through the research reports takes a lot of effort for Jake since he considers it a *"bulky file"* and explains he is *"not an engineer"* himself.

"What you see is that Jake plunges into [the research reports and] asks quite some questions (...) That is quite fantastic."

"[Particulate matter] is the number one priority."
Lara

"If it will be four megawatt, and you distribute all these documents in the community, then also come up with the most negative story. (...) Well, aren't we somewhat being deceived? I do not know, I become suspicious."

"At that ferry there are queuing lanes for trucks with dangerous matters that are not allowed to pass through the tunnel. They are directly under that wind turbine. That is impossible... (...) ...that was totally not discussed [by the research report]."

"My problem is, 104 decibels, how much of that remains at my facade? Because noise over water is a whole different story as noise over a forest or a field or I don't know what. (...) I don't know what it will do. We will find out, when they are built here."
Jake

"It are all of those vaguenesses. This plan is easier to present with two megawatt compared to three megawatt machines. Why don't they choose for that, when they already know now it will be three megawatt, why present with two megawatt?"

"If that is [Lara's] way of communicating, next to the fact that she wishes me a warm welcome at the working group and offers me a cup of coffee, and of course during the excursion she did show the truth, but that is again some... it is again some sort of fake truth. Because what it is really about, if it is really about safety and throw off distances (...) then there is always a contradiction between what we find out, from official reports, and what she communicates."
Vince

"Such a report about the turbulence in the air with the pollution and the rotor blades and such things, you know, if I read that then I think: guys, this incomprehensible for me."

"They know exactly what the defects of a mill are, that it can break, that it... right? And then they shout like 'that happens once in the I don't know how many revolutions, or one in so many mills. Well, It could just happen right here, with one of those tankers that pass. You can think of anything. So, then I wonder why you would want, in this crowded area, with so much industry, why do you plan it there? Because one mr Ivo, he said that there is such a nice wind here. Then I think that this mr Ivo should have researched this kind of things beforehand, but no, he only focuses on the air, and on the wind. But he does not know the consequences, you know, he only researched one tiny thing. Probably he is scared now, like 'oh shit, the pollution and the vibrations', you know."
Ellen

"[The research reports are] bad, very bad. It is just messed up."
Anthony

One of the main concerns of the residents is that the principal request is regarded *"too vague"* (Anthony). The research reports are perceived as not accurate. Certain elements are according to the working group forgotten (like the particulate matter issue) and the research reports increase the feelings of uncertainty about the magnitude of the possible negative effects. Shadow flicker is not perceived as a big issue (*"because there has never been a sunrise from the north"*, Jake). The following quotes are illustrative for the general feeling of the residents about the research reports and the principal report:

"Honest information, that I find the most important. And honest information we do not always get, what is worse, nowhere near. "
Jake

"If you want to have the support of people, you should directly come to the point. (...) Come with a story! But they do not do that! And that... that's the misery, that you have to discover yourself along the way what's crooked about it, and it costs many people a lot of free time to check what these guys are doing. Well, and that is out of... out of all proportions, because that's not how it is supposed to be."
Vince

"Who can come up with that, that you are going to place something in an industrial area that is dangerous and makes noise. on top of the noise that is already there. You know, how can you think of it?"
Ellen

"That is quite typical for E-Power, citation from the request: 'In autumn 2014 the residents decided to form a working group and a sounding board' *(...) Especially, espécially the residents did not choose for anything. E-Power came along there and said: shall we form a nice little working group?"*
Anthony

6.6.3. OTHER EVENTS IN PHASE 3

Other events that occurred between January 2015 and May 2015 are described in detail in Appendix E. These events are the presentation by Anthony at the Stationsweg Association (06/02/2015), the public speaking event in the town hall (22/02/2015), the definite decision by the province to appoint location Spuisluis for wind energy (02/02/2015), a second presentation by Anthony at the district platform of Velsen-Noord (04/03/2015) and an article by Jake in a local newspaper (30/04/2015).

6.6.4. PHASE 3 SUMMARY

In the period of January 2015 till May 2015 the working group consisting of residents from the different districts sees first action. The wind farm developers take the working group to an excursion during which the people get to know each other better and a wind turbine is visited. During the following email conversations the preliminary research reports are discussed. Although there is no strong opposition from residents, Anthony begins giving presentations highlighting the negative sides of the wind farm development. Finally, the provincial designation of location Spuisluis for wind energy becomes definite. The next step in the process is the area studio.

6.7. POST PHASE 3: LEADING UP TO THE AREA STUDIO

There is no interview data available on the months after May 2015, the time that leads up to the area studio. This goal of this section is therefore to give an illustration of the interviewee's perceptions and attitudes at this moment in time, and to give insight in the interviewees' expectations of the area studio. This happens in subsection 6.7.1 and subsection 6.7.2 respectively. Furthermore, a working group meeting was organized by the developers in preparation of the area studio on 26/08/2015. Both this meeting and the area studio on 28/09/2015 itself were attended and data is collected through observation. Relevant information from these observations is presented in subsection 6.7.3 and subsection 6.7.4 and put into perspective of the other data.

6.7.1. INTERVIEWEES' ATTITUDES

The end of phase 3 marks a good moment to recap some interviewees' attitudes and perceptions about the process. The following quotes give stakeholder views that are typical for the feelings that interviewees' expressed:

> *"People from IJmuiden, that are folks wearing their heart on their sleeves. They say you right in your face how they think about it. But as long as it does not affect them, they will not interfere with anything (...) The result is that... I think they will react when they are already there."*

> *"E-Power also indicated that, because they are kind of mandatory to do that, a part, it is an X percentage of the number of megawatts, has to flow back to the direct residents who experience the most annoyance of it. (...) If they will definitely come, then we still have to negotiate about that."*
>
> Jake

> *"The only thing I know is that the Stationsweg Association, that is this block, is against. And I have... I have understood from Jake that they are actually also against. Velsen-Noord is also against. I gave that presentation that evening over there. Well, that... the result was that... the residents are not looking forward to it, the shadow flicker and those things."*

> *"Then we will discuss compensation. At that point you might be able to make an deal with E-Power. And it better be a good deal, and not a deal like that is in that code of conduct."*
>
> Anthony

> *"As long as there is no real participation, you might as well do nothing. (...) We do not have any real influence. Who are we, as a handful of citizens who are then saying that they represent the district? And maybe there will be some more people to stop it. And I think, that is the democracy in the Netherlands in a nutshell. (...) The level of democracy of these kind of decision is... is very low."*
>
> Vince

> *"There are people absolutely against construction of wind turbines. And there also are, that is the majority, proponents given that... the requirements on safety, noise and additional particulate matter are met. Although everyone is convinced that noise is not an issue anymore."*

> *"Whether it is acceptable what the requirements are and how that all manifests itself. For example aspects of safety, as an example, is it justified that people worry or not? But is should come forward in a good way, put on*

the table in the right way. And yes, critical questions must be asked. I see that as the role of the residents."
Laurens

"Through the working group, that is for us the contact to keep things practical. And everybody is allowed to visit those district platforms. We are also open for everything, there will also be minutes on the site in general."

"We should primarily work together about the farm layout, and what is acceptable, and the fine-tuning. (...) In particular like where is it possible, and what is acceptable. And you could say, we will go from 120 meter hub height to 90 meter hub height, but will that actually solve something? (...) If you do not want shadow flicker at all, the environment, we can arrange that. That is very nice, such a thing will cost us something, but we are willing to do that when taking the environment into account. That kind of conversations, that really has to get going, so we really need those working group people later to do those research reports and to think with us. (...) And they should not only do they from their own perspective, but we have to ensure that the whole community is taken into account."
Lara

Up till now only a few residents are involved and acting on the issue, so Lara's goal to engage residents and obtain trust is not reached. Trust, as Vince points out, is also limited because the perceived level of participation is low. This is only partly a result of the developer's behavior, the manifestation of all the formal procedures also plays a large role. Future communication will, according to resident Laurens and developer Lara aim on finding out what an acceptable outcome is. It must be stressed that other interviewees do not hold this goal. Anthony and Jake, for example, anticipate on negotiation about compensation for adverse effects by the wind turbines.

6.7.2. INTERVIEWEES' EXPECTATIONS OF THE AREA STUDIO

Until this moment in time the province has largely remained on the sideline. They however already hinted at an early stage that the area studio will be the place where all stakeholder perspectives will come together. In these announcements they have not been very explicit in what the area studio will exactly entail. The following quotes give a good impression of the interviewees' expectations of the area studio:

"I do not exactly know what these area studios will be about."
Lara

"With exceptional interest I look forward to those area studios about which the province is bragging now."

"What there is really to gain, I am curious. Because the province is talking about the participation and... well... the [models of participation] are known, and [the local energy cooperation] shares the opinion of those, so yeah, what should you talk about over there? Then you are quickly like, talking because of the talking, right? Well, I'm not into that, I don't really... then I think I will just let go of that."
Ivo

"I see that just as a logical continuation on what has been done until now. So it becomes somewhat more concrete, and broad."

"The most important for residents at this moment is, I think, the particulate matter, and also safety. But I have the idea that they come up with that, and that it will be solved."

"At some point the real reports will come up, so the real noise conditions, noise measurements etc. etc. etc. That has to be documented neatly, and has to be verifiable easily, that it is correct what is stated. The same holds for safety and particulate matter, that there are no peculiar things written down. That is what I try to find out, kind of independent, and translate to the residents."
Laurens

"We will come up with [particulate matter] in the area studio, and we want that researched. (...) So that has become a demand of us. Here, of the whole, of all the [residents]."
Jake

"I am convinced that it will be a very interesting story, because all those contradictions will come to light there."

"I really hope that, in the area studio, but also in the promise of the extra research reports, that there will arise absolute clarity."
Vince

"They also want... they call it studios. Small groups, did you hear that?"

"I understood that those area studios are only for the residents."
Ellen

"(...) the real thing, of course, happens in those area studios."

"I join to try to stop it and if that does not work out, and that is quite likely, then it is... it becomes to minimize the damage. And with minimizing damage I mean to push those wind turbines to that side [west] as much as possible."
Anthony

The interviewees have mixed expectations about the area studio. In general, everybody expects more clarity on the contested issues. Some notable expectations are those of WindForceSea developer Ivo, Velsen-Zuid resident Laurens and Stationsweg Association member Anthony. Ivo does not see the added value of the area studio and does not know what there is to talk about. Laurens expects a more mediating role for himself, and Anthony has the expectation that negotiation will take place. At the same time the residents have a low trust in a good outcome, as the following quotes indicate:

"(...) existing problems will be alleviated and brushed aside."
Jake

"I am almost certain that, when these area studios will commence, (...) that we are already so far, that the decision making is already almost finished. (...) You just see that with all these kind of projects."
Vince

"I want the way of questioning [the particulate matter] to be discussed in the area studio, because I also want to join the conversation about how the questions are posed. That is why I don't do anything with the developer, because that developer will later, in the area studio, like they are already saying now, shout like: 'yes, no, but we already discussed everything with our own working group' and I think that the government should take the lead in this decision making."
Anthony

6.7.3. 26/08/2015: WORKING GROUP MEETING

The working group meeting took place in the office of E-Power in IJmuiden from 19:00 until 21:30. The meeting was held in a typical company meeting room: some ten by five meters with a long table in the middle. At the other side of the table large windows gave a unique view on the seascape. Both wind farm Reyndersweg and an offshore wind farm are clearly visible in the evening light. All interviewees except Anthony were present, plus an additional member of the working group who was not interviewed. Roughly the first half was spend on giving the working group the information about the ongoing research on the dike integrity and the latest updates from the province. The other half was spend on a discussion about organization of the area studio. The participants' behavior during this meeting reflects the interview data.

The attendants were already acquainted with each other. The atmosphere was therefore rather good and people seemed at ease. In the first half an hour, I would describe the meeting quite enjoyable. Despite diversity of personalities (in terms of expertise and fanaticism) the conversation progressed in a rather respectful and understanding manner. What especially struck me in a positive way was the sense of humor that all of the attendants seemed to foster, which definitely had a positive effect on how everyone experienced the meeting. Many good jokes were made, often related to the project. This confirms the interview data that the communication between developers and residents happens in good atmosphere. However, an increase in tension between the developers and the residents was sometimes clearly felt when sensitive topics such as particulate matter arose. This is eventually always 'released' with some jokes.

Different than the excursion, concrete steps were taken during this meeting. An expert that will research particulate matter had to be chosen. Surprisingly also the residents came up with names for experts since Jake already contacted some experts and Laurens knows them through his personal contacts. A decision for an experts is made collaboratively. On the question who of the residents wants to be involved in this research the working group members are not responding very eager (they consider it too complex, so there would not be any use to be involved). Eventually Laurens volunteers to be involved in the particulate matter research.

The working group gives additional suggestions about the organization and the content of the area studio, this is a healthy discussion and probably the most constructive part of the meeting. Amongst others, the residents indicate that a workshop on wind farm layout has little added value, because the available land does not provide much possibility for different layouts. While discussing the financial participation it becomes apparent that opinions remain divided: Laurens and Jessica like the idea of financial participation, Ellen gives some suggestions but does not express herself much as a proponent or opponent and Vince and Jake are not so much attracted by financial participation (*"you cannot bribe us"*, Vince). The NWEA code of conduct is also mentioned in this discussion. Additionally, the developers emphasize their benevolence by stating that they provide financial participation in wind farm Spuisluis while there is no possibility for financial participation in the other developments in the area (such as the new locks).

The discussion about financial participation leads to the question of public support among the community members. E-Power developer Lara mentions Anthony (not present because he avoids direct contact with the developers) as the one known opponent but his reasons for opposition are unknown to her. She expresses the wish to know the concerns of the people so the developers can provide them with the right information.

The discussion about the area studio ends with the question what the role will be for the members of the working group. They have to think about this for a while and do not seem to want a very visible role. Laurens volunteers to answer questions and Jake volunteers to have his email address visible on the website as a contact person.

6.7.4. 28/09/2015: AREA STUDIO

In August 2015 it became known that the area studio will take place on September the 28^{th}. This area studio is organized by the province, and obliges the developers to communicate with the other stakeholders. At the time of the interviews, it was not known yet what would exactly happen during this area studio. However, the province announced the following in their policy documents:

> *"In response of the principal requests and prior to the permit application and processing the province organizes area studios in the designated regions. Residents, district councils and town councils, interest groups, project initiators and municipalities are invited to participate in these area studios. The goal of these studios is to reach/obtain a supported spatial design and make clear agreements about the phasing of the restructuring, the remediation of turbines and possibilities for participation for residents. The province invites the municipalities concerned to make proposals for the organization of the area studios."*
>
> Provincie Noord-Holland (2014b)

The following data is obtained through observation. The evening was organized at a local venue and attended by about a hundred people of mid and old age. The attendants are the province (host), the developers, residents, the municipality, companies, a local energy cooperation and the Environmental Service IJmond. The goal of the event was to inform the residents and other actors, to answer their questions and take note of their concerns. The event lasted from 18:00 till 22:00 and consisted of a plenary session, during which the province and developers presented wind farm Spuisluis, and two parallel sessions. For both of the parallel sessions the attendants could choose to visit one of three presentations. The subjects of these presentations were financial participation, noise and shadow flicker, and particulate matter. The evening was closed through a short plenary session during which the evening was recapped. Additionally, there were visualizations of wind farm Spuisluis (amongst others the ones shown in Figure 6.4) and representatives of the local energy cooperation and the Environmental Service IJmond. A neutral host was hired who presided the evening. All interviewees were present and most of them were actively participating.

The evening started in a quite way. All attendants showed interest and many asked critical questions. The information density and complexity of the presentations was very high, and similar to the district platform presentations, there was no possibility to go into depth about the different concerns that are present among the residents. This resulted in many questions remaining unanswered despite the fact that the members of the working group sometimes indicated that things were already discussed between the working group and the developers. The most salient issue is the question why specifically location Spuisluis is designated for wind energy, and Anthony did not get a satisfactory answer to this. It did not become fully clear how the input of the residents will be taken into account in the process.

Although the working group was mentioned a few times, there was no explicit role for them. Lara described the working group as an *"important instrument"* and asked the attendants to also aim their questions at the working group. However, among the attendants there also existed a feeling of needlessness. The attendants were asked, multiple times, questions like: 'what should we take into account?', 'what do you think about it?', 'why are you here?'. Many residents however could not answer these questions because much information about the project is not yet available. After all the process is still in a relatively early phase as wind turbine types must still be chosen and detailed research must still be conducted. There is a very profound conflict here. Residents feel no need and no possibility to be involved because they perceive a perceive a *"half plan"* (Anthony) and the issues are very complex. If the residents are involved in a later stage, the plan is concrete but there will be less or no possibility for public process participation. Lara tried to point out this conflict a few times.

A five-page report is written by the province (Provincie Noord-Holland, 2015a). It gives a short review of the evening, illustrated with some photos. The document has a somewhat sloppy appearance because the text is written in different fonts and the photos are of low quality and not aligned.

> *"Several residents were surprised about the things that are not yet known about the wind farm at this moment, such as the height of the turbines."*
>
> *"The initiators have much contact with the residents through the district platforms, the working group and the sounding board, and call on the attendants to continue using these channels for questions and concerns."*
>
> *"E-Power and WindForceSea note that they heard many interesting things. They will take into account the questions that are asked for their research as much as possible."*
>
> Provincie Noord-Holland (2015a)

The report covers many concerns by residents, but remains unclear about how these will exactly be taken into account. Although this document from the province has a positivist approach, the contents are not inconsistent with the observation data. In contrast, a newspaper article published shortly after the area studio showed a more critical point of view (Noordhollands Dagblad, 2015a,b). This article is accompanied by the simplistic visualization of Figure 6.3, but not by one of the realistic visualizations of Figure 6.4 that became available during the area studio.

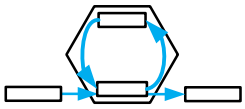
> *"There was a special atmosphere during the public evening, which attracted some hundred people. Next to residents who are (strongly) opposing (...) also quite some proponents of wind energy, who would like to join to purchase green electricity for their home or company. Everyone has their own interest, and they all seem big. Unfortunately the (environmental) space is small, and the dike short, so everything is critical and everyone tries hard to present their interest and is especially wary about the honesty of others. The distrust is sometimes large, despite the evening being meant to inform and to look for public support."*
>
> *"The only clear opposition is from a number of IJmuidenaren who will have a direct view on the row of wind turbines, living at the side of the canal, IJmuiderstraatweg. Although their arguments seem to only little influence the procedure. But also the Velsen-Noord residents do not approve construction, anxious about dangerous situations such as rotor blades flying around."*
>
> *"E-Power, together with initiator WindForceSea, engines behind the plan of six to seven turbines next to the Noordersluis, got the reproach of critical opponents to present a 'half plan'. But it should not be perceived like that, says the energy company; they come up with the rough plan 'to provide everyone the opportunity to give input'."*
>
> Noordhollands Dagblad (2015a,b)

E-Power and WindForceSea are both explicitly mentioned and also Vince is explicitly mentioned as an *"opponent"*. The existence of a working group however is not. The contents of the newspaper articles are consistent with the observational data as it also describes residents' feeling that they cannot change the plan and the conflict between early and late public involvement.

When comparing the data from the observation and document analysis with the expectations of the interviewees (presented in subsection 6.7.2), it becomes apparent that the expectations were not accurate. There are two main discrepancies. The first is that the area studio did not provide more clarity on the contested issues because there was no possibility to go into depth of the issues. It did however gave more clarity on *how* the particulate matter issue will be researched. The second main discrepancy is that there was no negotiation taking place. Hence the area studio most likely left the residents with a feeling of little progress.

7

ANALYSIS OF THE SOCIAL EXCHANGE RELATIONSHIP



In this chapter, the narrative from the former chapter will be analyzed using the conceptual model from chapter 4. A schematic representation of the conceptual model as the one shown at the left hand side of this page will indicate which concepts are discussed. The concepts of the model are 1) *boundary conditions and noise*, 2) *network & relationship initial conditions*, 3) *social exchange and change of relationship* and 4) *network & relationship final conditions*. These are respectively discussed in the four sections section 7.2, section 7.3, section 7.4 and section 7.5. First will be explained how the analysis is conducted.

7.1. DATA ANALYSIS

The coded transcripts of the interviews form the basis of the analysis. The data from the observations, documents and visual material are not structurally handled but interpreted. The analysis is roughly threefold. The first step is the compilation of the communication timeline (Figure 6.7 and Figure 6.8) from the interviews and document data and classification of events. The second step is an analysis of the perceptions of social exchanges and the third is an analysis of the (evolution of) network structure and actor relationships.

The partial in the following subsections show the relevant events in colors to indicate their function. The distinction is made between noise, something that influences the relationship between residents and developers from outside of the social system considered, social exchanges between residents and developers, and stabilization of the network where actors exhibit other behavior related to the wind farm development. The timeline is divided into three phases to emphasize the differences in social resources that are exchanged.

For every social exchange the perceptions that every actor holds (expressions that indicate an actor being giver, taker, receiver or deprived, and which resource) are listed and compared. There is not always enough data available to do this comparison. The reported relationship status and development in terms of cognition and affection and network conditions in terms of structure and tension are described at the end of each phase.

7.2. SOCIAL NETWORK BOUNDARY CONDITIONS AND NOISE

The system boundary conditions and noise acting on the system are covered here. As explained in section 4.3, the boundary conditions are any constant political, geographical or economical factors that limit the possibilities for exchange between actors. Noise is defined as anything that changes the dependency between actors, but which is not an exchange between the actors itself. Noise is a disturbance of the system due to a force from outside of the system.

7.2.1. BOUNDARY CONDITIONS

The geographical boundary condition regarding wind farm Spuisluis is very strict. The land on the northern dike of the Spuisluis locks is a long and narrow strip of land (mainly unused), see Figure 6.3, Figure 6.1 and Figure 6.5. The direct surroundings of this land are however used for multiple purposes. Ships pass through the canal and the locks, north of the proposed wind farm one finds heavy industry. Residential areas are present at the northeast, southeast and south of the proposed wind farm. The little available land and the surrounding land use greatly diminishes the possibility to adapt the wind farm layout. Changes in the wind farm layout can therefore not be part of an exchange. This is confirmed by the observation data of 28/08/2015, where the residents indicated that a parallel session about wind farm layout during the area studio does not have any added value.

Political boundary conditions regard te attitude of the municipality and the province towards communication and the policy concerning onshore wind energy. Both the province and the municipality consider location Spuisluis suitable for wind energy, but they do not or hardly actively engage in communication. Other political boundary conditions are the requirement by the province that a wind farm must consists of six to eight wind turbines, and that wind turbines must have a minimum distance of 500 meters to residential areas. The political decision to increase the distance from 500 meter to 600 meter in March 2015 led to the rejection of the controversial eastern wind turbine (indicated in red in Figure 6.1). Another political boundary condition is the levels particulate matter which the municipality does not allow to increase. The limits to particulate matter make the residents extra cautious about the local environmental impact of wind turbines and put strain on the exchange process. Finally the sector code of conduct (Nederlandse Windenergie Associatie et al., 2014) was not mentioned by the interviewees as a condition influencing exchanges between actors.

No economical boundary conditions influencing communication have been identified in the data. Added costs due to extra research reports demanded by residents and possible measures to reduce wind turbine noise and shadow flicker while operational have been mentioned, but are not identified as limiting factors: *"we are willing to do that (...)"* (Lara). The developers are in favor of financial participation of the community, but this is not much discussed yet because the development process is still in an early phase.

7.2.2. NOISE ACTING ON THE NETWORK

The main source of noise influencing the exchanges between residents and developers is the province, which is in the process of developing a policy framework for onshore wind energy. Each step in this development process excites the actors in the network (for example an information differential is created). This results in the developers and residents engaging in social exchanges. The three main instances that the network is disturbed by noise from the province are: the announcement of the development of the policy framework, the presentation of the draft policy framework and the submission of the principal requests. These instances of noise are marked as the beginnings of phase 1, phase 2 and phase 3. The details of these instances are described in section 7.4.

7.3. NETWORK & RELATIONSHIP INITIAL CONDITIONS

Prior to the exchanges between developers and residents, there already existed some relationships. The first time that these actors engaged in communication was the early summer of 2014. This point in time is therefore chosen t_0. The actors, their relationships, the degree that residents were aware of project Spuisluis and the tension in the network at t_0 is described below.

7.3.1. ACTORS AND RELATIONSHIPS

The actors concerned in this research are the wind farm developers and the local residents. The developers can be subdivided in the two developers E-Power and WindForceSea. The residents can be subdivided in the district platforms, Stationsweg Association and, from phase 3 in the communication timeline, the working group. The actors are visualized in Figure 7.1.

Ivo and Lara represent the developer firms WindForceSea and E-Power respectively. They only got to know each other personally at the first province presentation prior to phase 1. Their capabilities complement each

(a) (b)

Figure 7.1: The collection of actors at t_0 are the developers (D), the district platforms of IJmuiden-Noord (IJN), Velsen-Noord (VN) and Velsen-Zuid (VZ) and the Stationsweg Association (SA), they are shown in figure (a). In phase two the working group (WG) is initiated from a selection of committed residents, this is shown in (b).

other. WindForceSea knows the local situation but lacks experience in communication. E-Power has the right people and skills for communication, but is unaware of the local situation. In terms of cultural norms of exchange, WindForceSea can be considered more as a developer from the *classic school* while E-Power tends to the *romantic school* of wind farm development. Ivo is inclined to stick to the formal procedures characterized by the *decide-announce-defend* model, while Lara is inclined to share information in an early stage and intends to engage residents. The cooperation between the two is described as *"very good"* (Ivo).

The municipality of Velsen houses some 67,000 residents. The four districts directly neighboring the proposed wind farm amount to a combined population of 23,000 residents, see Figure 6.2.1. There is a sharp contrast between Velsen-Zuid and the other districts. This data shows that the residents in the area of interest are heterogeneous in terms of demographics.

Cultural norms of the residents in the community are that they are fairly direct in the sense that they say what is on their mind, but that they are not very active as long as they do not feel affected by any developments. The municipality is divided in districts and for every district surrounding location Spuisluis, except IJmuiden-West, there exists a so-called district platform. The members and president of these platforms are comprised of district residents. These are originally set up as a means for the municipality to communicate with its residents and are existing already for a long time. The members meet on a monthly basis to discuss issues that are considered important in the neighborhood, such as safety, pollution and noise. The members hold a chair in the platform on a voluntary basis. Next to this, there is a Stationsweg Association which represents the interests of the residents of the Stationsweg. For the geography of the districts and the Stationsweg Association, see Figure 6.2.

There are, prior to the exchange process, already some relationships between the developers and the residents. In terms of cognition, Ivo already has personal contacts among the members of the community, including members of the district platforms. His former company is well known in the neighborhood. E-Power does not have this direct relationship, but it is a well-known nationally operating energy company of which the brand is known to the residents. In terms of affection Ivo's former company is described as one of the *"most well-known companies in the neighborhood, with a good name."* (Laurens). Affection between E-Power and residents at t_0 is unknown.

7.3.2. NETWORK STABILITY AND TENSION

The state of the network prior to t_0 can be considered stable and low tension. Developers and residents did not engage in exchanges. The few rumors in the community did not increase the resident's feeling of dependency because the idea for wind farm Spuisluis was not new and always lacked concreteness. As one interviewee described it: *"it has been in the air for some time"* (Vince). The members of the Stationsweg Association also discussed the project before, but because wind farm Spuisluis always lacked concreteness, there has never been a sense of urgency to act. With the recent removal of location Spuisluis from the municipal policy, for

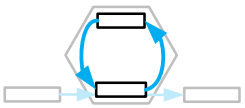
many people the project seemed history. Anthony clearly described his motivation to not attend the first district platform presentation at Velsen-Zuid: *"there were some contradictory rumors. (...) Yeah, bit vague, so I did not have many reasons to go there"*.

The district platforms and the Stationsweg Association are pre-existing organized institutions, which increases the stability of the network. These organized institutions had experience in the past with (protesting against) new infrastructures and they are especially engaged with topics regarding the well-being of the residents, such as particulate matter. Once the urgency of an issue is recognized, the existence of these platforms allows for a quick spread of information.

The relative inertness of the residents with respect to wind farm Spuisluis and the existence of the district platforms makes that any noise acting on the social network will not have significant destabilizing effects prior to t_0.

7.4. SOCIAL EXCHANGES AND CHANGE OF RELATIONSHIP

The origination and propagation of the relationship between the wind farm developers and the involved residents will be unraveled here using the types of social exchanges tabulated in Table 4.1 and the social resource classification by Foa and Foa (2012) as a basis.



There are positive and negative forms of reciprocal exchanges, which are reciprocity and retaliation. In unilateral exchanges, the actors are either the giver, receiver, taker or deprived of a social resource. Social resources are *information* (opinion or enlightenment), *status* (expressions of low or high regard) and *love* (affectionate regard).

This section starts with a short elaboration on how and why the communication between the two actors started in the first place (subsection 7.4.1). Per phase (subsection 7.4.2 up till subsection 7.4.4) will be looked at the social exchanges occurring during that phase and the change in relationship between developer and residents.

7.4.1. THE FIRST NUDGE AND THE (FALSE?) START OF EXCHANGES

The first attempt for communication with the community is the presentation by the province on the 24^{th} of June 2014. It was only attended by the developers, and not by the residents. This created an information differential between these two actors. It is the province that is changing the state (increased information) of the developer, this presentation is a force form outside the network and can therefore be considered *noise*. It is interesting to take a closer look at *why* the developers start engaging in the communication process in the first place. Or, since we are analyzing the network of actors here, why would a developer (who is in a powerful position because he has more information) risk a more unstable network?

The behavior of the developers at this early phase can be explained by looking at the norms of exchange, and especially the mutual dependence between developers and residents created by the information differential. The province presentation led to the start of communication with the community because *"you want that the community is informed about what is going to happen"* (Lara). Still, WindForceSea and E-Power interpret the mutual dependency in a different way because their behavioral norms differ. E-Power has the company policy to start communication with residents as early as possible in the process. The differences in the degree of expertise between WindForceSea and E-Power manifest themselves here. WindForceSea has the more short-term view that communication leads to opposition, and that it is therefore not favorable for the project. E-Power has a more long term view and understands that a small, controlled destabilization of the network early in the process could prevent an uncontrolled destabilization of higher magnitude later on. This high-magnitude destabilization could then potentially lead to de developers being unable to realize the project. Another piece of evidence that supports this long-term view of E-Power is the fact that, at the platform presentations, they explicitly ask the residents how they could become good neighbors, a concern that is not explicitly expressed by WindForceSea.

The following sections will elaborate, for each of the three phases, on the noise (disturbance of the network),

how actors attempt to reposition themselves in the network (social exchanges and stabilization) and the change in relationships and tension between the actors. It does so in chronological order, following the events as presented in the timeline in Figure 6.7.

7.4.2. PHASE 1: JULY 2014 - OCTOBER 2014

The timeline in Figure 7.2 recaps the events that happened during phase 1 (this figure is a part of the timeline in subsection 6.2.3). The events in this figure are colored. Noise is indicated in red, exchanges between developers and residents are blue, stabilization is purple and other events are black. For clarity, the events are also tabulated in Table 7.1. The following sections discuss the *exchanges and stabilization* and *relationship and tension* respectively.

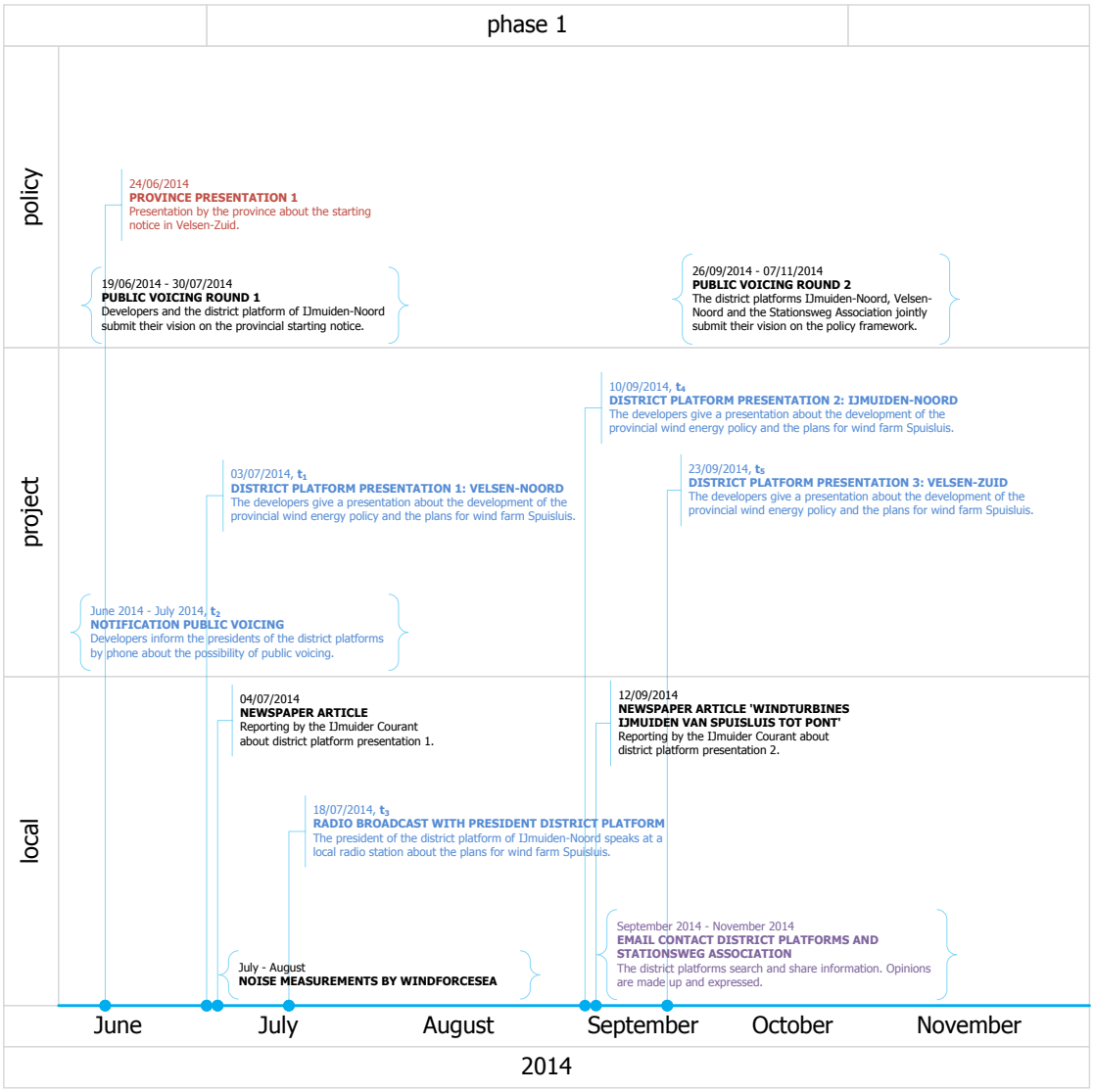


Figure 7.2: Events of phase 1 with noise indicated in red, social exchanges indicated in blue and other, stabilizing events indicated in purple.

Table 7.1: Noise, exchanges and stabilization during phase 1.

noise	province presentation 1
exchanges	t_1, presentation Velsen-Noord t_2, e-mail contact developers - district platforms t_3, radio broadcast t_4, presentation IJmuiden-Noord t_5, presentation Velsen-Zuid
stabilization	e-mail contact district platforms and Stationsweg Association

EXCHANGES AND STABILIZATION

$t_{1,4,5}$ **District platform presentations** The initial exchange of phase 1 is the district platform presentation at the Velsen-Noord district. The other two district platform presentations (t_4 and t_5) are similar events so they are also considered here. Information is the main resource exchanged between the developers and the residents attending the district platform presentations. The developers provide the residents with information about the wind farm and residents provide the developers with information about their opinion and concerns (amongst others wind turbine noise). This is for both actors of high value (*"nothing else is told about it"*, resident Ellen and *"I just truly want to know what keeps them going"*, developer Lara). This exchange of information can therefore be considered *reciprocity* from both actors' perspective, see Table 7.2 (a). Although this is a reciprocal exchange the exchange is not seen as being equal. The information transferred from the developers to the residents is much and complex. This makes it impossible to *"react in depth"* (Vince). Indeed the district platform of IJmuiden-Noord announces they have *"yet to deliberate internally"* about their next step. Hence the information differential is not fully alleviated and the residents start their search for additional information.

The remaining residents are, according to the developers, informed by newspaper articles published after the meetings. The remaining residents are however not informed well according to the interviewed residents. It is said that *"instead of stalking those district platforms, [the developers] should have put a page-size advertisement in the local newspaper"* (Anthony), while at the same time the district platforms are not *"representative"* (Jake) for the community. Hence the developers perceive a unilateral exchange of information from the developers (giver) to residents (receiver). The residents from the district platforms do not consider the few newspaper articles sufficient. This can be considered as the developers and residents being perceived as dissociated because the information differential is largely maintained. This inconsistency in perceptions is shown in Table 7.2 (b).

Furthermore, the residents' degrees of trust in governments and procedures are low, *"many attendants at the meeting of the district platform were surprised by the speed at which the province wants to achieve the plans"* (Haarlems Dagblad, 2014a), the residents perceive the presentations as *"one-sided communication"* (Vince), and the information provided at the district platforms is "not take-information, but bring-information." (Anthony). In other words, many residents have the feeling of being deprived of love. This is excited by the fact that the residents initially think that any plans for wind farm Spuisluis are canceled. This inconsistent exchange is indicated in Table 7.3.

Table 7.2: $t_{1,4,5}$: Reciprocal exchange of information during the district platform presentations (a) and a inconsistency of perceptions about the remaining residents being informed about wind farm Spuisluis through newspaper articles (b).

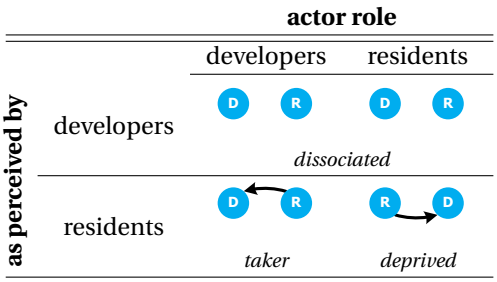
(a)

as perceived by \ actor role	developers	residents
developers	D R	D R
	reciprocity	
residents	D R	D R
	reciprocity	

(b)

as perceived by \ actor role	developers	residents
developers	D R	R D
	giver	*receiver*
residents	D R	D R
	dissociated	

Table 7.3: $t_{1,4,5}$, inconsistent perception of a unilateral exchange of love during district platform presentations.



t_2, Notification public voicing An exchange of information is identified when the developers (giver) notify the district platforms about the possibility for public voicing. The president of the district platform of IJmuiden-Noord reciprocates this by showing Lara the draft vision. This is highly valued by Lara because it confirms the *"totally open and transparent"* communication. The district platforms of Velsen-Zuid and Velsen-Noord receives the information as well but does not act upon the information given. The president of IJmuiden-Noord is not interviewed and the other residents did not mention this transfer of information. For this exchange there is not enough information to elucidate the different perceptions.

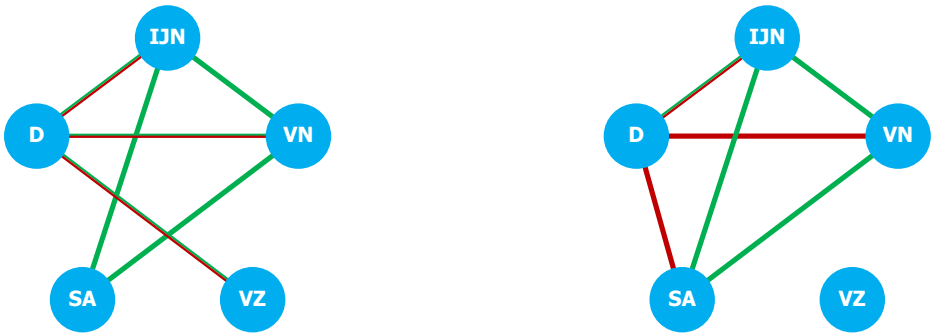
t_3, Radio broadcast Another exchange of information occurs between the president of the district platform of IJmuiden-Noord and the developers prior to the radio broadcast (Appendix E.1). According to Lara of E-Power, the president of the district platform of IJmuiden-Noord expresses the need for information about wind farm Spuisluis. In response Lara gives this information. So different than the former exchanges, this one is initiated by one of the residents. Lara values the information seeking behavior of the president of the district platform (*"that is just quite good that he does that of course."*). The president of the district platform of IJmuiden-Noord is not interviewed, so his experience of this exchange is not measured and a full analysis of the perceptions during this exchange is not possible.

Stabilization: e-mail contact district platforms and Stationsweg Association The complex information becoming available at the presentations, the residents searching for more information on the Internet and concerns about possible noise and other adverse effects results in an e-mail contact between the district platforms and Stationsweg Association. They contact each other in order to explore their possible alignment of interests as a preparation for the second round of public voicing.

RELATIONSHIP CHANGE AND NETWORK TENSION

The change of relationship between the actors in terms of cognitive and affective variables is shown in the networks of Figure 7.3. The green and red lines indicate a positive and negative change respectively. Cognition is measured in terms of shared objective, shared vision and defined roles. Affection is measured in terms of mutual understanding, commitment and trust.

Cognition The presentations were the first encounters between developers and the residents and therefore allowed for a coarse definition of each others' role in the process, although residents tend to not fully understand WindForceSea's role. There are some spillover effects, as some of the residents (Laurens, Anthony and Vince) did not attend any of these presentations but still got to know about the project and the developers through their personal contacts. No evidence is found for a shared objective among residents and developers. The developers are seen as having *"an economic interest"* (Vince), *"just filling [their] pockets"* (Ellen) and making *"filthy amount of money, with subsidies"* (Jake). This is partly because of the Internet search of residents. There is a limited shared vision on wind energy between residents and the developers. All interviewees state being in favor of wind energy. Their visions differ on the suitability of location Spuisluis. The developers think the location is very suitable, while the residents have doubts about the suitability of this location. A shared vision (against wind farm Spuisluis) and objective is obtained among the district platforms of IJmuiden-Noord, Velsen-Noord and the Stationsweg Association (Velsen-Zuid prefers to be neutral) because they jointly write a vision which they submit at the second round of public voicing.



(a) (b)

Figure 7.3: Change in cognitive (a) and affective (b) relationship between the different actors in phase 1. A green line indicates an improvement of the relationship and a red line indicates a deterioration of the relationship.

Affection The objectives of both actors being contrary, and the lack of public trust in the government and procedures concerning new infrastructures and the communication of the developers being aimed at only the district platforms leads to a low trust of the residents in the developers. The residents express that they understand that the developers want to create public support, so some mutual understanding is created. Lara also understands the information seeking behavior of residents, but Ivo mentions that only in Velsen-Zuid *"sensible questions"* are asked. Only a few residents show a high commitment, like Jake searching information, the president of the district platform IJmuiden-Noord contacting Lara for the radio broadcast and Anthony being involved in submitting the second vision. Personal communication, through for example e-mail is however reported *"pleasant"* (Lara), and no hostile atmosphere exists.

Network tension The end of phase on is characterized by considerable tension on the relationships. The involved residents report feelings of uncertainty (about noise and particulate matter) and distrust in procedures and developers, the latter being related to perceptions of unfairness and lack of information. This feeling of threat makes the residents very wary about the developers en sensitive to their actions.

7.4.3. PHASE 2: OCTOBER 2014 - JANUARY 2015

The analysis of phase two (described in section 6.5) is presented here. The partial timeline is shown in Figure 7.4. The events that happened are tabulated in Table 7.4. Again, a move by the province is considered noise acting on the network (the second province presentation). After that, the developers engage in exchanges with the residents through another presentation (t_6) and the initiation of the working group. Compared to phase 1, there are more events happening in the community which allows for stabilization of the network. Project Spuisluis is discussed at the district platform of Velsen-Noord, Vince meets the working group members and asks questions to the municipality from his seat in the municipality council.

Table 7.4: Noise, exchanges and stabilization during phase 2.

noise	province presentation 2
exchanges	t_6, presentation Velsen-Zuid t_7, e-mail contact working group - developers t_8, public speaking province hall
stabilization	district platform meeting Velsen-Noord Vince meets members working group municipality council questions

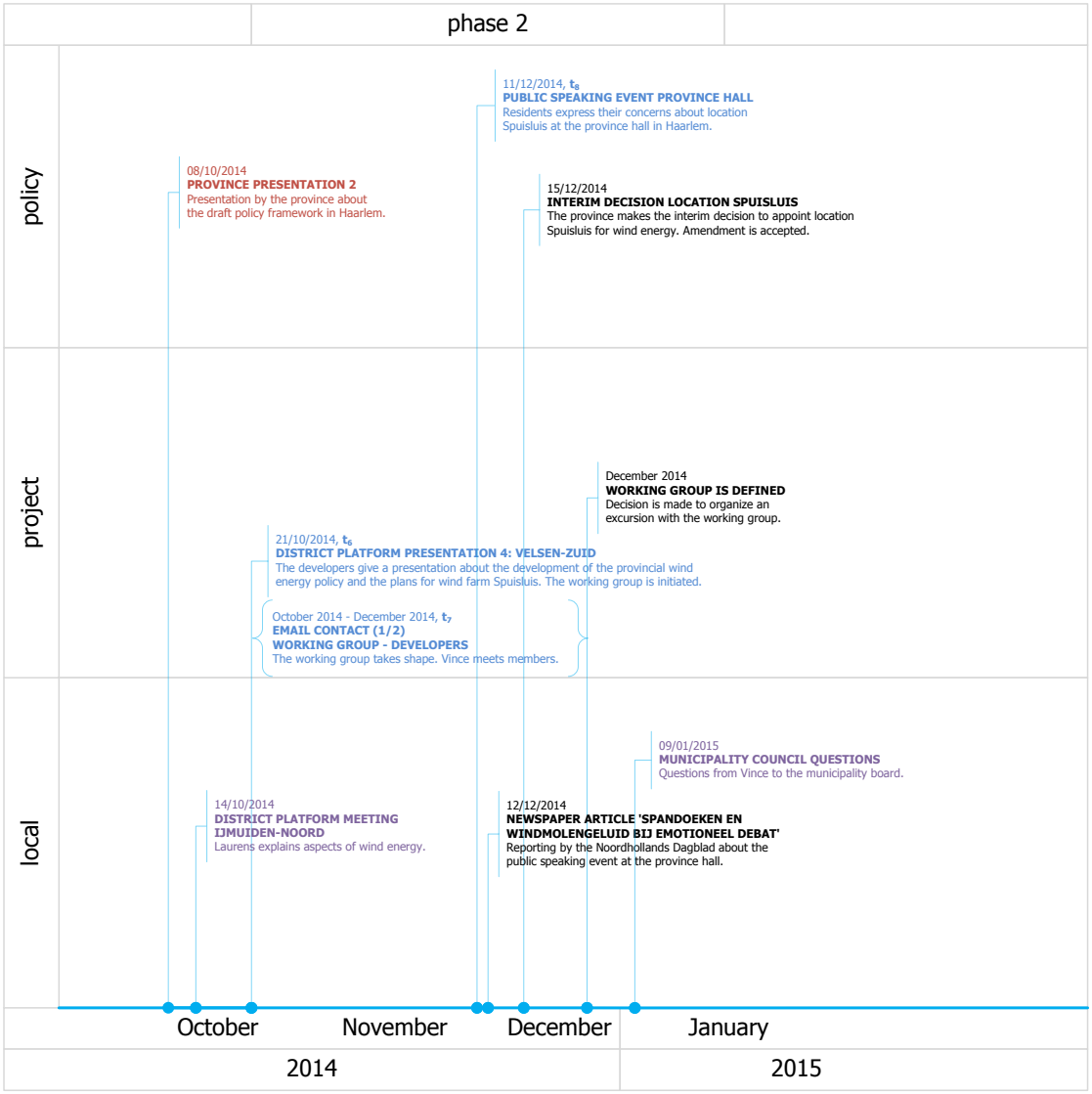


Figure 7.4: Events of phase 2 with noise indicated in red, social exchanges indicated in blue and other, stabilizing events indicated in purple.

EXCHANGES AND STABILIZATION

t_6, presentation Velsen-Zuid The fourth district platform presentation is exchange t_6. The developers aim their communication at the district platform of Velsen-Zuid, but this time also residents from other platforms were present. The developers again provide the residents with information about themselves, the provincial policy and project Spuisluis with the results of the noise measurements in particular. The residents provide information about their concerns. This reciprocal exchange is viewed in Table 7.5 (a). The self-conducted noise measurements of developer Ivo are however not accepted by the residents. *"I have an interest, so I am not official"*, he explains. Only when two residents from Velsen Zuid (one of which is Laurens) provided more in-depth information on the possible noise effects and confirm the developers, the information is accepted. Information on wind turbine noise is therefore of a very particular nature.

Additionally, the district platform of Velsen-Noord experienced a deprivation of love, see Table 7.5 (b). Love is deprived because according to them the developers announced that Velsen-Noord has no objections towards the project.

Table 7.5: t_6, Exchange of information during presentation 4 by both actors perceived as reciprocity (a) and the developers mentioning that Velsen-Noord has no objections (b).

(a)

as perceived by	actor role: developers	actor role: residents
developers	reciprocity	reciprocity
residents	reciprocity	reciprocity

(b)

as perceived by	actor role: developers	actor role: residents
developers	dissociated	dissociated
residents	taker	deprived

Furthermore a reciprocal exchange of status is discerned in the form of a proposal by the developers to establish a working group. Some residents were explicitly asked by one of the developers to become part of this group. This is a transaction of status because it gives residents not only a higher accessibility to information but also a means to influence the process, hence potentially decreasing their perceived dependency on the developers. This is reciprocated by (only a few) residents who applied for the working group. This is an expression of commitment to communication with the developers, hence giving them back the status of an equal communication partner. The reciprocal exchange of status is visualized in Table 7.6 (a).

The residents who did not apply for the working group are not able, or not willing to do so. Stationsweg Association member Anthony's response indicated an unwillingness to join because he considers the establishment of the working group not *"fair play"*. In other words, he perceives a deprivation of status. He responds to this deprivation by an intention to not engage in communication with the developers from this point. Councilman Vince also does not considers this fair play because he thinks that Lara *"worked towards [the working group] to create as much public support as possible"*, hence he also experiences a deprivation of status. His demand for information however made him apply for the working group nonetheless. Vince therefore experienced being deprived of status and being a giver of status. How Anthony and Vince experienced this exchange is visualized in Table 7.6 (b).

Table 7.6: t_6, Proposal working group is reciprocated by residents (a), but Anthony and Vince also experience a deprivation of status (b).

(a)

as perceived by	actor role: developers	actor role: residents
developers	reciprocity	reciprocity
residents	reciprocity	reciprocity

(b)

as perceived by	actor role: developers	actor role: residents
Anthony	taker	deprived
Vince	taker & receiver	deprived & giver

t_7, E-mail contact developers - working group The working group took shape during an e-mail exchange in the months following the district platform presentation. Residents applied in order *"to act and to monitor the interests of a town or region"* (Vince). In December the developers invite the members of the working group for an excursion which the involved residents join (reciprocal exchange of status). No detailed accounts were given by the respondents about this e-mail contact so a table with exchanges is not given.

t_8, Public speaking event province hall Another exchange of status occurred at the public speaking event at the province hall. This was the first time that developer Lara and Stationsweg Association member Anthony met. Lara intended to greet Anthony by shaking his hand, but this was immediately punished by Anthony in the form of *"purposely"* (Anthony) not engaging in further communication. This puts de developers in de giver & deprived role, and Anthony in the receiver & taker role, see Table 7.7 (a).

At the public speaking event a second exchange happened. The fact that the developers did not publicly spoke was perceived by Anthony as the developers being takers of love (see Table 7.7 (b)). The developers perceived this as dissociated since they were not realizing any harm would be done by not publicly speaking. This taking away of status by Anthony is not a retaliation on the handshake. It rather is a response to all events that happened earlier, such as the district platform presentations and the proposal of the working group where a deprivation of love and status were experienced. The status that Lara is deprived of is valued low. Although she considers the course of events unfortunate, she has no intention to retaliate her deprivation of status.

Table 7.7: t_8, Lara gives status and is deprived of status at the public speaking event (a) and a unilateral exchange of love when the developers refrain from public speaking (b).

(a)

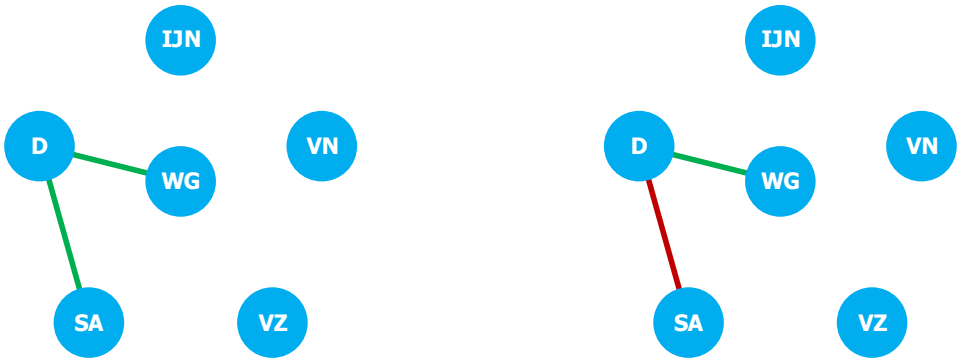
as perceived by	actor role: developers	actor role: residents
developers	*giver & deprived*	*receiver & taker*
residents	*giver & deprived*	*receiver & taker*

(b)

as perceived by	actor role: developers	actor role: residents
developers	*dissociated*	
residents	*taker*	*deprived*

Stabilization The following events are classified as a stabilization of the network. Laurens went to the district platform of Velsen-Noord to share information about wind energy. Vince who starts to meet all working group members in person. Finally, Vince (municipality councilman) also asks council questions to the municipality about wind farm Spuisluis.

RELATIONSHIP CHANGE AND NETWORK TENSION



(a) (b)

Figure 7.5: Change in cognitive (a) and affective (b) relationship between the different actors in phase 2. A green line indicates an improvement of the relationship and a red line indicates a deterioration of the relationship.

Cognition During the district platform meeting the residents' concern of noise is thoroughly discussed. As a result, a shared vision on the topic of noise is established among the majority of the attendants of the meeting. This is, however, to a large degree due to the explanations of the two residents from Velsen-Zuid, who are more knowledgeable than the average resident, and not because of the information that the developers provided.

With the initiation of the working group, new roles are defined between the members of the working group and the developers. A clear shared objective is not (yet) expressed. The meeting of Anthony and Lara at the

province hall is a manifestation of the earlier established negative attitude of Anthony with respect to the communication process, resulting in better defined roles.

Affection No increase in trust is measured as a result of the Velsen-Zuid residents confirming the developers statements about wind turbine noise. The Stationsweg Association's trust in the developers is decreased as the initiation of the working group is seen as an attempt to increase the dependency of the residents on the developers. Also one member of the working group has expressed the fear of being *"surrounded"* (Ellen), so some decrease in trust is detected here. The developers gain more trust in the benevolence of the involved residents because from each district some residents applied.

Still, the initiation of the working group also leads to commitment of residents and developers towards each other. It does not increase mutual understanding (yet), since the reasons of the residents to apply for the working group are mainly self-interested namely to gain information and influence the process.

The encounter of Lara and Anthony at the province hall does not seem to change their affective relationship but rather confirms the existing relationship. The fact that the developers did not publicly spoke however increased Anthony's feeling of distrust in the developers and the process.

Network tension With the formation of the working group, the developers and residents become more interdependent. This gives room for future exchanges and therefore lowers the tension between the developers and the residents who applied. The tension between the developers and Anthony, one of the residents who did not apply for the working group, increased as a result of this.

7.4.4. PHASE 3: JANUARY 2015 - MAY 2015

Phase 3 (the detailed description of events is in section 6.6) is analyzed in this section. The partial timeline is shown in Figure 7.6 and the events are tabulated and classified in Table 7.8. Again the exchanges and stabilization as well as the relationship change are discussed. The network tension will be treated in the next section (Network & relationship final conditions).

Table 7.8: Noise, exchanges and stabilization during phase 3.

noise	submission principal request
exchanges	t_9, excursion
	t_{10}, e-mail contact developers - working group
	t_{11}, public speaking event town hall
	t_{12}, definite decision location Spuisluis
	t_{13}, newspaper article 'windturbines langs het Noordzeekanaal'
stabilization	presentation Stationsweg Association
	letter Stationsweg Association
	presentation district platform meeting Velsen-Noord

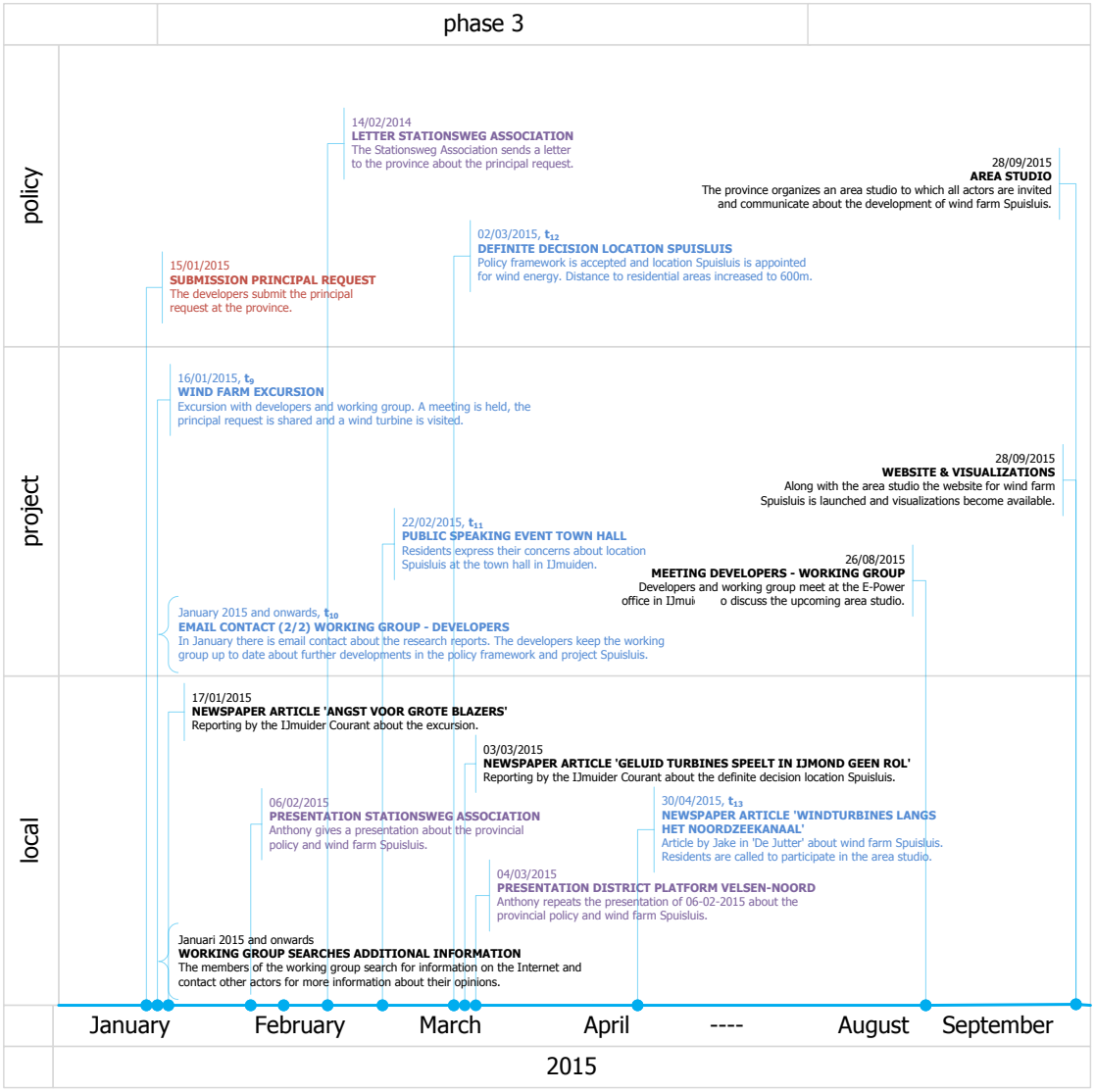


Figure 7.6: Events of phase 3 with noise indicated in red, social exchanges indicated in blue and other, stabilizing events indicated in purple.

EXCHANGES AND STABILIZATION

t_9**, Excursion** During the excursion the freshly formed working group and the developers visited a wind turbine and held their first meeting. In terms of resources, the excursion was the most advanced event as all three different social resources (information, status and love) are exchanged.

During the meeting both actors provided each other with information about themselves, such as their roles and expectations (Table 7.9 (a)). Additionally, the residents are provided with information in the form of the research reports that were compiled to support the principal request as well as additional information on safety in the Noordzeekanaal area (Table 7.9 (b)). This latter information is not directly reciprocated, since the research reports contain complex information and form a *"bulky file"* (Jake). The conversation with the residents is especially valued by Lara. The good atmosphere is appreciated by all interviewees.

There is furthermore a reciprocal exchange of status between the developers and working group (Table 7.10(a)). Both actors state the intention to have open communication and to share all information with each other. Also the developers also express their desire that the members of the working group become co-researchers in the

process, meaning that they have something to say in *what* is researched and *by whom* it is researched. Since this can be considered affectionate regard, it is something more than only an expression of high or low esteem, this is a unilateral exchange of love (Table 7.10(b)). This is not immediately reciprocated by the working group.

Table 7.9: t_9, excursion: Reciprocal exchange of information about actors goals and interests (a), and an unilateral exchange of information in the form of sharing research reports (b), (this has a longer payoff time and can thus not be reciprocated directly).

(a)

as perceived by	actor role: developers	actor role: residents
developers	D R	D R
	reciprocity	
residents	D R	D R
	reciprocity	

(b)

as perceived by	actor role: developers	actor role: residents
developers	D R	R D
	giver	*receiver*
residents	D R	R D
	giver	*receiver*

Table 7.10: t_9, excursion. Reciprocal exchange of status (a) when the actors express the intention of open, transparent communication , and a unilateral exchange of love (b) in the form of the developers propose working group to become co-researchers.

(a)

as perceived by	actor role: developers	actor role: residents
developers	D R	D R
	reciprocity	
residents	D R	D R
	reciprocity	

(b)

as perceived by	actor role: developers	actor role: residents
developers	D R	R D
	giver	*receiver*
residents	D R	R D
	giver	*receiver*

Next to social exchanges based on the benevolence of the involved actors, the excursion is also the first event where evidence for negotiated exchange is found. The working group namely *requested* information, by stating that they want to talk to local residents and demanding additional research reports on cumulative noise effects and air pollution. This is therefore a *negotiated exchange*, which is made possible by the earlier exchange of status by initiating a working group. The developers did not bargain, but immediately complied with this request. They promised that the additional research will be conducted and invited local residents to tell about their experiences. Talking with the local residents is highly valued by the members of the working group. The developers complying with the residents' demands is also highly valued by the residents since particulate matter and noise are the two of their main concerns. Only WindForceSea developer Ivo felt like he lost in this negotiation, he describes the requests by the residents as *"absurd demands"*.

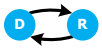
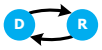
t_{10}, E-mail contact developers - working group The e-mail contact between the working group and the developers following the excursion contains two kinds of exchanges. The first is a reciprocal exchange of information, with the developers keeping the working group up to date about progress of the project, and the residents informing the developers about the neighborhood specific issues (Table 7.11(a)).

An deprivation of status is experienced by the residents when satisfactory answers to their questions about the research reports are not given (*"aren't we somewhat being deceived?"*, Jake). The developers however intended to increase the status of residents by playing with the cards *"fully open"* (Lara). This is illustrated in Table 7.9(b). What is interesting to note here is that two interviewees indicated the value of information being reduced through the use of e-mail as a communication means. There is also a variability in the use of e-mail among the interviewees. Lara and Jake are amongst the most active, while Ivo and Ellen remain quite and rather receive information.

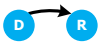
t_{11}, Public speaking event town hall At the public speaking event at the town hall of Velsen two unilateral exchanges of status took place between WindForceSea developer Ivo and the residents, in particular working

Table 7.11: t_{10}, E-mail contact, reciprocal exchange of information when developers and residents keep each other up to date (a), and a perceived deprivation of status when residents do not receive satisfactory answers to their questions about the research reports (b).

(a)

as perceived by	actor role: developers	actor role: residents
developers	 *reciprocity*	
residents	 *reciprocity*	

(b)

as perceived by	actor role: developers	actor role: residents
developers	 *giver*	 *receiver*
residents	 *taker*	 *deprived*

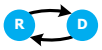
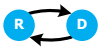
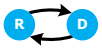
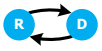
group member Ellen. Ivo perceives a deprivation of status because the residents *"don't oppose the production [of particulate matter], and instead oppose the possible distribution because of the turbines"*. Ellen experiences a deprivation of status because *"[Ivo] did see [the president of the district platform], I was sitting next to [the president] and he did not see me"*.

Table 7.12: t_{11},Public speaking town hall.

as perceived by	actor role: developers	actor role: residents
developers	 *deprived*	 *taker*
residents	 *taker*	 *deprived*

t_{12}, definite decision wind farm Spuisluis After the province made the definite decision to designate location Spuisluis for wind energy, a reciprocal exchange of information took place between the residents and developers. This exchange is shown in Table 7.13. During the meeting at the province, which was attended by Jake, Anthony and Lara, the deputy mistakenly mentioned location Spuisluis being rejected. Both the residents and developers perceived this different. This difference in perception was straightened out the next day through e-mail contact initiated by Jake.

Table 7.13: t_{12}, Definite provincial decision location Spuisluis.

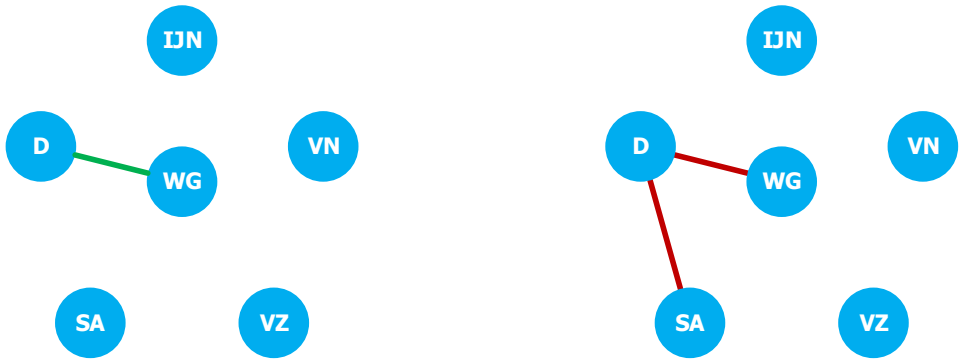
as perceived by	actor role: developers	actor role: residents
developers	 *reciprocity*	
residents	 *reciprocity*	

t_{13}, newspaper article in 'De Jutter': 'Windturbines langs het Noordzeekanaal' Jake wrote a short article which was published in a local newspaper. In this article he called on residents to visit the upcoming area studio. Lara complimented Jake through e-mail for doing this. There is not sufficient information on this exchange to fully unravel all the perceptions because it occurred at the time of the interviews (in fact, it happened just before the interview with Anthony). Nonetheless it is still worth mentioning.

Lara gave status to Jake when she complimented him on the article he wrote for the newspaper. But by doing that, Lara simultaneously took status from Anthony. From his perspective, it is the developers who are responsible for making sure that all residents are informed, and not Jake. It made Anthony *"angry"* because Lara did not do her *"homework properly"*. This is therefore an exchange with three actors involved. One actor giving status to a second actor while at the same time depriving a third actor of status.

Stabilization Compared to the former two phases, the stabilization mechanisms are much more present. The presentation of Anthony at the Stationsweg Association assembly initially started as a desire of this association to create a shared view among its members. As a result of that, a letter is send to the province and the presentation is repeated at the district platform of Velsen-Noord. The value of the information by this presentation is perceived as very high by all other residents. Anthony's second presentation at the district platform meeting of Velsen-Noord is therefore a big success.

RELATIONSHIP CHANGE



(a) (b)

Figure 7.7: Change in cognitive (a) and affective (b) relationship between the different actors in phase 3. A green line indicates an improvement of the relationship and a red line indicates a deterioration of the relationship.

Cognition The wind farm excursion marked the moment that the working group became active for the first time. This is not a new definition of roles per se, but can be interpreted as an explicit manifestation of the earlier defined roles. The working group and the developers shared information about themselves during the excursion. How the attendants saw their own roles is explicitly asked there, resulting in roles being better defined among the actors. Moreover, the shared objective of sharing information is explicitly expressed. The excursion did not clearly lead to a better shared vision and no concrete decisions were made yet. Whether steps are made towards a shared perception of wind energy and project Spuisluis is debatable. On the one hand did the developers comply with researching particulate matter, thereby implicitly confirming agree with the residents that this could be an issue, but on the other hand a variation in the perception of wind turbine noise still exists.

Affection The events during the excursion led to a higher mutual understanding. Interviewees express that they understand the other actor's behavior. The fact that the working group can choose the companies conducting the research is only by Laurens described as increasing trust between the actors. Other interviewees express also a fear that the working group will be 'used' by the developers to persuade the province to choose for wind farm Spuisluis. Although that the interviewees experienced the excursion as positive, trust in the developers is decreased when the residents claim to find mistakes in the research reports.

7.5. NETWORK & RELATIONSHIP FINAL CONDITIONS

The final conditions of the social network are given here in terms of cognitive and affective variables. It concerns the period of time after may 2015, which is a relatively quite period and people look forward to the area studio.

7.5.1. ACTORS AND RELATIONSHIPS

The aftermath of phase 3 provided the actors ample time to reposition themselves in the network and develop their attitudes. What is found is that the roles are loosely defined, but expectations of future exchanges differ in the details. Residents tend to think in terms of negotiating financial compensation. While developers think in a more broad perspective and expect deliberation on the details of the project, such as shadow flicker and hub height. Residents do not envision themselves participating in the technical details of the project because of two reasons. First, they still question the location Spuisluis itself and second, the technical details are too complex. During the working group meeting roles are defined for the residents during the area studio. Also here the working group was not too eager to put themselves on the foreground. There are furthermore two extremes found on the side of the residents when looking at Velsen-Zuid resident Laurens and Stationsweg Association member Anthony. A shared objective is found between developer Lara and Laurens, who both expressed that residents and developers should jointly find out what is acceptable in terms of noise, shadow flicker etc. Anthony on the other hand, is labeled the only known opponent and in terms of objective, the developer's and Anthony's objectives are opposite. From the data obtained through Anthony, it can be inferred that the majority of the residents are opponents, while Laurens indicated that the majority of residents are proponents, provided that the requirements considering the aspects of safety, particulate matter etcetera are met.

Trust of residents (both the working group and the community) in developers generally remains low. This becomes explicit in the expectations of the area studio where it is expected that issues will be *"brushed aside"* (Jake). Still the working group stays committed, and most members portray an active role in the discussions during the area studio. Among the remaining residents, there seems to be little momentum gained in terms of positively or negatively committing them to the wind farm development. The commitment to continue the relationship from the working group side is partly motivated by the fact that negotiations about financial compensation will take place. When considering financial participation of compensation, they however do not experience benevolence from the developers *"because they are kind of mandatory to do that"* (Jake). Furthermore they do not expect much influence on the project (*"We do not have any real influence. Who are we, as a handful of citizens who are then saying that they represent the district?"*, Vince). The developers seem to intend to bring the relationship with the working group to a higher level, since Lara mentioned to be 'open' for everything. Many uncertainties and therefore misalignment of mutual understanding still exists. The best example are the expectations of the area studio. Given that the area studio is organized by the province, it is difficult to point at the developers and the residents as a cause for this misalignment.

7.5.2. SOCIAL NETWORK STABILITY AND TENSION

Between the email exchange about the preliminary research reports and the working group meeting, the network is relatively stable. No new resources are exchanged (the resident's questions about the research reports will be dealt with in future detailed research reports) and no big shifts in the perceptions of actor's on wind energy in general and wind farm Spuisluis in specific are elucidated.

The residents however do experience considerable tension because they have the feeling that they cannot influence the process and outcome. At the area studio this tension becomes explicit, since residents feel unable to engage themselves with the project because there is only a 'half plan' and the technical details are too complex. This despite the developer's benevolence of providing information and inviting the residents to involve themselves.

8

CONCLUSION & DISCUSSION

The case study presented in this thesis is wind farm Spuisluis in the municipality of Velsen. The time domain covered is from June 2014 until October 2015. The proposed wind farm consists of six to eight wind turbines on the northern dike of the Spuisluis along the Noordzeekanaal. The landscape has an industrial character. The local developer WindForceSea and national energy company E-Power jointly develop this wind farm and engage in communication with the community prior to the permit application process. This communication consists of a series of presentations at the different districts, and the initiation of a working group through which residents become involved in the development process. Contact between developers and the working group is through email, an excursion and a meeting. The governments, municipality and province, are not very involved in the communication process. The province is the authority responsible for granting the permits for the wind farm and does organizes an area studio with the goal to inform the community, create public support and gain knowledge about the communities concerns as to take them into account during the development process.

In order to research reciprocity between two key stakeholders, the involved residents and the wind farm developers, multiple data collection methods are used which allows for triangulation of the data. The core of the research consists of eight interviews conducted in April and May 2015. The interviewees are two developers, five involved residents and one involved municipality civil servant. Furthermore two observations are conducted. The first one is a meeting of the working group and the developers in preparation for the area studio. The second one is the area studio itself. Furthermore a document analysis is performed making use of publicly available policy documents, media and other communication documents. The combined data collection methods result in a rich palette of chronologically ordered events and social exchanges, as well as actor experiences, perceptions and expectations.

This chapter will use the thorough analysis of the results from chapter 7 to reflect on the research question and underlying research objective. The research objective is to gain understanding in wind farm development process participation by analyzing the informal social interactions between key stakeholders. An answer to the research question is given in section 8.1. A discussion on the results and possible directions for future research are given in section 8.2.

8.1. THE ROLE OF RECIPROCITY IN WIND FARM DEVELOPMENT

The main research question is answered in this section through the subquestions. The section ends with a presentation of the *typology of exchanges*. This framework serves as a comprehensive tool for the analysis of social exchange and is a proposal for further development of the theory of social exchange. The typology of exchanges is applied in a workshop for wind energy professionals.

8.1.1. ANSWERING THE RESEARCH QUESTIONS

For clarity, the main research question is repeated here:

What is the role of reciprocity in the origination and propagation of the relationship between the wind farm developers and the involved residents during the wind farm development planning phase?

In order to find this role of reciprocity, the four subquestions will be discussed first.

SUBQUESTION 1: WHAT ARE THE PREVAILING PROCEDURAL, CULTURAL AND PERSONAL NORMS OF RECIPROCITY DICTATING AND INFLUENCING SOCIAL EXCHANGES BETWEEN THE WIND FARM DEVELOPERS AND THE INVOLVED RESIDENTS IN THE CASE STUDY?

Norms of reciprocity are dictating exchanges between actors through laws, regulation or contracts. Cultural and personal norms of reciprocity dictate the actor specific propensity to reciprocate.

The first observation is that the communication process is indeed *interdependent*. An actor chooses for a specific exchange because a specific response by the other actor is expected. As an example, the initial communication is a direct result of E-Power's realization of this interdependence. An information differential existed between the developers and the residents. The presentations on the district platforms had the goal to alleviate this differential. Not doing so would increase the probability of resident's mistrust in the developers. Another example of interdependency is the residents applying for the working group. They state that the possibility to influence the process is one of their reasons to apply. There is therefore an expectation that the developers will provide this influence later in the process. In other words, the behavior of actors is depending on the expectations of the exchange partner's behavior and therefore the outcome of the exchanges are a result of the behavior of all actors involved.

There is only one procedural norm dictating exchanges between developers and residents in the time domain researched. This is the area studio organized by the province in October 2015 during which the developers had to engage in exchange with the residents.

Two cultural norms of the residents are very defining for the exchange process. The first cultural norm is that residents are relatively inert with respect to developments in the area. This might be part of the explanation why there was no big public response after the first district platform presentation (another reason might be that it was in the period of summer holidays). The second norm is that people are reported being fairly direct in their verbal communication, meaning that they easily say what is on their mind. This leads to the situation that even while on a community scale there is not much involvement of residents, a small number of 'excited' residents, the 'committed few', who have a character of being direct can transfer huge amounts of information from the community to the developers and from the developers to the community.

The norms are personal and not company norms, change that. The two involved developers initially held two different cultural norms. The local developer WindForceSea intended to follow the formal procedure, in which public involvement commences at the permit application in the form of public voicing (the classic *decide-announce-defend* model), while E-Power intended to have the community informed and involved as early as possible (the more romantic approach of project communication). It is however interesting to see that when Ivo of WindForceSea is forced to act according to E-Power's norm, he does this with full commitment. The best example of this is the case when Ivo conducts noise measurements to provide more information to the community.

In December 2014 the working group is established. The working group is no formal entity (it has no legal status and no agreement is signed by its members) and therefore does not hold any accountability. During the excursion in January 2015, the working group and developers expressed the intention of sharing all available information, thus a new cultural norm is explicitly established there. Similar to the legal status of the working group, this new norm is also not sealed in the form of a contract or other agreement. Instead it is based on the actors' benevolence towards each other.

SUBQUESTION 2: WHAT PATTERN OF SOCIAL EXCHANGE CAN BE DISCERNED IN THE CASE STUDY?

A pattern of social exchange is indeed discerned when taking a closer look at social exchanges between developers and residents. Distinguishable are three phases, with each phase characterized by a *disturbance* (noise) of the social relationships, followed by *social exchanges* between the actors to deal with the disturbance resulting in a *stabilization* of the renewed social relationships. All disturbances are caused by the province. Actors initially act self-interested, but each phase shows more other-interested behavior. In terms of the social resource classification of Foa and Foa (2012) the successive social exchanges during each of the three phase are characterized by an increasingly more particular social resource. *Information* is the most basic resource, and *status* and *love* are more 'advanced' social resources. The lengthy decision process at the province often allows ample time for stabilization of the relationship between developers and involved residents. Below this

pattern will be explained in more detail.

The first phase, spanning June 2014 until October 2014, is characterized by information exchange. The initial disturbance is the province announcing the development for new policy concerning onshore wind energy. Since the residents are unaware of this announcement, the developers transfer information about the policy and wind farm Spuisluis through the presentations at the district platform meetings. The residents transfer information to the developers about their concerns. The respondents provided self-interested reasons for this exchange. The relationship somewhat stabilizes when there is a possibility for public voicing at the province and the involved residents position themselves critically towards the wind farm proposal. In other words, the utility of the relationship is different for both actors. The utility for the developers is to obtain the trust necessary to construct a wind farm. The utility for the residents is to be able to obtain information as to protect the interests of the local community as good as possible. There is no evidence of a stable relationship because the second province presentation is within a month after the third district platform presentation.

The second phase is from October 2014-January 2015 and, although information still plays a key role here, the exchange of status becomes more salient. The disturbance is the province presentation of the draft policy framework. Because this is the moment that the developers have to commence preliminary research, they give a fourth presentation at one of the district platforms and propose a working group through which residents can be involved. A selection of residents apply for this working group. This is a reciprocal exchange of status: both actors acknowledge each other as an exchange partner and provide a basis for further communication. Exchange of information only does not provide this basis and the exchange of status in this phase is therefore slightly more other-interested than the exchanges during phase one. The relationship between actors becomes, in other words, increasingly interdependent. It takes until December 2014 that the working group is actually formed and the relationship is stabilized.

In phase three, spanning from January 2015 until May 2015, again information forms the basis of exchanges. Status is materialized in the first meeting of the working group and developers (the excursion). This allows the actors to exchange love. The disturbance is again brought about by the province. The developers had to submit the principal request, supported by the conducted preliminary research, at the province. During the excursion this preliminary research (information) is shared with the residents. A new norm of exchange is established: attendants of the excursion express the intention to openly communicate all the information (see subquestion one), which can be accounted for as an exchange of status. During the excursion something more than status is exchanged between developers and residents: a redistribution of influence over the development process takes place. The members of the working group can choose which companies will conduct the detailed research necessary for the application of the permits, which is an exchange of the more particular social resource love. What is interesting is that the exchange of status in phase two did not only allow for increasingly particular reciprocal exchanges, but also paved the way for negotiated exchange. The working group successfully demanded additional research on the effects of wind turbines on the air pollution in the region. Stabilization of the relationship happened through email contact during which the preliminary research reports are discussed thoroughly. A higher interdependence is attained through the establishment of the new norm of exchange.

The three phases are characterized by increasingly particular resources that are exchanged, resulting in interdependency between the involved residents and developers.

SUBQUESTION 3: WHAT PERCEPTIONS DO INTERVIEWED ACTORS HOLD TOWARDS THE SOCIAL EXCHANGES?

If the analysis is put in a broader perspective, two kinds of social exchanges can be distinguished. The first kind of social exchange is where perceptions of both exchange partners are consistent with each other, meaning that the actors have the same perceptions of their own and the other's role in the social exchange. The second kind of social exchange is where these perceptions are inconsistent. This means that actors hold different perceptions of their own and the other's role. In chapter 4 it is explained that the theory of social exchange distinguishes between actor roles as actors being a *giver*, a *receiver* (both positive), a *taker* or *deprived* (both negative) of a social resource. When an actor perceives no exchange, there is *dissociation* (neither negative nor positive). Below the implications of actor perceptions being either consistent or inconsistent are given.

During the social exchange process of the case study, consistent exchanges are both positive and negative exchanges. When inconsistent exchanges are observed, the developers always have a more positive perception

(positive exchange, dissociation), and the residents have a more negative perception (dissociation, negative exchange). For example, the email contact between the developers and the working group (exchange t_{10}) consisted of a reciprocal exchange of information. But the developers also gave more information (positive unilateral exchange) on the research reports, which was perceived by the working group as a deprivation of status (negative) because this information was conflicting with their own searched information.

From the analysis it can be found that direct personal contact and explicit verbal expressions are more likely to result in consistent social exchanges while indirect and electronic contact more likely results in inconsistent social exchanges. The 'big exchanges' such the presentations and the excursion (as described in subquestion 2) are on aggregate largely consistent. The most salient consistent exchange is the excursion, during which people explicitly stated their goals and interests. Inconsistencies are found when looking at the details of perceived exchanges. People are very sensitive to details in the exchange process. One clear example is Velsen-Noord resident Vince his perception of being deprived of status after the fourth district platform presentation. Vince did not attend this presentation but heard through a fellow resident that the developers announced that Velsen-Noord had no objections against the wind farm. This experience defines to a large degree how Vince positions himself in the remainder of the exchange process. Inconsistent exchanges can be traced back to one of these contingencies on a very detailed level.

Retaliation is not directly observed in the case study. Two possible explanations are given. The first is that developers do not retaliate because it would amplify conflict and render their previous communication efforts futile. A clear example of this is resident Anthony depriving E-Power's Lara of status at the public speaking event at the province hall. Lara takes this behavior in a rather indifferent way because both giving or taking in response would amplify the conflict. The second explanation is that residents possibly do not have practical means to retaliate perceived unkind behavior by the developers. The most obvious manifestation of retaliatory behavior of residents towards developers is probably found in Anthony of the Stationsweg Association, who ignores the developers at the public speaking event at the province hall and subsequently gives a presentation at the district platform of Velsen-Noord against the wind farm. The latter one could be interpreted as indirect retaliation (congruent to indirect reciprocity) since developers were not attending this presentation.

SUBQUESTION 4: WHICH COGNITIVE AND AFFECTIVE CHARACTERISTICS OF THE RELATIONSHIP BETWEEN THE INVOLVED RESIDENTS AND THE WIND FARM DEVELOPERS IN THE CASE STUDY EMERGE FROM THE RECIPROCAL EXCHANGES?

The residents and developers are careful when engaging in social exchange because by doing this, they become vulnerable to the other actor. Resident Ellen explains this as the fear of becoming 'surrounded' by the developers. Similarly, developer Ivo openly questions the call to residents to submit a vision during the public voicing rounds. However, by exposing themselves to these vulnerabilities both actors gain access to information from each other and, to a lesser degree, influence over each other. The working group obtains first hand information on the process and the preliminary research reports. The developers obtain community specific information. In terms of influence the working group successfully demanded a research on the issue of particulate matter through negotiated exchange.

The series of reciprocal exchanges in terms of information, status and love led in this case study to considerable cognition between developers and involved residents. During the excursion, actors explicitly stated their roles in the process and a shared objective of open communication is attained. A clear definition of the actor's roles exists except for WindForceSea developer Ivo. Residents report that they do not understand his role. A shared objective concerning whether the wind farm should be constructed or not is also not obtained. There is no evidence found that interviewees changed their main objective during the time domain researched. The actors, in short, were open to change their objective concerning the *process*, but not concerning the *outcome*. Developer Lara and resident Laurens explained that their shared objective is to find out what is acceptable as a development which resonates with the ideas of Oosterlaken (2014). This shared goal is not found among the other interviewees.

Affection between developers and the working group is attained to a lesser extend. A reciprocal exchange of information alone is insufficient, as research reports are contested and little or no mutual understanding and trust is reached. This is consistent with literature (Burningham et al., 2006; Aitken, 2010). Exchanges of status and love do provide the possibility to create affection between actors. Residents reported low trust in

developers and the process. Interestingly enough, there is no evidence that this lack of trust is ever explicitly expressed by the residents. Mutual understanding is not attained on two important aspects: the perception of wind turbine noise and expectations of the area studio. Respondents generally do report a good understanding of the motivations behind the other actor's behavior.

Especially in the third phase, the resilience of the social relationship became apparent. Despite the developer's answers to the working group's questions on the preliminary research reports were not perceived satisfactory, communication between the actors continued. When the province erroneously announced wind farm Spuisluis being rejected, the actors contacted each other for clarification instead of going public.

MAIN RESEARCH QUESTION: WHAT IS THE ROLE OF RECIPROCITY BETWEEN THE WIND FARM DEVELOPERS AND THE INVOLVED LOCAL RESIDENTS IN THE ORIGINATION AND PROPAGATION OF THEIR RELATIONSHIP DURING WIND FARM DEVELOPMENT PROCESS PARTICIPATION?

Reciprocity is a repayment in kind. It is a feeling of obligation to engage in positive and negative exchanges with each other, without these obligations being made explicit. Reciprocity therefore serves as a balancing mechanism in social relationships. The role of reciprocity in exchange process between involved residents and developers of wind farm Spuisluis is essential but limited.

The personal norm of reciprocity of E-Power developer Lara to inform residents about developments that directly affects their environment is the origin of the series of social exchanges. The perceived lack of communication efforts by the governments, and the initial communication by the developers being only aimed at the district platforms initially invoked feelings of mistrust with the residents. The residents nonetheless involve themselves in the social exchange relationship because they feel responsible for the protection of the interests of the local community.

The propagation of the exchange relationship is further defined by three distinct phases, each of which characterized by the availability of new information. This new information does not only allow subsequent positive reciprocal exchanges, but also allows the relationship between the involved residents and the developers to become more close in terms of commitment and cognition. Exchange of increasingly particular resources, such as status in the form of a working group, always have 'balancing' counterforce. This force is apparent when some residents decide to join the working group and decrease the social distance to the developers, while other residents (Anthony) decide otherwise and increase social distance to the developers. Some residents, like Jake and Vince, are comfortable being in the working group but the limit of reciprocity is found at exchange of love, which they do not reciprocate. Resident Laurens however is comfortable at the resource exchange of love and he will take part in the additional research in particulate matter. A community consists of many different residents, each of them having their personal 'balance of reciprocity'. Also the developers are heterogeneous in this respect. The one developer initiates social exchanges while the other developer questions these exchanges and takes a submissive role, or does not participate at all in exchanges.

Complexity of information, the provincial process and uncertainties about the outcome pose limits on positive reciprocity. When information becomes increasingly complex, and actors become increasingly interdependent due to exchange of status and love, there is also an increased feeling of exploitation. This mechanism is especially salient in residents but certainly also occurring at the developers (the residents having *"absurd demands"*, Ivo). Exchanges where this feeling of exploitation is present are associated with inconsistent exchanges, hence perceptions of these exchanges are not the same. The point where positive reciprocity flips to more negative forms of reciprocity exists on the edge between consistent and inconsistent exchanges. Where exchanges are perceived inconsistent, residents always have a more negative perception than the developers.

Reciprocity leads to the shared objective of having open information, but 'higher order' objectives are unlikely to arise due to the earlier mentioned limits on reciprocity. Eventually only resident Laurens and developer Lara share the higher order objective to find out what is an acceptable outcome. Sharing information among all developers and working group members does not lead to consistent perceptions about noise concerns and expectations about the area studio, likely partly due to a lack of direct personal contact.

Evidence for resilience in the relationship is found in the fact that residents never explicitly tell the developers that they are not trusted. When they would do this, they would deprive the developers of status and/or love,

and give the developers reason for retaliatory behavior (the developers could in return, for example, stop giving the residents information). So by the things that are *not* said by the residents, it can be found that a basis for keeping a good relationship exists. This stability of the relationship becomes explicit when the residents and developers discuss the erroneous message by the province that wind farm Spuisluis is rejected.

The time variable plays a role in reciprocity since the wind farm development process is lengthy and iterative. Uncertainties in the outcome makes residents feel uncomfortable during wind farm development process participation. Involvement in a later stage would lower the uncertainties, but also lower the amount of involvement possible because research reports are already compiled and decisions are already made. When residents are involved in a later stage, it is unlikely that through reciprocity a shared objective is obtained in terms of whether the wind farm should be constructed or not. Instead reciprocity enables to make shared objectives on a lower level only, like having open communication.

The role of reciprocity between residents and wind farm developers in the classic *decide-announce-defend* model is limited because actors feel little need to establish a positive reciprocal relationship if it is perceived that decisions are already made. The current case study has characteristics of this classic decision model because, although the definite decision was not made yet, the location and the technology are already chosen by the developers and governments.

By combining the results of this research with the interpretation of social exchange theory as presented in chapter 4, a typology of exchanges is developed which can provide more insight in the balance of reciprocity. It is presented below.

8.1.2. TYPOLOGY OF SOCIAL EXCHANGES

The theory of social exchange distinguishes between reciprocal and unilateral exchanges, in both the positive and negative sense. These are tabulated in Table 4.1 in the conceptual design chapter. The findings from this research suggest two more types of exchanges. Adding these exchanges to the known exchanges and rearranging their relative position results in a clear overview of all types of social exchanges. This overview can be found in Table 8.1. It shows the possible actions of actors A and B (give, passive and take) and the resulting types of exchange as perceived by actor A. The typology of exchanges will be further explained below.

Table 8.1: Typology of social exchanges between actor A and B, with exchanges initiated and by from actor A. Exchanges in the upper left triangle have a positive character, exchanges in the lower right triangle have a negative character. In the bottom left exchanges A is independent of B, in the top right exchanges A is dependent on B.

A \ B	gives	passive	takes
gives	reciprocity	benevolent	disadvantaged
passive	favored	dissociation	disfavored
takes	advantaged	malevolent	settle

positive ↖ ↘ *negative*

dependent ↗ ↙ *independent*

The two additional social exchanges are depicted in the top right and bottom left corners of the table (denoted with 'advantaged' and 'disadvantaged' respectively). Their existence is inspired by exchanges t_6 (Table 7.6) and t_8 (Table 7.7) in chapter 7. In these exchanges an actor is both *giver and deprived* or *taker and receiver* at the same time, hence in a very advantaged or very disadvantaged position relative to the exchange partner.

These two additional types of social exchanges are conceptually created by combining two types of unilateral exchanges.

The typology of exchanges table uses more nuanced annotations than the original ones posed by the social exchange literature. The phrasing 'benevolent', 'malevolent', 'favored', 'disfavored' and 'settle' give, in my opinion, a more accurate view of the possible roles that actors can perceive in social exchange. They are less absolute than the phrasing in Table 4.1 and better represent the nature of social exchange in contrast to economic exchange.

The typology of exchanges presented here furthermore shows a symmetry that allows to classify exchanges relative to each other. It shows symmetries on the concepts of power distribution and tone of exchange. The power is distributed along the main diagonal axis. A is completely independent independent of B when he perceives the role 'advantaged', while A is completely dependent while he perceives the role 'disadvantaged'. Clearly, 'reciprocity' and 'settling' are balanced because the actors hold equal power to give or to take. The tone of exchanged, the degree that an exchange is perceived positive or negative, is distributed along the antidiagonal. The roles 'advantaged' and 'disadvantaged' are neutral, because there is always one actor acting from benevolence, and one from malevolence. The symmetry in the typology of exchanges allows for classifying exchanges on the basis of their relative tone of exchange and the power distribution which creates a deeper understanding of the actor's perceptions.

Finally there is the *dissociation* type of exchange. This is basically a perceived absence of any exchange. Dissociation comes up automatically by using the arrangement according the actors' behavior (give, take or passive), but does also actually hold some importance. What is found in the case study is that it can indeed happen that one actor perceives an exchange, while the other actor does not.

The typology of social exchanges is at the same time more detailed in the types of exchanges that are possible and more nuanced in the explanation of these exchanges than the exchanges currently presented by literature. Improvements to the model can still be made. It for example does not allow for *spite*, behavior of an actor that deprives himself in order to deprive another actor even more (this is what Anthony does when he starts to ignore the developers, he deprives himself of information in order to punish the developers). This could be implemented by adding the behavioral option 'deprive' to the list of behavioral possibilities.

8.1.3. APPLYING THE TYPOLOGY OF SOCIAL EXCHANGES

The typology of exchanges is presented and applied during a workshop named 'Reciprocity in Wind Energy' for NWEA and its members on 24/11/2015. The 15 participants are predominantly communication professionals and include wind farm developers, energy companies, a local energy cooperation, an environmental organization, a representative of residents and the national government. A report of the workshop is found in Appendix F (Dutch), a short summary is given below.

During the first half of the workshop the typology of exchanges was introduced as the 'Relationship Guide'. During the second half the participants were given fictional narratives and asked to identify the involved actors, the exchanges, and their relationship. Subsequently, the participants were asked to come up with examples from their own experience.

The participants were able to describe social interactions according to the Relationship Guide. They were in particular able to point out the different perceptions of the different actors. It is concluded that the Relationship Guide is an analytical tool that can help giving more structure during communication. It does so by making the communicators more aware of what they are doing, and by stimulating to think about how other people experience the communication. A drawback of the Relationship Guide is that it does not take a third actor into account. When a relationship is characterized by 'settle', it is difficult to find a way to more positive exchanges. A third actor could mediate and make positive exchanges possible. Similarly, a well established relationship based on reciprocity can become very difficult to sustain when a third actor is meddling. The model does also not explicitly take into account the time dimension, which is often crucial in communication processes.

8.2. DISCUSSION AND RECOMMENDATIONS ON AN APPLIED APPROACH TO WIND FARM DEVELOPMENT

The discussion and recommendations section consists of two parts which are aligned with the research objective. The research objective in this thesis is to gain understanding of wind farm development process participation during the planning phase by analyzing the informal social interactions between key stakeholders. This is a practice-oriented and diagnostic research, meaning that recommendations focus on the identification of problems in the participation process, some directions for how these problems could be tackled are also presented. Since a case study is conducted, some remarks on generalizability will be given as well. First, subsection 8.2.1 will cover a discussion on how this thesis improves the understanding of wind farm development process participation and how the results could be put to advantage. Next, in subsection 8.2.2 a discussion is given on the analysis of informal social interactions using social exchange theory and reciprocity.

8.2.1. DISCUSSION ON THE RESULTS AND RECOMMENDATIONS FOR PROCESS PARTICIPATION IN WIND FARM DEVELOPMENT

Socio-technological systems like wind farm development processes are highly complex and sensitive. The idea of social exchange theory and the results of this thesis can not be used to decrease the complexities, but can give insight in these complexities and thereby reduce sensitivities in social interactions. My interpretation of social exchange theory is comparable to bookkeeping. All actors keep a mental book in which they note down the experienced (un)kindness of others towards them and their (un)kindness to others in response. Their sums must be the same, i.e. the levels of experienced (un)kindness and (un)kindness in response are equal. But if the books are incorrect, due to for example assumptions that actor makes or their inaccurate perceptions, peculiar situations can arise.

The results for this research suggest that the challenge for both developers and involved residents is to keep the book clean, have consistent perceptions and be open-minded wherever possible. With consistent perceptions, it is not only meant that actors perceive an issue in the same way, but also that their perception of how other actors perceive this issue is correct. A relationship based on reciprocity, leading to commitment and trust, can only be stable when these perceptions are consistent. Reciprocity is the starting mechanism that can lead to this consistency of perceptions.

A first recommendation to actors in wind farm development is to assume inconsistent perceptions rather than consistent perceptions. This forces actors to communicate more careful and be more open minded when engaging in exchanges. Furthermore, actors can improve their open-mindedness by anticipating on a range of possible perceptions of the other actor. The typology of exchanges provides a framework that supports this anticipation. Next to these, perceptions of actors can be made more explicit. After some social exchange, for example an information evening, residents' perceptions can be surveyed such that developers get a clearer view of them. In the case of Spuisluis, this would have been possible for example through the newsletter and the area studio. Finally, actors should not be too anxious to ventilate their perceptions: when one keeps perceptions to him/herself, he makes it increasingly difficult for others to shape any idea of it. These recommendations do not only apply to actors' perceptions about an issue, but also the actors' perceptions of how others perceive an issue. By knowing each others perceptions, one can increase the likelihood of consistent social resource exchange. The following famous quote from *The Art of War*, an ancient book full of wisdom applicable to contemporary communication, reflects the former recommendations best. In this quote 'enemy' and 'battles' are easily imagined as being 'exchange partner' and 'social exchanges':

"Know the enemy,
Know yourself,
And victory
Is never in doubt,
Not in a hundred battles."
Sun Tzu

What is however clear is that the relationship between the developers and the residents is not perceived equal. The prime responsibility of the project and its effects on the direct environment is held by the developers. How then, can recommendations for residents be given? The residents experience a 'forced marriage' meaning that

they might not be willing, or feel anxious to engage in exchanges with developers. What is observed is that this fear of exploitation indeed exists, but that there is also an implicit fear of deterioration of the relationship once it is established. Evidence of this latter phenomenon is found in the case study in the fact that feelings of distrust are not explicitly expressed by residents because such expressions could affect the relationship negatively. Within the perceived inequality between actors, a healthy balance must be found between what is expressed and what not. On the topic of how wind energy technology is viewed (safe/dangerous or beautiful/annoying), explicit expression of feelings and perceptions can increase mutual understanding. On the topic of how actors feel towards other actors this is maybe not the case, and it might be that expressions of feelings and perceptions should, to some extend, be avoided.

Process participation in wind farm development should therefore not only focus on providing a framework for procedural justice, but also on establishing reciprocal relationships between key actors. When processes become increasingly long and complex (like wind farm developments), it is more likely that actors perceive a low procedural justice. Healthy relationships based on reciprocity can allow for the resilience and trust necessary to work towards a more procedural just development through mutual forgiveness and learning.

Whether these recommendations also apply for the community as a whole and the 'silent majority' is open for discussion. The present case study provides indications that perceptions of the uninvolved group of residents are heterogeneous, ranging from 'in favor, given that' to 'against'. Additionally, the use of mass communication means by the developers has been limited. The function of a relationship between the uninvolved residents and wind farm developers is difficult do discern, especially because the data does not provide motivations of uninvolved residents to be proponent or opponent. Initial benevolence of the wind farm developers to have an open and inclusive process is the first step in building op a reciprocal relationship. In terms of creating a positive relationship this is preferable behavior, independent on how the 'silent majority' responds to this.

Prell et al. (2009) suggest institutionalizing process participation. This is something that the Dutch Wind Energy Association also intended to do through the launch of a code of conduct (Nederlandse Windenergie Associatie et al., 2014). When taking a reciprocity perspective, an argument is found against this institutionalizing of process participation. When participation is institutionalized, the *true intention* of developers to involve other actors becomes questionable. Do they involve residents because they want to, or merely because they have to? If there is no true intention, residents are less likely to respond reciprocal. This devaluation of participation is clearly delineated by Anthony: *"...you might be able to make an deal with E-Power. And it better be a good deal, and not a deal like in that code of conduct."*. The possibility for developers to show real benevolence is lowered by institutionalizing process participation.

The shift from the *classic* style of wind farm development to the *romantic* style of development comes with challenges. These challenges stem from the iterative nature of projects and the accompanying uncertainties. There is a conflict of early involvement and uncertainty in the outcome versus on late involvement and certainty in the outcome. In the first case, residents feel no incentive to participate because there is no clear plan while in the latter case, residents feel no incentive to participate because everything is already decided. The question is therefore not how residents can become a variable in the iterative process of wind farm development, but how developers can allow themselves to let residents conduct this iteration process, with its many complexities, themselves. This is an enormous challenge for both developers and residents. This is incompatible with the classic *decide-announce-defend* model and a real change of the socio-technological system is needed.

Wind farm development is highly contingent and contextual parameters such as policy, local community and developer characteristics and landscape are factors influencing the course of events. The specific findings in this research are therefore not applicable to other wind farm developments. The provincial policy being in development, the formation of a working group and location specific issues such as particulate matter make this wind farm development unique. However, aspects such as research reports being contested, mistrust between actors and inaccurate media coverage is also found in other wind farm developments. It is likely that an initial perceived deprivation of love by the residents stands at the core of the issues around wind farm development. Participants of the workshop 'Reciprocity in Wind Energy' indicated that residents initially feel being 'disadvantaged' or at least 'disfavored', resulting in social exchanges becoming a spiral of negative reciprocity: 'settling'.

8.2.2. DISCUSSION ON THE RESEARCH AND RECOMMENDATIONS FOR FURTHER ANALYSIS OF SOCIAL INTERACTIONS IN WIND FARM DEVELOPMENT

Informal social interactions between key stakeholders in wind farm development were analyzed according to the conceptual framework and through a multiple data collection method. The strengths and limitations of the conceptual foundation and the methodology are outlined here. In-depth qualitative cross-sectional study.

Because of feasibility reasons, the biggest methodological simplification is to make use of cross-sectional rather than longitudinal data collection methods. This thesis presents a *process description* of wind farm development, spanning almost one and a half year, so ideally measurements were taken at more points in time. The drawback of the approach presented in this thesis is changing perceptions and relationships over time are not directly measured, but only indirectly through the interviewees' recollection of the events. This brings additional inaccuracies in the data. For example the order of events was not always well remembered by the interviewees and recollections of events further in the past are likely to be less accurate than more recent events. Another limitation in the data collection is that there were about four months between the last interview and the first observation. This results in a 'gap' in the data. And although it is known that no big events happened during this time, it is not exactly known what happened in these four months. More accurate data can be collected if actors can be interviewed before and after an event, to measure expectations and experiences, and that the event itself is observed. If more time is available, the research by Maillé and Saint-Charles (2014) is inspirational for researching social phenomena during wind farm development from a network perspective and in a longitudinal fashion.

The conceptual model introduced in the conceptual design chapter (Figure 4.2) is build up using the theories of social exchange, social networks and social capital. There are some challenges in operationalizing this conceptual model and make it usable to practically analyze social interaction. First, it includes successive and discrete social exchanges between actors resulting in relationships and network states. In reality, it is actually difficult to make a discretization of social exchange (Molm, 1994). Fortunately, the communication process for wind farm Spuisluis is relatively clear. From a macro-perspective the successive exchanges can be relatively easy discretized in the district platform presentations, the excursion and the area studio. However, the social exchanges on a micro-level occurring *during* these events are much harder to identify. A second helpful approach in discretization exchange is to focus on *perceptions*, something that Molm does not take into account. The conceptual model does not allow to trace back specific change in relationship to a specific (series of) social exchange. That is why the analysis in chapter 7 is depending on interpretation by the researcher and that changes in relationship are connected to specific social exchanges only when explicitly stated by respondents. In short, the causality in the conceptual model is not obvious. Secondly, the conceptual model does not explicitly include the different perceptions that involved actors can hold regarding the same social exchanges. This is a drawback because it is found that the (in)consistence of perceptions is something that can give an explanation to the propagation of the relationship between actors. Finally, in the conceptual model the social properties on a *network level* are connected to social exchanges on a *dyadic level*. This connection is however not that straightforward. Although the unit of analysis of a social network is social exchange, knowledge of the sum of social exchanges does not necessarily give knowledge of the properties of the social network because a network contains complexities.

The operationalization contains another flaw that many of the indicators are actually not exactly indicators in terms that they do not allow for direct measurement. An example is the use of the indicator 'trust', which can be subdivided into perceived benevolence, perceived competence and perceived integrity (Mayer et al., 1995), allowing for more detailed and consistent measurement. But this is not done in this thesis. Another example is the indicator 'commitment', which has proven to be difficult to measure because a clear definition is lacking. This is not necessarily a problem because of two reasons. The first reason is that it is difficult beforehand to know exactly what is searched for in the interview data, hence a loosely defined set of indicators allow for steering during the research. The second reason is that the questions asked during the interviews, which are based on the indicators, are open enough for the interviewees to present their own ideas and motivations. A more loosely defined set of indicators therefore allows for a more open interpretation of the data, which can be preferable in complex social situations such as wind farm development where also many unknowns for the researcher exist. The definition of indicators can be seen as an iterative process and future researchers are challenged to specify the indicators more unambiguous.

Multiple data collection methods are used in this research each of which having its own limitations. Because of feasibility reasons, only eight interviews were conducted. Although this gave insight in the exchanges between developers and the working group, it did not give full disclosure about social phenomena such as information diffusion within the community. The effects of mass communication means aimed at non-committed residents on the perceptions and relationship is for example not researched. It can therefore not be assumed that the full spectrum of perceptions is measured. Measured perceptions of the committed residents and developers are not necessarily equal or representative for the other, less committed residents and developers. The respondents furthermore might not have given full disclosure about their perceptions of the other actors. The developers for example have an image to maintain which could give reason for holding back information. The degree to which this influenced the outcome of the research is not known. Also some improvements can be made to the interview protocol used for data collection. Although the interview protocol was discussed with peers before conducting the interviews, and changed one time after a few interviews, two questions proved difficult to answer for the respondents. These are questions 3.c.v. and 3.d.ii of the interview protocol of April 15^{th}.

In section 1.2 the importance of taking a neutral research perspective is stressed. This thesis gives a practical implementation to the calls of Aitken (2010) and Ellis et al. (2007) to approach communication problems in wind farm development in a more neutral fashion and provide explanatory rather than descriptive insights. It is believed that by focusing on the relationships and taking social exchange as the unit of analysis, this neutral perspective is obtained. This forces the researcher to change the research question from an outcome oriented question (how can we build a wind farm?) to a process oriented question (how does communication work?). The approach of this research can be applied along the approach proposed by Oosterlaken (2014) to focus on 'acceptability' rather than 'acceptance'.

Further research on the topic of wind energy communication and process participation using the approach presented here should include more than two actors and other wind farm projects to increase the generalizability of the findings. This also gives opportunity to validate the newly developed typology of exchanges which was presented in subsection 8.1.2. With the current trend of institutionalizing process participation, an interesting direction of research is the varying value of reciprocity when public participation is imposed on developers. Finally, literature suggest that relationships based on reciprocity results in an increase of likelihood of successful negotiated exchange (Molm, 2003). Future research should find out how reciprocal exchange in an early stage of wind farm development can improve outcomes of negotiated exchange (for example about financial compensation) in a later stage.

From a more theoretical point of view, it is necessary to develop means that more accurately and consistently measure which social resources are exchanged. A data collection method must be designed that more objectively measures the perceived exchanged resources specific for socio-technological systems like wind energy. The conceptual model and the typology of exchanges presented in this thesis are a starting point for this design. A special case is the relationship *dissociation*. This type of exchange is difficult to measure but the meaning of dissociation between actors is interesting because it could signify a stable or instable social equilibrium. Furthermore, this thesis analyzed a spectrum of perceptions and reciprocal responses. It is necessary to further develop the relationship between actor personality and actor propensity to respond reciprocal. Knowledge about this mechanism enables to make predictions about the success of future social exchanges. The work of Ashton et al. (1998) and Perugini et al. (2003) provide interesting insights on how this could be achieved.

8.3. RELATION OF THIS THESIS TO RESEARCH AT THE SCIENCE COMMUNICATION DEPARTMENT

Science Communication is a broad field with many streams and different applications. The department of Science Communication at the TU Delft focuses on strategic communication. When designing communication strategies, the knowledge of process uncertainties is indispensable. This research is related to the focus on strategic communication because it takes a system perspective and makes the uncertainties explicit in the form of knowledge about social (in)stability of the socio-technological system of onshore wind energy. This research contributes by providing an approach to research interactions and relationships between actors. Social quantities that exist *between* stakeholders are the unit of analysis of the social network. By considering social interaction as a series of exchanges, or resource flow, communication can be made tangible and explicit.

III

AERODYNAMICS & WIND ENERGY

A THEORETICAL APPROACH TO RECIPROCITY IN WIND FARM DEVELOPMENT

9

INTRODUCTION TO A THEORETICAL APPROACH TO RECIPROCITY IN WIND FARM DEVELOPMENT

Part III of this thesis report presents the Aerodynamics & Wind Energy research that takes a theoretical perspective to reciprocity between key actors in wind farm development. It will acquaint the reader with a new network model of reciprocity and simulation results. The network model of reciprocity is constructed using concepts from (psychological) game theory, theory on reciprocity and network theory. The model is adapted in order to simulate exchanges specific for communication between wind farm developers and residents. Monte Carlo Simulation is performed to investigate outcomes of the model.

This chapter introduces the research objective and research question (section 9.1), the research scope and relevance (section 9.2) and elaborates on the type and context of this research (section 9.3). It ends with a short overview of the structure of Part III in section 9.4.

9.1. OBJECTIVE AND RESEARCH QUESTION

In the problem statement it was found that creating positive relationships between key actors in wind farm development can increase the levels of perceived procedural justice. Relationships based on reciprocity can result in relationships based on trust with committed actors. Reciprocity is a repayment in kind, meaning that actors act kind towards actors that are perceived kind and actors act unkind towards actors who are perceived unkind (Cropanzano, 2005). This mechanism has been found having a role in the stability of social systems (Gouldner, 1960), and can function as a starting mechanism of cooperation (Axelrod and Hamilton, 1981; Axelrod and Dion, 1988). A characteristic of a reciprocal relationship is that it is unknown whether or not actors return an act of kindness. In reciprocity, agreements or contracts therefore do not play a role. This makes reciprocity conceptually distinct from negotiation (Molm, 1994; Molm et al., 2000). Wind farm development is characterized by a multitude of actors such as developers, residents, policy makers etcetera, and each of those actors has different interests. In short, actors are embedded in a complex social network. This increases uncertainties in the wind farm development and communication process. It is unknown what the effects are of relationships based on reciprocity on the stability of the social network. In specific, it is interesting to have more knowledge about whether establishing positive personal relationships has consequences for the other actors in the network. The research objective of Part III is therefore to gain insight in the social network conditions for which mutual advantage between key actors is likely to occur by simulation of reciprocity between wind farm developers and involved residents who are embedded in a network.

This thesis work aims to integrate the ideas of Social Exchange Theory (SET) and Social Network Analysis (SNA) (Wasserman and Faust, 1994; Cropanzano, 2005) in order to shed light on the complexity of reciprocity on social networks in wind farm development. The relatively young branch of research that takes a quantitative perspective to social problems is called computational social science (Lazer et al., 2009). It has the potential to

make the link between actor interaction and network behavior explicit.

A focus on social resource exchange is therefore used. *Information*, *status* and *love* can be considered social resources (Foa, 1971; Foa and Foa, 2012). Positive reciprocity means that developers and residents give these resources to each other rather than taking them from each other. Feelings of fairness are invoked by the distribution of these resources among the actors. If, for example, residents are unable to obtain research reports for a wind farm development, the information distribution is not equal actors can consider the situation unfair. Actors are in this respect interdependent on other actors, because their behavior will only result in mutual advantage if the other actor's behavior is such that it enables the release of the potential benefit embedded in the relationship. In short, the resulting relationship between actors, mutual advantage, mutual disadvantage or unilateral advantage, is dependent on both actor's behavior.

The main research question reads as follows:

How can a network model of reciprocity which is tailored to simulate the social exchange process between key actors in wind farm development be used to gain insight in this process?

An answer to this research question is found by assuming a complex network consisting of actors who are embedded in groups, and simulating reciprocity between them. Varying the model conditions, such as actor characteristics, network configuration and developer and resident specific behavior leads to insight in the exchange process.

The model developed in this thesis helps to find the conditions that favor positive reciprocity resulting in equal outcomes. The subquestions that help in answering the main research question are threefold and they focus on model development, implementing actor specific behavior and the outcome of the model respectively:

1. How can a social network model of reciprocity been build based on the knowledge from scientific literature?
2. Based on the knowledge of social exchange between wind farm developers and residents from Part II of this thesis, what are suitable behavioral rules according to which wind farm developers and involved residents act towards each other in the model?
3. How do actor specific behavior and network structure relate to simulation outcomes?

The development of a network model of reciprocity makes use of existing models and theory from scientific literature. It combines game theory and network theory. Traditional game theory assumes actors being rational decision makers, meaning that they behave such that they receive the highest benefits. This traditional approach neglects notions of fairness. In this thesis fairness is incorporated using *psychological* game theory to better represent the social exchange between wind farm developers and residents (Falk and Fischbacher, 2006). This leads to the introduction of actors having perceptions, or beliefs, that they hold about other actor's behavior.

In wind farm development, the perceptions that developers hold towards residents, and residents towards developers, are not always rational. This has consequences for the social exchanges that happen between. A definition of how actor specific perceptions differ from the perceptions prescribed by the reciprocity theory is based on the results of Part II of this thesis.

The network model of reciprocity is finally implemented in a Monte Carlo Simulation, and the effects of actor heterogeneity and network structure on network outcome are systematically investigated. Groups between which communication can occur (the group 'developers' and the group 'residents') are interdependent, meaning that the actors base their actions on the other group's actions. The result can be mutual or unilateral (dis)advantage. Either one group is better off than the other, both groups are better off or both groups are worse off. In terms of wind farm development, the challenge is to find a positive and equitable outcome among wind farm developers and local residents.

The research framework for this part of the thesis is shown in Figure 9.1. It shows which consecutive steps are taken in order to reach the research objective. Scientific literature is searched for applicable theory on

networks and reciprocity. Together with the results of Part II a conceptual model will be constructed which is implemented using numerical simulation. The results from the simulations are analyzed after which allow for reaching the research objective: to obtain insight in conditions for mutual advantage in wind farm development.

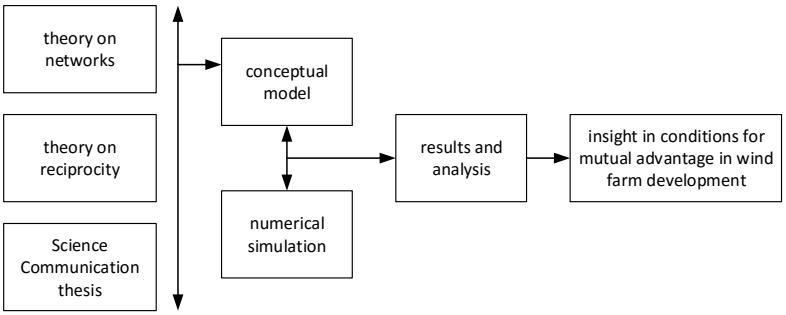


Figure 9.1: The research framework for Part III of this thesis. The theory on networks and reciprocity is dealt with in chapter 10. This chapter concludes with the conceptual model of reciprocity on networks. How the numerical simulation is performed is the topic of chapter 11. The results and analysis is subsequently covered by chapter 12. The insights in wind farm development that can be drawn from the model are given in chapter 13.

Subquestion one will be dealt with in chapter 10 where the theoretical foundations are presented and the building blocks of the model selected and integrated. The answer to subquestion two is instrumental in tailoring the model parameters to the specific problem of wind farm development, the details of which are elaborated in chapter 11 to a large extend. Subquestion three is answered by simulation using the newly developed social network model of reciprocity. The results and analysis of these simulations are presented in chapter 12.

9.2. RESEARCH SCOPE AND RELEVANCE

The research scope of Part III of this thesis is the development of a theoretical network model of reciprocity, applied to actor specific behavior found in wind farm development. Due to time limitations, parametrization will not be dealt with explicitly. Parametrization is the translation of real world conditions into specific model variables. As such, the results of this thesis provide a starting point for further investigation of reciprocity in wind farm development and multiple doors for future research are opened.

Approaching reciprocity in wind farm development from a theoretical perspective is scientifically relevant. The model presented in this thesis provide a novel way for further understanding of socio-technological innovation and wind farm development in specific. If reciprocity is, as (Gouldner, 1960) states, really at the core of social stability, then a network perspective to reciprocity is indispensable.

Despite the fact that the representativeness of the presented theoretical approach to wind farm development for a real world situation is limited , the practical relevance cannot be neglected. Wind farm development, and socio-technological innovation in general, is complex and outcomes are uncertain. The present model provides a mean to understand and communicate these complexities and uncertainties. As such, developers and residents alike can reap the benefits from a higher understanding of the social network dynamics of which they are a part.

9.3. TYPE AND CONTEXT OF RESEARCH

The present research is from the *theory-oriented* branch and *theory developing* in nature. The theories of several papers from literature are combined in order to develop a new model which helps to answer the research questions. In Appendix A all types of research are listed. The other side of theory-oriented research, that of theory testing, is touched upon, but not the main focus of this research.

This research is conducted for the Aerodynamics & Wind Energy Thesis (course code AE5110) in order to obtain the master's degree of Aerodynamics & Wind Energy at the faculty of Aerospace Engineering of the Delft University of Technology, The Netherlands. The research is carried out in collaboration with the Dutch Wind Energy Association (NWEA).

9.4. STRUCTURE OF PART III

The next chapter, chapter 10, explains the theoretical background and introduces the network theory of reciprocity. The methodology chapter, chapter 11, explains how the model is implemented in order to run numerical simulations. Results from the simulations and the analysis of these results are given in chapter 12. Finally, conclusions are given in chapter 13. This chapter also gives recommendations for future research.

10

CONCEPTUAL RESEARCH DESIGN

This chapter covers the theoretical background of this research. It introduces the reader to the models of reciprocity that exists and elaborates in detail on the model that is used in this thesis. Then the model is further developed by applying it in a sequential fashion and on social networks. The so called moonlighting game (MG) will be used to apply the network theory of reciprocity to the problem.

Before elaborating on the models of reciprocity, some conventions are given. First of all, I confine myself to exchanges between two exchange partners i and j. Between these partners, i always initiates the exchange after which j can respond. This will be referred to as the first and second move respectively. For the purpose of clarity , actor i will be referred to as a male, and actor j will be referred to as female (similar to Falk and Fischbacher). When considering networks, literature often considers 'communities'. However, instead of 'community', the word 'group' will be used to avoid confusion with the notion of community as residents of a neighborhood and the notion of communities as a set of connected actors in network theory. This chapter introduces concepts from game theory and network theory. A short introduction to game theory and its concepts is given in Appendix G and a short introduction to network theory is given in Appendix H for readers who are not familiar with (either one of) these.

In the remainder of this chapter the different kinds of models of reciprocity will be introduced (section 10.1) after which a detailed elaboration is given on the theory of reciprocity by Falk and Fischbacher including the additional conceptualization of sequential reciprocity and social networks. (section 10.2). Finally the model is applied to the Moonlighting Game (section 10.3).

10.1. THEORETICAL MODELS OF RECIPROCITY

There are two branches of research on reciprocity. The first looks at the *individual* characteristics related to reciprocity, or the *personal norm of reciprocity*. The other focuses more on how reciprocity evolves and sustains *between* actors. The latter applies, amongst others, *game theory* and networks.

This section is divided in two parts according to the two branches. First a qualitative consideration of the actor's propensity to reciprocate is given (the norm of reciprocity). The main question that will be answered is: when and how do actors reciprocate? The second part covers the existing dyadic theories of reciprocity found in literature. The goal of this section is to assess the different theories on applicability for this thesis.

Much of the conclusions of the presented research is supported by experimental data involving real humans. The settings in which these experiments take place are always stylized and optimized for measuring one specific mechanism. Moreover, the experiments span only a limited and finite time where relationships between subjects (for example trust) are solely based on the experiences during the experiment. Especially in experiments considering sequential games, games during which subjects have repeated encounters, this plays an important role. Also the stakes in the experiments are stylized from the real world. Often there is (little) money involved, or some other 'unit' or 'point'. Limitations of results can differ from experiment to experiment. In general the exception of 'noise' during the experiments poses a challenge for generalizing the

results to the real world.

10.1.1. THE PERSONAL NORM OF RECIPROCITY

The first comprehensive paper on the personal norm of reciprocity is written by Gouldner (1960). Since then, research on reciprocity has made extensive use of questionnaires to measure people's propensity to reciprocate. Experiments are subsequently done to test to proposed hypothesis about people's behavior in cases where reciprocity plays a role. The following sections elaborate on outcomes of this research. In specific, I will cover the difference between positive and negative reciprocity, the feeling of self versus other, and the role of perceived fairness in reciprocal exchange relationships.

POSITIVE AND NEGATIVE RECIPROCITY

When desired behavior by i is rewarded by j, we speak of positive reciprocity. When undesired behavior by i is punished by j, we speak of negative reciprocity, in literature often referred to as retaliation. Through questionnaires and experiments, it has been shown that people can be divided in 'positive reciprocators' and 'negative reciprocators' (Perugini et al., 2003). The former is more sensitive to positive exchanges, and has a preference towards cooperative behavior. The latter is more sensitive to negative exchanges and has a preference towards retaliatory behavior. (Ashton et al., 1998) also looks at differences in people's propensity to reciprocate, but additionally includes the similarity between exchange partners (e.g. friends and relatives versus unknown exchange partners). Individuals characterized by high empathy and low emotional stability is related to giving to similar actors. A high empath and high emotional stability are related to giving to non-similar actors. Also (Chen et al., 2009) shows that positive and negative reciprocity are likely to vary depending on the existing or lack of relationship with the exchange partner.

It is furthermore found that positive and negative reciprocity is not correlated (Perugini et al., 2003) and that positive and negative reciprocators are really two different kinds of people in the sense of their unemployment rates and well-being (Dohmen et al., 2009).

SELF VERSUS OTHER

Outcomes of social dilemma's cannot always be explained by actors having pure self-interested motives. There exists, so to say, a belief in reciprocity which is described by Perugini et al. as *'the efficacy and widespread use of reciprocity-based behaviors and expectations of others' reciprocal behavior"* (p.254). Cotterell et al. (1992) refers to this as a *reciprocity ideology*, it is a belief in an obligation to others to return greater help than they received. The other side of the spectrum is fear of being exploited, which is *reciprocation wariness*.

The relationship is moreover very important in whether someone decides to give to another or not. People are most generous to close kin and least generous to competitors, while personality treats of close kin are of less important in the decision as the personality of competitors (Ben-Ner and Kramer, 2011; Jung et al., 2014). This is related to the notions of unconditional *kin altruism* and *reciprocal altruism* where expectations of a return are much higher (Ashton and Lee, 2001, 2007). In general, a low belief in reciprocity hampers the development of interpersonal relationships (Cotterell et al., 1992). Beliefs in reciprocity can however change when multiple encounters between actors are considered.

PERCEIVED FAIRNESS IN RECIPROCAL EXCHANGES

If i gives to, or takes from j, how does j decide to what degree to respond to this? Perceived fairness plays a role in this. Falk and Fischbacher show experimentally that, even when j is deprived of a resource, she will not turn to retaliatory behavior when i did not have any other choice than to deprive j. Similarly, an act of benevolence is not perceived particularly fair if i is forced to give to j. Whether an act is fair or not, and whether the receiving actor feels obliged to (positively or negatively) reciprocate, is dependent on the choices that i has in the first place. This is, of course, only true when there is complete disclosure of information (j actually knows about $i's$ choices). Concluding, the perceived degree of fairness is always subjective, and consists of fairness of social exchange (intention) and fairness of the outcome (Perugini et al., 2003). The precise meaning of fairness and experimental data must be taken with caution since Perugini notes that *"it appears that often fairness is more a justification of behavior rather than a motive on its own"*.

Furthermore, i also has to take $j's$ possibility to reciprocate or retaliate into account. Would i harm j, when he is certain that j has the possibility to harm i even more in return? Would i be overly generous, if there is no possibility for j to reciprocate?

10.1.2. DYADIC THEORIES OF RECIPROCITY

This subsection covers a selection of popular dyadic theories of reciprocity. The theories are, roughly, in order of increasing complexity. Furthermore the theories are grouped according their similarities. There are game theoretical theories, psychological game theories and other theories. The difference between 'normal' game theory and psychological game theory is that *"psychological games provide a framework for the formal analysis of strategic settings in which expectations and emotions play a role"* and they rely on the beliefs, or expectations, of the actors (Geanakoplos et al., 1989). The abbreviations FF, MM and BB are given in accordance with the authors names. The theories are:

1. game theories
   (a) repeated prisoner's dilemma (direct reciprocity)
   (b) gift-exchange game (positive reciprocity)
   (c) ultimatum game (negative reciprocity)
2. psychological game theories
   (a) intention-consequence reciprocity (FF)
   (b) expectation-evaluation reciprocity (MM)
3. Other theories
   (a) power-dependence reciprocity (BB)

In game theoretic models, actors base their decision to play a certain strategy on the so called *utility function*. Actors aim to maximize their utility. The utility is simply calculated by the probability that j plays a strategy times the payoff that i will receive for playing a strategy of his choice. The strategy chosen is the one that maximizes $i's$ utility. Originally, utility functions focused on the material outcome, or *material utility* which gives a rational decision to choose for a strategy in for example the prisoner's dilemma. People do not behave rationally, therefore economists have come up with *social utility functions*, to account for non-rational behavior (for example Rabin (1993)).

The differences in the game theoretical models and the psychological game theoretical models above is exactly in this utility function. The adapted models correct the pure material utility with a perceived fairness term, or psychological or social utility. This adaption accounts for actor's behavior that does not comply with maximizing their own material benefit (selfish actors) by including a perceived fairness term.

REPEATED PRISONER'S DILEMMA

The simplest theory of reciprocity is given by actors playing a repeated prisoner's dilemma (PD) game. During a (one-shot) prisoner's dilemma two actors can either cooperate (C) or defect (D), and the payoff, or reward, for each actor is depending on the combination of decisions that the players make. Both actors get a payoff R when both actors cooperate. Both actors get reward P when botch actors choose to defect. If one actor cooperates and the other defects, the cooperator receives S and the defector receives T. This game is called a prisoner's dilemma when $T > R > P > S$. This is a dilemma because two cooperators will receive higher payoffs than two defectors. But at the same time the temptation for actors to defect is very high, because an actor obtains the highest payoff when he defects while the other cooperates. Similarly, to cooperate is risky because the other actor might exploit the cooperator.

It is shown that the tit-for-tat (TFT) strategy yields high payoffs when the prisoner's dilemma is played many times (Axelrod and Dion, 1988). The tit-for tat strategy is purely reciprocal: the actor starts by cooperating, and consequently copies the other actor's move (cooperate or defect). The tit-for-tat player therefore punishes defectors, and rewards cooperators. However, there is no consensus on what are the best strategies. Adaptions to the TFT strategy exist. For example (Rumble et al., 2010) shows that TFT+1 is more successful when opponents 'accidentally' defect, because it does not immediately retaliate by defecting as well. The prisoner's dilemma can also be played on networks (Floría et al., 2009; Ohtsuki and Nowak, 2007), where clusters of cooperators can arise which are resilient to 'attacks' from defectors.

The repeated prisoner's dilemma is a very basic game, with the players making a move at the same time. There are no actual resources transferred, so the value of cooperation and defection is known and constant. Also, both actors have to cooperate or defect (give or take) but have no option to refrain from playing the game. When playing the game, both actors perceive the same transaction.

GIFT-EXCHANGE GAME

The gift-exchange game is a positive reciprocity game (Gächter and Falk, 2002). It is explained by an employer offering a wage w to an employee. The employee subsequently makes a calculated decision to provide effort c which is a function of an effort decision $e(c)$. The employee receives the payoff $w - e$. The key element in this game is that the payoff for the employer is multiplied by a margin such that his payoff is $ve - w$. This game is therefore a model of positive reciprocity. If the employer wishes to give a high wage, the employee subsequently feels the obligation to make much effort, thereby increasing the additional payoff for the employer.

This game includes the possibility to refrain from exchange and can be played in both a sequential and simultaneous manner. The total amount of resource can increase as a result of the chosen strategies of actors. The standard game does not take perceptions of actors into account, and does not allow for negative reciprocity.

ULTIMATUM GAME

The ultimatum game is a negative reciprocity game between two actors. In this game the first mover (proposer) is given an amount of resource. Subsequently, the proposer can endow the second mover (responder) with nothing, a fraction, or the total amount of the resource. The responder accepts of rejects the endowment. Acceptance leads to both players receiving the payoff according to the proposed division by the proposer. Rejection lead to both players receiving zero.

Perceived fairness plays a role in the ultimatum game. Proposers would not propose more than half of the resource, because acceptance would lead to an unfair distribution. However, proposing less than half of the resource increases the risk of rejection by the responder. He perceives an unfair distribution of resources and might reject the offer to punish the proposer for the unfair offer.

This is a sequential game and, opposite to the gift-exchange game, the total amount of resource can decrease. There exists no possibility to refrain from playing. The game does not allow for positive reciprocity.

INTENTION-CONSEQUENCE RECIPROCITY (FF)

The mathematical model of Falk and Fischbacher (2006), hereafter named FF, takes the perceived intention and the consequences of an exchange as variables that influence the degree of reciprocity. The basic premise of this model is that perceived kindness will be returned with kindness, and perceive unkindness will be returned with unkindness. It is based on the work of Rabin (1993), who takes into account the first and second order beliefs of actors' behavior. The first order belief s_i' is *"$i's$ belief about the behavior strategy s_j, which player j will choose"*. The second order belief s_i'' is "*$i's$ belief about $j's$ belief about which behavior strategy i will choose*" (p.295). s_i just denotes actor $i's$ behavior. FF can, amongst others be applied to the earlier described prisoner's dilemma, gift-exchange game and ultimatum game.

In this model, actors are described having a kindness term ϕ and a reciprocation term σ. ϕ denotes how kind an actor i perceives the action by another actor j. The kindness term is the product of the outcome and the intention of an action and it is positive for a rewarding action and negative for a punishing action. The degree of intention fairness is a result of the possibilities that actors have. This means that even if an actor i deprives the actor j it is not perceived unfair if there are no other possibilities for i to act otherwise.

The FF model also makes use of a utility function $U(f, s'', s')$ incorporating a linear combination of material utility π and social utility (the 2006 paper uses the term *reciprocity utility*). The social utility is a function of the above described kindness term ϕ and reciprocation term σ and an additional reciprocity parameter ρ which describes the strength of the actor's reciprocal preferences (similar to the belief in reciprocity by (Perugini et al., 2003), although this model does not discriminate between positive and negative reciprocators). The kindness term and the reciprocation term are extensively discussed in their paper. The kindness term is dependent on the difference of both actor's material payoffs, and the reciprocation term is related to the actor's actual possible choices (i.e. if there is no possibility to reward, but only punish, this is not necessarily perceived unfair. Just because there is no other possibility). The utility function is given by:

$$U_i(f, s_i'', s_i') = \pi_i(f) + \rho_i \sum_{\substack{n \to f \\ n \in N_i}} \phi_j(n, s_i'', s_i')\sigma_i(n, f, s_i'', s_i')$$

When beliefs match actual behavior such that $s_i = s_j' = s_i''$, then there is a *reciprocity equilibrium*. This notion is conceptually similar to my qualitative findings in my science communication thesis, where exchanges are either perceived equal or perceived differently.

The model explicitly takes into account perceptions of other actors in the form of the first and second order beliefs. It also takes into account that large material utilities diminish the importance of social utility. It however assumes that the actors have full knowledge about the other actors possible choices'. Falk and Fischbacher (2006) is cited 448 times, no research is found that uses this theory in a network fashion.

EXPECTATION-EVALUATION RECIPROCITY (MM)

The expectation-evaluation reciprocity model is proposed by Gallucci and Perugini and is referred to as the MM model (MM is according to the author's first names). This is, to my knowledge, the earliest model of reciprocity which incorporates perceptions of the other player into strategies. The norm of reciprocity in the MM model prescribes *"individuals to reward (help) those who have rewarded (helped) or are expected to reward (help) them and to punish (hurt) those who have punished (hurt) or are expected to punish (hurt) them"* (p.369).

Similar to FF this model uses a utility function U. Interacting actors always aim to choose a strategy that maximizes their utility. In this model, individuals *"compare the utility derived from offering a given payoff to the other and the utility derived from having been offered, or expecting to be offered, a given payoff"* (p.369). The outcome of this comparison can be different for each actor. The utility U_i is a linear combination of the material utility π_i, and the social utility. A generic utility function is given by:

$$U_i(\pi_i, \rho_j, \rho_i) = \pi + \lambda_i F(\rho_j - \rho_i)$$

With the sensitivity to reciprocity parameter λ_i and the norm of reciprocity $F(\rho_j - \rho_i)$ in which ρ_i is the value that i offers or is going to offer to j, and ρ_j is the value that j offers or has offered to i. The sensitivity to reciprocity parameter λ serves a similar function as ρ in the FF model and could therefore be interpreted as the *belief in reciprocity*. ρ in the MM model is a subjective variable.

The model is experimentally tested by letting subjects play a PD game followed by a dictator game (DG). In the dictator game, actor i has a certain amount of money (or other credit) and decides how much of this he will share with j. j subsequently receives this amount, and the game is over. The experiment by Gallucci and Perugini works as follows: the outcome of the PD invokes positive or negative feelings in i, who subsequently decides how much money he shares with j during the dictator game. The model and experiments show that the amount that the dictator gives is depending on the outcome of the PD game. It does so in such a way that the amount b that i gives to j $b(C,D) < b(D,D) < b(D,C) < b(C,C)$ with C and D the strategies that i and j can choose (cooperation or defect) during the PD game. This outcome is fundamentally different than the outcome of games where actors are either self-interested or aim at an equitable allocation of resources.

The model allows for positive an negative reciprocity, only during the DG part of the game there is actual resource flowing, and only from i towards j. Actors have full knowledge about the other actor's possible choices, cannot refrain from playing and social utility becomes less important when stakes of material utility are high. Interesting is that no direct measurement of λ is necessary in the experiments, because it is implicit in the model (for example, high-λ dictators who were confronted with a defector will donate more than low-λ dictators). For numerical models λ must be assumed.

Some flaws in the model remain. How, for example, to determine what is the social utility function? The paper gives some suggestions based on mathematical elegance. It also does not describe on basis of what ρ is determined by the other actor, but suggest that this could be a function of all the possible strategies of the other actor j. This article is only cited 17 times. and the applicability is more limited than the FF model. No further research has been found that explicitly uses the model.

POWER-DEPENDENCE RECIPROCITY (BB)

The power-dependence model of reciprocity is proposed by Bonacich and Bienenstock (2009) and will be referred to as the BB model. It is a mathematical model of reciprocity based on the research on power-dependence of Molm (which is also used in Part II). Dependence between actors is created through network structure, in which more central actors have power over more peripheral actors. The model is compared with experimental results on simple 5-actor networks. The mechanism of reciprocity is as follows: every round, each actor has to give points to one neighboring actor of choice. Actors can give other actors a certain amount of points up to a maximum and giving does not reduce the amount of points of the giver. Only receiving points counts. When points are given from i to j, $j's$ propensity to give back to i, p_{ij} increases, at an expense of $j's$ propensity to give to other neighbors p_{ik}. How much the propensity changes is given by:

$$p_{ij}^{(t+1)} = p_{ij}^{(t)} + \alpha c_{ji}(1 - p_{ij}^{(t)})$$

$$p_{ik}^{(t+1)} = (1 - \alpha c_{ji}) p_{ik}^{(t)}$$

where c_{ji} is the amount of points that j can possibly receive from i and $\alpha \geq 0$ is the responsiveness of actors to rewards (again, a similar notion to the belief in reciprocity of Perugini et al., ρ in the FF model and λ in the MM model). Each round, all participants have the possibility to give a certain amount of points to one of their connections. The goal is to gain as much points as possible. The amount of points that actors can give to each other c is not equal for all connections, giving rise to increased dependencies between actors. In the experiments, the game is played for 150 rounds between four or five actors. One example of a used network is given in Figure 10.1.

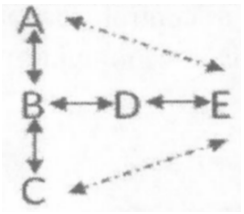


Figure 10.1: One of the networks used by Bonacich and Bienenstock to numerically and experimentally research reciprocity and dependence between actors. The dashed arrows indicate a lower maximum resource transfer than the full arrows.

There is no explicit negative reciprocity in the BB model, although choosing to give to one neighbor j at the expense of giving to another neighbor k could be perceived by k as a punishment. Perceptions of other actor's behavior is also not explicitly taken into account in the model. Contrary to the FF and MM models, this is actually numerically *and* experimentally applied to networks with more than two actors ($N > 2$) with significant results.

In this model of reciprocity actors can not refrain from exchanging, but always have to choose between neighboring actors (sum of probabilities to give to other actors is always 1). The notion of power and dependence is however very interesting since the shape of the network allows some actors to receive more points than other actors. This can be analyzed on two levels: the dyadic dependence (which of the two actors gives more to the other) and global power (who, in the network, receives most). The paper is however only cited three times.

10.2. CONCEPTUAL NETWORK MODEL OF RECIPROCITY

The quantitative dyadic (between two actors) model of reciprocity that is used for this research needs to comply with the following requirements:

1. Actions by i are dependent on its perception of j an vice versa.
2. Actors can hold different perceptions of the same situation: perceptions can be consistent or inconsistent.
3. The model should explicitly allow for positive and negative reciprocity.

4. Resources are non-depletable.

5. Actors have memory and base their move on (all) previous moves.

The intention-consequence model of reciprocity by Falk and Fischbacher described in subsection 10.1.2 fits these requirements best. Perceptions of other actors are incorporated using a set of beliefs (1), and these perceptions can differ from actor to actor (2). The model allows for positive and negative reciprocity (3), but this is depending on whether the game considered allows for both positive and negative reciprocity (for example, the previously mentioned gift-exchange game and ultimatum game allow for either positive or negative reciprocity). Whether resources are depletable or not is also depending on the type of game considered (4). Memory of actors is not described by Falk and Fischbacher since they do not describe sequential games, but can be implemented using the work of Dufwenberg and Kirchsteiger (2004) through updating the actors' beliefs (5).

Next to this, the *FF* model has acquired the most firm response within the scientific community, giving rise to its credibility and applicability. The theory is elegantly deduced from experimental results and earlier work of Rabin (1993) and applicable to a wide range of games. One feature that distinguishes this model from the others is that the *possible choices* of actors are taken into account, meaning that an actor is not necessarily perceived unfair when this actor had no other possibility than to deprive the other actor. If material stakes become large in the *FF* model, then reciprocal motivations become less important. These characteristics make the model most suitable for describing reciprocity on two-mode networks.

The remainder of this section presents the dyadic theory of reciprocity by Falk and Fischbacher (2006) extended by beliefs updating model (Dufwenberg and Kirchsteiger, 2004) applied to a "moonlighting game" (Abbink et al., 2000). This game allows for both positive and negative reciprocity. First, the general equations of the model are presented along with some examples to clarify the meanings of the equations.

10.2.1. THE UTILITY FUNCTION

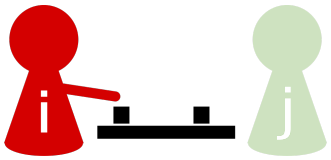
A game consisting of f nodes ('moves') is played by actors i and j. A node n is a move by one of the players. The utility U of a move of an actor at a specific node consists of a linear combination of the (expected) *material payoff* π at node f and the sum of *social payoffs* of all nodes $n \rightarrow f$ for that specific move. The actor chooses the move that has the highest utility. The material payoff is purely dependent on the outcome of the game. The social payoff is dependent on the fairness of all moves of both actors throughout the game, and therefore a summation of all subsequent moves $n \rightarrow f$. The utility function is given by:

$$U_i(f, s_i'', s_i') = \pi_i(f) + \rho_i \sum_{\substack{n \rightarrow f \\ n \in N_i}} \phi_j(n, s_i'', s_i') \cdot \sigma_i(n, f, s_i'', s_i') \tag{10.1}$$

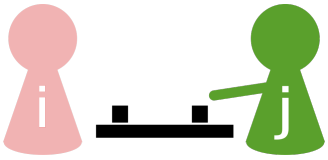
The social payoff consists of the reciprocity parameter ρ, the kindness term ϕ and the reciprocation term σ. ρ is the actor's propensity to reciprocate with $\rho \geq 0$. ϕ indicates how kind the other actor is based on the difference in material payoff for each actor and the intentions of the other actor. When the other actor is perceived unkind, $\phi < 0$, when the other actor is perceived kind $\phi > 0$. The reciprocation term σ the response of an actor by experienced (un)kindness of the other actor. $\sigma > 0$ for rewarding behavior following perceived kindness $\sigma < 0$ for punishing behavior following perceived unkindness.

The payoff π is a function of the strategies s chosen by both actors such that $\pi_k(s_i, s_j)$ with k being one of the actors i or j and strategy sets S_i and S_j such that $s_i \in S_i$ and $s_j \in S_j$. This section will explain the different terms in Equation 10.1 supported by examples.

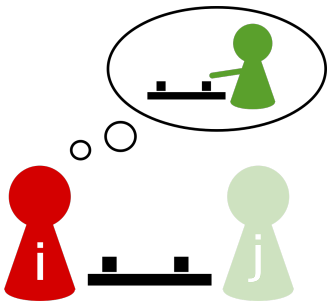
Actors have to make a decision which strategy s to choose based on their perception of the other actor. This perception is included through the first order belief s' and the second order belief s''. The first order belief s_i' is *"$i's$ belief about the behavior strategy s_j, which player j will choose"*. The second order belief s_i'' is "*$i's$ belief about $j's$ belief about which behavior strategy i will choose*" (Falk and Fischbacher, 2006)(p.295). These beliefs are at the core of the model, and are visually shown in Figure 10.2. The implications of the inclusion of the first and second order belief in Equation 10.1 will be discussed later in this section. First the beliefs will be illustrated with some examples.



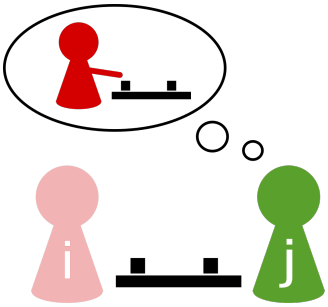
(a) Chosen strategy of actor i, s_i.



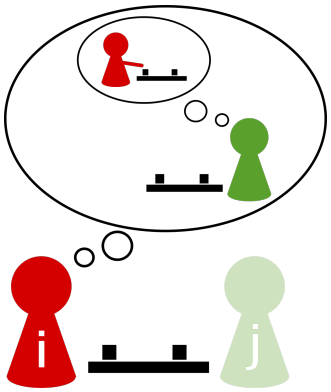
(b) Chosen strategy of actor j, s_j.



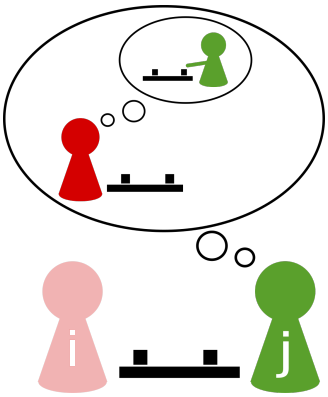
(c) Actor i's belief of the strategy that j will choose, s'_i (first order belief).



(d) Actor j's belief of the strategy that i will choose, s'_j (first order belief).



(e) Actor i's belief of actor j's belief of the strategy that i will choose, s''_i (second order belief).



(f) Actor j's belief of actor i's belief of the strategy that j will choose, s''_j (second order belief).

Figure 10.2: Visual representation of strategies ((a) and (b)), the first order beliefs ((c) and (d)) and second order beliefs ((e) and (f)) of actors i and j playing a game.

A simple example to illustrate the meaning of the first and second order belief is the decision making process one goes through when sending Christmas cards ($S_i \in$ {send, don't send}). Actor i in Figure 10.2 has to make the decision whether to send a Christmas card (s_i = send) to j or not (s_i = don't send). Obviously, i will only send a card when he thinks that j will send him a card while i will not send a card when he thinks that j will not send him a card. In other words, the decision that i will make is depending on his belief of the action of j. The same decision process is followed by j, and she also has a belief that i will or will not send a Christmas card. The problem is that actors cannot know which action to choose with this first order belief only. Not until i has the knowledge of actor j's belief of the action that i will choose, can i make a good decision whether to send a Christmas card or not. If i thinks that j thinks that i will send a Christmas card, then the reasonable action for j will be to send a Christmas card (as perceived by i). If i thinks that j will send a Christmas card,

then i will send a Christmas card. The former example is typical for a *simultaneous game*, when the Christmas card is replaced by a birthday card, a *sequential game* is obtained. It is much easier for i to decide what to do, because i did or did not receive a birthday card on his last birthday, and responds accordingly.

Back to the utility function. Note that when the material payoffs become sufficiently large (relative to social payoff), they will dominate the utility. This is consistent with real human behavior. Consider, for example, that actor i has to choose whether to give one Euro to actor j or to keep it himself. There is a probability that i will indeed give this Euro to j, especially when there is an expectation of future interactions. When i has to make the same decision but now for, say, 1000 Euros, it is less likely that he will give this to j. The probability of giving becomes increasingly smaller for higher amounts of money. For more insight, Example 1: application with $\rho = 0$ gives an application of Equation 10.1 to the prisoner's dilemma with $\rho = 0$.

EXAMPLE 1: APPLICATION WITH $\rho = 0$

When the reciprocity parameter $\rho = 0$, fairness concerns do not play a role and only material payoff matters. Equation 10.1 reduces to:

$$U_i(f) = \pi_i(f)$$

Now consider the simultaneous one-shot prisoner's dilemma (one move, so $f = n$) which has the payoff matrix as shown below ($T = 3 > R = 2 > P = 1 > S = 0$). Actors can both choose to either *defect* (d) or *cooperate* (c). Thus, the strategy set for actor i is $S_i = (c, d)$ and the strategy set for actor j is $S_j = (c, d)$. The possible outcomes $\pi_k(s_i, s_j)$ for the players are:

$$\begin{aligned}
\pi_i(c,c) &= 2\\
\pi_j(c,c) &= 2\\
\pi_i(c,d) &= 0\\
\pi_j(c,d) &= 3\\
\pi_i(d,c) &= 3\\
\pi_j(d,c) &= 0\\
\pi_i(d,d) &= 1\\
\pi_j(d,d) &= 1
\end{aligned}$$

		Actor j	
		c	**d**
Actor i	**c**	2 / 2	3 / 0
	d	0 / 3	1 / 1

The utility is equal to the material payoffs and actors choose a strategy that yields the highest utility. When $s_j = c$, actor i would rationally choose $s_i = d$ because $\pi_i(d,c) = 3 > \pi_i(c,c) = 2$. When $s_j = d$, actor i would rationally choose $s_i = d$ because $\pi_i(d,d) = 1 > \pi_i(c,d) = 0$. The same holds for actor j. Both actors are better of choosing d despite the fact that they receive the highest payoff when they both choose c. Both actors choosing d is generally known as the *Nash equilibrium*.

THE KINDNESS TERM ϕ

Now turning back to the equations of reciprocity, let's take a closer look at the kindness term ϕ. The kindness of an actor is dependent on *the difference in material payoffs of both actors*. In other words, if $\pi_i > \pi_j$, then j is perceived kind towards i, and when $\pi_i < \pi_j$, j is perceived as being unkind towards i. This is, however, not the complete story. If j has *no other possibility* than to choose a strategy such that the outcome is $\pi_i < \pi_j$, then j does not necessarily act unkind. After all, j was not left a choice. So the *intention* of j also plays a role. The kindness term is given by:

$$\phi_j(n, s_i'', s_i') = \theta_j(n, s_i'', s_i')\Delta_j(n, s_i'', s_i') \tag{10.2}$$

with the intention factor θ_j and the outcome term Δ_j. I first want to cover the outcome term. The outcome term is simply given by:

$$\Delta_j(n, s_i'', s_i') := \pi_i(n, s_i'', s_i') - \pi_j(n, s_i'', s_i') \tag{10.3}$$

which equals the difference in expected payoffs. Δ_j is positive for $\pi_i > \pi_j$, meaning that j receives less material payoff than i. Similarly Δ_j is negative for $\pi_i < \pi_j$, meaning that j receives more material payoff than i. Whether j is being kind or not towards i depends on i's material payoff π_i *relative to the other possible material payoffs* $\tilde{\pi}_i$. This is shown in Table 10.1.

Table 10.1: Material payoff outcomes for both actors and possible alternatives.

outcome	**alternatives**
$\pi_i \geq \pi_j$	$\tilde{\pi}_i < \pi_i$ (1)
	$\tilde{\pi}_i \geq \pi_i$ (2)
$\pi_i < \pi_j$	$\tilde{\pi}_i > \pi_i$ (3)
	$\tilde{\pi}_i \leq \pi_i$ (4)

The intention factor θ_j is then defined as being a parameter between zero and one, with $\theta_j = 0$ meaning a non-intentional material payoff distribution and $\theta_j = 1$ when j very intentionally chose for a specific material payoff distribution. If we now take a look at situation (1) in Table 10.1, it can be seen that in terms of material payoff i is better of than j, while there exists at least one alternative outcome that yields a lower payoff for i. j has thus intentionally chosen a strategy such that i does not receive the lowest material payoff possible, so $\theta_j = 1$. The same hold for situation (3): i has a lower material payoff than j, while there were higher payoffs possible for i. In this case j intentionally deprived i of material payoff and $\theta_j = 1$.

In situations (2) and (4) it is less apparent what the intention of player j is. For this, Falk and Fischbacher introduce a *pure outcome parameter* ε_i. It states "i's *pure* concern of an equitable *outcome*: If, e.g., ε_i is equal to zero, [actor] i considers a particular outcome only as kind or unkind if it was caused intentionally, i.e., if the other player had an alternative to act differently. [An actor] with $\varepsilon_i = 0$ has a purely intention driven notion of fairness. [An actor] with $\varepsilon_i = 1$ cares *only* about the consequences of j's action, i.e., intention plays no role" (p.300-1). For cases (2) and (4) $\theta_j = \varepsilon_i$. Falk and Fischbacher formally write down θ_j as follows:

$$\theta_j\left(n, s_i'', s_i'\right) = \begin{cases} 1 & \text{if } \pi_i \geq \pi_j \text{ and } \exists \tilde{\pi}_i \in \Pi_i\left(n, s_i''\right) \text{with } \tilde{\pi}_i < \pi_i \\ \varepsilon_i & \text{if } \pi_i \geq \pi_j \text{ and } \forall \tilde{\pi}_i \in \Pi_i\left(n, s_i''\right), \tilde{\pi}_i \geq \pi_i \\ 1 & \text{if } \pi_i < \pi_j \text{ and } \exists \tilde{\pi}_i \in \Pi_i\left(n, s_i''\right) \text{with } \tilde{\pi}_i < \pi_i \\ \varepsilon_i & \text{if } \pi_i < \pi_j \text{ and } \forall \tilde{\pi}_i \in \Pi_i\left(n, s_i''\right), \tilde{\pi}_i \geq \pi_i \end{cases} \tag{10.4}$$

Table 10.1 and ε tell us that it is sometimes clear whether j acts intentionally, but in the cases that this is not clear, the kindness depends on how much i cares about an equitable material payoff. The intention factor θ_j basically scales the positive or negative outcome Δ_j. Let's put the pure outcome parameter ε into perspective of Equation 10.2 with an example. Consider that i, based on his beliefs, expects the outcome of a game $\pi_i < \pi_j$ with $\tilde{\pi}_i \leq \pi_i$ (situation (4) in Table 10.1). This yields a negative Δ_j. If i has a very high concern of an equitable outcome ($\varepsilon = 1$) then $\phi_j = \Delta_j$ is negative and j is perceived as being unkind. If i has a low concern of an equitable outcome ($\varepsilon = 0$) then $\phi_j = 0$ and j is not perceived as being unkind. In reality $0 \leq \varepsilon \leq 1$ and varies from person to person and the perceived (un)kindness then varies between zero and Δ_j. If j has no alternatives, then $\theta_j = \varepsilon_i$.

When taking the kindness of actors into account in the utility function, the *perceptions* of actors are implicitly included. Whereas in example 1 the utility was merely a function of the strategies chosen by the involved actors, now it is included *why* actors choose for a specific strategy. Because now perceptions play a role, this is the place to elaborate on the *first and second order beliefs* s' and s''. This is done in Example 2: Determining the kindness term ϕ.

EXAMPLE 2: DETERMINING THE KINDNESS TERM ϕ

This example uses the perspective of actor i. Again, the one shot simultaneous prisoner's dilemma is considered. Actor i will determine how kind j is to him according to his perceptions of her. The four possible belief sets and the outcomes Δ_j corresponding to these belief sets (calculated using the results of example 1 and Equation 10.3) are:

$$s_i'' = c, s_i' = c \qquad \Delta_j(s_i'', s_i') = \Delta_j(c,c) = 2-2 = 0$$
$$s_i'' = c, s_i' = d \qquad \Delta_j(s_i'', s_i') = \Delta_j(c,d) = 0-3 = -3$$
$$s_i'' = d, s_i' = c \qquad \Delta_j(s_i'', s_i') = \Delta_j(d,c) = 3-0 = 3$$
$$s_i'' = d, s_i' = d \qquad \Delta_j(s_i'', s_i') = \Delta_j(d,d) = 1-1 = 0$$

The intention factor θ_j is determined as follows: given a belief of j's strategy s_i' and a belief of j's belief of i's strategy s_i'', and the accompanying possible payoff set of i, Π_i, which is a function of s_i'', j can choose a strategy that yields a material payoff for i.

For example: for beliefs of i $s_i'' = c, s_i' = c$, $\pi_i = 2$ and $\Delta_j(c,c) = 0$. The question now is whether there exist an *alternative material payoff* $\tilde{\pi}_i$ which yield higher or lower payoffs than π_i. For a given s_i'', s_i' can be two possible values (either c or d). When looking at the material payoff matrix, the only alternative payoff is $\tilde{\pi}_i = 0$ (the entry $s_i'' = c, s_i' = d$). This corresponds to situation 1 in Table 10.1, meaning that j fully intentionally grants i with a high payoff and thus the intention factor $\theta_j = 1$. The other three possibilities are determined in a similar fashion and give the results shown below. The kindness term ϕ_j is obtained by multiplying the outcome term Δ_j with the intention factor θ_j.

$$\theta_j(s_i'', s_i') = \theta_j(c,c) = 1 \qquad \phi_j(c,c) = 0 \cdot 1 = 0$$
$$\theta_j(s_i'', s_i') = \theta_j(c,d) = \varepsilon_i \qquad \phi_j(c,d) = -3 \cdot \varepsilon_i = -3\varepsilon_i$$
$$\theta_j(s_i'', s_i') = \theta_j(d,c) = 1 \qquad \phi_j(d,c) = 3 \cdot 1 = 3$$
$$\theta_j(s_i'', s_i') = \theta_j(d,d) = \varepsilon_i \qquad \phi_j(d,d) = 0 \cdot \varepsilon_i = 0$$

π_i \ π_j	Actor j: **c**	Actor j: **d**
Actor i: **c**	2 / 2	3 / 0
Actor i: **d**	0 / 3	1 / 1

ϕ_i \ ϕ_j	Actor j: **c**	Actor j: **d**
Actor i: **c**	0 / 0	-3 / 3
Actor i: **d**	3 / -3	0 / 0

THE RECIPROCATION TERM σ

The reciprocation term in Equation 10.1 is given by $\sigma_i(n, f, s_i'', s_i')$ and describes the response of i to the experienced (un)kindness of j. This response consists of an alteration of j's material payoff π_j as a result of i's chosen strategy s_i and i's alternative strategy $\tilde{s}_i$. The term is given by the alternative payoff minus the payoff given s'' and s':

$$\sigma_i\left(s_i'', s_i', \tilde{s}_i\right) = \pi_j\left(\tilde{s}_i, s_i'\right) - \pi_j\left(s_i'', s_i'\right) \tag{10.5}$$

σ_i can be positive or negative. For $\sigma_i > 0$, i is rewarding j for being kind, for $\sigma_i < 0$, i is punishing j for being unkind. The social utility term of Equation 10.1 becomes positive for either reward or punishment. An example of a calculation of the reciprocation term is given in Example 3.

EXAMPLE 3: DETERMINING THE UTILITY FUNCTION

Consider the PD of examples 1 and 2 and actor i having the belief set $s_1' = d$ and $s_2'' = c$ and $\rho = 1$. Which strategy, c or d, will i choose?

For the given data, $\pi_i(c,d) = 0$ and $\phi_j(c,d) = -3\varepsilon_i$ (see previous examples). Now we can calculate the reciprocation term σ_i using Equation 10.5 for all possible strategies. We expect this to be negative because j has been acting unkind towards i ($\phi_j(c,d) < 0$). Let σ_i^c be the reciprocation term describing the rewarding or punishing behavior of i towards j's kind or unkind behavior with respect to the other alternatives that i has at his disposal when $s_i = c$. Similarly σ_i^d is the reciprocation term describing the rewarding or punishing behavior of i towards j's kind or unkind behavior with respect to the other alternatives that i has at his disposal when $s_i = d$. Using Equation 10.5:

$$\sigma_i^c\left(s_i'', \tilde{s}_i, s_i'\right) = \pi_j(c,d) - \pi_j(c,d) = 3 - 3 = 0$$
$$\sigma_i^d\left(s_i'', \tilde{s}_i, s_i'\right) = \pi_j(d,d) - \pi_j(c,d) = 1 - 3 = -2$$

Indeed, the reciprocation term $\sigma_i^d < 0$. Now inserting the above results and the results from examples 1 and 2 in Equation 10.1:

$$U_i^c(s_i'', s_i') = \pi_i + \rho_i \phi_j(s_i'', s_i') \sigma_i^c(s_i, \tilde{s}_i, s_i') = 0 + 1 \cdot -3\varepsilon_i \cdot 0 = 0$$
$$U_i^d(s_i'', s_i') = \pi_i + \rho_i \phi_j(s_i'', s_i') \sigma_i^d(s_i, \tilde{s}_i, s_i') = 0 + 1 \cdot -3\varepsilon_i \cdot -2 = 6\varepsilon_i$$

For actor i choosing strategy $s_i = c$ the utility $U_i^c = 0$ and for choosing strategy $s_i = d$ the utility $U_i^d = 6$. With $U_i^d > U_i^c$ for belief set $s_i' = d$ and $s_i'' = c$, i will choose strategy d (defect) for $0 < \varepsilon \leq 1$.

There are four possible belief sets and two possible strategies per belief set. The calculated utilities of actor i for all belief sets are:

$$s_i'' = c, s_i' = c \begin{cases} U_i^c = 2 \\ U_i^d = 2 \end{cases} \quad , s_i'' = c, s_i' = d \begin{cases} U_i^c = 0 \\ U_i^d = 6\varepsilon_i \end{cases} \quad , s_i'' = d, s_i' = c \begin{cases} U_i^c = 9 \\ U_i^d = 3 \end{cases} \quad , s_i'' = d, s_i' = d \begin{cases} U_i^c = 1 \\ U_i^d = 1 \end{cases}$$

In this simple PD game, the equal material outcome situations (c,c) and (d,d) yield equal utilities.

10.2.2. THE RECIPROCITY EQUILIBRIUM

In example one, the *Nash equilibrium* was found. When fairness is incorporated in games the utilities of the different strategies change and this Nash equilibrium is not always the equilibrium solution. Instead, there exists a *reciprocity equilibrium*, sometimes called the *psychological Nash equilibrium*. The idea of a reciprocity equilibrium for *psychological games* is first explained by Geanakoplos et al. (1989). Both Dufwenberg and Kirchsteiger and Falk and Fischbacher hold the same notion of the reciprocity equilibrium and provide proofs for the existence of this equilibrium.

The reciprocity equilibrium is defined as the strategy with highest utility with the requirement that actor beliefs match actual chosen strategies of the actors. This means that $s_i'' = s_j' = s_i$ and $s_j'' = s_i' = s_j$ with s_i and s_j for which $\max U_i$ and $\max U_j$ hold. In Example 4: The reciprocity equilibrium an example is given.

This is analogous with the typology of exchanges table of the science communication thesis. Exchanges are *consistent* when both actors experience the same type of exchange in a real social situation, while exchanges are inconsistent when both actors hold different perceptions of an exchange.

When considering sequential games, with every subgame the probability distributions (history profiles) change in favor of actual behavior. Dufwenberg and Kirchsteiger states that this allows for *"dynamically inconsistent preferences"* (p. 279) when both actors hold beliefs that are inconsistent with actual behavior.

EXAMPLE 4: THE RECIPROCITY EQUILIBRIUM

For the one-shot prisoner's dilemma it can be shown that a reciprocity equilibrium exists. To show the reciprocity equilibrium, the results from example 3 are used with both actors having $\rho = 1$. Instead of only considering i's perspective also j's perspective must be taken into account. The strategy sets and the material payoff matrix of both actors are the same, the utilities are therefore determined in the same matter. The results from example 3 are therefore applicable to both actors.

The belief sets $s'' = c, s' = c$ and $s'' = d, s' = d$ yield equal utilities for the possible strategies. The decision of an actor to choose a strategy s is then dependent on the product of material outcomes for each of the strategies (Osborne and Rubinstein, 1994). The actor will choose to play the strategy for which this product is maximum. For $s_i = c, s_j = c$ the product of material outcomes is $\pi_i \cdot \pi_j = 2 \cdot 2 = 4$ and for $s_i = d, s_j = c$ the product of material outcomes is $\pi_i \cdot \pi_j = 3 \cdot 0 = 0$. Actor i will thus choose $s_i = c$, cooperation. Similarly, for $s_i'' = d, s_i' = d$, actor i will thus choose $s_i = d$, defect.

Both actors can have four different belief sets, which means that there are $4 \cdot 4 = 16$ possible combinations of belief sets. If, for example, the belief sets $s_i'' = c, s_i' = c, s_j'' = c, s_j' = c$, the actors choose $s_i = c, s_j = c$ (from Example 3: determining the utility function). This results in $s_i'' = s_j' = s_i$ and $s_j'' = s_i' = s_j$, meaning that there exists a reciprocity equilibrium. If, another example, $s_j'' = d, s_j' = c$, then j follows a different decision path. In example 3 it is shown that the utility for choosing c is higher than the utility for choosing d, so $s_j = c$. In this latter situation $s_i'' = s_j' = s_i$ but $s_j'' \neq s_i' = s_j$, so there is no equilibrium.

The strategies that both actors choose for all possible combinations of belief sets and whether they are reciprocity equilibria or not are tabulated below. The reciprocity equilibria exist for $s_i'' = s_j' = s_i = s_j'' = s_i' = s_j = c$ and $s_i'' = s_j' = s_i = s_j'' = s_i' = s_j = d$. Theoretically belief sets resulting in either $s_i'' = s_j' = s_i = c$ and $s_j'' = s_i' = s_j = d$ or $s_i'' = s_j' = s_i = d$ and $s_j'' = s_i' = s_j = c$ would also be reciprocity equilibria, but in this game these equilibria do not exist. Note that when $\rho = 0$, what remains of the reciprocity equilibrium is equal to the Nash equilibrium of example 1.

(s_i'', s_i') \ (s_j'', s_j')	**(c,c)**	**(c,d)**	**(d,c)**	**(d,d)**
(c,c)	$s_i = c, s_j = c$ *equilibrium*	$s_i = c, s_j = d$	$s_i = c, s_j = c$	$s_i = c, s_j = d$
(c,d)	$s_i = d, s_j = c$	$s_i = d, s_j = d$	$s_i = d, s_j = c$	$s_i = d, s_j = d$
(d,c)	$s_i = c, s_j = c$	$s_i = c, s_j = d$	$s_i = c, s_j = c$	$s_i = c, s_j = d$
(d,d)	$s_i = d, s_j = c$	$s_i = d, s_j = d$	$s_i = d, s_j = c$	$s_i = d, s_j = d$ *equilibrium*

10.2.3. SEQUENTIAL RECIPROCITY AND UPDATING BELIEFS

If the MG is played multiple times between the same actors, sequential reciprocity, the problem of belief updating arises. Whereas the reciprocity parameter ρ from Equation 10.1 and the pure outcome parameter ε can be assumed constant since they describe actor specific personality factors, the assumption that the first and second order beliefs remain constant throughout a sequential game seems invalid. For example: Suppose that i has the belief that j will act kind to him, but during many games j treats i unkind move after move. Then at one point i will change his belief to a more realistic one: that j will act unkind towards him.

Dufwenberg and Kirchsteiger (2004) introduce a model that describes a method of updating beliefs to account for these dynamic perceptions. The model assumes that at every beginning of a subgame, the actors hold a belief that is motivated by earlier experienced (un)kindness. These are the beliefs the actors use during the whole subgame. When entering the next subgame, the beliefs will be updated.

Updating the beliefs is done according to the following procedure: when actors play a sequence of subgames, they obtain knowledge of the *history* of actual behavioral strategies of the other actor. Let the history profile of actor j be called h_j, and let $s_i'^n$ and $s_i''^n$ be the first and second order belief of actor i at node (move) n. The history profile h_j is a probability distribution on the set of possible strategies of j, based on earlier chosen strategies of j. If the beliefs are depending on the history profile, then $s_i'^{(n)}(h_j)$ and $s_i''^{(n)}(h_i)$. Inserting this in Equation 10.1 results in Equation 10.6.

$$U_i(f, s_i''(h_i), s_i'(h_j)) = \pi_i(f) + \rho_i \sum_{\substack{n \to f \\ n \in N_i}} \phi_j(n, s_i''(h_i), s_i'(h_j)) \sigma_i(n, f, s_i''(h_i), s_i'(h_j)) \tag{10.6}$$

An example gives a good illustration of the mechanism: If a sequential prisoner's dilemma is played with $f = 5$ subgames, the current subgame $n = 5$ and the history of moves h_j of actor j is [c c d c], then $s_i'^5 = c$ with a probability 3/4 and $s_i'^5 = d$ with a probability 1/4 (the total probability always equaling 1, since j cannot refrain from making a move). Remember that s_i'' is actor i's belief of actor j's belief about the strategy that i will choose. Therefore, the only possible basis on which s_i'' can be established is the history of i's own moves h_i. In other words, if h_i is [d d d d], then i beliefs that j beliefs that i will again choose strategy d in move 5, because $s_i''^5 = c$ with a probability 0/4 and $s_i''^5 = d$ with a probability 4/4. Example 5: Sequential reciprocity shows how the beliefs are updated for the prisoner's dilemma game of the previous examples.

EXAMPLE 5: SEQUENTIAL RECIPROCITY

Consider again the prisoner's dilemma. All sixteen possible belief sets and the strategies that actors will choose according to these belief sets are tabulated in Example 4: The reciprocity equilibrium. Below these belief sets and strategies are again tabulated, but now also with the updated belief sets for the second subgame. The updated beliefs are equal to the actually chosen strategies. This is because actors have only played one strategy, so the probability of that strategy to become the updated belief is equal to one.

Situations 1 and 16 in the table below are *sequential reciprocity equilibria* (Dufwenberg and Kirchsteiger, 2004). Situations 3, 6, 8, 9, 11 and 14 start with belief sets that lead to a reciprocity equilibrium in the second subgame. The remaining situations do not lead to an reciprocity equilibrium.

#	**belief sets**		**strategies**		**updated belief sets**	
	(s_i'', s_i')	(s_j'', s_j')	s_i	s_j	(s_i'', s_i')	(s_j'', s_j')
1	(c,c)	(c,c)	c	c	(c,c)	(c,c)
2		(c,d)	c	d	(c,d)	(d,c)
3		(d,c)	c	c	(c,c)	(c,c)
4		(d,d)	c	d	(c,d)	(d,c)
5	(c,d)	(c,c)	d	c	(d,c)	(c,d)
6		(c,d)	d	d	(d,d)	(d,d)
7		(d,c)	d	c	(d,c)	(c,d)
8		(d,d)	d	d	(d,d)	(d,d)
9	(d,c)	(c,c)	c	c	(c,c)	(c,c)
10		(c,d)	c	d	(c,d)	(d,c)
11		(d,c)	c	c	(c,c)	(c,c)
12		(d,d)	c	d	(c,d)	(d,c)
13	(d,d)	(c,c)	d	c	(d,c)	(c,d)
14		(c,d)	d	d	(d,d)	(d,d)
15		(d,c)	d	c	(d,c)	(c,d)
16		(d,d)	d	d	(d,d)	(d,d)

This results in the case that both actors i and j base their new beliefs on *the same probability distributions* h_i and h_j. In a two actor game, there are for each subgame two history profiles h_i and h_j and four beliefs to be updated $s_i'(h_j)$, $s_i''(h_i)$, $s_j'(h_i)$ and $s_j''(h_j)$. This has implications for the possibility of the existence of a reciprocity equilibrium. When, for example history profile h_j is close to a uniform distribution, the beliefs $s_i'(h_j)$ and $s_j''(h_j)$ are more likely to be inconsistent compared to the case when the history profile shows

a clear peak at a specific strategy. In the latter case, both actors are more likely to pick the same belief of strategy.

This method of updating shows characteristics that are consistent with reality. First of all, when actor i is defecting often, and later seeks to obtain mutual cooperation, actor j will still belief that i will defect with a high probability because the history profile is full of defective behavior. It will take a long time for i to 'repair' the relationship such that the probability that j beliefs that i will cooperate is becoming sufficiently large. Also, the history profile basically is a basis on which the expectations of the future are determined. This also becomes apparent in Part II. Developers initiating a working group for the residents ('cooperating') and the residents joining the working group (also 'cooperating'). The residents subsequently expected that the developers will keep them informed and give them some influence over the process (expectation of further cooperation).

A downside of this updating method is that every move is weighted equally. It might be that more recent moves deserve more weight than older moves because actors remember them more vivid. It might also very well be possible that the very first move is defining the character of the history profile (as the first communication often sets the 'tone' of the relationship) and should therefore deserve more weight than the remaining moves. Furthermore, in this method of updating beliefs actors remember every move, i.e. they do not forget information (it is a perfect information game). This model also does not answer the question how the beliefs prior to the very first move are determined.

10.2.4. RECIPROCITY ON NETWORKS

The prisoner's dilemma game has been applied to networks with two interdependent groups of actors (e.g. Wang et al. (2013)). Wind farm development can also be interpreted as a network with multiple interdependent groups between which reciprocity exists. This subsection explains how the previously described model of reciprocity can be applied to networks.

There is a difference in the prisoner's dilemma game on networks as Wang et al. applies it, and the reciprocity model on networks. In the former one, the chosen strategy of an actor i is *independent* of the randomly chosen connected neighbor j. An actor thus always plays either strategy cooperate (c) or defect (d) irrespective of the opposing player. Next, the winning strategy is imitated by the loser. When the loser faces a new game, he will choose this new strategy. This independence, and the possibility of strategies to be 'copied' from winning actors to losing actors, causes that strategies can 'flow' through the whole network. However, in the reciprocity model, the chosen strategies of i and j are *dependent* on the belief sets that the actors hold towards each other (drawn from the history profiles). Whether j loses or wins the game, this has no influence on the strategy that he will play towards another actor k, because it does not influence the belief set of j towards actor k. Therefore there is, in the current form, no way that interactions between connected actors i and j influence the interactions between connected actors j and k. Whereas in the prisoner's dilemma game presented by Wang et al. strategies can 'flow' through the network, in the reciprocity model this is not possible because the belief sets of all actors towards all other actors are defining the chosen strategies.

Instead of strategies flowing through the network, another social quantity should be used. In subsection 10.2.3 it is explained how the history profiles are used to update actor beliefs. These history profiles, containing all the strategies that an actor has played before, is a variable that can be used to indirectly let strategies flow through the network. Neighbors are therefore given the possibility to see the strategies that their neighbors choose towards other actors. How this is implemented in the model is explained below.

Figure 10.3: Network consisting of three actors i, j and k. Each actor has a history profile h of chosen strategies towards its neighbors. When updating beliefs from the history profiles, the history profiles of one actor towards all its neighbors are combined.

Consider actor i, j and k connected as in Figure 10.3. In this network exist four history profiles h_{ij}, h_{ji}, h_{jk} and h_{kj}. h_{ij} means the history of chosen strategies by i towards j, and similar for the other history profiles.

Reciprocity on networks works as follows: if i faces j in a game, i picks his belief s'_i (i's belief of the strategy that j will choose) from the probability distribution $h_{ji} + h_{jk}$. This means that he picks a belief from the sum of the history profiles that j played towards both i and k. Actor i picks the belief s''_i (i's belief of j's belief of the strategy that i will choose) from the probability distribution h_{ij} (since i has no other neighbors). Similarly, s'_j is picked from h_{ij} and s''_j is picked from $h_{ji} + h_{jk}$. When i would also be connected to k, then the second order belief of i and the first order belief of j are drawn from $h_{ij} + h_{ik}$. This method of network reciprocity through history profiles allows beliefs to indirectly 'flow' through the network.

10.3. APPLICATION OF THE MODEL TO THE MOONLIGHTING GAME

The model of reciprocity described in the former section will be applied to a *moonlighting game* (MG). The moonlighting game is a game involving both positive and negative reciprocity. It is coined and by Abbink et al. (2000) who conducted experiments, and further experimentally researched by Falk et al. (2008); Engelmann and Strobel (2010). It is called the moonlighting game because it involves a 'principal' who uses a 'moonlighter' (Dutch: schnabbelaar) to perform a piece of work. The general ideas of the game are given here, in the next section the rules of the game are explained in terms of the payoff matrix.

The moonlighting game is based on the premise that collaborative effort increases the total material payoff of both actors, while the total material payoff is decreased when both actors position themselves uncooperative. Since there is no binding agreement trust between actors plays a role and both actors are vulnerable to exploitation. The expectation of cooperative effort creates trust and encourages reciprocal behavior. The moonlighter can then provide a good job on the piece of work, expecting that the principal will reward him. Or the moonlighter can choose to do a bad job on the piece of work, risking retaliation by the principal. Both rewarding and retaliation is costly for the principal. If the principal rewards the moonlighter, he settles the payment. If the principal punishes the moonlighter, he does not pay and has to fix the piece of work himself. The latter one is disadvantageous for both actors.

The moonlighting game is illustrative for many social situations where positive and negative reciprocity is involved and there are no legal agreements (Abbink et al., 2000). Examples are dividing chores in the household, helping a good friend moving, etc.

The characteristics of the game have strong similarities with the working group presented in the case study of Part II as well. The residents are the principal and the developers are the moonlighter. There is no binding agreement on the working group participating in the wind farm development process. The developers are expected to provide information and participation (the piece of work). Doing so will result in rewards from the residents. Failing to do so will result in punishment from the residents. Both rewarding and punishment is disadvantageous for the residents. A reward will mean an increased burden on the residents' environment, a punishment means that they oppose which costs time and energy.

Main differences with the prisoner's dilemma from the previous examples is that the strategies and payoffs are of a continuous character rather than discrete, that both players do not move simultaneously, and that the payoff matrix is not symmetric. The details of the rules of the moonlighting game are unveiled in the following section. The next two sections elaborate on the kindness term (Equation 10.3.2) and the reciprocation term Figure 10.3.2 in relation to the moonlighting game.

10.3.1. THE MOONLIGHTING GAME MATERIAL PAYOFF MATRIX

The moonlighting game is a two-player game. Initially, both actors are endowed with 12 points[1]. Actor i, the 'moonlighter', is the first one to make a move. i's strategy set in the first move is $s_i \in \{-6, -5...5, 6\}$. For a chosen strategy $s_i > 0$, s_i points are transferred from i to j such that i loses s_i and j receives $3s_i$. For a chosen strategy $s_i < 0$, i receives $|s_i|$ and j loses $|s_i|$. For $s_i = 0$ nothing happens. In the second move, j, the 'principal' can choose a strategy $s_j \in \{-6, -5...17, 18\}$. For $s_j > 0$, i receives s_j and j loses s_j. For $s_j < 0$ j loses $|s_j|$ and i loses $3|s_j|$. The payoff is determined after the second move, such that $\pi_k(s_i, s_j)$. The moonlighting game is an

[1] In this thesis the conventions of Falk and Fischbacher are followed. Abbink et al. uses a fictitious currency named 'talers' and Engelmann and Strobel uses 'Experimental Monetary Units' (EMU). Changing the name of the currency dealt with does not affect the dynamics of the game. Furthermore, the strategies that players i and j can choose are originally labeled a and b by Abbink et al.. I will refer to 'points' as the exchange currency and the strategies that i and j choose are s_i and s_j.

asymmetric sequential non-zero-sum psychological game with perfect information.

The payoff matrix of the moonlighting game is given in Table 10.2. The material payoffs for both actors in the moonlighting game are plotted in Figure 10.4. Not all combinations of and b are possible because the total amount of points for each of the players cannot become less than zero. Since both actors are starting with 12 points, the combinations of s_i and s_j that lead to a material payoff smaller than -12 for either one of the actors are not possible.

Table 10.2: Payoff matrix of the moonlighting game. The bottom left entries of the cells are the material payoffs π_i, the top right entries of the cells are the material payoffs π_j.

Actor i			Actor j: **gives** $0 < s_j \leq 18$	Actor j: **passive** $s_j = 0$	Actor j: **takes** $-6 \leq s_j < 0$
	gives	$0 < s_i \leq 6$	$3s_i - s_j$ / $-s_i + s_j$	$3s_i - 0$ / $-s_i + 0$	$3s_i - \lvert s_j \rvert$ / $-s_i - \lvert 3s_j \rvert$
	passive	$s_i = 0$	$0 - s_j$ / $0 + s_j$	$0 - 0$ / $0 + 0$	$0 - \lvert s_j \rvert$ / $0 - \lvert 3s_j \rvert$
	takes	$-6 \leq s_i < 0$	$-\lvert s_i \rvert - s_j$ / $\lvert s_i \rvert + s_j$	$-\lvert s_i \rvert - 0$ / $\lvert s_i \rvert + 0$	$-\lvert s_i \rvert - \lvert s_j \rvert$ / $\lvert s_i \rvert - \lvert 3s_j \rvert$

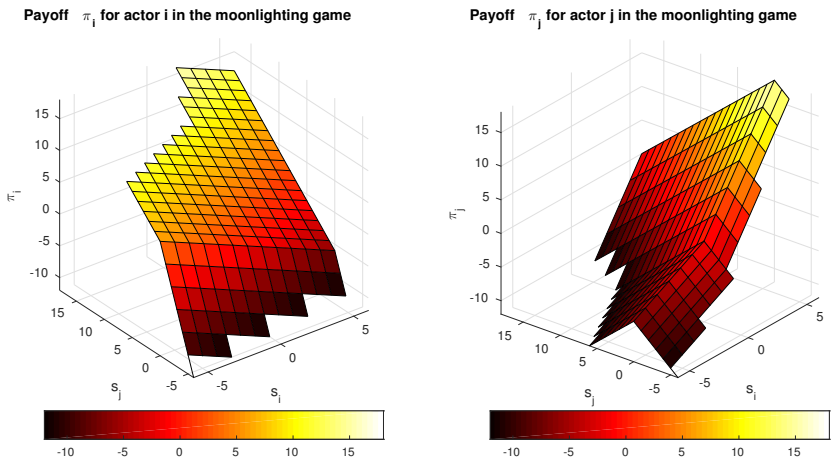


Figure 10.4: Moonlighting game payoffs for both actors.

10.3.2. THE UTILITY FUNCTION IN THE MOONLIGHTING GAME

The moonlighting game is a sequential game in which both actors can make only one decision ($n \in \{1\}$). The utility function for actor i as given in Equation 10.1 reduces to:

$$U_i(\tilde{s}_i, s_i'', s_i') = \pi_i(\tilde{s}_i, s_i') + \rho_i \phi_j(s_i'', s_i') \cdot \sigma_i(\tilde{s}_i, s_i'', s_i') \tag{10.7}$$

$\tilde{s}_i$ are all possible strategies in S_i that lead to all possible outcomes at end nodes f. Because $S_i = -6, -5 ... 5, 6$ thus i has 13 different strategies to choose from, there are thirteen possible outcomes for any belief set (s_i'', s_i'). The remainder of this section also uses the perspective of actor i. An elaboration of the utility function from the perspective of j is given in Appendix I.

THE KINDNESS TERM

As explained in Figure 10.2.1, the kindness term ϕ_j is equal to the product of the outcome term Δ_j and the intention factor θ_j. The outcome term is defined as the differences in payoffs $(\Delta_j(s_i'', s_i') = \pi_i(s_i'', s_i') - \pi_j(s_i'', s_i'))$

between both actors, and is plotted in Figure 10.5. The sum of the differences $\Delta_j + \Delta_i$ for any combination (s_i'', s_i') is always zero because $\Delta_i(s_j'', s_j') = \pi_j(s_j'', s_j') - \pi_i(s_j'', s_j')$. The intention factor θ_j is a function of Δ_j and is determined according to Equation 10.4 for simple games and describes whether actor j is perceived kind or unkind. The moonlighting game however is more complex as both actors can be both kind an unkind and the strategies are continuous. In this case, a degree of perceived (un)kindness is introduced. Actors can be perceived very (un)kind or only slightly (un)kind.

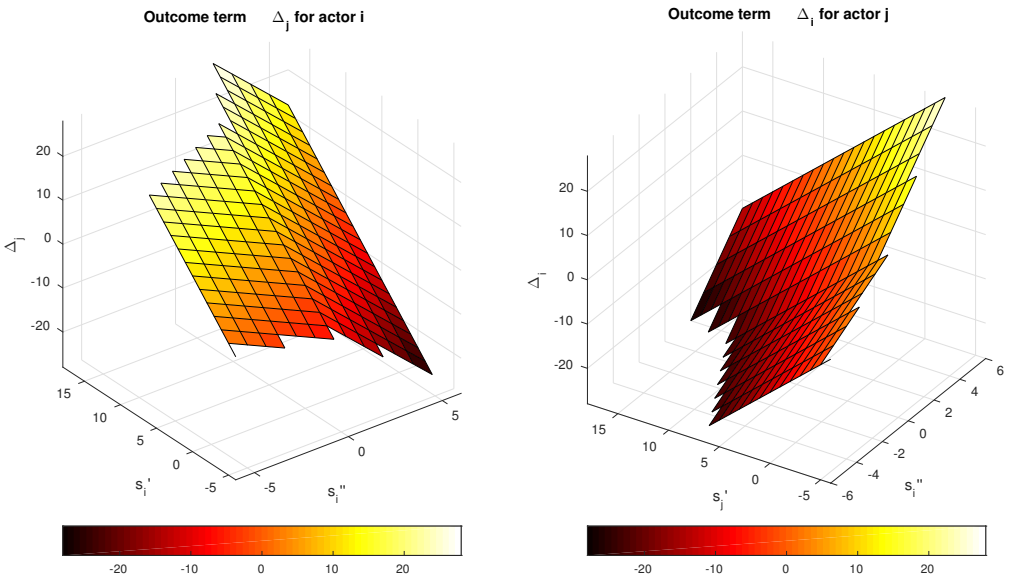


Figure 10.5: Outcome terms (differences in payoffs between actors i and j) in the moonlighting game for strategies s_i'' and s_i'.

Falk and Fischbacher (2006) provide equations to incorporate this increased complexity in Appendix 1 of their publication. The perceived intention of actor j can be interpreted as a weight to the perceived (un)kindness. This means that if j is perceived kind but but this kindness is unintentional, the reciprocal response of i will be weaker. The factor θ_j is a scalar value existing for each possible belief set (s_i'', s_i') and is determined with reference to the worst possible outcome for j when $\Delta_j < 0$ and to the best possible outcome for j when $\Delta_j > 0$. Equation 10.8 shows how the intention factor is determined for each (s_i'', s_i').

$$\theta_j\left(s_i'', s_i'\right) = \begin{cases} \max\left(\frac{\Delta_j(s_i'', s_i')}{\Delta_i(s_i'')_{max}}, \varepsilon_i\right) \leq 1 & \text{if } \Delta_j > 0 \\ \max\left(1 - \frac{\Delta_j(s_i'', s_i')}{\Delta_i(s_i'')_{min}}, \varepsilon_i\right) \leq 1 & \text{if } \Delta_j < 0 \end{cases} \tag{10.8}$$

In words, Equation 10.8 reads as:

$$\text{perceived kindness intention actor j} = \frac{\text{positive outcome for i}}{\text{best possible outcome for j}}$$

$$\text{perceived unkindness intention of actor j} = \frac{\text{negative outcome for i}}{\text{worst possible outcome for j}}$$

θ_j is a value between ε_i and 1. and the $1-$ in Equation 10.8 makes sure that i responds slightly unkind when j is perceived only slightly unkind and that the response is very unkind when j is perceived very unkind. Consider for example the belief set $(s_i'' = 3, s_i' = 5)$. A contour plot of the outcome term Δ_j is shown in Figure 10.6 with this belief set indicated with a green dot. With $\Delta_j = -2$, j is perceived as being slightly unkind. For this distribution of material outcomes, the intention term determined according to the bottom equation in Equation 10.8. The intention of actor j to treat i unkind is calculated using the *worst* possible outcome for actor j for all possible actions that j can choose given the belief s_i''. This worst possible outcome exists at the point $(s_i'' = 3, s_i' = 18)$

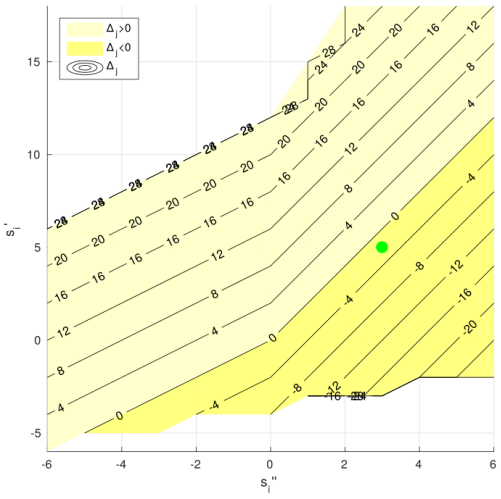


Figure 10.6: Outcome term Δ_j for each possible belief set (s_i'', s_i').

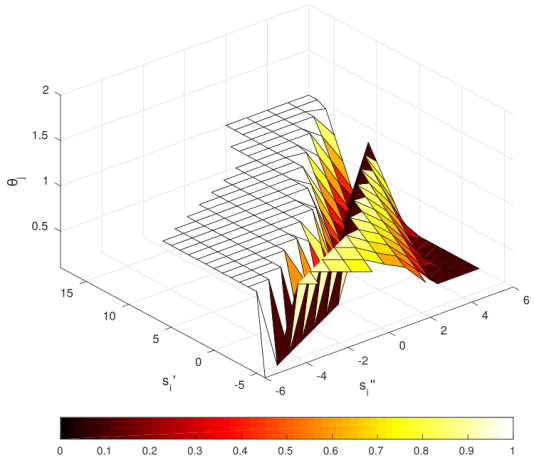


Figure 10.7: Intention landscape for each possible belief set, determined using Equation 10.8.

and is $\Delta_i = -18$. Therefore $\theta_j = 1 - (-2/-18) = 0.89$. A plot of the intention term θ_j for each belief set (s_i'', s_i') is shown in Figure 10.7.

THE RECIPROCATION TERM

The reciprocation term σ_i is an alternation of the payoff of actor j by a possible action of actor i. For every combination s_i'' and s_i', there exists thus a function $\sigma_i(S_i)$ in which S_i is the strategy set of i (all possible strategies that i can choose) resulting in a range of alternative payoffs for j. Let all possible strategies that i can choose be denoted by $\tilde{s}_i$, then the reciprocation term is given by:

$$\sigma_i\left(\tilde{s}_i, s_i'', s_i'\right) = \pi_j\left(\tilde{s}_i, s_i'\right) - \pi_j\left(s_i'', s_i'\right) \tag{10.9}$$

Figure 10.8 shows σ_i for all strategies that i can choose (S_i) relative to the belief set $(s_i'' = 3, s_i' = 5)$. For $\sigma_i(s_i > 3)$ the reciprocation term is positive hence these strategies would give a reward to j relative to the perceived situation $(s_i'' = 3, s_i' = 5)$, and for $\sigma_i(s_i < 3)$ the reciprocation term is negative hence these strategies are a punishment to j relative to the perceived situation $(s_i'' = 3, s_i' = 5)$.

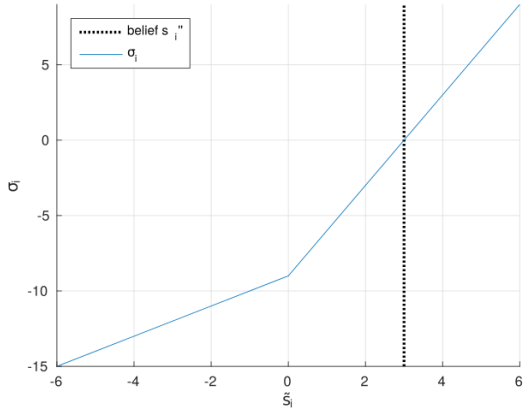


Figure 10.8: The reciprocation term σ_i as a function of all alternative strategies $\tilde{s}_i$ for the given belief set $\left(s_i'' = 3, s_i' = 5\right)$. $\sigma_i = 0$ at $\tilde{s}_i = 3$ because $\tilde{s}_i = s_i''$.

THE UTILITY FUNCTION

At this point we have knowledge about the kindness term (the product of the outcome term and the intention factor, it is one value) and the reciprocation term which is a function of all possible strategies that i can choose. The social payoff is equal to the product of the kindness term and the reciprocation term. The outcome term Δ_j for ($s_i'' = 3, s_i' = 5$) is negative. The social payoff is thus equal to the reciprocation term being 'flipped' vertically and scaled by the kindness term. This is shown in the bottom left plot of Figure 10.9. The utility is calculated by adding the material payoff to the social payoff, and is shown in the bottom right plot.

The strategy that i will choose is the strategy out of all possible strategies which leads to a maximization of the utility function, or $s_i = \tilde{s}_i$ with $\tilde{s}_i$ for which holds $U_i = \max(U_i(\tilde{s}_i))$. The strategy for maximum utility is in the bottom right plot indicated with a × and is, in this case, equal to $s_i = -6$.

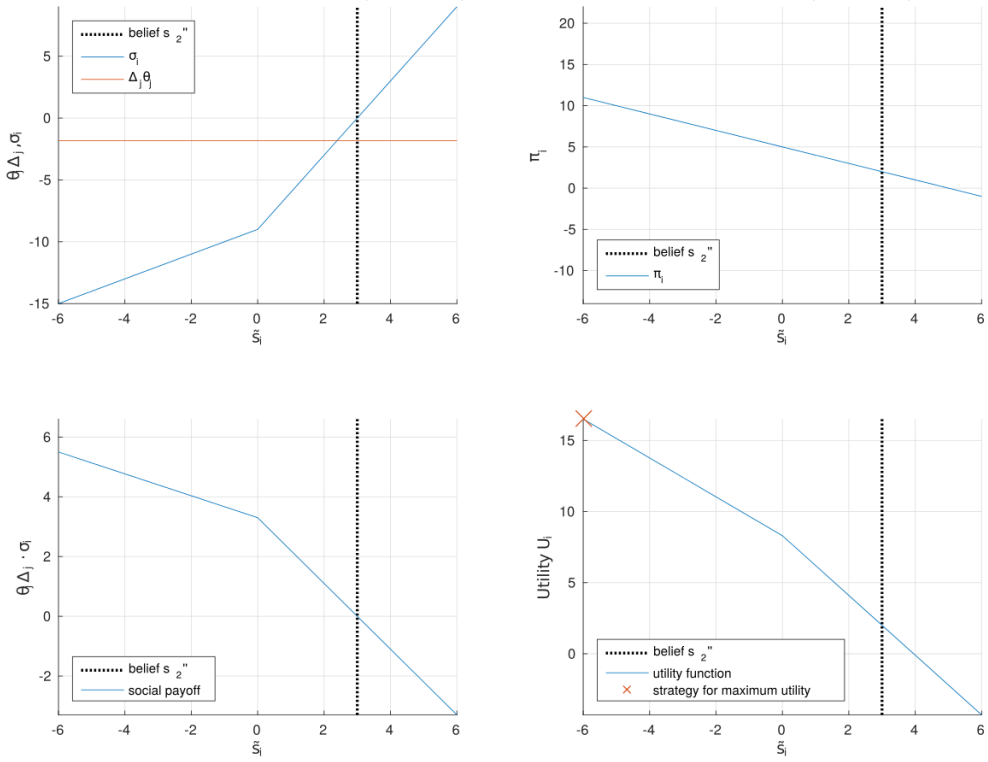


Figure 10.9: The determination of the utility U_i of the possible strategies as a function of the beliefs $\left(s_i'', s_i'\right)$. The top left plot shows the kindness term and the reciprocation term. Top right plot shows the material payoff. The bottom left plot shows the social payoff and the bottom right plot shows the utility, which is comprised of the sum of the material and social payoff.

This is obviously incorrect because when j is perceived only slightly unkind (as is the case for belief set ($s_i'' = 3, s_i' = 5$)), then i does not intend to punish her very much, but only just a little. In the current situation, for any belief set where $\Delta_j < 0$ (j is perceived unkind), i will respond with total retaliation $s_i = -6$. Similarly, for any belief set for which $\Delta_j > 0$, i will respond with total reward ($s_i = 6$). Falk and Fischbacher have therefore overseen the intention that i has to *not* punish and *not* reward j. The following section introduces a *target intention* θ_i of actor i to *not* punish and reward that serves as a weight to the reciprocation term.

THE EXTENDED RECIPROCATION TERM AND UTILITY FUNCTION

The proposed target intention term θ_i can easily be incorporated by using Equation 10.8 but now from the perspective of actor i and for the complete strategy set S_i. The equation, verbally, becomes:

$$\text{target kind intention of actor i} = \frac{\text{all outcomes for j} - \text{best outcome for j}}{\text{best outcome for i}}$$
$$\text{target unkind intention of actor i} = \frac{\text{all outcomes for j} - \text{worst outcome for j}}{\text{worst outcome for i}}$$

The terms 'best outcome for j' and 'worst outcome for j' in the numerator makes sure the numerator is always negative (upper equation) or always positive (lower equation). The target intention term written as a function of the outcome terms gives:

$$\theta_i(\tilde{s}_i, s_i') = \begin{cases} -\frac{\Delta_i(\tilde{s}_i,s_i') - \Delta_i(\tilde{s}_i,s_i')_{max}}{\Delta_j(\tilde{s}_i,s_i')_{max}} & \text{if } \Delta_j > 0 \\ -\frac{\Delta_i(\tilde{s}_i,s_i') - \Delta_i(\tilde{s}_i,s_i')_{min}}{\Delta_j(\tilde{s}_i,s_i')_{min}} & \text{if } \Delta_j < 0 \end{cases} \tag{10.10}$$

θ_i is a value equal or greater than zero assigned to each possible strategy $\tilde{s}_i$. The target intention factor is not a function of s_i'' since this is implicit in $\tilde{s}_i$. The minus sign makes the difference between the *perceived intention* θ_j and the *target intention* θ_i explicit. The perceived intention θ_j is the intention of j to act kind of unkind. The target intention θ_i is the intention of i to *not* act kind or unkind in response. The minus sign makes sure that the smaller the value of θ_i for a possible strategy $\tilde{s}_i$, the less attractive it is for player i to choose the corresponding strategy.

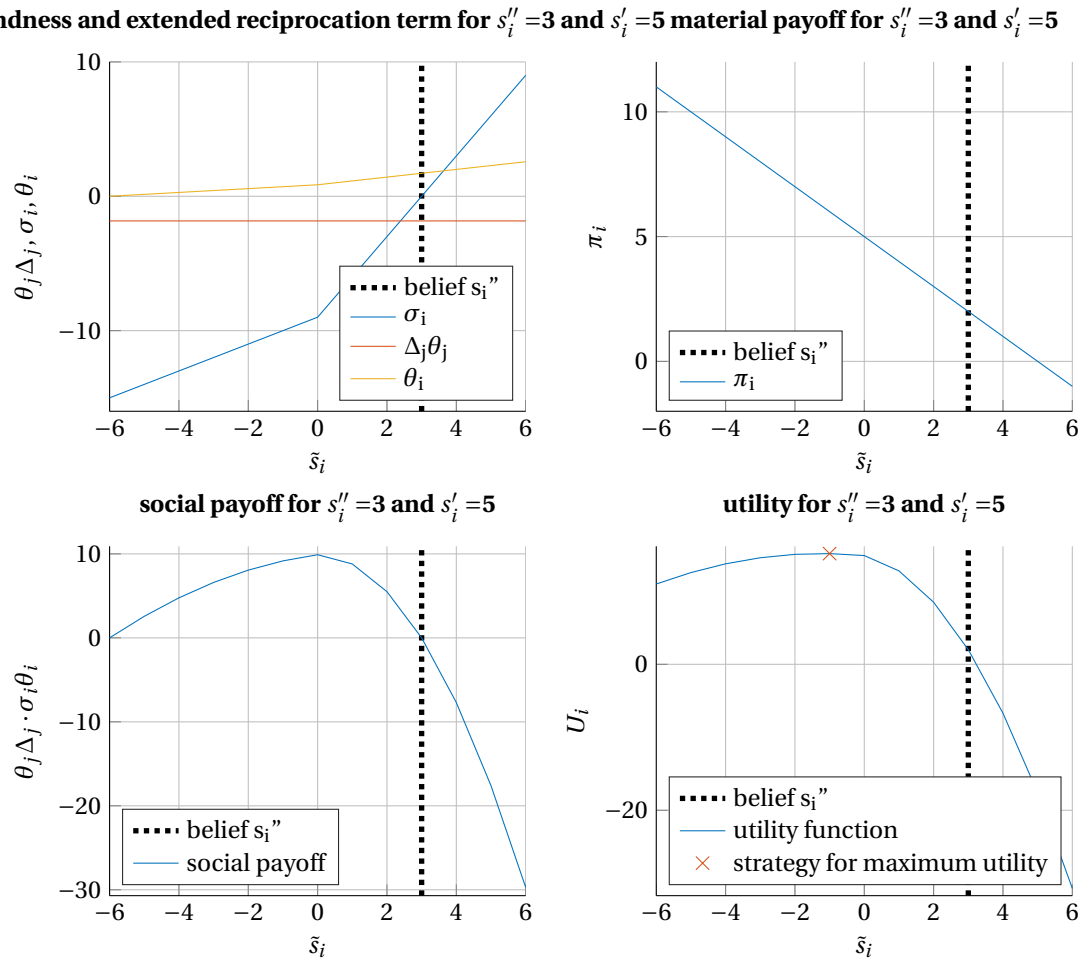


Figure 10.10: Determination of the utility U_i of the possible strategies. The same figures as Figure 10.9, but now using the extended reciprocation term.

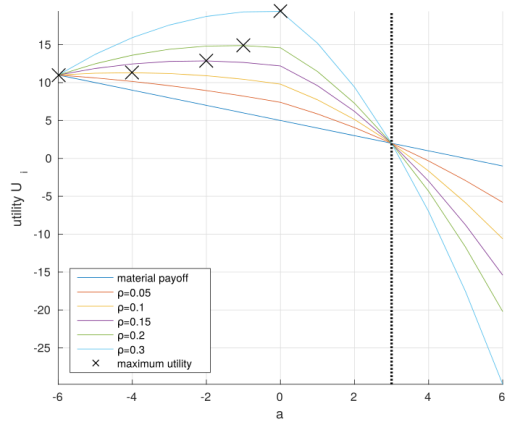
Incorporating the target intention term in the utility function also gives a more aesthetic equation. The kindness term is a scalar value consisting of the product of the outcome term (difference in payoff between actors) and the perceived intention term (weighting the difference in payoff). The extended reciprocation term is a function of all possible strategies consisting of the product of the reciprocation term (range of possible differences in payoff between actors) and the target intention term (a weight to all the possible differences in payoff). The complete utility function then becomes:

$$U_i(\tilde{s}_i, s_i'', s_i') = \pi_i(\tilde{s}_i, s_i') + \rho_i \cdot \Delta_j(s_i'', s_i')\theta_j(s_i'', s_i') \cdot \sigma_i(\tilde{s}_i, s_i'', s_i')\theta_i(\tilde{s}_i, s_i') \tag{10.11}$$

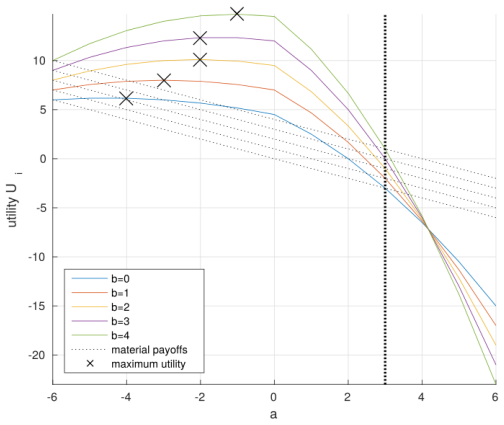
The effect of the introduction of this extended reciprocation term on the social payoff function and the total utility is shown in Figure 10.10. These are the same figures as Figure 10.9 but now with the inclusion of the target intention θ_i Indeed, i now only gives a very nuanced response of $s_i = -1$ to the perceived slight unkindness of j.

10.3.3. UTILITY AS A FUNCTION OF ρ AND s'

In order to illustrate the dynamics of the model and its variability with the actor personal propensity to reciprocate, the utility function is presented for different values of ρ and first order belief s'. Figure 10.11 shows the utility functions for the case $\Delta_j < 0$ and Figure 10.12 shows the utility functions for the case $\Delta_j > 0$.

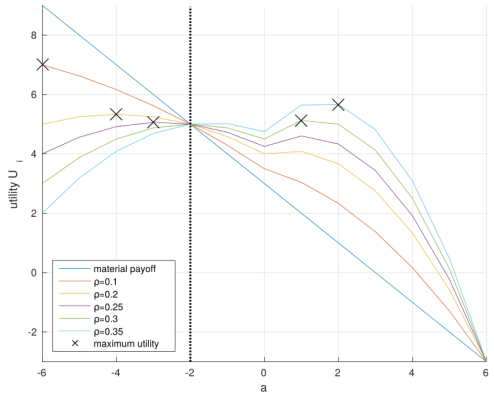


(a) Utility functions for variable ρ.

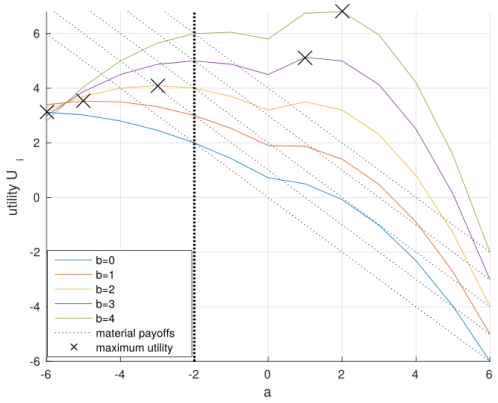


(b) Utility functions for constant ρ_i and variable s'. Material payoffs increase when j is more generous (s' increases).

Figure 10.11: Utility functions U_i for $\Delta_j < 0$. Figure 10.11a shows how the utility is a function of ρ. Figure 10.11b shows how the utility changes for different s'_i



(a) Utility functions for ($s''_i = -2, s'_i = 3$) and different reciprocation terms ρ_i.



(b) Utility functions for constant ρ_i and variable s'. Material payoffs increase when j is perceived more generous (s' increases).

Figure 10.12: Utility functions U_i for $\Delta_j > 0$. Figure 10.12a shows how the utility is a function of ρ. Figure 10.12b shows how the utility changes for different s'_i

10.3.4. THE STRATEGY LANDSCAPE

For every combination of s'', s', and ρ a strategy can be determined through the utility function. If the strategies that an initiating actor i having a reciprocity parameter ρ_i are plotted, a strategy landscape is obtained. The strategy landscape can be thought of as the 'brain' of individual actors. Heterogeneity between actors is caused because every actor has its own ρ and acts according to a different strategy landscape. The strategy landscapes for some values of ρ_i of initiating actor i are shown in Figure 10.13.

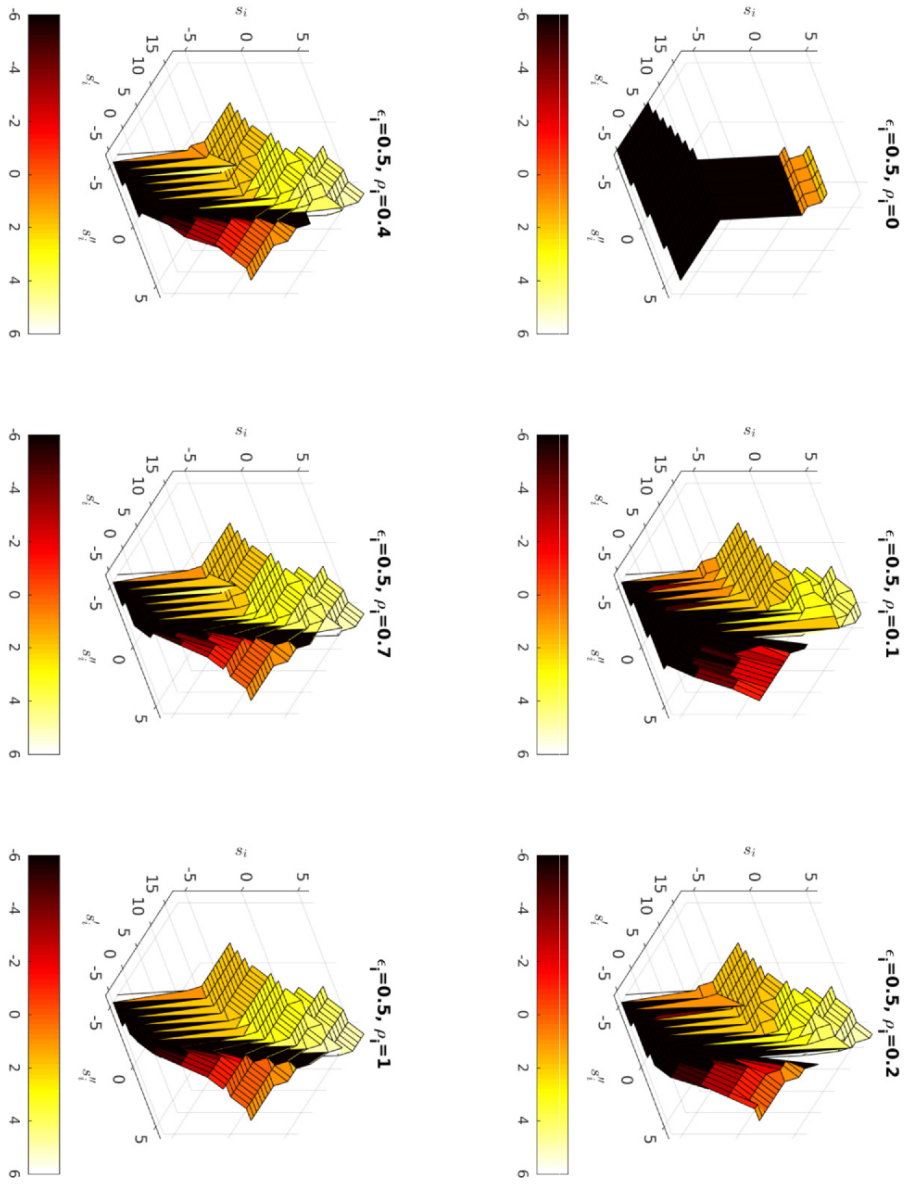


Figure 10.13: The strategy landscape is the 'brain' of individual actors and shows how actor i responds (s_i, z-axis) when he holds a first order belief (s_i', y-axis) and a second order belief (s_i'', x-axis). Six strategy landscapes are shown with different values for ρ_i.

11

METHODOLOGY

Numerical simulation is applied to elucidate the dynamics of the network model of reciprocity from the former chapter. The goal of this chapter is to explain the details of the used methodology. The simulation strategy is elaborated in section 11.1. It explains Monte Carlo Simulation and gives background information of the model parameters of interest and the criterion for convergence of the social system. Next, section 11.2 introduces the reader to the way that developer and resident specific behavior is implemented. Practical implementation and code verification is covered by section 11.3.

11.1. SIMULATION STRATEGY

The simulation strategy involves the implementation of the theoretical model to a computer code in order to be able to structurally investigate the behavior and dynamics of the model. To this end Monte Carlo Simulation is used (subsection 11.1.1), a methodology that is suitable for studying the behavior of complex systems. An overview of the actor and network parameters is given in subsection 11.1.2 and the criterion for convergence of the system is given in subsection 11.1.3.

11.1.1. MONTE CARLO SIMULATION

For the simulation of reciprocity between wind farm developers and residents Monte Carlo Simulation (MCS) is applied. This strategy is similar to the one presented by Wang et al. (2013). Monte Carlo Simulation is a strategy that involves repeated random sampling of a stochastic process and yields numerical outcomes. But, as Harrison (2010) states: "There is no single Monte Carlo method". He however observes that the following pattern in simulation is recurring:

1. model a system as a (series of) probability density functions (PDFs)
2. repeatedly sample from the PDFs
3. tally/compute the statistics of interest

MCS is suitable for modeling reciprocity on networks because the presented model is stochastic and nonlinear. The stochastic element comes from the updating of beliefs according to the history profile. The nonlinearity comes from the network structure and actor heterogeneity. This stochastic and nonlinearity combined amounts to complexity of the system, resulting in uncertain outcomes. However, by running the simulation many times a pattern will arise. The steps are the following: A specific configuration of the model is run a large number of times. These runs are independent of each other. Every run consists of a fixed number of time steps, or 'ticks', and every time step consists of N social exchanges. The actors between which these social exchanges take place are randomly picked according to a uniform distribution. The outcome of the MCS is a probability distribution of the outcome variable, which in this case is the material payoff earned by the actors in the network.

In agent based network models, time steps can represent a real unit of time such as days or months (Chappin, 2015). In more theoretical network models, such as the one presented in this thesis, this is not the case. Then

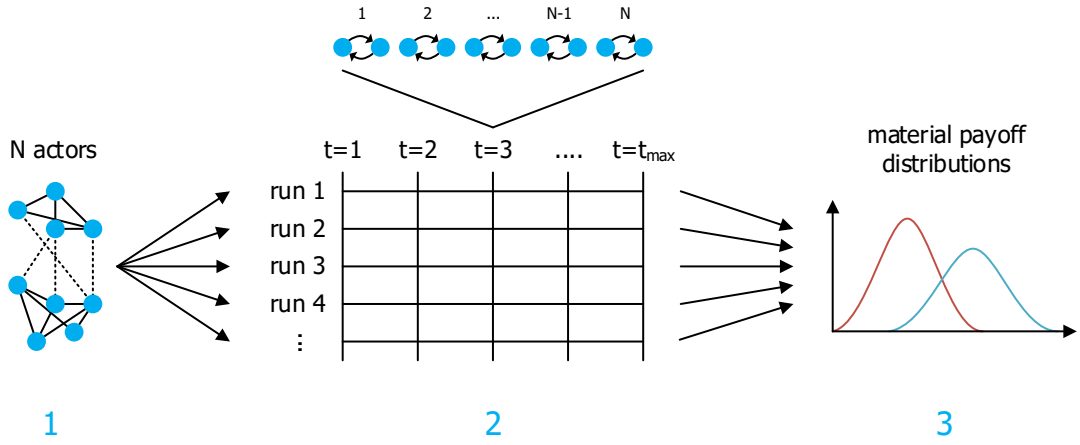


Figure 11.1: Three steps of the Monte Carlo Simulation. Prepare N-actor network (1), run the simulation many times for t_{max} time steps with every step consisting of N random exchanges (2) and aggregate results (3).

what does a time step represent? Above it was explained that every time step, there are N random exchanges occurring. In other words, during a time step, every actor gets a change to be the initiator or the responder in a social exchange. As such every time step can be interpreted as a 'social event', for example an information evening or an email exchange. A sufficient number of social events leads to a proper understanding of each others behavior (the history profiles).

In the present study a Monte Carlo Simulation consists of three steps, see Figure 11.1. First, the actors and the network are predefined (the next subsection gives more details about this). The second step is the actual simulation, which consists of many independent runs, each consisting of $t \cdot N$ random social exchanges. In the third and last step, the results of the independent runs are aggregated and presented in the form of probability distributions. Conclusions can be drawn about the probability that a predefined system leads to a certain outcome which is a useful outcome because real social exchanges are highly contingent.

11.1.2. MODEL PARAMETERS

The parameters of the model can be divided into two parts. These are actor specific parameters, which dictate actor behavior, and network specific parameters. These parameters are defined before a MCS commences (step 1 in Figure 11.1), and every run in the MCS uses the same initial conditions. The details of these parameters and the way they are used in the simulations are further elaborated below.

ACTOR SPECIFIC PARAMETERS

The parameters that prescribe actor behavior are the propensity to reciprocate ρ, the pure outcome parameter ε and the initial first order and second order belief s'' and s' towards the actors they are connected to. ρ and ε are therefore defined on the actors, and the beliefs are defined on the connections between actors.

The parameters ρ and ε, are constant parameters describing personality and they are independent of the connected other actors. The vary between zero and one, but for simplicity the values that these variables can assume are limited to $\varepsilon = 0$ and $\rho = 0, 0.1 ... 0.9, 1$. By assuming $\varepsilon = 0$ a variable is eliminated and analysis is simplified. There are therefore 11 unique personalities possible, i.e. each personality acts according to its own strategy landscape. Every actor is assigned a personality prescribed by ρ.

The initial first and second order beliefs that the actors hold towards each other are randomly drawn from the possible belief sets, except where a connection between an actor and developer exists. On these edges the possible belief sets that can be assigned are limited. More about this can be read in section 11.2.

NETWORK SPECIFIC PARAMETERS

Network parameters considered are the number of groups, the number of actors per group, the network structure, and the number connections between the groups. Since the interactions between residents and developers are of interest, always two different groups will be used.

To research reciprocity in a structured way, two different network structures are taken into account: the dyad and a system of two groups which are both fully connected 10-actor networks (this is equal to a random network with edge density of one). The dyad is chosen in order to isolate network structure from the effects of actor specific behavior. This will allow for a better understanding of the concept of social exchange as the unit of interest. The network case uses two fully connected networks of ten actors because to allow the introduction of heterogeneity within a group but also heterogeneity between groups.

Furthermore, Wang et al. (2013) does not allow strategies to flow from one group to the other. The presented model will also implement this condition in the form of history profiles not being shared with members of another group. This is consistent with reality, where opinions and behavior are more easily shared within groups than between groups (Burt, 2004).

11.1.3. CONVERGENCE CRITERION

Many MCS are characterized by a *transient* and *equilibrium* stage (Thomopoulos, 2013). Since history profiles are build up as a result of repeated interactions, also the model presented in this thesis has a transient and equilibrium stage. Repeated interactions between heterogeneous actors embedded in a network result in converging history profiles and therefore convergence of the whole social system. Only from the equilibrium stage, a converged system, conclusions can be drawn. Spontaneously emerging social networks, where heterogeneous actors start in a 'soup' do not exist in reality[1]. Hence a criterion for convergence of the system must be defined.

In order to find at which time step the transient stage has entered literature suggest choosing a variable of interest and identifying when the change of the average of this variable between time steps reaches zero (Thomopoulos, 2013). In this thesis, the amount of points that is earned by the system per time step averaged over all simulations $\bar{\pi}$ is used as a measure for convergence. This is a suitable measure because it gives information of the resulting relationships between actors (positive or negative reciprocity) rather than a actor oriented measure like the average strategies that are played. Suppose a convergence criterion $c \approx 0$ and the time step at which this convergence criterion is reached is t_c. c is the difference of the total points earned between two time steps, averaged over all runs in the Monte Carlo Simulation. Because the model is stochastic and the amount of points reach an asymptote, a power law equation is fit the points (Equation 11.1). The time step at which the system enters the transient stage (or converges) t_c is the time step where the derivative of this power law is equal to c (Equation 11.2).

$$\bar{\pi}(t) \approx at^b + d \tag{11.1}$$

$$\frac{d\bar{\pi}(t_c)}{dt} \approx abt_c^{b-1} = c \tag{11.2}$$

A suitable convergence criterion is a balance between model accuracy and computation time. A convergence criterion of $c = 1 \cdot 10^{-3}$ is found to give good results which also deals well with variation between time steps when a relatively low number of simulations is used. In Figure 11.2 an example is given of the convergence of a system. Note that all actors first have a possibility to exchange and 'set' the exchange trend, the power law is thus fitted at a point $t > 1$. In specific, only the simulation points after $\frac{\sum A}{N}$ (the number of connections divided by the number of actors) time steps are taken into account. This makes sure that every connection has at least a $1/\sum A$ chance of interaction.

The results presented in chapter 12 only take into account the time steps of the converged system ($t > t_c$). More specifically, because every time step has N interactions, the results of at least the number of connections divided by N time steps are needed in order to let every connection have a fair possibility of engaging in social exchange.

[1] There are however certain television formats that rely on putting a set of heterogeneous actors in an enclosed environment.

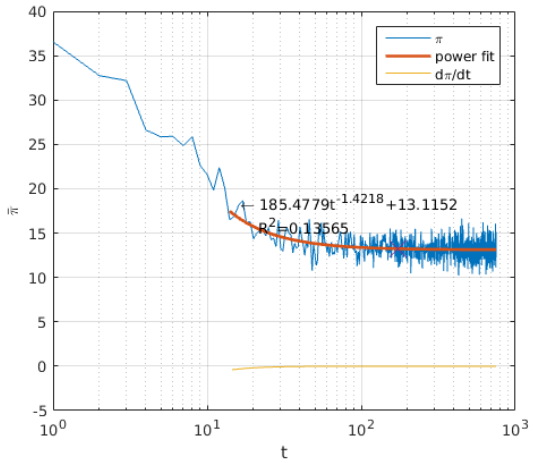


Figure 11.2: Example of a convergence plot.

11.2. ACTOR BEHAVIOR AND NOISE

Actor behavior during the moonlighting game is based on their perceptions. In Part II of this thesis, the different perceptions of key actors involved in wind farm development are researched. It is concluded that when the perceptions of residents and developers are inconsistent during a social exchange, then the perceptions of residents are always more negative than perceptions of the developers (subsection 8.1.1). The goal of this section is to integrate this idea into the model of reciprocity presented in chapter 10.

The perceptions that actors have of each other are represented by the first and second order beliefs. In the following two subsections, the initial actor beliefs and actor specific beliefs are specified. As explained in subsection 10.2.3, the initial first and second order belief of one actor towards another cannot be determined using the model of sequential reciprocity, because at $t = 1$ there are no history profiles existing yet. Furthermore noise is introduced in the model, which imposes the condition that the perception of residents is more negative than a perception of a developer. Because actors look at the relative outcome, the specification of the beliefs makes use of the outcome term Δ.

11.2.1. INITIAL ACTOR SPECIFIC BELIEFS

When developers engage in exchanges with residents, they often hold a belief that both actors will have an equal outcome, or that they outcome will be favorable for the developers. Otherwise there is no reason for developers to engage in exchange. When a residents is confronted with an exchange with developers, they often hold a belief that the outcome will be unfavorable for the residents. Residents and developers look at their outcome relative to the other actor type.

These observations are translated to the belief sets that actors can have in the moonlighting game. The initial belief sets of developers towards residents, and residents towards developers are therefore chosen in the following way: the initial beliefs of actors are randomly drawn from all combinations of beliefs for which hold $\Delta_i = \Delta_j \geq 0$ (for developers, see Figure 11.3) and $\Delta_i = \Delta_j < 0$ (for residents, see Figure 11.4). The beliefs of residents towards residents and developers towards developers are any randomly picked belief set.

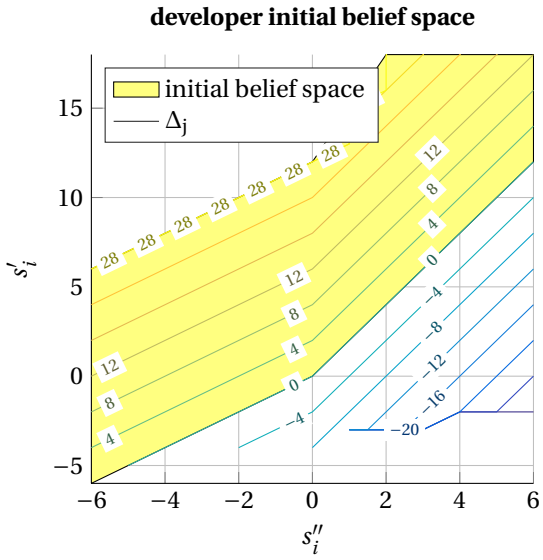


Figure 11.3: Developer initial beliefs towards residents in the moonlighting game are randomly picked from all belief sets for which $\Delta_j \geq 0$ holds.

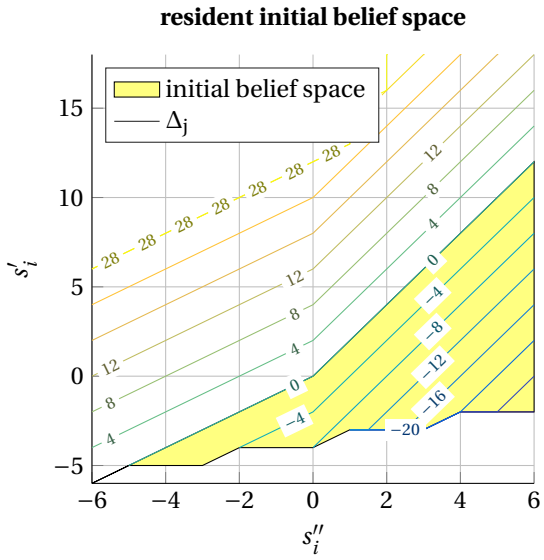


Figure 11.4: Resident initial beliefs towards developers in the moonlighting game are randomly picked from all belief sets for which $\Delta_j < 0$ holds.

11.2.2. NOISE INDUCED ACTOR SPECIFIC BELIEFS

Actor specific beliefs *during* the moonlighting game are specified in a similar way as the initial actor specific beliefs. To this end a time-independent noise factor ν is introduced to incorporate actor specific behavior. This noise makes developers act more like developers, and residents act more like residents. ν is a value between zero and one and is a probability that an actor draws the beliefs not from the history profiles but from some other source. This source may be the media, information search, policy changes or just random opinion changes. In short, *"time-independent noise in the model parameters often represents the variability in the nature of single individuals"* (Castellano et al., 2009). Exposure to noise induces an 'irrational' belief set with corresponding behavior. The result of noise is that actors within a community act more homogeneous towards another community and is therefore an additional variable that distinguishes actors from different communities from each other. As such, it makes developers act like developers towards residents, and residents act like residents towards developers. As explained below, noise has different effects on the two types of actors. When developers engage in exchange with developers, and residents engage in exchange with residents, noise is not effective ($\nu = 0$), i.e. actors act 'normal' towards each other.

Noise thus is a probability that the beliefs are not drawn from the history profiles but from some other source and give developers and residents actor specific beliefs (and thus behavior). The implementation in the model is similar to that of the initial sets. Noise will affect developers such that they randomly obtain a belief set for which $\Delta_j \geq 0$ (initiating) or $\Delta_i \geq 0$ (responding) holds and residents such that they randomly obtain a belief set for which $\Delta_j < 0$ (initiating) or $\Delta_i < 0$ holds. Figure 11.5 until Figure 11.8 visually show the noise belief spaces of residents and developers when they are in the initiating and the responding position.

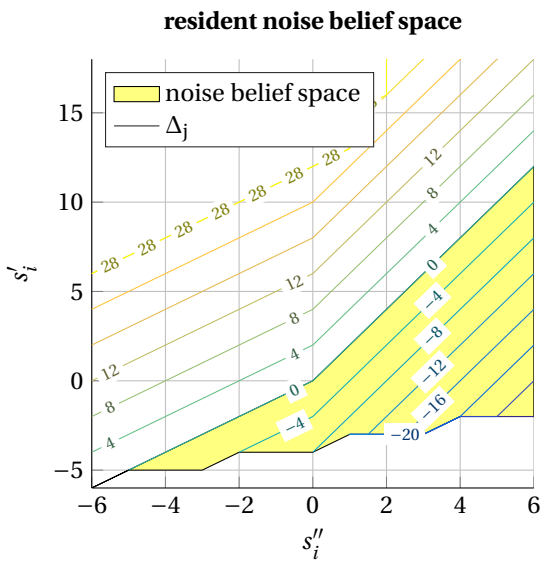


Figure 11.5: A resident facing a developer and being exposed to noise will randomly pick a belief set for which $\Delta_j < 0$ holds.

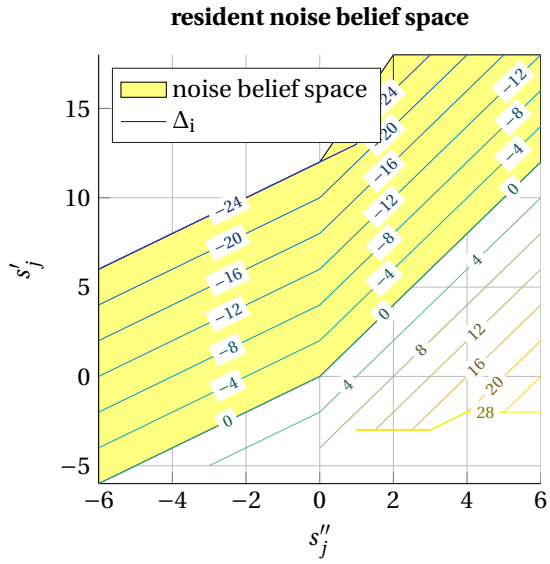


Figure 11.6: A resident responding to a developer and being exposed to noise will randomly pick a second order belief s''_j for which $\Delta_i < 0$ holds.

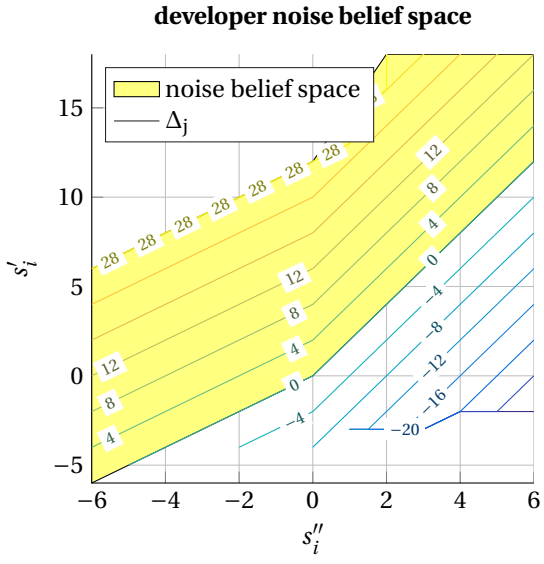


Figure 11.7: A developer facing a resident and being exposed to noise will randomly pick a belief set for which $\Delta_j \geq 0$ holds.

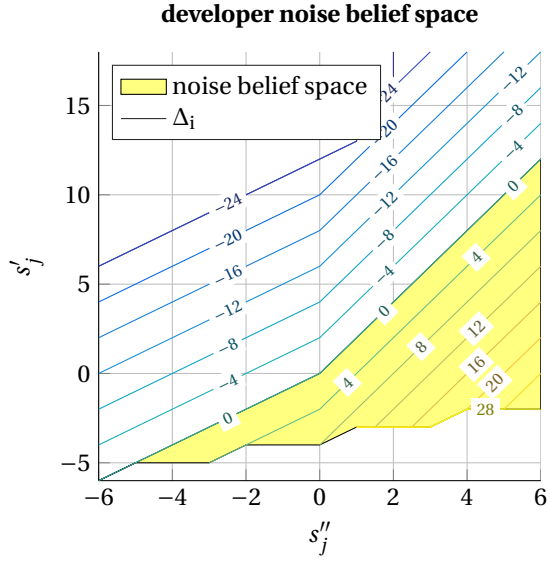


Figure 11.8: A developer responding to a resident and being exposed to noise will randomly pick a second order belief s''_j for which $\Delta_i \geq 0$ holds.

11.3. MODEL IMPLEMENTATION AND VERIFICATION

The model of reciprocity of chapter 10 is implemented using MATLAB (version R2015b) according to the simulation strategy and actor parameters as described in the former sections. The complete MATLAB code can be found in Appendix J. The next sections give a flowchart of the simulation and code verification respectively.

11.3.1. SIMULATION FLOWCHART

The flowchart of the implementation of the network model of reciprocity using Monte Carlo Simulation is shown in Figure 11.9. The code consists of the following steps: first the user can predefine the simulation parameters. These parameters are subsequently used to create the network and define the actors. Then the MCS is performed. Finally, the data is processed, plotted and saved. A detailed flowchart of the MCS is given in Figure 11.10.

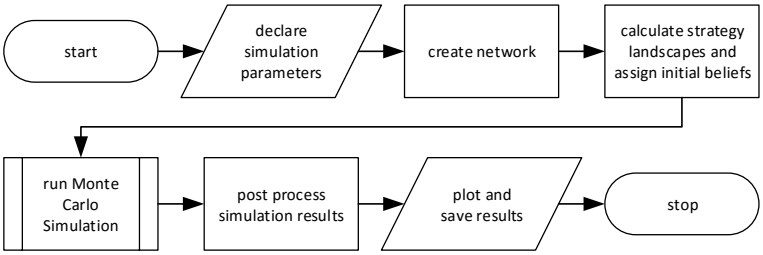


Figure 11.9: Flowchart of the implementation of the network model of reciprocity using MCS. A detailed flowchart of the MCS is given in Figure 11.10.

11.3.2. CODE VERIFICATION

In order to be sure that the code runs the model as intended a verification study is performed. This is done in four steps which are elaborated further below. The complete code verification can be found in Appendix K.

- Individual actor behavior
- Dyadic interaction
- 3-actor interaction
- Network interaction

Individual actor behavior is prescribed by the strategy landscapes, see subsection 10.3.4. It is verified that the least reciprocal oriented actors ($\rho = 0$ and $\varepsilon = 0$) act such that they always maximize their own material payoff, and that the most reciprocal oriented actors ($\rho = 1$ and $\varepsilon = 1$) always respond kind to perceived kindness, and always respond unkind to perceived unkindness.

The verification of dyadic interaction shows that actors with $\rho = 0$ and $\varepsilon = 0$ act such that they always maximize their own material payoff, while a dyad where $\rho_i = \rho_j$ results in both actors playing the same average strategies.

When subsequently adding a third actor, such that a triad or a 1D lattice is created, this third actor influences the average strategies and material payoff of the other actors. In the 1D lattice, the third actor only directly influences the second actor, and indirectly the first actor. In the triad, the third actor directly influences the two other actors.

With increasing network size, the combination of actors and their embeddedness in the network are innumerable. With a high enough number of connections (network density), the results in terms of total points earned must average out and become equal. With $\varepsilon = 0$ and $\rho = 0, 0.1 ... 0.9, 1$ there are eleven different kinds of actors. Any fully connected network of eleven actors with any $\rho_i \neq \rho_j$ yields the same outcome.

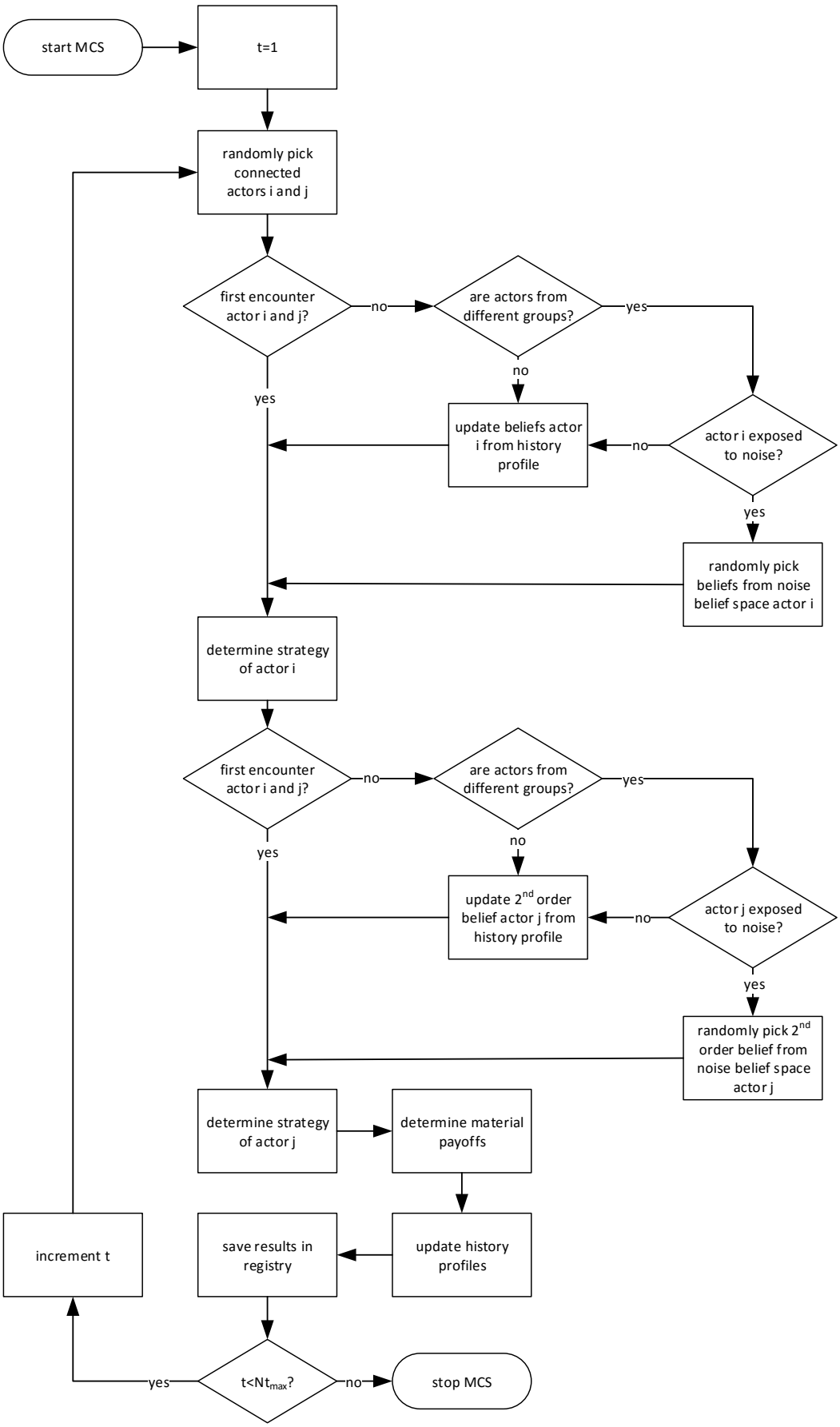


Figure 11.10: Detailed flowchart of the MCS.

12

SIMULATION RESULTS AND ANALYSIS

The network reciprocity model of chapter 10 is implemented according to the methodology in chapter 11. The results of the simulations are presented in this chapter. Along with a presentation of the simulation results an analysis and interpretation of the dynamics of the model are given. During these analyses, special interest is given to the situations for which an equal outcome or highest total material payoff will occur.

This chapter consists of two sections. In order to isolate network effects (complexity) the simulations are first done on a dyad, a network consisting of one developer and one resident (section 12.1). The simulations are then expanded to a network, where a group of developers engage in social exchange with a group of residents (section 12.2). In both sections the reader is first introduced to the results after which the analysis is treated.

In the dyadic exchange, the reciprocity parameters of the actors and the degree of noise are structurally altered to measure its effects on the simulation outcome in terms of material payoff. In the network exchange, the reciprocity parameters are assumed (such that $\rho_d < \rho_r$) and the focus shifts to the alteration of the fraction of connections between the groups δ. For every simulation, the simulation parameters are given (MCS parameters, actor parameters and network parameters). The results in terms of material payoff are given in the form of normal distribution means $\bar{\pi}$ and standard deviations SD, as well as the accompanying confidence interval boundaries CD_l and CD_u. The normal PDFs $P(\pi)$ are shown along with scatter plots indicating the distribution of material payoff per actor or group. From the material payoff per actor or group, the outcome Δ can be calculated. The outcome is the difference in material payoff between the actors or groups.

Specifically, the outcome term Δ_d will be used to present the difference in material payoff between actors. The decision to use Δ_d and not Δ_r is arbitrary. Remember that $\Delta_d = \pi_r - \pi_d$ and $\Delta_r = \pi_d - \pi_r$ which makes $\Delta_d = -\Delta_r$, so in terms of simulation results it does not make a difference. Next to the outcome term, there are four different combinations of the material payoff for both actors. These are a mutual advantage ($\pi_d > 0, \pi_r > 0$), a mutual disadvantage ($\pi_d < 0, \pi_r < 0$) and a unilateral advantage ($\pi_d > 0, \pi_r < 0$ and $\pi_d < 0, \pi_r > 0$).

12.1. DYADIC EXCHANGE

The actors modeled in the dyad are one developer and one resident. The network is shown in Figure 12.1. Three cases of dyadic interaction are considered. The first one is the case when both reciprocity parameters are equal, which serves as a benchmark because the outcomes are equal for both actors. In the second case the reciprocity parameter of the developer is larger than that of the resident, and in the third case, the reciprocity parameter of the resident is larger than that of the developer.

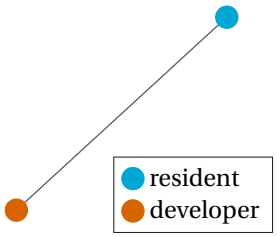


Figure 12.1: 2-actor network (dyad) which is used for the simulations in section 12.1.

12.1.1. DYADIC EXCHANGE SIMULATION RESULTS

BENCHMARK CASE

As a benchmark, dyadic exchange between two actors with $\rho_d = \rho_r = 0.2$ and $\nu = 0$ is used. The reciprocity parameters are chosen such that they yield a mean material payoff that is approximately zero. This situation is gives a 'neutral' outcome, since there is no difference in outcome between actors and there is no net total positive or negative material payoff. Further details of the simulation parameters are given in Table 12.1. To show how the material payoffs differ when the reciprocity parameter of both actors increase, also the results for $\rho_d = \rho_r = 1$ are tabulated in Table 12.3.

Table 12.1: Simulation parameters for benchmark simulation of the dyad with $\rho_d = \rho_r$

simulation parameters				
runs	t_{max}	ρ_d	ρ_r	ν
10,000	100	0.2, 1	0.2, 1	0

Table 12.2: Simulation results for $\rho_d = \rho_r = 0.2$, mean $\bar{\pi}$, standard deviations SD and 95% lower and upper confidence interval boundaries CI_l and CI_u, $t_c = 30$.

actors	$\bar{\pi}$	$CI_{\bar{\pi}_l}$	$CI_{\bar{\pi}_u}$	SD	CI_{SD_l}	CI_{SD_u}
residents	0.23	0.17	0.29	6.32	6.28	6.36
developers	0.22	0.16	0.27	6.32	6.28	6.36
total	0.45	0.38	0.51	7.30	7.25	7.34

Table 12.3: Simulation results for $\rho_d = \rho_r = 1$, mean $\bar{\pi}$, standard deviations SD and 95% lower and upper confidence interval boundaries CI_l and CI_u, $t_c = 30$.

actors	$\bar{\pi}$	$CI_{\bar{\pi}_l}$	$CI_{\bar{\pi}_u}$	SD	CI_{SD_l}	CI_{SD_u}
residents	1.23	1.17	1.29	6.47	6.43	6.51
developers	1.26	1.20	1.32	6.45	6.41	6.49
total	2.49	2.42	2.56	7.94	7.89	7.99

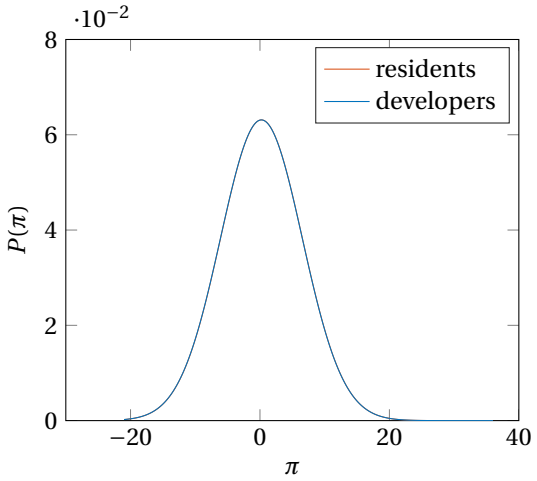


Figure 12.2: Actor material payoff distributions for a dyad ($\rho_d = \rho_r = 0.2, \nu = 0$). The probability curves are equal.

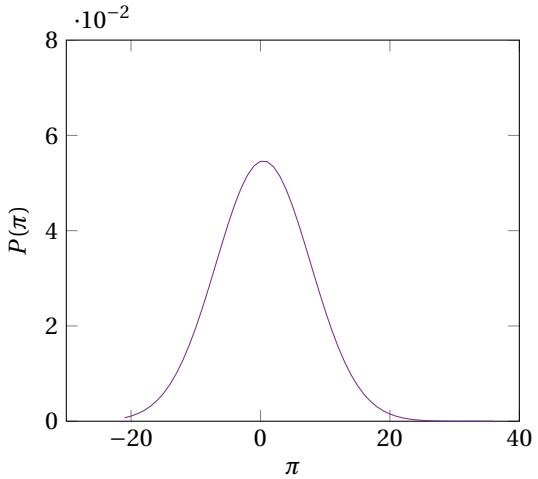


Figure 12.3: Total material payoff distribution for a dyad ($\rho_d = \rho_r = 0.2, \nu = 0$).

The results of this simulation are tabulated in Table 12.2. The values are visually represented by the normal distributions in Figure 12.2 and Figure 12.3. The material payoff mean $\bar{\pi}$ is approximately zero. The outcomes of relatively many runs (two times 33%)are distributed in favor of one of either actors, as is shown in Figure 12.4.

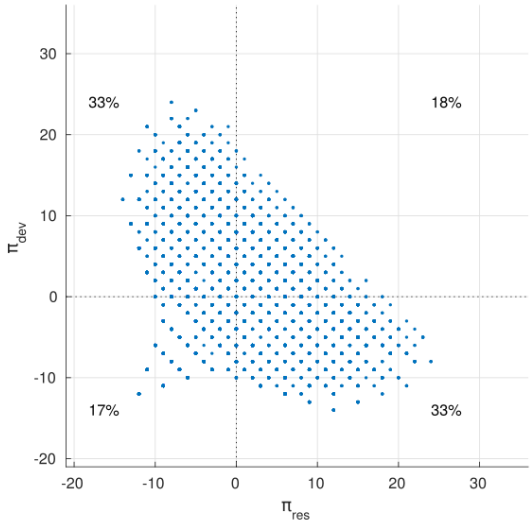


Figure 12.4: Scatter plot of actor material payoff for a dyad ($\rho_d = \rho_r = 0.2, \nu = 0$). The percentages indicate how many runs of the MCS have a result that falls within the quadrants.

CASE: $\rho_d = \rho_r$

Subsequently noise is added to the benchmark situation of $\rho_d = \rho_r = 0.2$. Noise is added in steps of 20% up till the maximum of 100%. The simulation parameters are tabulated in Table 12.4. The material payoff means an standard deviations for each actor and each value of noise are tabulated in Table 12.5. As an illustration, plots of the material payoff distributions for $\nu = 0.4$ are shown in Figure 12.5 and Figure 12.6. The results are graphically represented by plotting the material payoff means and the outcome term as a function of noise (Figure 12.7), and the scatter plots for every value of ν (Figure 12.8).

Table 12.4: Parameters for simulation of the dyad exchange ($\rho_d = \rho_r = 0.2$).

simulation parameters				
runs	t_{max}	ρ_d	ρ_r	ν
10,000	100	0.2	0.2	0, 0.2...0.8, 1

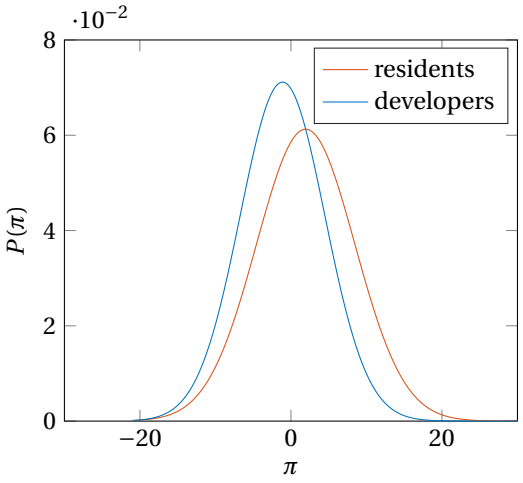


Figure 12.5: Actor material payoff distributions for a dyad ($\rho_d = \rho_r = 0.2, \nu = 0.4$).

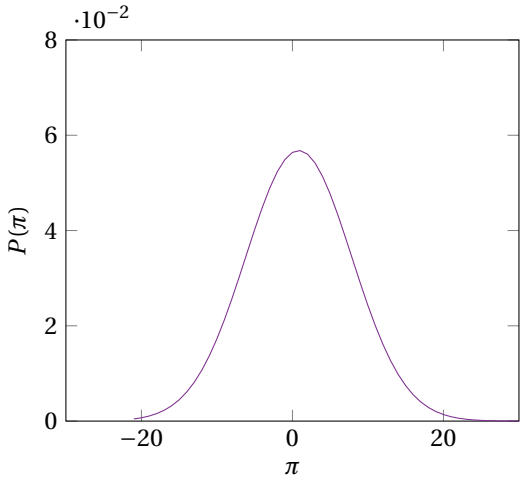


Figure 12.6: Total material payoff distribution for a dyad ($\rho_d = \rho_r = 0.2, \nu = 0.4$).

Table 12.5: Simulation results of dyadic exchange ($\rho_d = \rho_r = 0.2$). The table shows the mean material payoff $\bar{\pi}$, standard deviations of the material payoff SD and 95% lower and upper confidence interval boundaries CI_l and CI_u.

actors	ν	$\bar{\pi}$	$CI_{\bar{\pi}_l}$	$CI_{\bar{\pi}_u}$	SD	CI_{SD_l}	CI_{SD_u}
residents	0	0.23	0.17	0.29	6.32	6.28	6.36
	0.2	0.98	0.92	1.04	6.43	6.39	6.47
	0.4	1.95	1.89	2.01	6.51	6.47	6.55
	0.6	3.05	3.00	3.11	6.56	6.52	6.60
	0.8	4.54	4.48	4.60	6.43	6.39	6.47
	1.0	6.35	6.30	6.41	6.08	6.04	6.12
developers	0	0.22	0.16	0.27	6.32	6.28	6.36
	0.2	-0.44	-0.49	-0.39	5.99	5.96	6.03
	0.4	-1.12	-1.16	-1.07	5.61	5.57	5.64
	0.6	-1.80	-1.85	-1.76	5.12	5.09	5.16
	0.8	-2.57	-2.61	-2.53	4.52	4.50	4.55
	1.0	-3.41	-3.44	-3.38	3.56	3.54	3.58
total	0	0.45	0.38	0.51	7.30	7.25	7.34
	0.2	0.54	0.48	0.60	7.19	7.14	7.23
	0.4	0.84	0.78	0.90	7.02	6.98	7.07
	0.6	1.25	1.19	1.31	6.71	6.67	6.75
	0.8	1.97	1.92	2.02	6.18	6.14	6.22
	1.0	2.94	2.90	2.99	5.30	5.27	5.33

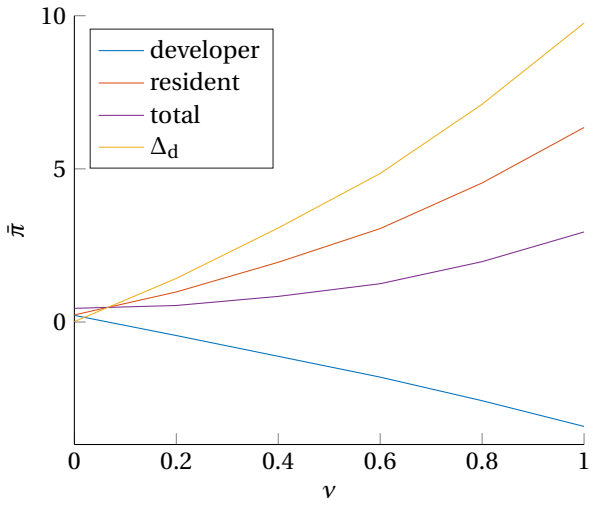
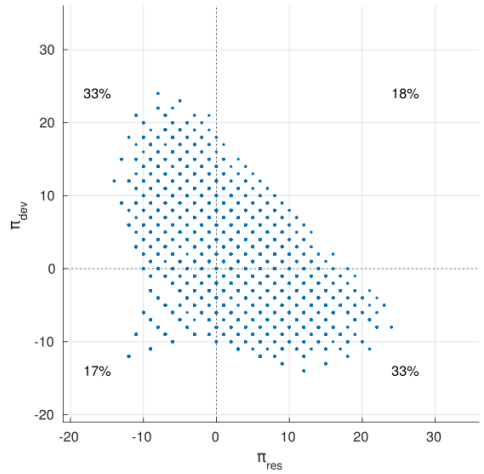


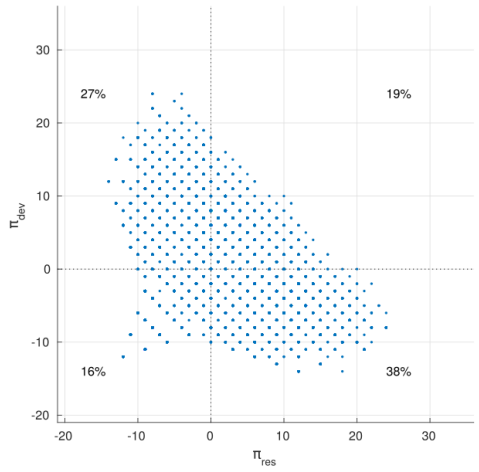
Figure 12.7: Actor and total mean material payoffs $\bar{\pi}$ and outcome term Δ_d as a function of noise ν ($\rho_d = \rho_r = 0.2$).

The results of the $\nu = 0$ situation are equal to that of in the benchmark. Noise results in the mean of the residents material payoff becomes higher and positive, and the mean of the developers material payoff becoming lower and negative. The mean total material payoff however increases slightly.

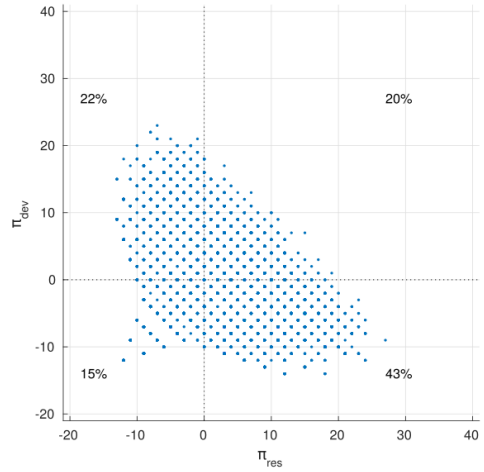
The effects of noise on the material payoff distributions becomes more apparent when looking at the scatter plots of Figure 12.8. In this figure, Figure 12.8a is equal to Figure 12.4. Using these specific actor personalities, $\rho_d = \rho_r = 0.2$, noise works in favor of the residents and at a cost of the developers. The probability of $(\bar{\pi}_d < 0, \bar{\pi}_r > 0)$ increases from 33 to 71%. While at the same time the probability of $(\bar{\pi}_d > 0, \bar{\pi}_r < 0)$ decreases from 33 to 4.6%. An optimal value of ν can be found when considering the situation $(\bar{\pi}_d > 0, \bar{\pi}_r > 0)$. Initially for $\nu = 0$ the probability of this situation occurring is 18%, this probability increases to 21% for $\nu = 0.6$. When ν is further increased, the probability of mutual advantage decreases again.



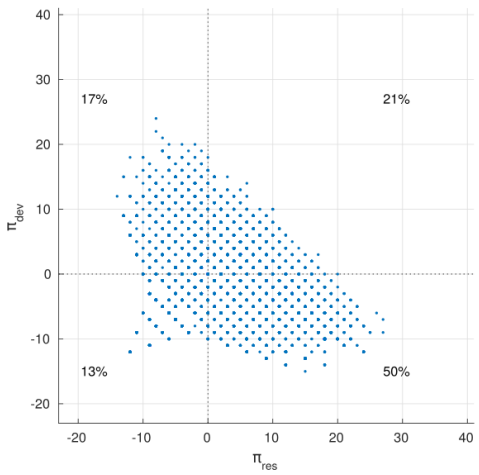
(a) $\nu = 0$, (equal to Figure 12.4).



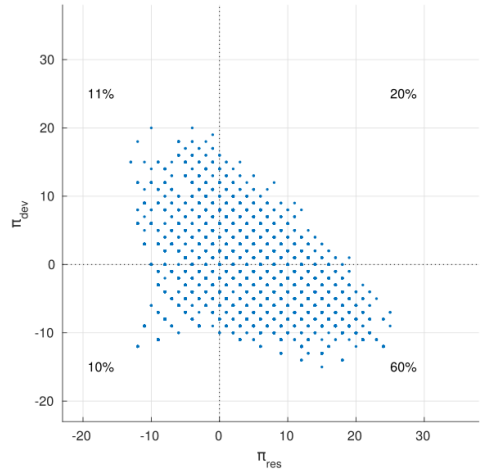
(b) $\nu = 0.2$



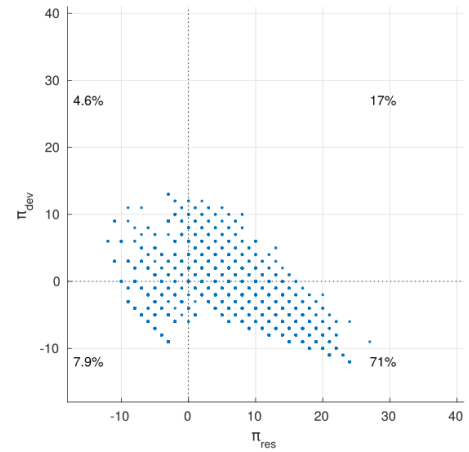
(c) $\nu = 0.4$



(d) $\nu = 0.6$



(e) $\nu = 0.8$



(f) $\nu = 1$

Figure 12.8: Scatter plots of actor material payoff for a dyad ($\rho_d = \rho_r = 0.2$) as a function of ν, ranging from zero to one. The percentages indicate how many runs of the MCS have a result that falls within the quadrants.

CASE: $\rho_d > \rho_r$

The simulation above is repeated with different actor reciprocity parameters. In the following case the reciprocity parameters $\rho_d = 1$ and $\rho_r = 0.1$ are assumed. The other simulation parameters are tabulated in Table 12.6. Again the results in terms of material payoff are tabulated (Table 12.7). The mean material payoff and outcome term as a function of noise is plotted in Figure 12.9. The scatter plots indicating the distribution of material payoff for both actors are shown in Figure 12.10.

Table 12.6: Parameters for simulation of the dyad exchange ($\rho_d = 1, \rho_r = 0.1$).

simulation parameters				
runs	t_{max}	ρ_d	ρ_r	ν
10,000	100	1	0.1	0, 0.2...0.8, 1

Table 12.7: Simulation results of dyadic exchange ($\rho_d = 1, \rho_r = 0.1$). The table shows the mean material payoff $\bar{\pi}$, standard deviations of the material payoff SD and 95% lower and upper confidence interval boundaries CI_l and CI_u.

actors	ν	$\bar{\pi}$	$CI_{\bar{\pi}_l}$	$CI_{\bar{\pi}_u}$	SD	CI_{SD_l}	CI_{SD_u}
residents	0	1.20	1.14	1.26	6.45	6.41	6.49
	0.2	2.31	2.25	2.37	6.73	6.69	6.77
	0.4	3.56	3.50	3.62	6.85	6.81	6.89
	0.6	4.98	4.92	5.04	6.79	6.75	6.83
	0.8	6.82	6.76	6.87	6.46	6.42	6.50
	1.0	9.07	9.02	9.12	5.65	5.62	5.69
developers	0	-1.80	-1.86	-1.75	6.34	6.31	6.38
	0.2	-2.37	-2.43	-2.32	5.98	5.94	6.02
	0.4	-2.94	-2.99	-2.90	5.59	5.55	5.62
	0.6	-3.53	-3.58	-3.49	5.07	5.04	5.10
	0.8	-4.16	-4.20	-4.12	4.40	4.37	4.42
	1.0	-4.94	-4.97	-4.91	3.38	3.36	3.40
total	0	-0.60	-0.68	-0.53	8.66	8.60	8.71
	0.2	-0.06	-0.13	0.01	8.30	8.24	8.35
	0.4	0.618	0.55	0.69	7.73	7.68	7.78
	0.6	1.44	1.38	1.50	7.02	6.97	7.06
	0.8	2.66	2.61	2.71	5.83	5.79	5.86
	1.0	4.13	4.09	4.16	3.96	3.94	3.98

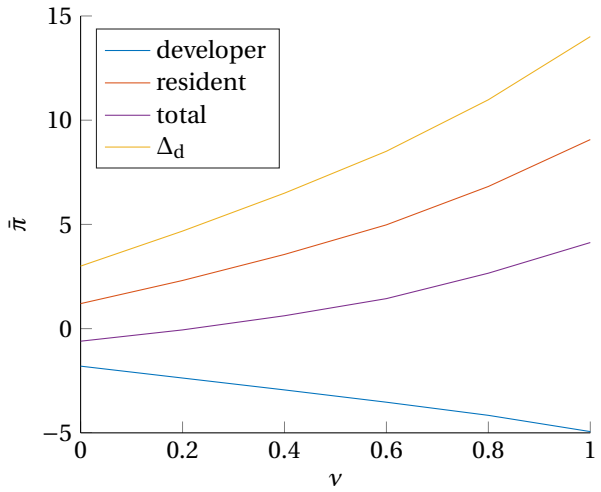
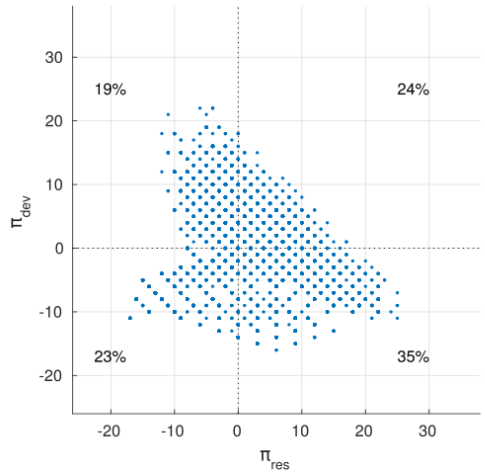
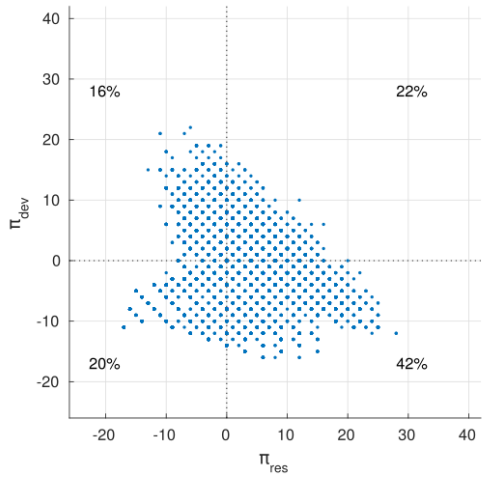


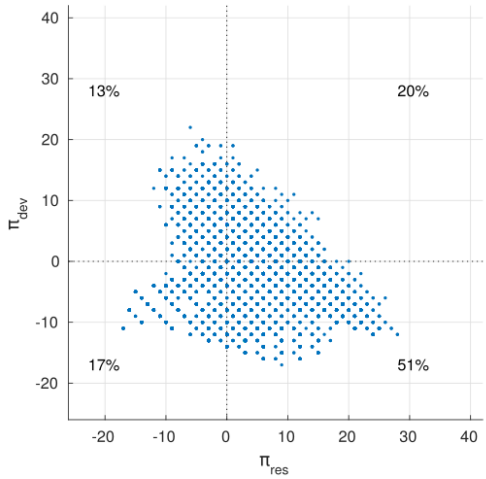
Figure 12.9: Actor and total mean material payoffs $\bar{\pi}$ and outcome term Δ_d as a function of noise ν ($\rho_d = 1, \rho_r = 0.1$).



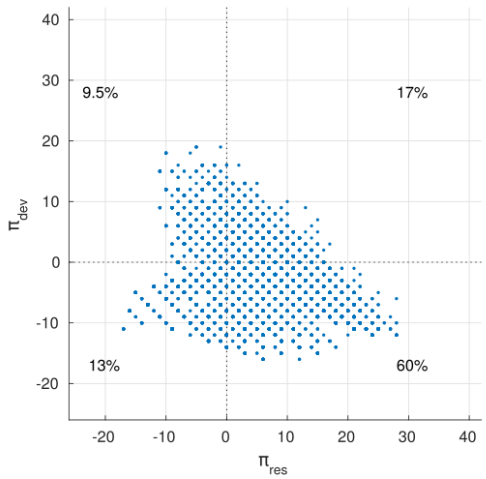
(a) $v = 0$



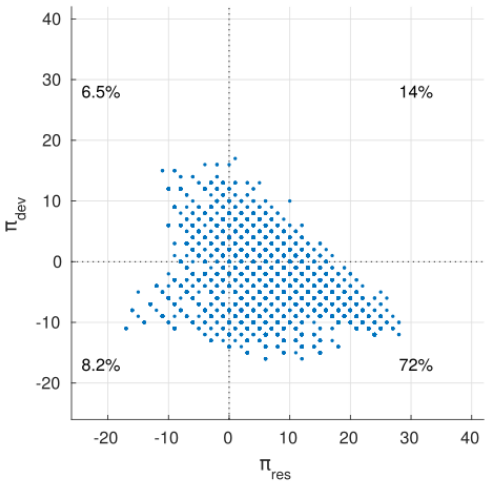
(b) $v = 0.2$



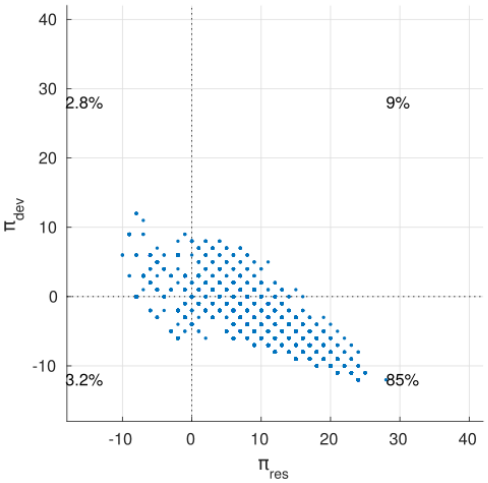
(c) $v = 0.4$



(d) $v = 0.6$



(e) $v = 0.8$



(f) $v = 1$

Figure 12.10: Scatter plots of actor material payoff for a dyad ($\rho_d = 1, \rho_r = 0.1$) as a function of v, ranging from zero to one. The percentages indicate how many runs of the MCS have a result that falls withing the quadrants.

Different from Figure 12.7, where $\rho_d = \rho_r = 0.2$, this simulation shows that the resident starts off with a relative advantage over the developer in terms of mean material payoff ($\Delta_d > 0$). The total material payoff however is negative for $\nu = 0$. A mean total material payoff of zero or higher is attained from approximately $\nu > 0.2$. This increase in mean total material payoff is always accompanied with an increase of Δ_d, meaning that the developers are increasingly more disadvantaged with respect to the residents.

When considering the scatter plots of the material payoffs, it is seen that increasing noise has an advantageous effect on the material payoff of the residents, not only at a cost of the advantageous outcome of the developers ($\pi_d > 0, \pi_r < 0$), but also at a cost of the mutually beneficial outcome($\pi_d > 0, \pi_r > 0$). The effects are stronger than the results for $\rho_d = \rho_r$ presented in Figure 12.8.

CASE: $\rho_d < \rho_r$

Finally, a simulation of a dyad with $\rho_d = 0.1$ and $\rho_r = 1$ is performed. An overview of the simulation parameters is given in Table 12.8. The results are tabulated in Table 12.9. The mean material payoffs and the scatter plots are shown in Figure 12.11 and Figure 12.12 respectively.

Table 12.8: Parameters for simulation of the dyad exchange ($\rho_d = 0.1, \rho_r = 1$).

simulation parameters				
runs	t_{max}	ρ_d	ρ_r	ν
10,000	100	0.1	1	0, 0.2...0.8, 1

Table 12.9: Simulation results of dyadic exchange ($\rho_d = 0.1, \rho_r = 1$). The table shows the mean material payoff $\bar{\pi}$, standard deviations of the material payoff SD and 95% lower and upper confidence interval boundaries CI_l and CI_u.

actors	ν	$\bar{\pi}$	$CI_{\bar{\pi}_l}$	$CI_{\bar{\pi}_u}$	SD	CI_{SD_l}	CI_{SD_u}
residents	0	-1.79	-1.85	-1.74	6.35	6.31	6.39
	0.2	-1.17	-1.22	-1.11	6.36	6.32	6.39
	0.4	-0.42	-0.48	-0.37	6.32	6.28	6.36
	0.6	0.49	0.43	0.54	6.30	6.26	6.34
	0.8	1.65	1.60	1.71	6.17	6.13	6.21
	1.0	3.19	3.14	3.24	5.78	5.75	5.82
developers	0	1.26	1.20	1.32	6.47	6.43	6.51
	0.2	0.78	0.72	0.83	6.30	6.26	6.34
	0.4	0.37	0.32	0.42	6.01	5.97	6.05
	0.6	-0.14	-0.19	-0.09	5.63	5.60	5.67
	0.8	-0.73	-0.77	-0.68	5.05	5.01	5.08
	1.0	-1.29	-1.33	-1.26	4.14	4.11	4.17
total	0	-0.54	-0.61	-0.46	8.61	8.56	8.66
	0.2	-0.39	-0.46	-0.32	8.51	8.45	8.56
	0.4	-0.05	-0.12	0.02	8.22	8.17	8.27
	0.6	0.35	0.28	0.41	7.93	7.88	7.98
	0.8	0.93	0.86	0.99	7.44	7.39	7.48
	1.0	1.90	1.84	1.96	6.53	6.49	6.57

For the situation $\nu = 0$, the outcomes are equal but opposite of those in Table 12.7. This is expected because the reciprocity parameters of both actors are opposite. When noise is added to the system the actors exhibit actor specific behavior and the mean material payoff changes. For approximately $\nu > 0.4$, the mean total material payoff is larger than zero. Whereas Δ_d was always positive in the former simulations (mean difference in material payoff in favor of residents), this simulation shows that there is an optimum point where the mean material payoff of both actors is equal. This points is at approximately $\nu = 0.5$.

With the mean material payoffs of the individual actors drawing closer towards each other and the mean total material payoff being more positive, the probability of an outcome yielding mutual advantage ($\pi_d > 0, \pi_r > 0$) increases. This is visible in the scatter plots of Figure 12.12. Although noise is still favoring the material outcomes of the resident at a cost of that of the developer. The probability of mutual advantage is considerably

increased from 23% for $\nu = 0$ till 37% for $\nu = 1$. At the same time, the probability of mutual disadvantage decreases from 23% to 11%.

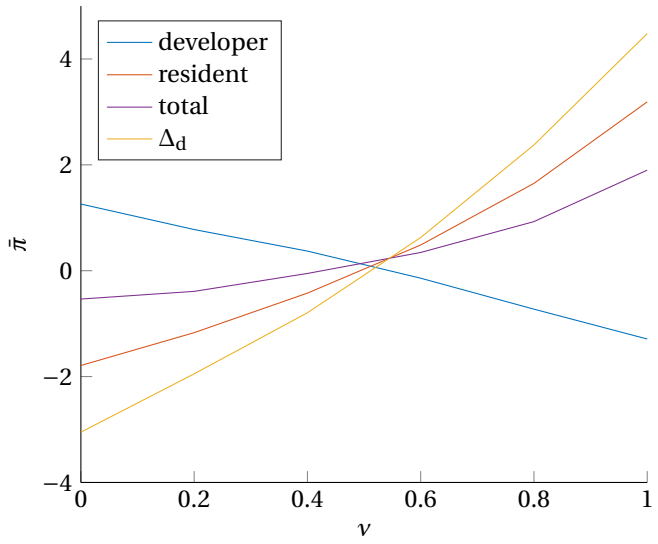
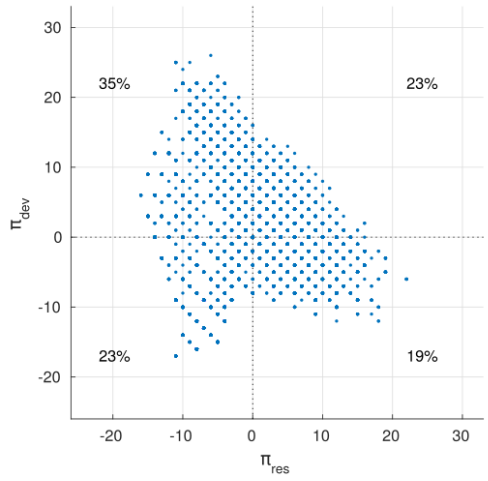
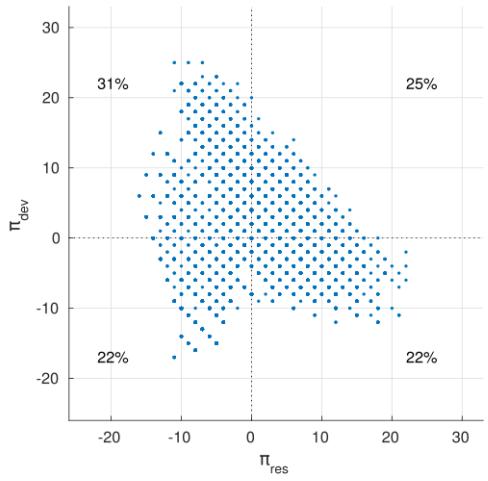


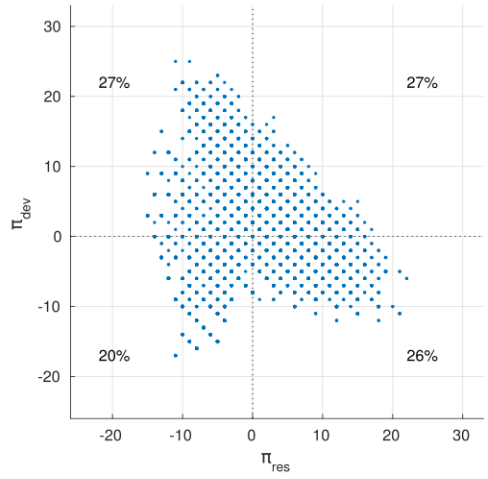
Figure 12.11: Actor and total mean material payoffs $\bar{\pi}$ and outcome term Δ_d as a function of noise ν ($\rho_d = 0.1, \rho_r = 1$).



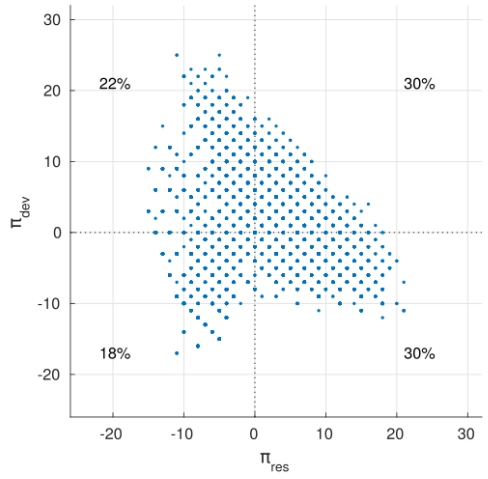
(a) $\nu = 0$



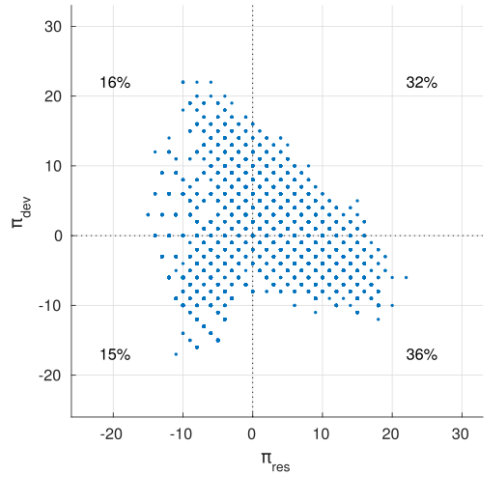
(b) $\nu = 0.2$



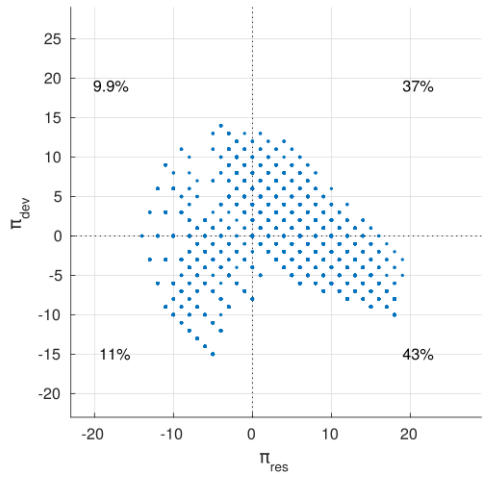
(c) $\nu = 0.4$



(d) $\nu = 0.6$



(e) $\nu = 0.8$



(f) $\nu = 1$

Figure 12.12: Scatter plots of actor material payoff for a dyad ($\rho_d = 0.1, \rho_r = 1$) as a function of ν, ranging from zero to one. The percentages indicate how many runs of the MCS have a result that falls within the quadrants.

12.1.2. ANALYSIS OF DYADIC EXCHANGE

EQUALLY RECIPROCAL ACTORS YIELD EQUAL MEAN MATERIAL PAYOFF FOR $\nu = 0$

It is observed that actors having equal reciprocity parameters yield equal mean material payoff when no noise is acting on the system. For $\nu = 0$, actors do not exhibit actor specific behavior. The notion of 'developer versus resident' is thus non-existent. The fact that the actors yield an equal material payoff is not surprising in this case. When actors have the same 'personality', they treat each other in a similar way and the outcome (the difference in material payoff) becomes zero. The material payoff distributions for $\rho_d = \rho_r = 0.2$ of Figures 12.2 and 12.3 show this point. For $\rho_d = \rho_r > 0.2$ mutual advantage and equal material payoff will occur ($\pi_d > 0, \pi_r > 0, \Delta_d = 0$).

LESS RECIPROCAL ACTORS YIELD HIGHER MEAN MATERIAL PAYOFF WHEN EXCHANGING WITH MORE RECIPROCAL ACTORS FOR $\nu = 0$

For the situation of $\rho_d \neq \rho_r$ and $\nu = 0$ the mean material payoff of the least reciprocal actor is higher than the mean material payoff of the more reciprocal actor. This is shown by Tables 12.7 and 12.9 in the rows for which $\nu = 0$. Remember that in this situation, there is still no notion of 'developer versus resident'. This discrepancy in material payoff can be interpreted in the following way: suppose that a highly reciprocal actor gives a compliment to another actor, then he might expect that the other actor becomes more prone to give compliments back. When she does not do that, because she has a less reciprocal personality, then the net outcome of the exchange is in favor of the second, less reciprocal actor. In the end she received the compliments, while he did not receive anything.

NOISE FAVORS RESIDENTS' AND TOTAL MEAN OUTCOME

When noise is added to the dyad, then the resident increasingly expects a negative outcome and the developer increasingly expects an equitable or favorable outcome. Because the actors change their behavior according to these beliefs, the mean material payoff distributions change.

The effects of increasing noise are that the total mean material payoff increases (the purple lines in Figures 12.7, 12.9 and 12.11) and the mean outcome of the exchanges increases in favor of the residents (the yellow lines in the same figures). The total mean material payoff increases as a function of noise because the resident's mean material payoff increases with a faster rate than the decrease of the developer's mean material payoff. The effects of noise are independent of the actors' reciprocity parameters.

This system behavior as a function of noise has implications for social exchange between a developer and a resident. It means that, when noise is present, an equitable outcome ($\Delta_d = 0$) is possible only if $\rho_d < \rho_r$. This is shown in Figure 12.11, where $\Delta_d = 0$ for approximately $\nu = 0.5$. On the contrary, when $\rho_d > \rho_r$ there does not exist a point $\Delta_d = 0$, see Figure 12.9.

NOISE POTENTIALLY INCREASES THE PROBABILITY OF MUTUALLY ADVANTAGEOUS MATERIAL PAYOFF AND ALWAYS DECREASES THE PROBABILITY OF A MUTUAL DISADVANTAGE OF MATERIAL PAYOFF

When only taking the mean material payoffs into account, a poor interpretation of the data is obtained. The material payoff distributions have considerable standard deviations. This indicates for example that, when the mean material payoff is positive for both actors ($\pi_d > 0, \pi_r > 0$) the existence of situations where the material payoff is negative for both actors ($\pi_d < 0, \pi_r < 0$) cannot definitely be excluded. A closer look at the scatter plots of Figures 12.8, 12.10 and 12.12 give more insight in the distribution of outcomes of a MCS.

The scatter plots show that increasing noise always leads to a decrease in the probability of outcome ($\pi_d > 0, \pi_r < 0$) and always leads to an increase in the probability of outcome ($\pi_d < 0, \pi_r > 0$). Hence the former analysis that noise always favors resident's mean outcome finds resonance here. Furthermore, the probability of a mutual disadvantageous material payoff ($\pi_d < 0, \pi_r < 0$) is always decreasing with increasing noise. Differences in mutually advantageous outcomes ($\pi_d > 0, \pi_r > 0$) as a function of noise however exist when looking at the three different combinations of reciprocity parameters.

- For the situation $\rho_d = \rho_r = 0.2$ (Figure 12.8), the probability of mutual advantage increases from 18% for $\nu = 0$ to 21% for $\nu = 0.6$. When ν is further increased, the probability of mutual advantage decreases again.

- In the situation of $\rho_d > \rho_r$ the mean material outcome for $\nu = 0$ favors the residents ($\Delta_d > 0$). Figure 12.10 shows that increasing actor specific behavior ($\nu > 0$) only increasingly favors the resident's outcome, even at a cost of the probability of a mutual advantage. The probability of an outcome ($\pi_d > 0, \pi_r > 0$) decreases from 24% for $\nu = 0$ to 9% for $\nu = 1$. At the same time probability of a mutual disadvantage ($\pi_d < 0, \pi_r < 0$) decreases even stronger: from 24% for $\nu = 0$ until 3.2% for $\nu = 1$.
- In the analysis above it was already shown that only for the situation $\rho_d < \rho_r$ an equitable mean outcome Δ_d is possible. The data points in the scatter plots of these simulations (Figure 12.12) thus should show less tendency to the quadrants ($\pi_d > 0, \pi_r < 0$) and ($\pi_d < 0, \pi_r > 0$) compared to the other scatter plots. Indeed the probability of a mutual advantage ($\pi_d > 0, \pi_r > 0$) is increased with increasing noise from 23% for $\nu = 0$ to 37% for $\nu = 1$. The probability of a mutual disadvantage ($\pi_d < 0, \pi_r < 0$) is decreased, albeit the decrease is slower than the increase of a mutual advantage.

EXTREME DATA POINTS

When considering the scatter plots indicating the distribution of material payoff the extreme data points are further analyzed. The extreme data points are the largest values of the outcome term Δ_d and Δ_r, and the largest and smallest total material payoff $\pi_d + \pi_r$. The data points with these values occupy the corners in the scatter plots.

When taking a look at, for example, the scatter plot in Figure 12.4 of the benchmark situation. The smallest total material payoff is indicated in the bottom left corner, where both actors have a material payoff of -12. Under which circumstances does this situation occur and how do these circumstances differ from the other, non-extreme data points? The answer lies in the history profiles. When taking a closer look at individual runs within the MCS, it is found that the history profiles of the actors always converge to the same distribution. The extreme values are therefore not a result of a difference in history profiles between runs, but are merely a result of the probabilistic nature of the model. In the specific case described above, the beliefs are updated such that both actors choose a strategy -6. Both actors choosing this most selfish strategy leads to a mutual disadvantageous situation of $\pi_d = \pi + r = -12$. Because the history profiles for different runs of the same MCS are equal, the extreme data points only arise in some cases when the beliefs are updated such that actors play the strategies that yield these extreme data points.

12.2. NETWORK EXCHANGE

Results of network simulations of the model of reciprocity are presented here. For this the network structure of Figure 12.14 is used. This structure is composed by assuming two fully connected groups of 10 developers and 10 residents (Figure 12.13), and adding connections between the groups with a probability of $\delta = 0.5$. Using more than two actors allows therefore not only for varying the reciprocity parameters, but also the network structure. The variable δ is used to control this network structure.

First, the benchmark results similar to those of subsection 12.1.1 are presented. Next strongly reciprocal residents weakly reciprocal developers are assumed and the effects of noise on the social system are investigated. The reciprocity parameters are assumed in this way because of two reasons. The first reason is that, especially in the classic style of wind farm development, developers have a low propensity to engage with residents. The second reason is that residents who let themselves be involved in the exchange process do so because they have a relatively high propensity to reciprocate (either positively or negatively). If they would have a low propensity to reciprocate, they would not be a part of the exchange process. Finally, simulation results are shown where the probability of connections between the groups δ is systematically varied for a constant noise to elucidate its effects on network outcome.

12.2.1. NETWORK EXCHANGE SIMULATION RESULTS

BENCHMARK CASE

In the benchmark simulation of the network the reciprocity parameters for all actors are, similar to the dyad benchmark simulation, $\rho = 0.2$. This is done because it results in approximately $\pi_d = \pi_d = 0$ and $\Delta_d = 0$. The simulation parameters are shown in Table 12.10.

The results of this simulation in terms of mean material payoffs $\bar{\pi}$ and standard deviations SD are tabulated in Table 12.11. Also the probability density functions and the scatter plot of the material payoff are shown in

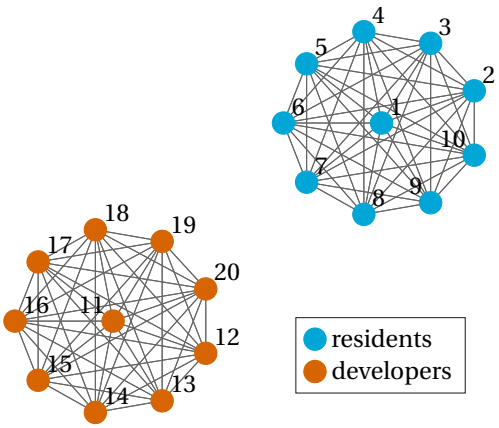


Figure 12.13: Two fully connected groups of actors without connections between groups ($\delta = 0$).

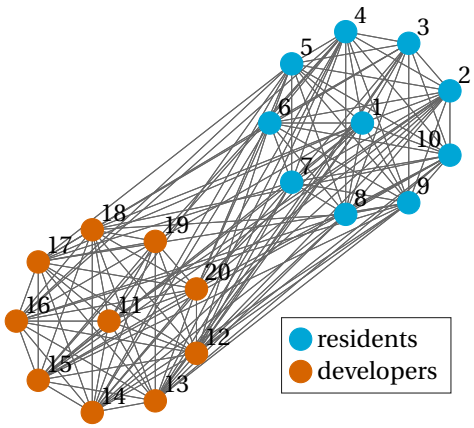


Figure 12.14: 20-actor network consisting of two fully connected groups of actors with connections between groups existing with a probability of 50% ($\delta = 0.5$) which is used for the first simulations in this chapter. For the latter simulations a similar network is used, but instead of varying the noise ν, the number of connections between groups δ is varied.

Figure 12.15, Figure 12.16 and Figure 12.17.

Table 12.10: Parameters for simulation of the network exchange ($\rho_d = \rho_r = 0.2$).

simulation parameters					
runs	t_{max}	ρ_d	ρ_r	ν	δ
500	800	0.2	0.2	0	0.5

Table 12.11: Simulation results of network exchange ($\rho_d = \rho_r = 0.2, \nu = 0, \delta = 0.5$). The table shows the mean material payoff $\bar{\pi}$, standard deviations of the material payoff SD and 95% lower and upper confidence interval boundaries CI_l and CI_u.

actors	$\bar{\pi}$	$CI_{\bar{\pi}_l}$	$CI_{\bar{\pi}_u}$	SD	CI_{SD_l}	CI_{SD_u}
residents	2.50	2.41	2.59	20.50	20.40	20.60
developers	2.48	2.39	2.57	20.50	20.50	20.60
total	4.98	4.86	5.09	26.20	26.10	26.30

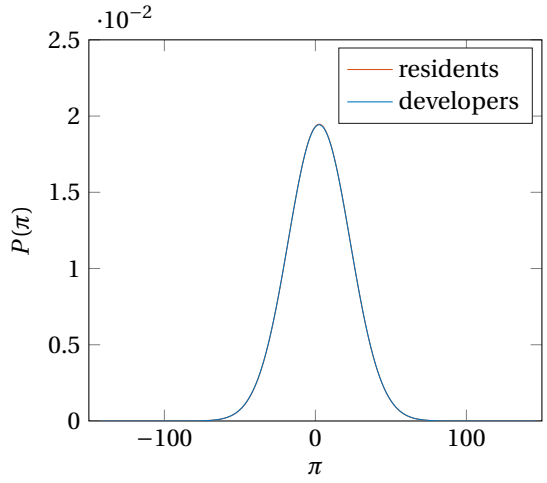


Figure 12.15: Group material payoff distributions for a network ($\rho_d = \rho_r = 0.2, \nu = 0, \delta = 0.5$). The probability curves are equal.

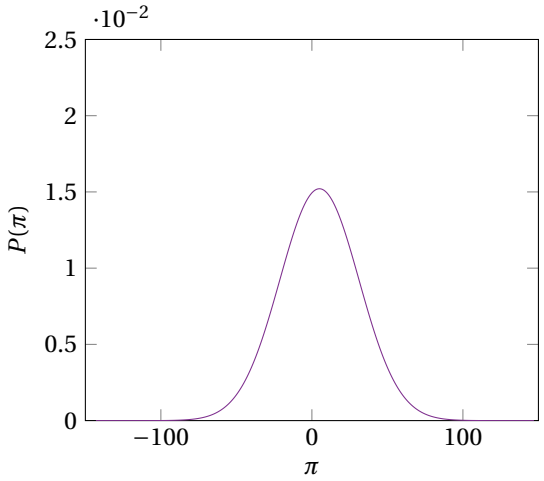


Figure 12.16: Total material payoff distribution for a network ($\rho_d = \rho_r = 0.2, \nu = 0, \delta = 0.5$).

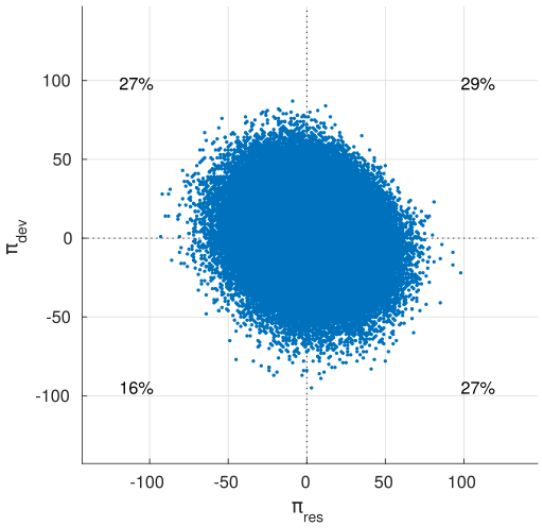


Figure 12.17: Scatter plot of group material payoff for a network ($\rho_d = \rho_r = 0.2, \nu = 0, \delta = 0.5$). The percentages indicate how many runs of the MCS have a result that falls within the quadrants.

CASE: VARIATION OF NOISE ν

The following simulation results are for two fully connected groups with $\delta = 0.5$, $\rho_d = 0.1$ and $\rho_r = 1$ and noise increasing in steps of 20%. The simulation parameters are given in Table 12.12. The material payoff means and standard deviations are tabulated in Table 12.13, and the situation $\nu = 0.4$ is plotted in Figure 12.18 and Figure 12.19. The mean group and total material payoff as a function of noise is plotted in Figure 12.20. Finally, also the scatter plots of the material payoff are given in Figure 12.21.

Table 12.12: Parameters for simulation of the network exchange ($\rho_d = 0.1, \rho_r = 1$).

simulation parameters					
runs	t_{max}	ρ_d	ρ_r	ν	δ
500	750	0.1	1	$0, 0.2 \ldots 0.8, 1$	0.5

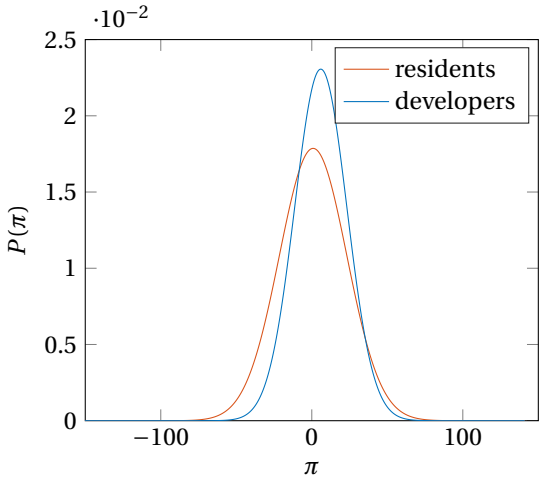


Figure 12.18: Group material payoff distributions for a network ($\rho_d = 0.1, \rho_r = 1, \nu = 0.4, \delta = 0.5$).

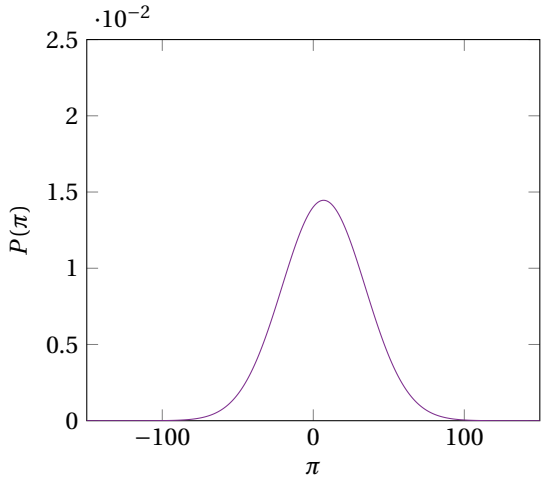


Figure 12.19: Total material payoff distributions for a network ($\rho_d = 0.1, \rho_r = 1, \nu = 0.4, \delta = 0.5$).

The behavior of the network under influence of noise is similar to the dyad behavior. The material payoff of the residents increases, and the material payoff of the developers decreases with increasing noise. Because the

Table 12.13: Simulation results of network exchange ($\rho_d = 0.1, \rho_r = 1, \delta = 0.5$). The table shows the mean material payoff $\bar{\pi}$, standard deviations of the material payoff SD and 95% lower and upper confidence interval boundaries CI_l and CI_u.

actors	ν	$\bar{\pi}$	$CI_{\bar{\pi}_l}$	$CI_{\bar{\pi}_u}$	SD	CI_{SD_l}	CI_{SD_u}
residents	0	0.87	0.78	0.97	22.3	22.3	22.4
	0.2	3.62	3.52	3.71	22.0	21.9	22.0
	0.4	6.68	6.58	6.77	21.8	21.7	21.8
	0.6	10.40	10.30	10.50	21.4	21.3	21.4
	0.8	15.30	15.20	15.40	20.9	20.8	21.0
	1.0	21.80	21.70	21.90	20.3	20.2	20.3
developers	0	5.95	5.87	6.03	17.3	17.2	17.4
	0.2	3.82	3.75	3.90	17.0	17.0	17.1
	0.4	1.38	1.31	1.46	16.6	16.5	16.7
	0.6	-1.08	-1.15	-1.01	16.0	16.0	16.1
	0.8	-3.89	-3.95	-3.82	15.4	15.3	15.4
	1.0	-6.89	-6.96	-6.83	14.2	14.1	14.2
total	0	6.82	6.70	6.94	27.6	27.5	27.7
	0.2	7.44	7.32	7.56	27.0	26.9	27.1
	0.4	8.06	7.94	8.18	26.5	26.4	26.6
	0.6	9.36	9.25	9.47	25.8	25.7	25.9
	0.8	11.40	11.30	11.50	24.9	24.9	25.0
	1.0	14.90	14.80	15.00	23.8	23.7	23.8

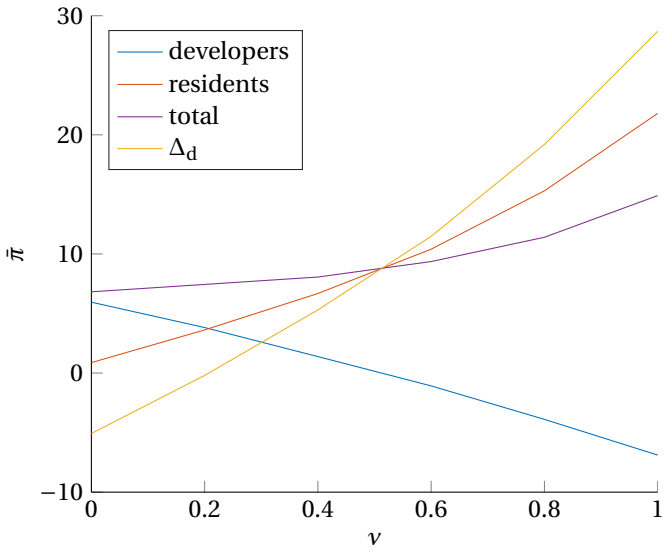
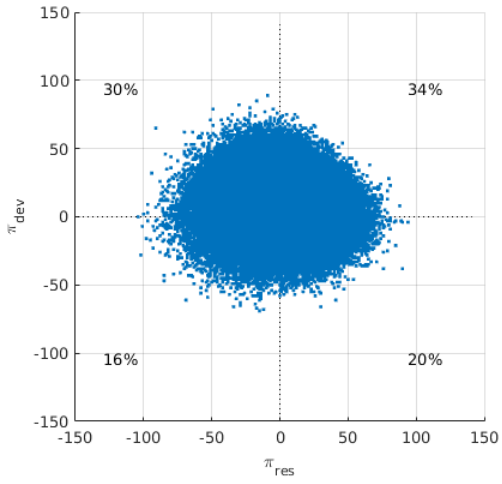


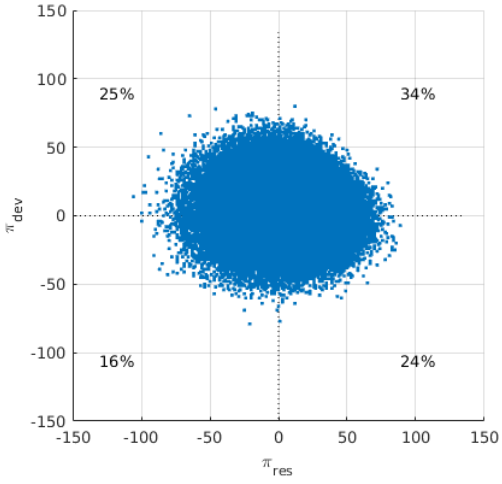
Figure 12.20: Group and total mean material payoffs $\bar{\pi}$ and outcome term Δ_d as a function of noise ν ($\rho_d = 0.1, \rho_r = 1, \delta = 0.5$).

outcome Δ_d for $\nu = 0$ is smaller than zero (outcome favors developers), there exists a value for ν that there is an equitable outcome $\Delta_d = 0$. This happens for approximately $\nu = 0.2$. At this point, there also exists a mutual advantage, because the mean total material payoff is positive. From table Table 12.13 it can be read that $\bar{\pi_{total}} = 7.44$ for $\nu = 0.2$.

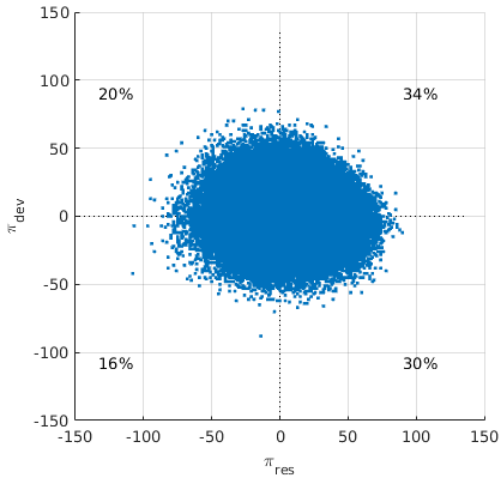
From the scatter plots in Figure 12.21 it can be found that the probability of an outcome with mutual advantage ($\pi_d > 0, \pi_r > 0$) and mutual disadvantage $\pi_d < 0, \pi_r < 0$ do not vary much, except for high values of noise $\nu \geq 0.8$. The probabilities of a unilateral advantage however change much and in favor of the residents with increasing noise. The 'balance', equal probability of unilateral advantages for both actors ($\pi_d > 0, \pi_r < 0$ and $\pi_d < 0, \pi_r > 0$) exist for $\nu = 0.2$, which are about 25%. Qualitatively, the network simulation for $\rho_d = 0.1, \rho_r = 1$ shows slightly different behavior than the dyad simulation for $\rho_d = 0.1, \rho_r = 1$. The dyad case shows an increase of probability of mutual advantage ($\pi_d > 0, \pi_r > 0$) as a function of noise, while the network case shows a decrease of probability of mutual advantage as a function of noise.



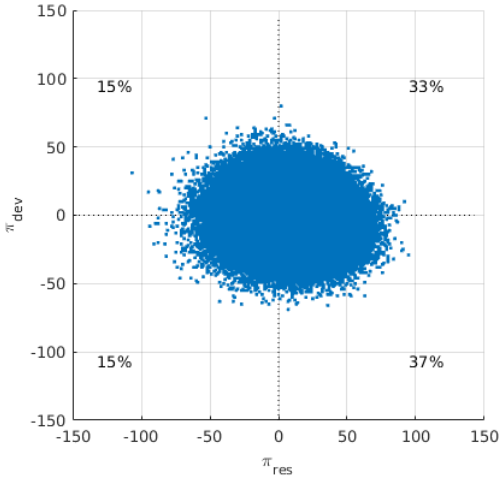
(a) $v = 0$



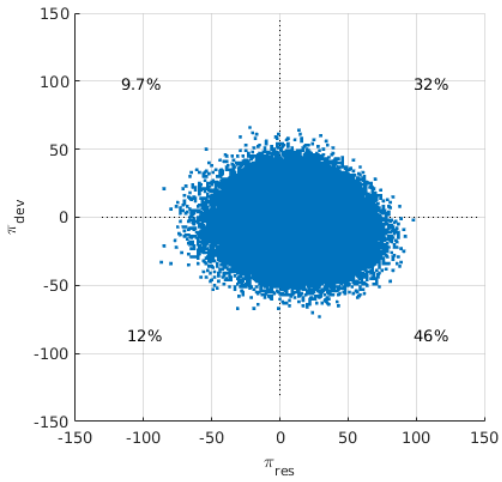
(b) $v = 0.2$



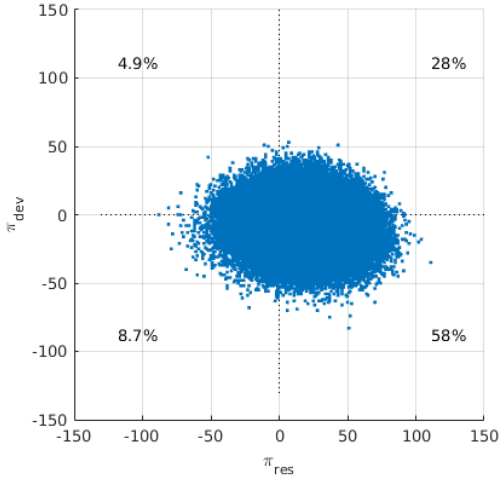
(c) $v = 0.4$



(d) $v = 0.6$



(e) $v = 0.8$



(f) $v = 1$

Figure 12.21: Scatter plots of actor material payoff for a dyad ($\rho_d = 0.1, \rho_r = 1, \delta = 0.5$) as a function of v, ranging from zero to one. The percentages indicate how many runs of the MCS have a result that falls within the quadrants.

CASE: VARIATION OF CONNECTIONS BETWEEN GROUPS δ

The simulation with equitable outcome ($\nu = 0.2$) from the former network configuration is taken as a starting point of varying the number of connections between groups prescribed by δ. δ is structurally increased from zero to one, in steps of 0.25, while ν will have the constant value of 0.2 (the situation $\delta = 0.5$ will thus be equal to the situation of $\nu = 0.2$ in the former simulation). $\delta = 0$ is a network where the groups are not connected, such as the one found in Figure 12.13, while $\delta = 1$ results in a fully connected network. See Table 12.14 for the simulation parameters.

The results, this time as a function of δ instead of ν are tabulated in Table 12.15. Figure 12.22 and Figure 12.23 show how the (mean) material payoff distribution varies as a function of the connections between groups δ.

Table 12.14: Parameters for simulation of the network exchange ($\rho_d = 0.1, \rho_r = 1$).

simulation parameters					
runs	t_{max}	ρ_d	ρ_r	ν	δ
500	750	0.1	1	0.2	$0, 0.25, 0.5, 0.75, 1$

Table 12.15: Simulation results of network exchange ($\rho_d = 0.1, \rho_r = 1, \nu = 0.2$). The table shows the mean material payoff $\bar{\pi}$, standard deviations of the material payoff SD and 95% lower and upper confidence interval boundaries CI_l and CI_u.

actors	δ	$\bar{\pi}$	$CI_{\bar{\pi}_l}$	$CI_{\bar{\pi}_u}$	SD	CI_{SD_l}	CI_{SD_u}
residents	0	15.50	15.40	15.60	20.3	20.2	20.3
	0.25	7.21	7.12	7.31	21.6	21.5	21.6
	0.5	3.62	3.52	3.71	22.0	21.9	22.0
	0.75	0.28	0.19	0.38	22.5	22.4	22.6
	1.0	-2.18	-2.28	-2.08	22.9	22.9	23.0
developers	0	-0.98	-1.04	-0.93	13.0	12.9	13.0
	0.25	2.37	2.30	2.44	15.8	15.7	15.8
	0.5	3.82	3.75	3.90	17.0	17.0	17.1
	0.75	5.03	4.96	5.11	18.0	17.9	18.0
	1.0	5.99	5.90	6.07	18.7	18.7	18.8
total	0	14.60	14.40	14.70	24.1	24.0	24.2
	0.25	9.58	9.47	9.70	26.2	26.1	26.2
	0.5	7.44	7.32	7.56	27.0	26.9	27.1
	0.75	5.32	5.20	5.44	27.8	27.8	27.9
	1.0	3.81	3.68	3.93	28.6	28.5	28.7

Increasing the number of connections between the residents and developers ($\delta > 0.5$) decreases the total material payoff, but increases the outcome in favor of the developers ($\Delta_d < 0$). Decreasing the number of connections between residents and developers ($\delta < 0.5$) increases the total material payoff and increases the outcome in favor of the residents ($\Delta_d > 0$). In relatively many situations ($0.1 < \delta < 0.75$), the mean material payoff for both groups of actors is positive ($\bar{\pi_d} > 0, \bar{\pi_r} > 0$).

What is most distinguishing from Figure 12.22 compared to the same plots of other simulations, is that there seems to be a sharp transition of the mean material payoffs at $\delta = 0.25$. This suggests that the initial establishment of connections between groups has a large influence on network outcome, while continually increasing the number of connections has increasingly smaller effects on network outcome.

In line with Figure 12.22, the scatter plots of Figure 12.23 show that increasing δ leads to a higher probability of unilateral advantage in favor of the developers. This is 10% for $\delta = 0$ and rises to 34% for $\delta = 1$. For the residents, the exact opposite can be seen. An increase in connections between groups results in a lower probability of unilateral advantage (38% for $\delta = 0$ to 19% for $\delta = 1$). From the former analyses it is known that increasing ν always leads to a lower probability of a mutual disadvantageous outcome ($\pi_d < 0, \pi_r < 0$). An increase of δ however, has the opposite result since it increases the probability of a mutual disadvantageous outcome. A doubling is seen when increasing δ from zero, where the probability of ($\pi_d < 0, \pi_r < 0$) is 10%, to one, where

the probability of ($\pi_d < 0, \pi_r < 0$) is 18%. Also the probability of a mutually advantageous outcome decreases with increasing δ.

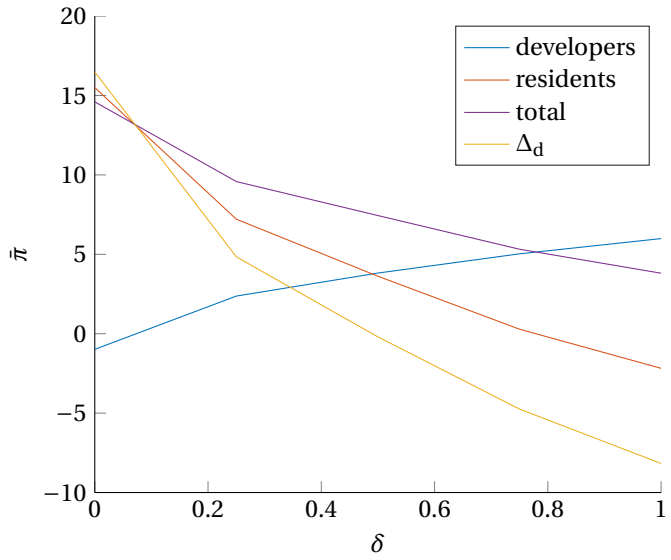
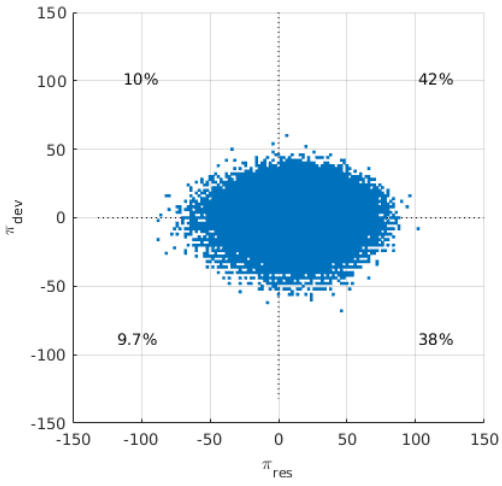
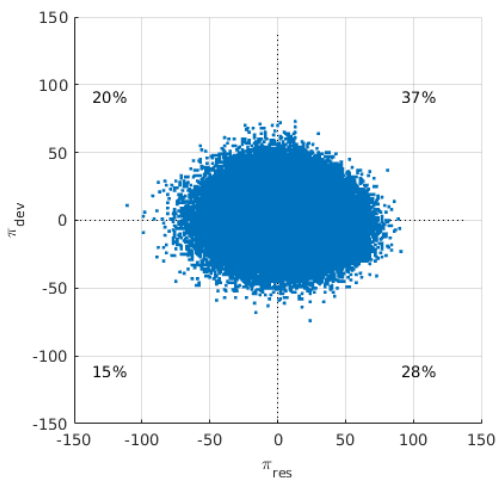


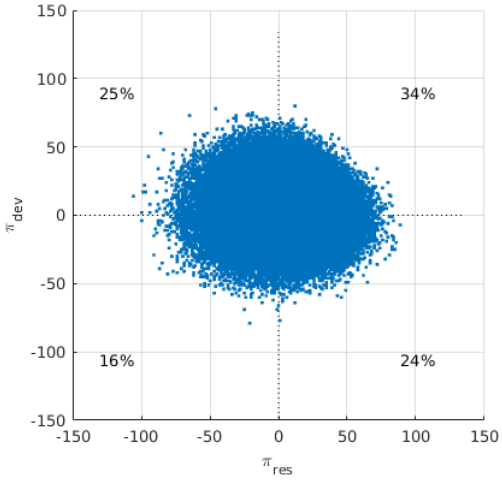
Figure 12.22: Group and total mean material payoffs $\bar{\pi}$ and outcome term Δ_d as a function of the connections between groups δ ($\rho_d = 0.1, \rho_r = 1, \nu = 0.2$).



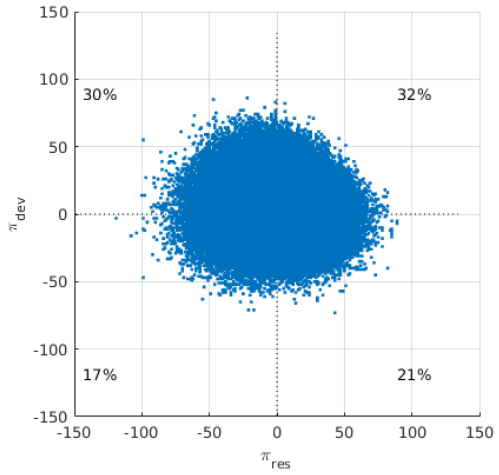
(a) $\delta = 0$



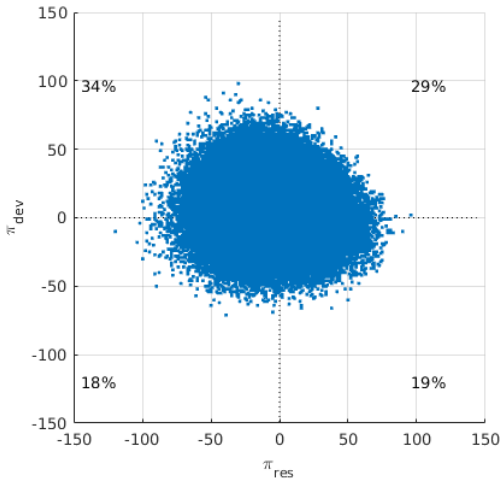
(b) $\delta = 0.25$



(c) $\delta = 0.5$, equal to Figure 12.21b.



(d) $\delta = 0.75$



(e) $\delta = 1$

Figure 12.23: Scatter plots of actor material payoff for a dyad ($\rho_d = 0.1, \rho_r = 1, \nu = 0.2$) as a function of δ, ranging from zero to one. The percentages indicate how many runs of the MCS have a result that falls within the quadrants.

12.2.2. ANALYSIS OF NETWORK EXCHANGE

The above network cases where noise and the number of connections are systematically varied are analyzed below. This analysis only takes into account weakly reciprocating developers, and strongly reciprocating residents.

ACTOR SPECIFIC BEHAVIOR CAN LEAD TO A MUTUAL ADVANTAGEOUS OUTCOME WITH POSITIVE TOTAL MATERIAL PAYOFF

When actors from the different groups do not have the same reciprocation parameters, a difference in material payoff between the groups will exist. Actor specific behavior, induced by noise, changes material outcome in favor of the residents and can therefore have a favorable effect on the material outcome distributions. In the case that developers are less reciprocal than residents and actors exhibit some actor specific behavior, then a mutually advantageous outcome with a positive total material payoff can occur.

Noise is therefore not necessarily a bad thing. It serves a function, and it makes residents cautious during social exchange and developers more open to a positive social exchange. This can, under the circumstance $\rho_d < \rho_r$, have favorable effects on the relationship between the groups. From the results, the suggestion can be made that for any ν there exists a δ for which Δ_d is closest to zero (or the other way around, for every δ there exists a ν for which Δ_d is closest to zero).

A NUMBER OF CONNECTIONS, BUT NOT TOO MANY, BETWEEN RESIDENTS AND DEVELOPERS HAS FAVORABLE EFFECTS ON THE OUTCOME EQUITY.

The effects of the network structure become apparent when zooming in at the variable δ. When changing the network structure from $\delta = 0$ to $\delta = 0.25$, a relatively big change in network outcome is observed. Further incrementing δ will also result in change, but less strong (Figure 12.22). When, for example, only one connection exist between the groups, the maximum path length between two actors is three because the groups are fully connected. When adding a few more connections, the mean path length will drastically decrease. But adding more connections will result in an increasingly smaller decrease of mean path length. This mechanism is elegantly shown by the 'small-world' network dynamics (Watts and Strogatz, 1998). This mechanism, that a few connections are sufficient to transfer big amounts of data through the network, result in a relatively few connections being sufficient to reach an equitable outcome of $\Delta_d = 0$.

In short, an number of connections between groups δ is a trade-off between equitable outcome and total material payoff. A wind farm developer puts efforts in communication, established more connections and by this increases his material payoff at a cost of total material payoff. Too many connections is disadvantageous for residents. This latter phenomenon also finds resonance in reality. When developers increasingly invest in connections with residents, then residents can become uncomfortable with this situation because they experience increased perceived dependency. The results show that it can indeed be the case that residents will have a outcome not favoring them when the number of connections between groups is increased. The caution that residents have while engaging with developers is confirmed by the model.

THE RISKINESS OF CONNECTIONS IN SOCIAL EXCHANGE BETWEEN GROUPS: EVERYBODY CAN GET WORSE OFF.

In general, the network case shows higher probabilities of mutual advantage than the dyad case. But, whereas noise can have favorable effects on mutual advantage in the dyad case, it always has unfavorable effects on mutual advantage in the network case. Increasing the connections δ and noise ν decreases the probability of a mutual advantageous outcome ($\pi_d > 0, \pi_r > 0$), Increasing ν decreases the probability of a mutual disadvantageous outcome ($\pi_d < 0, \pi_r < 0$), and increasing δ increases the probability of a mutual disadvantageous outcome ($\pi_d < 0, \pi_r < 0$).

This leads to the situation that for $\delta = 0$ the highest probability of a mutual advantage and the lowest probability of a mutual disadvantage occurs. When $\delta = 0$ noise does not play any role. Actors cannot exhibit actor specific behavior towards actors of the other group because there are no connections between groups on which noise can act. For the situation of $\delta \neq 0$, noise favors unilateral advantage for residents ($\pi_d < 0, \pi_r > 0$).

13

CONCLUSION & DISCUSSION

Part III of this thesis presents a theoretical network model of reciprocity which is used to gain more insight in the dynamics of communication between wind farm developers and residents. Reciprocity means that actors act kind to others who act kind, and that actors act unkind to others who act unkind. The network reciprocity model combines existing network theory and psychological game theory, and by using actor specific behavior deducted from the conclusions of Part II of this thesis it models social exchange between key stakeholders in wind farm development. Actors base their decisions on the perceptions they hold of the other actor. Perceived kindness is returned with kindness, and perceived unkindness is returned with unkindness. Because of the stochastic nature of the model, Monte Carlo Simulation is applied to investigate the dynamics of the model. The role of actor heterogeneity, actor specific behavior and number of connections between developers and residents are investigated.

This chapter is used to answer the research question and present a discussion of the results. The conclusions are given in section 13.1, and will treat all the research questions posed in chapter 9. section 13.2 subsequently gives a discussion on the results and gives some recommendations for communication wind farm development. This section also critically reflects on the model, and gives additional directions for future research. Finally, section 13.3 reflects on the relation of the thesis to the Aerodynamics & Wind Energy department.

13.1. INSIGHTS FROM A SIMULATION OF RECIPROCITY IN WIND FARM DEVELOPMENT.

A conclusion of this thesis is given here in the form of answers to the research questions. First, the main research question will be repeated here.

How can a network model of reciprocity which is tailored to simulate the social exchange process between key actors in wind farm development be used to gain insight in this process?

The subquestions will lead us to the answer of the main research question. The answers to these subquestions are therefore discussed first.

SUBQUESTION 1: HOW CAN A SOCIAL NETWORK MODEL OF RECIPROCITY BEEN BUILD BASED ON THE KNOWLEDGE FROM SCIENTIFIC LITERATURE?

Reciprocity is widely recognized as a mechanism between actors that is responsible for the social stability of relationships. Therefore not only qualitative but also a considerable amount of quantitative has been published on the topic. A selection of the most popular quantitative theories of reciprocity is reviewed in this thesis (subsection 10.1.2).

None of the existing models conformed all the requirements of being applicable on a network and for repeated interaction, include positive and negative reciprocity as well as actor specific perceptions. The psychological game theories, however, resonate well with Social Exchange Theory (SET) as they take perceptions and notions of fairness into account. Eventually the intention-consequence reciprocity model by Falk and Fischbacher

(2006) is used as a basis since it takes into account perceived intentions of other actors. Actors have, according to this model, a reciprocity parameter ρ which describes how strong they respond to perceived (un)kindness. Actor heterogeneity is obtained by assigning different values of ρ to different actors. A target intention term is added to to the model account for an actors' tendency to *not* reward or punish the other actor, which results in actors giving a nuanced response to perceived (un)kindness. It is applied to the Moonlighting Game (Abbink et al., 2000) which allows for positive and negative reciprocity. Downsides of the model (in the original form) are that it does not allow for reciprocity on networks and for repeated interactions.

The moonlighting game is representative for social exchange in wind farm development. It simulates an exchange of social resource between to actors. This social resource can be thought of as information, status and/or love (Foa, 1971; Foa and Foa, 2012). If both actors give social resource to each other they reap the mutual benefits. Since there is no binding agreement (like in many economic exchanges), both actors are vulnerable to exploitation and trust plays a role. In wind farm development, developers are expected to 'give' something when they engage in social exchange with residents. They for example give information. Based on their perceptions of fairness, the residents decide to reward the developers (return information) or punish the developers (protest, or distribute misleading information). Whatever the resident chooses, both actions require some degree of effort for the residents. The moonlighting game gives a practical implementation of the principle of social inequality aversion.

As stated above, the intention-consequence model of reciprocity does not allow for repeated interaction. Repeated interactions is implemented using so-called 'history profiles' (Dufwenberg and Kirchsteiger, 2004). In the reciprocity model, the perceptions that actors have of other actors are specified by the first order and the second order belief. The first order belief is the belief of the first actor about the strategy that a second actor will choose (i.e. give or take), the second order belief is the belief of the first actor about the other actor's belief about the strategy that the first actor will choose (i.e. give or take). These beliefs combined give a perception of fairness, according to which an actor chooses a strategy (to either give or take). When an interaction is repeated one can assume that the former interaction is remembered by the actors, thus that they might alter their beliefs based on the former exchange. In the present model, actors remember the real chosen strategies of other actors, since they are saved in history profiles. This history profile forms a strategy probability distribution from which the new first and second order belief are drawn. The first order belief is drawn from the other actor's history profile, and the second order belief is drawn from the actor's own history profile. The history profile is 'build up' with each additional social exchange. Given a sufficient number of exchanges, the history profiles will converge, and a stable relationship is attained.

The model by Falk and Fischbacher also does not allow for network interaction. If the model would be applied to a network in the original form, then all exchanges would be independent and there would be no complexity. Complexity is added to the social system as follows: if an actor i is engaging in exchange with actor j, then i draws his first order belief from the strategies that j plays towards *all* neighbors of j. The history profile thus contains all the strategies that j played towards all her neighbors. The second order belief of i is determined in a similar fashion. It is drawn from the history profile of i containing all the strategies that i ever played, rather than only the strategies that i played towards j. By introducing this aggregate history profiles behavior of actors at one side of the network have, given sufficient time, an effect on the behavior of actors at the other side of the network.

Concluding, the models proposed by scientific literature do not allow for a direct implementation of a social network model of reciprocity. The ideas of network theory and psychological game theory are integrated to provide a basis for investigating reciprocity on networks. In specific, the models of Falk and Fischbacher (2006), Abbink et al. (2000) and Dufwenberg and Kirchsteiger (2004) are combined which gives a basis for researching interaction between key stakeholders in wind farm development.

SUBQUESTION 2: BASED ON THE KNOWLEDGE OF SOCIAL EXCHANGE BETWEEN WIND FARM DEVELOPERS AND RESIDENTS FROM PART II OF THIS THESIS, WHAT ARE SUITABLE BEHAVIORAL RULES ACCORDING TO WHICH WIND FARM DEVELOPERS AND INVOLVED RESIDENTS ACT TOWARDS EACH OTHER IN THE MODEL?

In Part II of this thesis a qualitative research on social exchange between wind farm developers and residents is presented. It concerns an in-depth case study where special attention is given to the perceptions that actors hold towards a social resource exchange and the resulting relationship. The distinction is made

between consistent perceptions and inconsistent perceptions. Perceptions being consistent means that both actors have the same idea about what is exchanged and which amount. An example of consistent exchange of information is when a developer informs the residents about possible locations of future wind turbines, And the residents inform the developers about their opinion on the suitability of these locations. During an inconsistent exchange, perceptions that actors hold are different. This can be the case when, for example, developers intend to give status to the residents and propose financial participation, and the residents perceive a deprivation of status, because the proposal for financial participation is felt as a 'bribe'. It is concluded that, when there is a case of inconsistent perceptions on a social resource exchange, that the perceptions of residents are always more negative than the perceptions of the developers. In Part III, this idea of inconsistent perceptions is applied to the network model of reciprocity.

In the network reciprocity model the actors base their perceptions, or beliefs, on the history profile. As such, drawing beliefs from the history profiles provides a 'best guess' belief set. Since actors base their actions on their beliefs, it is attempted to implement actor specific inconsistent perceptions by changing the way that the beliefs are updated before a social exchange commences. It is also attempted to control the amount of inconsistent perceptions by relating it to an independent noise variable.

So instead of drawing beliefs from the history profiles, beliefs are updated in a different way with a probability prescribed by the noise variable ν. When a resident is exposed to noise, the beliefs are not drawn from the history profiles but randomly picked from all belief sets for which the material outcome would be in favor of the developers. In other words, a resident exposed to noise expects to be disadvantaged relative to the developer. As a result, the resident will exhibit more selfish behavior. When a developer exposed to noise beliefs are randomly picked from all belief sets for which the material outcome would be equal or in favor for developers. In other words, a developer expects that both actors will reap equal benefit or burden from the exchange, or that they will be advantaged relative to the resident. As a result, the developer will exhibit less selfish behavior. These behavioral rules result in inconsistent exchanges where residents have more negative perceptions than the developers, while at the same time the degree to which this is the case is controllable through the noise variable ν.

When reflecting back on the qualitative research and relating its results to the concept of noise, then the following interpretation can be given to noise: noise is any external force (from outside the social system) that makes developers act more like developers towards residents and residents actor more like residents towards developers. This external force can be the media, information search, policy changes or random personal opinion changes. Using noise as an independent variable to control the specification of actor behavioral rules in the network model of reciprocity leads to a simplified but proper implementation of actor specific behavior observed in the qualitative data of Part II.

SUBQUESTION 3: HOW DO ACTOR SPECIFIC BEHAVIOR AND NETWORK STRUCTURE RELATE TO SIMULATION OUTCOMES?

Actor specific behavior is implemented in the model as described in subquestion 2. The networks on which the model is applied are the dyad, one developer and one resident connected, and the network, two fully connected groups of 10 actors with a probability δ of connections between the groups.

The outcome of the model are measured in terms of material payoff π earned or lost by the actors (in case of a dyad) or groups (in case of a network). The moonlighting game is a non-zero-sum game, so the total amount of points can increase or decrease during the game. The material payoff can therefore be one of the following four situations: mutual disadvantage ($\pi_d < 0, \pi_r < 0$), unilateral advantage ($\pi_d < 0, \pi_r > 0$ and $\pi_d > 0, \pi_r < 0$) or mutual advantage ($\pi_d > 0, \pi_r > 0$). Similarly, the outcome of the model Δ, being the difference in material payoff between actors or groups, can be zero (equitable outcome) or non zero (inequitable outcome). Because the network reciprocity model is stochastic in nature, the beliefs of actors are updated according to the history profile distribution, different simulations of the same network and actor configuration can lead to different outcomes. A Monte Carlo Simulation is performed to elucidate the distribution of simulation outcomes. Special attention is given to the cases where the total material payoff of the social system is equal to or greater than zero ($\pi_d + \pi_r \geq 0$) and where there exists a mutually advantageous material outcome ($\pi_d > 0, \pi_r > 0$).

The simulations on the dyad show that increasing noise leads to an outcome increasingly favoring the residents.

Because the increase in mean material payoff of the resident is larger than the decrease of mean material payoff of the developer, the total mean material payoff increases with increasing noise. In all dyad simulations, the probability of a mutually disadvantageous outcome decreased with increasing noise.

The network simulations show slightly different results than the dyad simulations. The simulations are performed using weakly reciprocal developers ($\rho = 0.1$) and strongly reciprocal residents ($\rho = 1$). Using this specific network configuration and $\delta = 0.5$, there exists a ν for which results in both a mean equitable outcome and a mutually advantageous mean material payoff. Actor specific behavior induced by noise does therefore not always have a negative influence on the outcomes of the model. Furthermore it is found that establishing a few connections between groups has big effects on outcome equity, while increasingly adding more connections will have smaller and smaller effects. Different from the dyad simulation, with the number of connections between the groups increasing, also the probability of a mutual disadvantageous outcome increases.

MAIN RESEARCH QUESTION: HOW CAN A NETWORK MODEL OF RECIPROCITY WHICH IS TAILORED TO SIMULATE THE SOCIAL EXCHANGE PROCESS BETWEEN KEY ACTORS IN WIND FARM DEVELOPMENT BE USED TO GAIN INSIGHT IN THIS PROCESS?

A network model of reciprocity incorporating two key actors in wind farm development, developers and residents, is proposed in this thesis. It simulates social exchange by incorporating both positive and negative reciprocity, with the unitless 'points' as an exchange resource. Point resemble any resource which is exchanged when a social interaction of some sort takes place, being it exchange of information (research reports), status (starting a resident working group), money (financial participation) or any other. The model, as such, does not allow, and does not intend, to predict the outcome of specific communication means deployed by developers. It does however give a more fundamental insight in the equilibria of the social system based on perceptions of fairness, in the effects of actor specific perceptions and behavior, and it suggest that social exchange processes can be optimized.

Simulations show that stable equilibrium situations exist for a social system with a given actor heterogeneity and network structure. By systematically altering these variables the network model of reciprocity can be used the investigate how the mechanisms of social interaction, with actors exhibiting behavior specific for their role in the network, lead to equilibrium situations where actors have a net advantage or disadvantage. It therefore also has the potential to serve as a communication tool to make the complexity in the communication process in wind farm development explicit.

In subquestion two it is explained how empirical data contributed to the definition of actor specific behavior in the network model of reciprocity. By doing so, insight can be inferred about why this actor behavior exists. It is found that, in some circumstances, developers having a too positive perception and residents having a too negative perception of a social exchange can actually benefit both actors.

The model further suggest that communication in wind farm development can be viewed as an optimization problem. There is a trade-off between minimizing the difference in material payoff between actors (outcome) and maximizing total material payoff. The network case simulation shows that for a nonzero value of noise (then developers behave more like developers, and residents behave more like residents) an equal outcome is possible, but this is at a cost of total material payoff. This happens in reality when a selection residents are given a role in a working group, resulting in a better distribution of status, but at the same time the residents who are left out might have a feeling of being treated unfair, resulting in a net decrease of total status in the social system.

The model also shows that social exchange is not without risk. By engaging in reciprocal exchanges both actors risk either mutual disadvantage or unilateral disadvantage. Above it was for example stated that actor specific behavior can lead to mutual advantageous material payoff, but too much actor specific behavior is risky for the developers because it also increases the probability of the residents being better off and the developers being worse off. Similarly, both actors can gain benefits when connections exist between the groups, but too many connections is risky for residents because it will increase the probability of a unilaterally advantageous outcome in favor of the developers.

13.2. DISCUSSION AND RECOMMENDATIONS ON A THEORETICAL APPROACH TO WIND FARM DEVELOPMENT

The discussion and recommendations section is divided into two parts. First a discussion of the research results is given along with recommendations for communication in wind farm development. This part also reflects on the validation of the results. Then the network model of reciprocity is discussed. It gives a critical reflection on the model and, because the type of research conducted is *theory developing*, directions for future research are thoroughly discussed. The content of this section reflects upon the research objective, which is to find insight in the social network conditions for which mutual advantage between key actors is likely to occur by simulation of reciprocity between wind farm developers and involved residents, embedded in a network.

13.2.1. DISCUSSION ON THE SIMULATION RESULTS AND RECOMMENDATIONS FOR WIND FARM DEVELOPMENT

The results of the network model of reciprocity show what effect reciprocal behavior of wind farm developers and residents, responding kind to perceived kindness and responding unkind to perceived unkindness, has on the total network outcome. It therefore neglects a large number of real world phenomena (although some of these phenomena can be assumed to be included in the noise variable). There are, for example, no process and environment description. There is also no explicit inclusion of the effect of a wind turbine on the actor's perceptions (annoyance etcetera). The specialized nature of research reports is left out, there are only two actors taken into account and policy measures are also no part of the social system. It is therefore of importance to have an idea of the validity of the simulation results.

A validation study to check whether the simulation results actually describe real complex social dynamics found in wind farm development is however not conducted. Two reasons are given for this. The first reason is that the results from Part II of this thesis serves as an input for Part III, which makes it increasingly difficult to also use these results for validation purposes. The second reason is that no other (empirical) studies exist where wind farm development is researched using a social exchange perspective.

These difficulties in validation are not unique. It is generally observed that *"very little attention has been paid to a stringent quantitative validation of models and theoretical results"* (Castellano et al., 2009). This little attention does not necessarily stem from the unwillingness of the researchers, but for a large part result from the difficulties in translating empirical qualitative data to model parameters. A suggested solution is that results can be supposed valid when empirical data falls within the range of results shown by theoretical models (Jager, 2016). There is a need for bringing empirical and experimental research closer to each other. This research could therefore be considered the first step in a *"positive feedback mechanism"* (Castellano et al., 2009) where empirical and experimental research take turns and serve as a basis for validation for each other.

So does empirical data fall within the results of the network model of reciprocity? There are reasons to think that this could indeed be the case. The model shows for example that residents are disadvantaged with respect to the developer if the number of connections between the groups is increased. In other words, developers are in a relatively powerful position, and residents feel dependent. Empirical data confirms that wind farm developers and decision makers are viewed as a *"a coalition of the mighty"* by residents (Zoellner et al., 2005). The model also shows that a total lack of connections is not beneficial. Empirical data confirms that the inclusion of diverse actors results in wind farm developments being perceive more just (Ottinger et al., 2014; Maillé and Saint-Charles, 2014). Some general behaviors of the network model of reciprocity are consistent with empirical data.

From the analysis of the dynamics of reciprocity between developers and residents recommendations for wind farm development can be given. The first is to make key actors aware that communication means which have the intent to increase the perceived justice do so at a cost of something else. Either one of the actors have to become more vulnerable to the other actor, or the risk increases of all actors being worse off. Think of the latter one as an information evening organized by benevolent wind farm developers where protesting residents arrive and the situation escalates. This does not mean that both developers and actors should refrain from trying to reach a perceived just relationship.

When zooming in at establishing reciprocal relationship between groups, actors should realize that there are

two ways to do this. The first way is to invest in the existing relationships. The advantage of this is that these relationships become more resilient (the existing history profiles are strengthened). The disadvantage is that network structure effects (complexity) will play a relatively large role in the resulting state of the social networks. The second way is to invest in new relationships. This however brings its own uncertainties because initially it is unknown whether the other actors will reciprocate. Additionally, once contact is made with new actors, it is costly in terms of resources to build up a relationship (establish the history profile). Making new connections can however reduce the complexity that network structure brings about, because exchanges can happen directly between actors, rather than indirectly through opinion makers. For every wind farm development the balance of making new connections versus strengthening existing connections will be different because the actors and network structure are different.

The results suggest that the existence of unconscious 'irrational' perceptions of actors (because actors can not be aware of their perceptions not being correct) might serve a purpose. While not intending to reflect too much on fundamental origins of reciprocity, an evolved human biological tendency to perceive a situation too positive or negative might increase the 'survival rate' of the interdependent actors. In short, the model shows that the existence of (too) positive perceptions of developers and (too) negative perceptions of residents can be understandable when looking at the resulting effects of these 'irrational' perceptions. Further research is needed to investigate whether this line of reasoning is correct.

Furthermore, based on the results the recommendation can be given that both residents and wind farm developers should be aware, but not afraid, of themselves assuming perceptions about the other. Developers and residents base their perceptions of the other on their experiences with the other. But a certain degree of noise can lead to inaccurate perceptions. For example residents who experience a changeable policy by the authorities, should be careful by using this to create expectations and judge the behavior of the developer. Similarly, developers should be careful in misinterpreting positive signals from the residents. Especially because residents are far less well organized than developers. Preventing inaccurate perceptions is a very hard thing to do (and probably impossible), that is why an increased awareness about this mechanism can help in creating more balance in the social relationships and potentially increases the perceived justice by actors. The results of the network model of reciprocity show that a certain degree of actor specific behavior actually increases the mutual benefits, so inaccurate perceptions about others do not necessarily lead to a deterioration of the social relationship.

In the past Social Exchange Theory has mainly been applied to employer-employee relationships (Cropanzano, 2005). This situation is in some sense similar to the relationship between wind farm developers and residents. In both cases the actors are interdependent, but one of the actors (developers, employers) is perceived more powerful than the other. The present model might be generalizable to other situations, such as the employer-employee relationships, where one of the actors perceives the relationship too positive, and the other perceives the relationship too negative. Further research should find out if this is indeed the case. If not, inspiration can be drawn from this thesis as to how define actor specific behavior in other social situations.

13.2.2. DISCUSSION ON THE NETWORK MODEL OF RECIPROCITY AND RECOMMENDATIONS FOR FURTHER RESEARCH

The network model of reciprocity is intentionally kept relatively simple. This is done because of two reasons. The first reason is that a simple model allows for better fundamental understanding of the inner workings of the model. The second reason is the time constraint. Every model is merely an approximation of reality and the challenge is therefore to create a model that is simple yet representative. If the inner workings of the model are understood and the results reflect empirical data, conclusions might be inferred as to how reality works. The network model, and in specific its representativeness in terms of actor behavior, network mechanisms, modeling techniques and parametrization, is discussed below and recommendations are given for further research.

Actor behavior, defined by the utility function, forms the basis of the model. Actors play a moonlighting game and base their strategic decisions on perceptions of kindness, which in turn is a combination of actor *intentions* and the *outcome* of the exchange (Abbink et al., 2000; Falk and Fischbacher, 2006). The moonlighting game is chosen for the model because it incorporates both positive and negative reciprocity (actors can exhibit both rewarding and punishing behavior). Actor heterogeneity is introduced using the individual reciprocity

parameter ρ, which is an actor's propensity to reciprocate perceived (un)kindness.

The moonlighting game has been experimentally tested where it is found that intentions indeed play a significant role in exchanges, something that only the theory of reciprocity of Falk and Fischbacher takes into account. Further (experimental) research is needed to elucidate the accuracy of the theory of reciprocity applied to the moonlighting game. Based on the present research the following points of interest in the definition of the utility function are found. First, when actors perceive an equitable outcome ($\Delta = 0$), then the utility function is reduced to the material payoff. The strategies that the actors choose are then always the strategies that yield the highest material payoff (usually $s_i = -6$ and $s_j = 0$). This is independent of the value of the reciprocity parameter ρ. It is more logical, however, that the actors choose a strategy that yields an equitable outcome ($\Delta = 0$) for higher values of ρ. In other words, the strategies that actors choose when they hold a belief set yielding $\Delta = 0$ must converge to the second order belief for high ρ, because this strategy would exactly yield this equitable outcome $\Delta = 0$. A second point of interest of the original model is the absence of an intention term that weights the reciprocation term. The absence of this term will lead to extreme reciprocal responses, i.e. either complete retaliation or complete reward at the expense of one's own payoff. The 'target intention' term proposed in this thesis makes sure that a small perceived unkindness will only be retaliated mildly, while a small perceived kindness will only be rewarded mildly. Future research can deepen the understanding of the exact meaning of the target intention term. Furthermore, the actors' propensity to reciprocate is prescribed as a single variable ρ for both positive and negative reciprocity. Research indicated that the propensity to reciprocate negatively and positively does not necessarily have to be the same for a single actor, and that these two different propensities are furthermore uncorrelated (Perugini et al., 2003). This is backed up by the empirical findings of Part II, where developers have not been found to exhibit negatively reciprocal behavior. A more exact model can be achieved when two different propensities to reciprocate, one for positive and one for negative reciprocity, are used for each actor. Finally, the current model does not distinguish between one-shot games and repeated games. It is known that actors behave differently when they know that they will encounter another actor again (Rabin, 1993). When actors encounter each other only one time, they behave more selfish compared to the case where actors will encounter multiple times.

The fact that actors are embedded in a network causes complexity. Because every actor indirectly influences the behavior of every other actor, the exact outcome of the social system is initially unknown. Complexity is implemented in the current model by letting actors see all the behavior of their neighbors (i.e. actors base their first order belief on the complete history profile of neighbors). There is, however, no solid reason to assume that actors are always able to see their neighbor's behavior. A more accurate description of complexity on networks might be obtained by letting actors perceive only the histories of their neighbors' actions towards themselves and towards *shared* neighbors. This means that three actors i, j and k connected in a triad can see all the actions by other actors, but if the connection between i and k would be destroyed, then i is unable to see the strategies that j chooses towards k. An interesting direction for future research would to be also include *opinion leaders*. An opinion leader is an actor who has a higher status than other actors so information from opinion leaders is in higher demand. This can be modeled by assigning every actor an additional parameter which gives a weight, or degree of importance, to the history profile of that actor.

The current implementation using Monte Carlo Simulation allows for determining the social equilibrium situation for two types of actors as a function of time-independent noise. A direction for future research is to implement more types of actors in the network, such as policy makers. This implies that actor specific behavior concerning these actors has to be researched as well. Ideally not only knowledge about the equilibrium situation is obtained but also about the stability of the social network. This can be incorporated using time-dependent noise and checking whether the system diverges or converges. And when a system is converging, will it converge to the original equilibrium, or will a new equilibrium be obtained? Before such a model can be realized, a closer look must be taken at the history profiles of actors. Currently, the history profiles of actors contain all previously chosen strategies of all time steps. This leads to the result that any time-dependent noise will have little influence, because the history profile is not changed much. When instead the history profiles are limited to a fixed number of time steps, let's say ten, then the actors have a limited memory of the course of events, making them more susceptible for noise. How actor's real memories relate to the history profiles is yet unknown. Finally, the model propagates according to the dimensionless unit of time step, or 'tick'. Since wind farm developments are usually lengthy it could prove valuable to have more understanding of the relationship between the time step in the model and the time that is needed for real social exchanges to take place.

There is an ultimate need for a better representation of actors in the model. Increasing representativeness can be done using parametrization. It is for example currently unknown how the reciprocity parameter ρ relates to real propensity to reciprocate. Parametrization can be used to assign this ρ to real individuals. Promising work has been conducted by Ashton et al. (1998) and Perugini et al. (2003) who use the 'Big Five' personality factors to quantify actor personalities. Similar research must be conducted when concerning the actual social or economical resource that is exchanged and network structure. Similarly, a better understanding of the outcomes of the model with respect to reality is needed. The found standard deviations in the results are, for example, relatively high. This suggests high uncertainty in the exchange process. But how uncertain is uncertain? Further investigation is needed to elucidate whether this is uncertainty stems mainly from the model, or is really a results of the translation of empirical data into the theoretical network model of reciprocity. Finally, the technology itself, wind turbines, is left out in the model. Exchanges are not dependent on the technology around which it evolved. A valuable addition of to the research of wind farm development (and socio-technological systems in general) is to add technology dependent behavior. In this case, actors do not only base their behavior on perceptions of other actors, but also on perceptions of the technology (size, safety etcetera).

13.3. RELATION OF THIS THESIS TO RESEARCH AT THE AERODYNAMICS & WIND ENERGY DEPARTMENT

Research at the department of Aerodynamics & Wind Energy focuses on the technological artifact of a wind energy converter itself, rather than how this technology is handled by its users. There is therefore no direct connection between this thesis work and the research conducted at TU Delft. The two types of research, however, can learn from each other. Computational social science can improve its methods by looking at the engineering techniques that use a system perspective. In this thesis a Monte Carlo Simulation is performed, but beyond doubt also many other simulation and optimization techniques can be applied to tackle social questions. Similarly, research at TU Delft in general and at Aerodynamics & Wind Energy in specific can become more aware on how technology affects social systems. This goes further than the question of how a technology is perceived by, for example, a public and why this is the case. The questions that is more important here is how these perceptions of technology vary over a set of heterogeneous actors and what are the consequences on how these actors behave towards each other. When these mechanisms are known better, the social aspects can be taken into account as a design variable for a technological artifact like a wind turbine.

IV

INTEGRATION OF AN APPLIED AND THEORETICAL APPROACH TO RECIPROCITY IN WIND FARM DEVELOPMENT

This thesis presents an applied and a theoretical approach to reciprocity in wind farm development to better understand the communication between wind farm developers and involved residents. The applied and theoretical approach are separate research projects, yet covering the same subject. The purpose of this overlapping structure is that taking these two approaches to one and the same problem can give insights that these research projects on their own cannot provide.

The opportunity and challenge alike was doing something qualitative (Science Communication) and something quantitative (Aerodynamics & Wind Energy) on the same topic. Finding a suitable theory and a suitable scope were key in establishing this overlap. During the theory search, I've been through the theories of networks, trust, justice, social capital, power, dependence and many more. Significant time was needed to end up at Social Exchange Theory and reciprocity. Thanks to the urges of several people, I went in search for a case study. This greatly helped reducing the scope of the project to the interaction between the developers and the residents. This made things more practical and tangible.

This thesis is the first step towards a hybrid approach to wind energy communication based on reciprocity and networks. The value of social network analysis is recognized in improving stakeholder participation and increasing perceived procedural justice (Prell et al., 2009), and it has been applied to wind farm development before (Maillé and Saint-Charles, 2014). The next challenge is to connect qualitative and quantitative studies in order to maximize the value of these studies (Squazzoni et al., 2013). The pathway in Figure 13.1 shows how this could be done. Applied and theoretical approach take turns and the insights of each research serves as a basis for the next research. In this respect, this thesis is represented by the very first arrow from the applied to the theoretical approach. The process converges to a hybrid approach, where I envision a combination of qualitative and quantitative data collection methods, combined with computational power to support shared decision making in wind farm development among all involved actors based on shared interests and mapping (communication) process uncertainties.

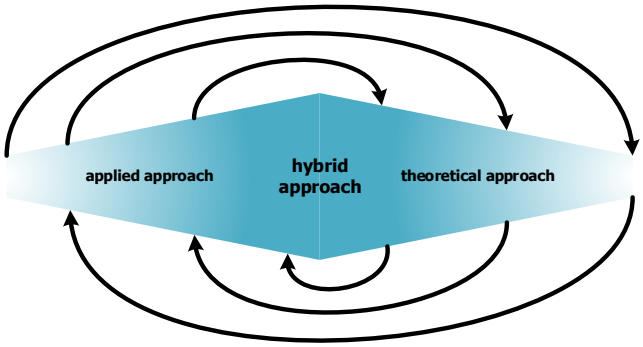


Figure 13.1: The left side is the applied approach, which concerns case studies and is very specific. On the right hand side is the theoretical approach, which concerns simulation and has a more general character. The arrows indicate how these two branches of research could merge in the future towards an hybrid approach. This thesis could be seen as the first arrow from applied approach to theoretical approach.

The integration of an applied and theoretical approach to wind farm development also raises new questions concerning concepts and recommendations for wind farm development. This could be considered the added value of this double degree master thesis over a single degree thesis. First of all in Part II the notion of *perception* refers to a social exchange that *has happened in the past*, in Part III, the notion of *belief* refers to a social exchange that *will happen in the future*. This is a conceptual 'gap' that has to be dealt with in future research. Important questions then are how expectations of future social exchanges are measurable qualitatively, and how perceptions (beliefs) about past social exchanges can be modeled quantitatively. When zooming in at the results of both the applied and theoretical approach, the question arises what is exactly the role of inconsistent perceptions among actors. In Part II it has been argued that inconsistent perceptions should be minimized in order to have a relationship based on mutual understanding, while in Part III suggestions have been made that inconsistent perceptions are not necessarily a bad thing and can even serve the purpose of increasing the equity in a relationship among actors. A conceptual solution to this contradiction would be to assume

that all perceptions are inconsistent and realizing that some are just more inconsistent than others. But in practice this stresses the importance of having more knowledge on why perceptions of two actors are the same or different on one and the same issue.

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Appendices

A

TYPES OF RESEARCH

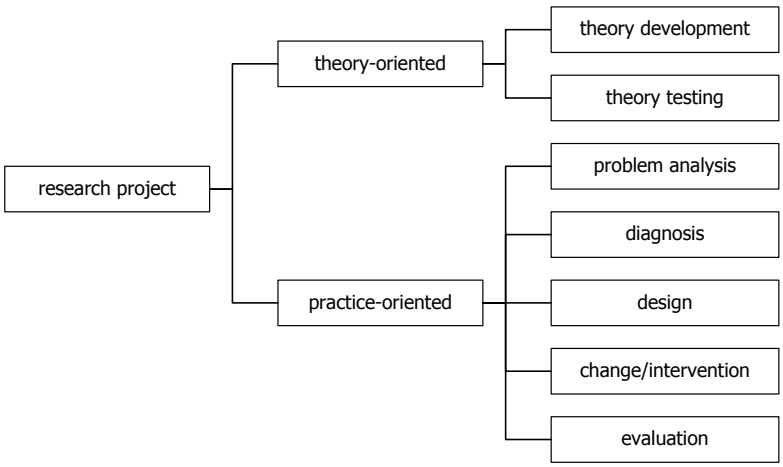


Figure A.1: Types of theory-oriented and practice-oriented research (Verschuren and Doorewaard, 2010) (p.41). Short explanations are given below.

Theory-Developing Research	Development of concepts by further elaboration and conceptualizing of empirical phenomenon.
Theory-Testing Research	Testing a set of mutually related hypotheses stemming from one and the same theory in order to assess the validity of that theory.
Problem-Analyzing Research	Examination of (the impact of) critical factors determining success or failure of the research object.
Diagnostic Research	Search for background and causes of dysfunctional disorder related to the problem.
Design-Oriented Research	Obtaining a certain structural or policy-induced solution by design.
Intervention-Oriented Research	Analyzing the implementation of the proposed design intended to solve the diagnosed problem.
Evaluation Research	Evaluating an intervention according to assessment criteria based on requirements, standards, targets, theory and so on.

B

INTERVIEW PROTOCOL

Het doel van het interview is om informatie te krijgen over wat er is gebeurd in het proces van windparkontwikkeling (tot nu toe), hoe de omwonenden en ontwikkelaars daaraan meededen en hoe zij dit ervaren hebben.

Drop-off vragen

- Naam geïnterviewde:
- Datum en tijd interview:
- Locatie interview:
- Leeftijd:
- Woonplaats en wijk:
- Geslacht:

Openen interview Voorstellen en vragen wie de persoon voor me is. Vragen of opnemen goed is en uitleggen hoe de resultaten gebruikt gaan worden.

1. **Introductievragen**
   (a) Kunt u in het kort vertellen waar [project] over gaat?
   (b) Hoe en wanneer bent u bij [project] betrokken geraakt
   (c) Wat is de oorsprong van [project] en [samenwerking]?
   (d) Wat is uw relatie met het gebied? Wanneer en hoe ontstaan? Hoe lang woont u hier al/zijn in de buurt meerdere projecten?
   (e) Waarom vindt u [project] wel of geen goede locatie?
   (f) Leeft windenergie in de omgeving?
2. **Transistievragen** De geïnterviewde wordt gevraagd een tijdlijn te maken met de bijeenkomsten ('events') met ontwikkelaar en omwonenden. Aan de hand van deze tijdlijn worden verdere vragen gesteld.
   (a) Kunt u aangeven wat er allemaal georganiseerd is? Workshops, excursies, informatieavonden, bijeenkomsten etc.
   (b) Welke [events] bent u bij aanwezig geweest?
   (c) Welke van deze [events] is/zijn voor u het meest belangrijk/succesvol/frustrerend/spannend geweest? Waarom?
   (d) Wat was het onderwerp van [event]?
   (e) Wie was verantwoordelijk voor de organisatie van [events]?
   (f) Wie waren hier aanwezig?
   (g) Wat was concreet de uitkomst van [event]?

3. **Sleutelvragen** Met de sleutelvragen ga ik, per interessant event, in op de concepten die voor mij van belang zijn. Focus is op de exchanges op drie levels: project, proces en persoonlijk (de drie 'P's').

   (a) **Regels en normen**, over uitkomsten en hoe die tot stand zijn gekomen.

      i. Kunt u kort uitleggen wat er gebeurd is tijdens [event]? (presentatie/workshop etc.)
      ii. Wat heeft u bijgedragen tijdens [event]? Hoe?
      iii. Wat heeft [actor] bijgedragen tijdens [event]? Hoe?
      iv. Hoe zou u de sfeer beschrijven tijdens [event], hoe gaan de mensen met elkaar om? Voorbeeld? formeel/informeel debat/discussie? Voorbeeld? Is dit voor u een gewenste sfeer? Waarom?
      v. Wat is de setting van [event]? Wie is verantwoordelijk voor de agenda?
      vi. Is er iets afgesproken over de samenwerking tussen u en [actor]? Mondelinge of schriftelijke overeenkomst?
      vii. Zijn jullie het binnen werkgroep/platform/ontwikkelaars wel eens oneens? Voorbeeld?

   (b) **Uitwisselingen**, aan de hand van eerder genoemde dingen, per uitwisseling ga ik in op de concepten die van mij voor belang zijn.

      i. Is [uitwisseling] belangrijk voor u? Waarom?
      ii. Wat heeft u met [uitwisseling] gedaan?
      iii. Hoe voelde u zich daarbij?
      iv. Wat verwachtte [actor] terug?

   (c) **Relatie - 1**, over rollen, de hogere doelen, alignment.

      i. Hoe zou u uw rol/verantwoordelijkheid beschrijven tijdens [event]?
      ii. Hoe zou u de rol/verantwoordelijkheid van [actor] beschrijven tijdens [event]?
      iii. In hoeverre hebben jullie dezelfde doelstellingen?
      iv. Waar zijn jullie ideeën over hoe deze doelstellingen te halen hetzelfde of anders?
      v. Kunt u zich de laatste keer herrinneren dat u [actor] niet begreep of verkeerd werd opgevat, of dat [actor] u niet begreep? Waarom was dit denkt u?

   (d) **Relatie - 2**, aan de hand van eerder genoemde dingen, vragen naar de huidige situatie en dan terugwerken naar de oorsprong hiervan.

      i. Zou u kunnen uitleggen waarom u denkt dat [actor] [uitwisseling] deed? Hoe weet u dit?
      ii. In welke mate bent u toegewijd aan/voelt u zich verantwoordelijk voor [proces]? Waarom? Voorbeeld?
      iii. Wat zijn belangrijke dingen waar u en [actor] samen aan moeten werken?
      iv. Kunt u belangrijke beslissingen overlaten aan [actor]? Waarom? Voorbeeld?

4. **Besluitende vragen**

   (a) Hoe ziet u de toekomstige samenwerking met [actor] voor zich?

   (b) Wat zijn uw verwachtingen van volgende [event]? Waarom?

   (c) Wat is de ideale uikomst voor [project]?

   (d) Verzoek aanwezigheid volgende [event]?

   (e) Korte samenvatting geven van de besproken dingen en belangrijke bevindingen.

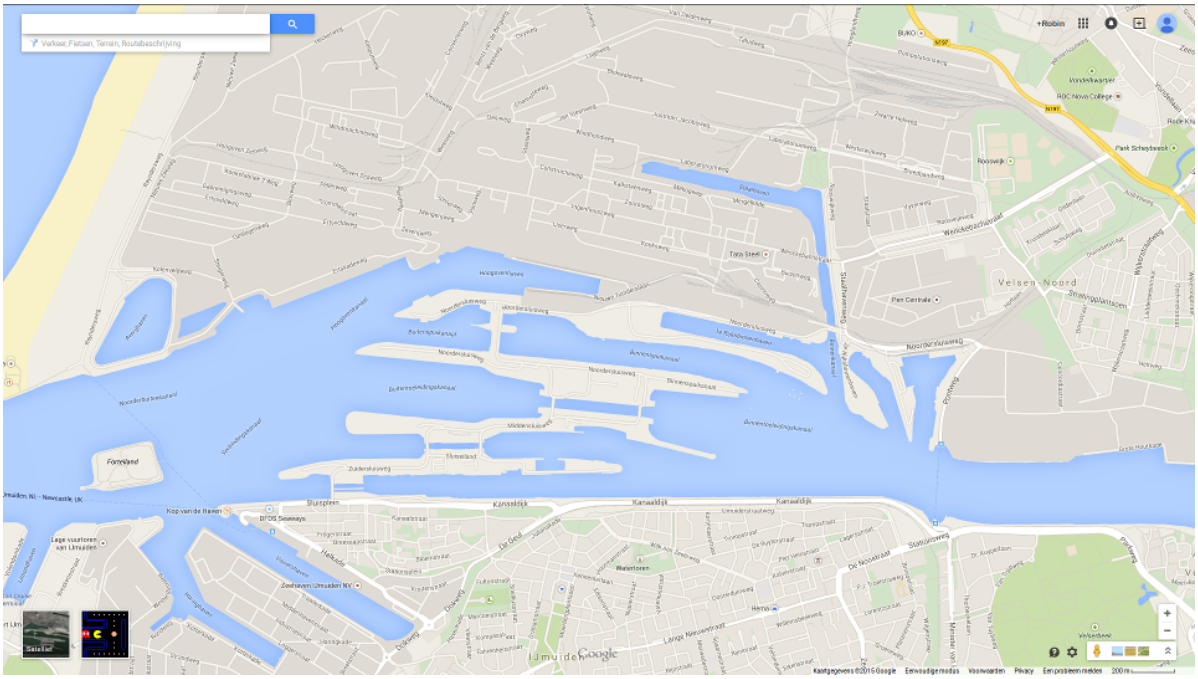
   (f) Zijn er nog dingen die u kwijt wilt of toe wilt voegen?

   (g) Kan ik contact met u opnemen als mij later dingen te binnen schieten?

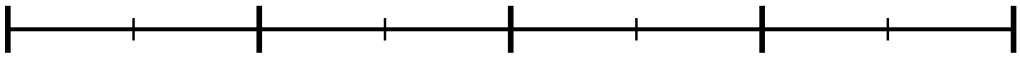
C

INTERVIEW SUPPORTIVE DOCUMENTS

C.1. AREA MAP



C.2. TIMELINE



D

CODING SCHEMES

Table D.1: Bottom-up coding scheme emerging from the first two interviews.

code	subcode	description
LOCATIE		De code LOCATIE wordt gegeven aan alle onderdelen in de tekst die informatie geven over de locatie van windpark Spuisluis.
PROCEDURE		De code PROCEDURE wordt gegeven aan stukken in de tekst die informatie geven over de procedure van de ontwikkeling van het windpark, of het effect van de procedure op andere aspecten van het windpark.
HINDER		De code HINDER wordt gegeven aan uitspraken van de respondent waarin (mogelijke) hinder als gevolg van de bouw van het windpark aangehaald wordt.
ONDERZOEK		De code ONDERZOEK wordt gegeven aan passages in de tekst waarin wordt gesproken over uitkomsten van onderzoek of onderzoek dat gedaan moet/zal worden.
ONZEKERHEID		De code ONZEKERHEID wordt gegeven aan passages in de tekst waarin de respondent aangeeft iets niet zeker te weten over de ontwikkeling van het windpark en/of de effecten op de omgeving.
	T.O.V. ANDERE ACTOR	Idem als ONZEKERHEID, maar dan in relatie tot andere actoren.
WIJKPLATFORM		De code WIJKPLATFORM wordt gebruikt bij informatie over (de rol van) de wijkplatforms.
INFORMATIE		De code INFORMATIE wordt gebruik voor passages waarin een uitwisseling van informatie wordt beschreven.
PERSOONLIJKHEID		De code PERSOONLIJKHEID wordt gebruikt wanneer de respondent iets zegt over zijn persoonlijkheid.
WERKGROEP		De code WERKGROEP wordt gegeven aan passages in de tekst die iets zeggen over (de rol van) de werkgroep.
GEDRAG		De code GEDRAG wordt gegeven aan passages in de tekst die iets zeggen over het gedrag van een actor.
CONTACT		CONTACT is een contactmoment tussen omwonenden en ontwikkelaar.
VERGELIJKING		Respondent gebruikt een VERGELIJKING om een (mogelijk) aspect van windenergie duidelijk te maken.
GEZONDHEID		Uitingen over de bezorgdheden over of effecten van windturbines op GEZONDHEID.
VERTROUWEN		Uitingen van VERTROUWEN tegenover een andere actor.
ZIENSWIJZE		Informatie met betrekking tot een ingediende ZIENSWIJZE (public voicing).
ZELFVERTROUWEN		Uitingen van ZELFVERTROUWEN van de geïnterviewde.
COMMUNICATIE		Belangrijke evenementen waarin COMMUNICATIE plaatsvond tussen actoren.
EMOTIE		EMOTIE beschrijft een emotie of diepe indruk van de respondent.
SETTING/SFEER		SETTING/SFEER beschrijft een situatie.
ERVARING		ERVARING is een code gebruikt om een persoonlijke ervaring van de respondent aan te geven.
BELEID		De code BELEID wordt gegeven aan passages die iets zeggen over het beleid waarbinnen de windparkontwikkeling plaatsvindt.
JARGON/TAAL		Code JARGON/TAAL heeft te maken met verschillen in jargon en taal dat gebruikt wordt.
BELANG		De code BELANG wordt gebruikt voor passages waarin een belang van een partij besproken wordt.

Table D.2: Final coding scheme developed from bottom-up coding scheme and the concepts from the conceptual model.

code	subcode	subsubcode	description
PERSOONLIJKHEID EN GEDRAG			Informatie over de PERSOONLIJKHEID en het GEDRAG (anders dan exchanges) van de geïnterviewde.
PERCEPTIE WE & SPUISLUIS			Informatie over hoe de perceptie van de geïnterviewde met betrekking tot WIND ENERGIE in het algemeen en locatie SPUISLUIS in het specifiek.
LOCATIE & PROCEDURE			Informatie over LOCATIE spuisluis en de wettelijke PROCEDURE.
RECIPROCITEIT			
	COMMUNICATIE		
		RULES & NORMS	Procedurele en culturele REGELS en NORMEN en uitingen van afhankelijkheid (dependence) van de andere actor.
		EXCHANGE RESOURCE	Informatie over de waarde, particulariteit en payoff time van de EXCHANGE RESOURCE.
	RELATIE		
		AFFECTIEF	Uitingen van AFFECTIE: vertrouwen, toewijding en wederzijds begrip.
		COGNITIEF	Uitingen van COGNITIE: gedefiniëerde rollen, gedeelde doelen en gedeelde visie.
GEBIEDSATELIER			Informatie en verwachtingen over het GEBIEDSATELIER.
PROVINCIE & BELEID			Informatie en percepties over PROVINCIE en het BELEID.
GEMEENTE			Informatie over de rol of gedrag van de GEMEENTE.
CULTUUR			Informatie over de lokale CULTUUR van omwonenden.
EVENT DATE			DATUM van een evenement.
EXPLOITATIE PARTICIPATIE			Informatie over en percepties van PARTICIPATIE in de EXPLOITATIE.
WERKGROEP			Informatie over de WERKGROEP die niet in RECIPROCITEIT passen, bijvoorbeeld over het ontstaan.
COMMUNICATIE OVERIG			OVERIGE passages die relevant zijn maar niet direct onder een andere code passen.

E

CASE STUDY DETAILED DESCRIPTION OF OTHER EVENTS IN PHASES 1, 2 AND 3

E.1. PHASE 1: JULY 2014 - OCTOBER 2014

Other events that occurred between July and October 2014 are two rounds of public voicing on the provincial policy (19/06/2014 and 26/09/2014), a radio broadcast (18/07/2014) and a presentation by the province (08/10/2014). These are described below in chronological order.

19/06/2014 - 30/07/2014: PUBLIC VOICING ROUND 1

The developers informed the district platforms about the upcoming possibility for public voicing at the province. Initially Ivo did not want to inform the residents about this because, as Lara puts it, they become *"vulnerable"*. Public complaints would only work against the project. But E-Power's policy demands that a community is informed about developments in their neighborhood.

> *"If you have that attitude, and people find out in hindsight, yes, then they immediately feel... they will become suspicious of course. And that is just because then you are already doing things that affect them without consulting them."*
>
> Lara

Only the district platform of IJmuiden-Noord eventually claimed their right for public voicing and wrote up a vision to submit at the province. The president of the district platform is very active in engaging with matters in the neighborhood and shared their vision with Lara for a double-check. This was much appreciated by Lara. In the vision they expressed a concern for possible noise disturbance as a result of the construction of the wind farm.

> *"I actually really liked that, (...) also that was totally open and transparent to each other."*
>
> Lara

18/07/2014: RADIO BROADCAST

About two weeks after the presentation in Velsen-Noord, this same president of the district platform of IJmuiden-Noord arranged a radio broadcast on a local radio station to inform the listeners about the project. In order to get his information straight he contacted Lara. Lara provided him with additional information.

> *"He makes sure that people are kind of informed. So a radio talk like that, that is just quite good that he does that of course."*
>
> Lara

08/10/2014: PROVINCE PRESENTATION 2

In the beginning of October, the province did a second presentation, this time about the draft policy framework (Provincie Noord-Holland, 2014f). The developers and Jessica of the Environmental Service IJmond were present. Contrary to the province presentation in June, this one was also attended by residents. Jake, also

present, spoke about *"a big group of people from IJmuiden"* being present there. Lara describes this as a *"success"*.

This time the topic was the explanation of the draft policy framework and the supporting research reports (Provincie Noord-Holland, 2014d). It became known that initiators of wind farms have to submit a *principal request* at the province in the beginning of 2015. What this request exactly should contain was at this moment not known yet. It was also announced that so-called 'area studios' will be organized in the future for each of the designated wind farm locations in the province, as is illustrated by the following quote:

> *"During the area studios the province, municipality and initiator will join the conversation with residents, district platforms, stakeholders. In this manner it is attempted to give public support a role at the front-end of the process."*
> Provincie Noord-Holland (2014e)

The residents present at the presentation responded with the known concerns about noise and presented a new concern: the possible negative influence of wind turbines on the particulate matter issue in the area. Additionally they mentioned the culmination of (heavy) industry being a reason not to designate location Spuisluis for wind energy. For the developers started a period of waiting for the establishment of the policy framework.

The next steps of the province are again a period of six weeks for public voicing, where residents could submit their vision on the proposed draft policy framework, and a public speaking event on the 11^{th} of December where residents could react on the proposed policy framework during a committee meeting at the province hall.

26/09/2014 - 07/11/2014: PUBLIC VOICING ROUND 2

In the period between the 26^{th} of September and the 7^{th} of November there was a possibility for public voicing regarding the proposed draft policy framework. The district platforms already contacted each other in order to discuss wind farm Spuisluis (but never physically met). This resulted in the district platforms of Velsen-Noord and IJmuiden-Noord as well as the Stationsweg Association submitting a joint vision (Velsen-Zuid prefers to remain neutral). The residents, to this end, search information on the Internet to make up their mind about wind farm Spuisluis:

> *"Knowing that those turbines suck up the air that high, get it delivered, and displace it to the ground level, I say: wrong choice here."*

> *"Investors in wind energy make a filthy amount of money, with subsidies. (...) Everything I read is that there is only a small group who earns massive amounts of money. (...) That is what I hear from all sides."*

> *"There is nothing against making money, really, I allow them to built windmills. But in the end, I pay them (...) Through the taxes on energy. Because that is how the subsidies are financed."*
> Jake

> *"Why are you creating public support? Because both mr Ivo and company and ms Lara, they just have an interest, an economic interest, in those windmills."*
> Vince

> *"[Ivo] is hired as a windmill expert, then I think, you know... this man is just filling his pockets/profiteering. I do not have a good feeling with it. (...) I do not know his role towards E-Power. He is by all means not stimulating the residents."*
> Ellen

> *"They took up the information very well I think. Also they are all interested, I think that is very nice, at least those who we reach through the district platforms of course. They also just... do something with it."*

> *"You just see that they want to understand it. They are googling much so... that is... well if you Google wind energy then you mainly encounter very bad things. So they really are very concerned. But I have the notion that we continue talking with each other, and that is kind of nice."*
> Lara

Air pollution caused the heavy industry has always been a major issue in the municipality of Velsen. Wind turbines have approximately the same height as the chimneys, and there are serious concerns that the turbulence behind the wind turbine rotors could cast down the particulate matter (See the photos in figure Figure 6.5a, Figure 6.5c and Figure 6.5f for a view of the chimneys on the north side of the canal). This concern is communicated with the other district platforms and implemented in the vision as an argument against the wind farm. Also contrary to the first vision, Lara was not approached to double-check its contents. However, via her established contacts with the residents she got to see the final version of the vision. The Internet search by the residents furthermore resulted in the developers being perceived as having a strong economic interest.

E.2. PHASE 2: OCTOBER 2014 - JANUARY 2015

Other events that occurred between October 2014 and January 2015 are a public speaking event at the province hall (11/12/2014), the interim decision of the province to appoint location Spuisluis for wind energy (15/12/2014), council questions to the municipality of Velsen (09/01/2015) and the submission of the principal request by the developers (15/01/2015). These are described below in chronological order.

11/12/2014: PUBLIC SPEAKING EVENT PROVINCE HALL

An event was organized by the province for the residents and other actors from all wind energy areas in the province (the ones indicated in Figure 6.6) to personally illustrate the visions that they submitted during the second round of public voicing. Stationsweg Association member Anthony used this opportunity to speak to the province on behalf of the district platforms of IJmuiden-Noord and Velsen-Noord and the Stationsweg Association. Also residents from other possible wind energy locations were present. The developers Ivo and Lara were attending this event as well, but they did not use the possibility to speak to the province.

> *"I told a four minute story over there on behalf of these three clubs."*
>
> *"And we think that an area (...) that is already that heavily burdened, that you should not burden extra in the form of a bunch of windmills."*
>
> Anthony

> *"I was not there. No, I had obligations here. No, that is... that was well managed by Anthony and company."*
>
> *"The concerns are shared concerns. We do not have conflicting interests, (...) we are not opposing each other. These platforms, they share the same story."*
>
> Vince

Anthony basically repeated the main points as written in the vision and attempted to make clear that location Spuisluis is not suitable for wind energy. Municipality councilman Vince was not attending this event, but explains that he felt confident in Anthony speaking on behalf of the residents. Anthony thinks that the developers should also have publicly spoken: *"If you play the game, play it fair"*. He describes the behavior of the developers as *"cowardly"*.

This event was also the first time that Anthony and the developers met in person. Lara already knew about Anthony and the Stationsweg Association through earlier contact with the residents, and she took the opportunity to approach Anthony and start a conversation. Anthony, however, did not feel like having a talk and did not make any further efforts to engage with the developers.

> *"[Anthony] once spoke at the province, that was the first time I met him. (...) At the province I have shaken his hand, which was shaken back with much effort, but that's it. That man just does not want to have anything to do with us."*
>
> *"He has the idea that, when he talks with me, that he... that he will be in a bad position if we ever end up at the supreme court or something. So he is really... he is a retired judge, and he is very busy with litigation, and advices also the Stationsweg people, his neighbors. They have a special association, and there he also says like: 'You shouldn't talk with E-Power because when we litigate we are in a weaker position'. I doubt that, I think the more information, the more sticks you have to hit with. But he has that opinion and that... he does not play it dirty or something. So that... his questions also reach me, and I answer them indirectly, so... eh... there is some form of communication."*
>
> Lara

"I did not talk with [Lara] then, I kept her off purposely."

"You should not stir in the pot yourselves while the province is not even finished yet."
Anthony

One day after the public speaking event a newspaper article was published in the Noordhollands Dagblad. It mainly covers the opposition by communities from the north of the province, but additionally states, consistent with the interviewees' recollections, that *"also from IJmuiden (...) people showed up to make clear that they really do not want windmills in their environment"* (Noordhollands Dagblad, 2014).

15/12/2014: INTERIM PROVINCIAL DECISION LOCATION SPUISLUIS

Four days after the public event at the province hall the province council accepted the new policy framework and made the interim decision to designate location Spuisluis for wind energy. This decision was not definite because also a resolution was accepted which should provide more protection of residents from wind turbine noise (Provincie Noord-Holland, 2014a). A quote from Anthony is illustrative for the residents responses to this decision by the province:

"It meant that in quite areas, we can apply an extra norm for sound, so it remains quite. And people who live in industrial areas, we can put some more sound can't we? Because they do not hear that anyway, because they already have so much noise, that is really what it came down to."
Anthony

The acceptance of this resolution was perceived unfair by the residents because it would make wind farm Spuisluis possible *because* there are already high levels of noise in the area. It would take until March 2015 to implement this resolution and make the definite decision for the locations.

With the policy slowly taking shape and the deadline for the submission of the principal request drawing near, the developers and residents decided to make a start with the working group. An excursion on January 16 was planned to another wind farm owned by E-Power.

09/01/2015: COUNCIL QUESTIONS TO MUNICIPALITY

Up till this moment the municipality of Velsen was not much involved in the development wind farm Spuisluis. Yes, they are in favor of wind energy, but the province is the authority for this project. The influence of the municipality is therefore limited to an advisor during the permit application phase. It is expected that this phase will only start early 2016. This does not withhold Vince from trying to use his role as a councilman to move the municipality. In early January 2015, the municipality council asked questions to the municipality board.

"It is not possible to have a discussion on the content."

"Up till now you won't get any attention from the municipality of Velsen. They also do not talk about it. (...) I asked council questions, but everything remains superficial. (...) At this moment, the municipality of Velsen does not communicate about all remarks and comments and everything that happens around that Spuisluis."
Vince

15/01/2015: SUBMISSION OF PRINCIPAL REQUEST

The principal request for wind farm Spuisluis was submitted at the province on January 15^{th}, one day before the excursion. This principal request is supported by preliminary research reports on the topics of noise, shadow flicker, safety and impact on wildlife.

E.3. PHASE 3: JANUARY 2015 - MAY 2015

Other events that occurred between January 2015 and May 2015 are the presentation by Anthony at the Stationsweg Association (06/02/2015), the public speaking event in the town hall (22/02/2015), the definite decision by the province to appoint location Spuisluis for wind energy (02/02/2015), a second presentation by Anthony at the district platform of Velsen-Noord (04/03/2015) and an article by Jake in a local newspaper (30/04/2015). The events are described in detail below.

06/02/2015: PRESENTATION ANTHONY AT THE STATIONSWEG ASSOCIATION

The board of the Stationsweg Association asked Anthony to prepare a presentation to inform the members of the Stationsweg Association about project Spuisluis during their general assembly. This with the purpose to establish a shared standpoint towards te project. The board asked Anthony to do this because of his knowledge, being a retired judge he has much expertise about legal procedures or, as he states himself because *"the board always seeks me for help and support if it concerns traffic and environment"*.

Members of other district platforms are also invited. Vince and the president of the district platform of Velsen Noord showed up. Velsen-Zuid was not attending (remind that they intend to be neutral in the issue, as became apparent during the second round of public voicing in November 2014, as explained in section E.1). Government and developers were not invited and therefore also not attending the presentation. The presentation Anthony (pseudonym) (2015), titled 'Windmills in Velsen at the Noordzeekanaal side?' intended to, according to Anthony, *"tell the current state of affairs and how things came about at that moment"*. It gives a critical overview of the technical details, research reports and the process. It ends with the slogan: 'Onshore wind energy, very risky!!!' The presentation mentions E-Power as the developer, The name 'WindForceSea' is not mentioned in the presentation, although the names of Ivo and his partner are mentioned only once in a small font.

A few things happened as a result of Anthony's presentation. First, the Stationsweg Association decided *"explicitly"* (Anthony) to be against the wind farm. Second, they appointed two members to take seat in the future area studio (of which Anthony is one). Third, they send a letter to the province (dated 14/02/2015) explaining that the principal request was not of sufficient quality and should therefore not have been accepted by the authorities (see also subsection 6.6.2). As a response to this letter the Stationsweg Association is invited to the area studio by the province. Fourth, the president of the district platform of Velsen-Noord requested Anthony to give a similar presentation at their district platform meeting, which he agreed upon. This presentation would take place on 04/03/2015, see also section E.3.

22/02/2015: PUBLIC SPEAKING EVENT TOWN HALL

At the 22nd of February 2015 there was a public speaking event at the municipality of Velsen during which residents could ask questions to the municipality. Of the interviewees councilman Vince, IJmuiden-Noord resident Ellen and developer Ivo were attending. The residents expressed the arguments, amongst others the high levels of particulate matter, against the wind farm towards the municipality. Ellen and Ivo about this event:

> *"I assume that things will be done with [the arguments], because I do not know how that continues in the municipality council."*
>
> *"You try to get hope out of everything."*
> Ellen

> *"What do you think of your position, that you don't oppose the production [of particulate matter][1], and instead oppose the possible distribution because of the turbines, what do you think of that? I think it is a joke. (...) I do not understand it anymore."*
> Ivo

Ellen expressed a feeling of desperation because she tried to get *"hope"* out of asking the municipality questions. Ivo on the other hand experienced more frustration because he felt that the residents only oppose the wind farm project, and not other projects. What adds to his confusion is that municipality does not hold any decision power over the wind farm (the province is responsible for handling the permit application). Up till now Ellen never directly spoke to Ivo and also during this event at the municipality they would not engage in direct conversation. There was however, as the following quotes clearly illustrate, non-verbal communication between them during this session at the town hall:

> *"He was, let's say, pulling faces, like 'it is not true at all', you know? (...) That was the feeling I kind of got. (...) And he did see [the president of the district platform], I was sitting next to [the president] and he did not see me."*

[1] Another project is running alongside wind farm Spuisluis. This concerns the expansion of the locks allowing bigger ships to enter the canal, with possibly higher levels of particulate matter as a result.

"It is his thing and [the wind farm] has to come, and he wants to make a good... good impression to E-Power."
Ellen

02/03/2015: DEFINITE PROVINCIAL DECISION LOCATION SPUISLUIS

The new policy for onshore wind energy was eventually established at March 2^{nd} 2015 and incorporated the resolution from 15/12/2014 to protect residents for noise and the definite designation of locations for wind energy. The implementation of the resolution resulting in the distance margin between wind turbines and residential areas being increased from 500 meters to 600 meters. The province publicly announced the new policy, and residents and developers attended this public event. From the interviewees Jake and Anthony attended, from the developers Lara was present. The following quotes are illustrative for the residents reactions to the provincial decision:

"They experienced too much opposition in North-Holland, in the farmlands, so they reject that. And, well... then you get stories like yeah, it is already industrial, the mills here will even beautify the view... it is all nonsense."

"On visual aspects you cannot stop them, so you have to forget that, that is... you will never accomplish that. But the arguments for noise, well, in the meanwhile we are of course in a phase that the noise margin is somewhat shifted and this mill [number 8] is rejected and that this one [number 7] is still being looked at, (...) whether this one can be placed or not. So then the story of noise for Velsen-Zuid is also outdated. "
Vince

"There was a second area for restructuring (...) and they managed with exactly the same arguments, we are already highly burdened, they managed that the location is rejected."

"I understand why [the developers] want to keep open... all options open [in the principal request]. Because you see now that some mills are already rejected."
Anthony

So the resolution resulted in the most eastern wind turbine of wind farm Spuisluis being rejected (number 8, indicated in red in Figure 6.1). Although the designation of Spuisluis was not unexpected, the attending residents were not happy that location Spuisluis definitely appointed for wind energy. The feeling of unfairness is increased by the rejection of other locations in the province, because this rejection puts more pressure on wind farm Spuisluis to be realized in order to meet the provincial goals for onshore wind energy. Although the resolution results in the rejection of the eastern wind turbine, it is not perceived fair because it is perceived that the resolution is intended to protect the residents from quite areas elsewhere in the province. Following this decision the developers also came up with a so-called back-up wind turbine at the Averijhaven (the western lilac wind turbine in Figure 6.1).

Another interesting occurrence during this day was the deputy explicitly (but incorrectly) mentioning that location Spuisluis was rejected. This caused some further communication between the working group and the developers:

"The deputy responded [to a audience question], now brace yourself: 'location Spuisluis will not be continued and it will be rejected'. Literally! So, we... Hallelujah! (...) But something in the story was not right (...) and I sended the province an email like can I have this confirmed? And then I got an email from the deputy, he made an error, he did not mean Spuisluis."
Jake

"One day later I reported and I did not mention that for that reason, because I knew it was wrong. And then Jake said: 'Yes! How is that possible? The most important you do not mention, it is rejected, take a look at this recording!' (...) And then it seems that you inform them incorrect. So I responded quickly: 'this was the story and well, sorry that I didn't report it. I did it because of this and this reason'. But yes, I understand now it was perceived incomplete. But yes, Jake already called with that provincial officer and he also already confirmed it."

"So that was resolved quickly. (...) My greatest fear is that I, unconsciously, because I cannot do it consciously of course, that I do not report something or do something wrong, or that... that makes enormous mistrust... yes... that they perceive things differently, unconsciously, because of me. And that I seem to be a liar then."
Lara

The residents felt relieved by the initial rejection of location Spuisluis, but the deputy made a mistake: he intended to tell that the expansion of wind farm Reyndersweg would not be possible. In the event summary that Lara send around by e-mail one day later this *"most important"* (Lara) thing was not mentioned since Lara understood that the deputy made a mistake. In the meanwhile Jake had send an e-mail to the province, asking for a confirmation of the rejection. In the end, this error was set straight this same day, without this message going public.

One day after the provincial decision for wind energy locations a short newspaper article was published in the IJmuider Courant named 'Turbine noise does not play a role in the IJmond' (IJmuider Courant, 2015a). This article is rather negative towards the province and seem to contain inaccuracies since it is conflicting with the interviewees statements and the provincial policy documents (Provincie Noord-Holland, 2015a). It basically says that restrictions on sound, distance, safety and shadow flicker are not effective any more for wind farm Spuisluis.

"the provincial resolution protects the delicate little ears of the northlings with complicated calculations"

"For construction of new wind turbines in the IJmond a maximum noise loading and a minimum distance to residential homes are not applicable."

"Wind turbines can be placed unconditionally in areas where the prevalent background noise levels are higher than 40dB(A) (...) So you can place the new turbines wherever you want. The old regulation on safety, shadow flicker etcetera is not effective any more."
IJmuider Courant (2015a)

04/03/2015: PRESENTATION ANTHONY AT DISTRICT PLATFORM VELSEN-NOORD

As requested by the district platform of Velsen-Noord, Anthony repeated his presentation he gave at the general assembly of the Stationsweg Association in early February. This time the audience was bigger since also representatives of nearby companies, municipality councilmen and members of the municipality board were attending. (*"There were some 30, 35 people I think" "So I had a nice, I had a pretty audience, yes. I kind of liked that"*, Anthony). The developers were not invited. Through the indirect communication via the working group Lara got to know about it and she responded to the contents of the presentation. The presentation became publicly available through the website of the district platform of Velsen-Noord.

"I think that that was as objective a story, as the objectivity here during the excursion."
Vince

"At Velsen-Noord he gave a presentation about the effects of wind energy, from what he had googled, he shared that. (...) That presentation is also on the website of the district platforms. So he is kind of... running opposition somewhat, but not in an annoying way. I think, anyway, that what he does stays within the boundaries."
Lara

"Only indirectly in that working group she gave some comments on it. (...) Jake just forwarded me Lara's response, and that... well it was some muttering in the margins, but really on the content they could not counter it."
Anthony

30/04/2015: NEWSPAPER ARTICLE IN 'DE JUTTER'

An article written by Jake was published in the a local newspaper named 'De Jutter' (Jake (pseudonym), 2015). It shortly explains in a factual way that Spuisluis is designated as a location for wind energy and elaborates on some details of the project, including the rejection of turbine 8. It furthermore explains the future steps in the process. It ends with a call to residents to join the area studio that will be organized *"between May and October 2015"*. Some extracts from the article are:

"Some still want to initiate an action group, but the stage of opposition is already passed."

"[The developers] have, as recommended by [the land owner], picked a back-up location east of the Averijhaven."

"District platform IJmuiden-Noord calls all residents who are living within 1500 meters of the locks, interested in the continuation, and want to visit the area studio, to apply via the website of the district platform."
Jake (pseudonym) (2015)

"That I find an exceptionally good call. Just a nice and clear story by Jake."

"...and next Mrs. Lara also shouts like 'Oh, Jake, so well done that you involve the people!'. I think, damn it, if you and your... eh... one year earlier, instead of sneaking into the district platforms, placed a proper advertisement, then Jake did not have to do this at all, because then everybody was already awake. (...) Well, that made me angry."
Anthony

The article was shared and discussed through e-mail with the involved residents, including Anthony. In a response, Lara praised Jake's initiative to write this article which Anthony did not appreciate. There are no recollections of Lara and Jake about this event available because their interviews took place before this article was published. After the publishing of Jake's article it remains relatively quite in the community. At the end of phase 3 the process of wind farm development is idle and the actors are waiting for the province to make the next move: the long awaited area studio.

"Everything is quite now. Everything is said, and positions are taken."
Vince

"Right now it is waiting for the next step. But from the IJmond, we involved the newspaper and they wrote quite some things about it, but... it remains quite."
Jake

F

Report on workshop 'Reciprocity in Wind Energy'

dinsdag 24 november 2015, 13:00-15:00

Introductie

Dit document is een algemeen verslag van de workshop 'Wederkerigheid in windenergie'. Deze workshop is georganiseerd naar aanleiding van het afstudeeronderzoek van Robin Vermeij, stagiair bij NWEA. Hij heeft onderzoek gedaan naar communicatie tijdens windenergie projectontwikkeling.

Communicatie en acceptatie zijn belangrijke onderwerpen in windenergie projectontwikkeling. Meer inzicht in communicatie is nodig, want het is een van de taken van de windenergiesector om zo goed mogelijk om te gaan het informeren en betrekken van lokale bevolking. Het onderwerp van vandaag, wederkerigheid, kan meer inzicht geven in hoe relaties tussen actoren in windparkontwikkeling ontstaan.

De deelnemers hopen nieuwe manieren en inzichten te verkrijgen over communicatie met omwonenden. Communicatie wordt gezien als een belangrijk element in windparkontwikkeling en over het onderwerp acceptatie wordt al jaren nagedacht (het gaat eigenlijk niet over de techniek). Toch wordt communicatie 'spannend' genoemd en de deelnemers doen het vaak op gevoel. Het is namelijk lastig om in iemand anders zijn schoenen te gaan staan. Dit geld niet alleen voor de ontwikkelaars, ook voor omwonenden kan dit moeilijk zijn.

In de workshop kijken we naar hoe de betrokken actoren communicatie ervaren. Communicatie is dan ook niet goed of fout, omdat iedereen vanuit zijn eigen perspectief handelt. De workshop bestaat uit twee delen. In Deel I wordt de Relatiewijzer gepresenteerd, in Deel II wordt de Relatiewijzer gebruikt om meer inzicht te krijgen in communicatie.

DEEL I – De Relatiewijzer

Communicatie kun je zien als het geven van kadootjes aan elkaar. Er is sprake van wederkerigheid wanneer de betrokken actoren het gevoel krijgen 'iets terug te moeten doen'. Bij wederkerigheid is er geen onderhandeling over wat dat teruggeven precies is. Het omgekeerde van wederkerigheid is 'vereffening'. Dit is het geval wanneer actoren elkaar dingen 'afnemen'. Wederkerigheid begint dus altijd bij de welwillenheid van één actor. Die actor geeft iets aan een andere actor in het vertrouwen dat dit beantwoord wordt. Wanneer er sprake is van wederkerigheid, wordt er een klein stukje aan vertrouwen opgebouwd.

In het geval van windparkontwikkeling kunnen de betrokken actoren zoals windparkontwikkelaars, omwonenden en overheden verschillende dingen uitwisselen. Denk dan aan informatie over het windpark, informatie over het ontwikkelproces, invloed in bepaalde besluiten en het wel of niet respectvol omgaan met elkaar. Communicatie in windenergie is erg gevoelig, één kleine misstap kan de relaties op spanning zetten.

De Relatiewijzer (zie handout) geeft op een gestructureerde manier aan welke interacties tussen actoren allemaal mogelijk zijn en welke rol de actoren innemen. Uitwisselingen zijn positief van aard ('wederkerigheid', 'altruïst', 'begunstigd') of negatief van aard ('egoïst', 'achtergesteld', 'vereffening'), en geven de sfeer van de communicatie weer.

De 'sociale norm' speelt ook een rol in de interpretatie van een interactie. Iedereen interpreteert een interactie namelijk op zijn eigen manier. Het kan bijvoorbeeld zo zijn dat bij het geven van informatie aan omwonenden, omwonenden het gevoel hebben dat ze respect worden afgenomen. Elke actor ziet communicatie vanuit zijn eigen perspectief.

DEEL II – RELATIE-ANALYSE & DISCUSSIE

In deel twee van de workshop gebruiken de deelnemers de Relatiewijzer om communicatie in windparkontwikkeling te beschrijven. Hiervoor worden eerst fictieve anekdotes uitgedeeld en geanalyseerd, later komen deelnemers met voorbeelden uit hun eigen ervaring.

Uit het analyseren van de anekdotes wordt duidelijk dat de deelnemers goed in staat zijn om sociale interacties te beschrijven aan de hand van de Relatiewijzer. Met name de verschillende interpretaties van de verschillende actoren weet men goed te benoemen. Er is enige discussie over de interactie 'dissociatie', waarin beide actoren feitelijk niets aan het uitwisselen zijn. Als bijvoorbeeld omwonenden niet geïnformeerd worden, kunnen zij dit nog wel opvatten alsof ze achtergesteld zijn. Het gaat dus om hoe een actor communicatie (of het ontbreken ervan) ervaart.

Daarna worden verschillende voorbeelden genoemd uit de praktijk. Eén gaat over een grote ontwikkelaar die samenwerkt met een lokale energiecoöperatie. Dat wordt een 'win-win situatie' genoemd omdat de coöperatie zelf geen middelen heeft om een windpark te ontwikkelen, maar zij hebben wel de lokale know-how en connecties. Hier is sprake van wederkerigheid. In een ander voorbeeld dat wordt genoemd is er sprake van wederkerigheid binnen een grote groep stakeholders, maar niet allemaal. Natuurorganisaties, omwonenden en ontwikkelaar zijn bij elkaar gebracht en hebben informatie uitgewisseld. Dit heeft geleid tot een ontwerp van het windpark. De uiteindelijke beslissing van de layout van het park ligt bij de ontwikkelaar, maar mensen hebben mee kunnen denken en op die manier respect gekregen. Communicatie is een mix tussen één op één met mensen praten en brede communicatie zoals informatie op de website zetten. Dit heeft tot gevolg dat er sprake is van vertrouwen en mensen in gesprek blijven met elkaar.

In andere projecten is goed aangevoeld wanneer mensen 'meegaan'. Bij het traject van ruimtelijke ontwikkeling, wat vaak aan de daadwerkelijke projectontwikkeling vooraf gaat, is het belangrijk dat er niet al frictie ontstaat tussen omwonenden en ontwikkelaars. Je kunt dan niet van omwonenden verwachten dat zij gelijk op 'volle snelheid' mee kunnen gaan. Er zit dus een bepaalde opbouw in het geven aan omwonenden.

Wederkerigheid met omwonenden zou gemakkelijker kunnen gaan wanneer er een kleinere groep omwonenden is die namens alle omwonenden meepraten. Dat wordt inderdaad soms georganiseerd door een tussenpersoon. Het wordt dan ook gemakkelijker om mensen te laten meebeslissen over hoeveel windturbines er bijvoorbeeld komen te staan.

Wanneer een initiatiefnemer in een nieuw gebied komt, en de locaties zijn nog niet duidelijk, dan begint de relatie met omwonenden bij dissociatie. Vaak wanneer omwonenden vervolgens geïnformeerd worden (geven van informatie), voelen zij zich al achtergesteld (respect wordt afgenomen). Je begint dus al in de negatieve hoek van de Relatiewijzer. Maar door in ieder geval open te communiceren met omwonenden is het mogelijk om naar de positieve hoek van de Relatiewijzer te stappen. Mensen zorgvuldig meenemen in het proces is daarom belangrijk.

POSITIEVE PUNTEN VAN RELATIEWIJZER:

De Relatiewijzer is een analyse-tool en kan structuur geven in communicatie. Het maakt je meer bewust van wat je precies doet tijdens communicatie. Je kunt het in je achterhoofd houden en je kan jezelf afvragen 'waar heb ik nou eigenlijk mee te maken?'. Het nuttige aan de Relatiewijzer is dat stimuleert om na te denken hoe de ander in de communicatie staat.

Aanbevelingen voor Relatiewijzer:

De Relatiewijzer is een theoretische beschouwing van communicatie. De Relatiewijzer voorziet niet in een nieuwe 'ingang' in een vastgelopen relatie omdat het alleen de interactie tussen twee actoren beschrijft. Als de andere partij bijvoorbeeld niet open staat voor informatie, dan zijn er ook geen andere mogelijkheden tot communicatie. Op dezelfde manier kan een relatie tussen bijvoorbeeld omwonenden en ontwikkelaars erg goed zijn en een wederkerig karakter hebben, maar kan derde actor (bijvoorbeeld een overheid) het lastig maken om dit zo te houden. Als de Relatiewijzer iets praktischer is dan kan deze beter gebruikt worden bij communicatie. Wel geeft de Relatiewijzer inzicht in de manier waarop verschillende actoren hun interactie beleven. Daarmee is het een instrument om de communicatie te verbeteren.

G

A SHORT INTRODUCTION TO THE CONCEPTS OF GAME THEORY

A short introduction to the concepts of game theory is given here. This introduction is not exhaustive, only the basic knowledge necessary to understand this thesis is treated. Game theory has evolved to a mathematically advanced science. In this appendix it is not the goal to show mathematical proofs for all concepts, but rather give a qualitative introduction as to be able to understand the ideas and mechanisms. For the sources of this information and further reading, see Osborne and Rubinstein (1994) Rabin (1993)

Game theory is the mathematical study of interaction between rational decision makers. It finds applications in many different areas, such as economics, biology, computer science and psychology. A game consists of four ingredients. These are the *players* (or *actors*)of the game, available *information*, available *actions* (or *strategies*) and the *payoffs* defined for each set of actions by the players. Different games have different ingredients (the games that are mentioned in chapter 10 are the *prisoner's dilemma*, the *gift-exchange game*, the *ultimatum game* and the *moonlighting game*).

Games can be represented by a matrix, the *normal form* or a game tree, the *extensive form*. See Figures G.1 and G.2 and Tables G.1 and G.2 for examples of the game matrices and game trees of the prisoners' dilemma and the moonlighting game. The general idea of the decision making behavior of actors is that they choose strategies that result in a maximization of their material payoff. The moment that a decision is made by an actor is called a game node n. At the end node f, all actors have chosen a strategy and the payoff for both actors is known.

The concepts of game symmetry, simultaneous/sequential games, (non-)zero-sum games and information are further explained below. Also a short note on psychological game theory is given.

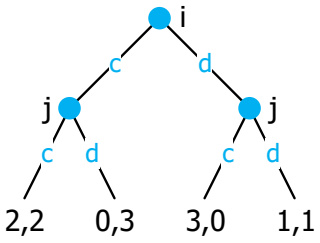


Figure G.1: Game tree of the prisoner's dilemma.

Table G.1: Prisoners' dilemma material payoff matrix. The bottom left entries of the cells are the material payoffs π_i, the top right entries of the cells are the material payoffs π_j.

Actor i \ Actor j	**c**	**d**
c	2 / 2	3 / 0
d	0 / 3	1 / 1

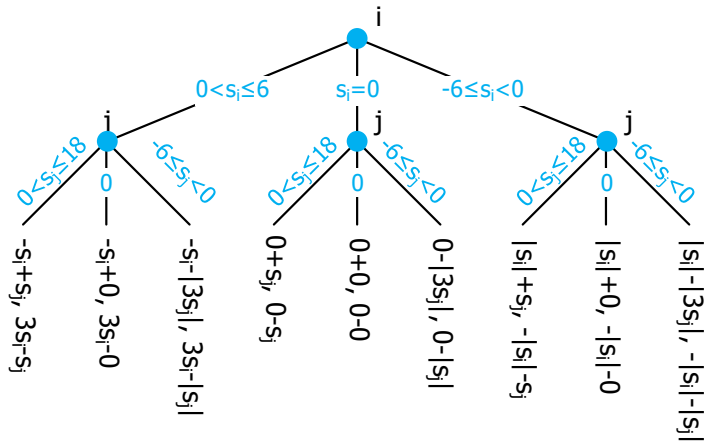


Figure G.2: Game tree of the moonlighting game

Table G.2: Payoff matrix of the moonlighting game. The bottom left entries of the cells are the material payoffs π_i, the top right entries of the cells are the material payoffs π_j.

Actor i \ Actor j		**gives** $0 < s_j \leq 18$	**passive** $s_j = 0$	**takes** $-6 \leq s_j < 0$
gives	$0 < s_i \leq 6$	$3s_i - s_j$ / $-s_i + s_j$	$3s_i - 0$ / $-s_i + 0$	$3s_i - \lvert s_j \rvert$ / $-s_i - \lvert 3s_j \rvert$
passive	$s_i = 0$	$0 - s_j$ / $0 + s_j$	$0 - 0$ / $0 + 0$	$0 - \lvert s_j \rvert$ / $0 - \lvert 3s_j \rvert$
takes	$-6 \leq s_i < 0$	$-\lvert s_i \rvert - s_j$ / $\lvert s_i \rvert + s_j$	$-\lvert s_i \rvert - 0$ / $\lvert s_i \rvert + 0$	$-\lvert s_i \rvert - \lvert s_j \rvert$ / $\lvert s_i \rvert - \lvert 3s_j \rvert$

GAME SYMMETRY

A game is symmetric when the decision makers can choose from the same actions (they have the same strategy set S), and the payoffs according to the chosen strategies of both actors are the same for both actors. When the strategy sets are not equal, the game is asymmetric. When the strategy sets are equal, but the payoffs are different, then the game is also called asymmetric.

SIMULTANEOUS/SEQUENTIAL GAME

When actors have to choose a strategy at the same time, the game is considered simultaneous. When the actors choose their strategy after each other, the game is considered sequential. During a sequential game the actor playing second thus has knowledge of the strategy that the first actor chose, and can act according to this information. A sequential game is better represented by a game tree, while a simultaneous game often suffices with a matrix. When a specific game is played more than one time, then every individual game is referred to as a subgame.

(NON-)ZERO-SUM GAMES

Games in which the total amount of points always adds up to zero are called zero-sum games. A good example from reality is the game poker, where the amount of money that a player wins is equal to the amount of money that all other actors lose. When the total amount of points does differ during the game, then the game is considered non-zero-sum.

(IM)PERFECT INFORMATION

During a game of perfect information all actors know all the strategies that all actors have played. This is apparent in the game tree shown above. If actor 1 makes a move, then both actor 1 and actor 2 know which strategy was chosen. A good real life example is playing a game of chess. A game is imperfect is actors do not know all the strategies that all actors have chosen. For simultaneous games can not be games of perfect information, because both actors have to make a decision at the same time, and actors can not know about the decision oft the other actor until both actors choose a strategy.

PSYCHOLOGICAL GAME THEORY

In psychological game theory, actors do not aim on maximizing the material payoff because perceived fairness plays a role. It has been shown that seemingly irrational behavior can be explained by psychological game theory. Use perceptions/beliefs, to account for irrational behavior

H

A SHORT INTRODUCTION TO THE CONCEPTS OF NETWORK THEORY

This appendix presents a short introduction to the concepts of network theory. The information below is not exhaustive: only the information relevant for this thesis is included. It for example only treats *social networks*, while there are many other types of networks existing. For the sources of this information, and for additional information on network theory, the reader is referred to Newman and Park (2003), Wasserman and Faust (1994), Strogatz (2001), Boccaletti et al. (2006), Borgatti et al. (2009); Borgatti and Halgin (2011) and Vespignani (2011).

NODES AND EDGES

A social network is a set of people or groups of people with some pattern of contact or interaction between them. Actors can be though of as individuals or groups and relationships can be friendship, kinship, status, sexual, business or political and so on. Network theory often refers to them as *nodes* (or *vertices*) and *edges*, but in this thesis the nomenclature *actor* and *connection* or *relationship* are used. A social network thus has two main ingredients: actors and relationships. But combining these two automatically adds a new third variable: structure. Structure always affects the behavior of the network.

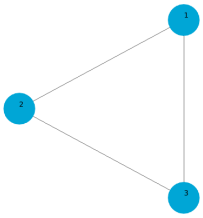
Actors, connections and structure are represented by an adjacency matrix A. A social network consisting of N actors can be described by an $N \times N$ matrix of which the entries are zero when no connection exists, and one where a connection exists. The sum of this adjacency matrix $\sum A$ is equal to the number of connections in the whole network. As an illustration Table H.1 shows three types of simple networks and their adjacency matrices.

The number of edges that one has to walk from one actor to the other is called a *path*. The mean path length, or the *characteristic path length*, is obtained by determining the sum of the paths between all combinations of actors, and dividing this by the total number of paths.

THE RANDOM NETWORK AND COMMUNITIES

A random network, although often not representative for real world networks, is one of the best studies network structures. It assumes N actors, and the actors have a probability $0 < p < 1$ of being connected to each other. A network of N actors can have a maximum of $\frac{N}{2}(N-1)$ connections. The density of a network is defined as the number of connections divided by the maximum number of possible connections. If indeed all the connections exist (the density of the network is equal to one), a *fully connected network* is obtained. If, within a network, there exists a subset of actors who have a higher density of connections compared to actors outside of this subset, then this subset of actors is called a *community*. The fraction of connections between communities is referred to as δ. In this thesis a community is referred to as a *group* in order to avoid confusion with the notion of community as a group of residents living in a neighborhood. An example of two random 10-actor networks (two communities) and some connections between them is shown in Figure H.1.

Table H.1: Three simple networks and their adjacency matrices.

network name	*dyad*	*triad*	*3-actor 1D lattice*
visualization			
A	$\begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}$	$\begin{pmatrix} 0 & 1 & 1 \\ 1 & 0 & 1 \\ 1 & 1 & 0 \end{pmatrix}$	$\begin{pmatrix} 0 & 1 & 0 \\ 1 & 0 & 1 \\ 0 & 1 & 0 \end{pmatrix}$
$\sum A$	2	6	4

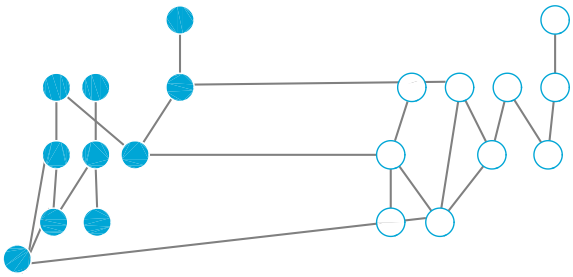


Figure H.1: A $N = 20$ network with two communities or groups (blue and white). The communities are two random networks.

I

THE UTILITY FUNCTION FROM THE PERSPECTIVE OF ACTOR j

A short delineation of the utility function for actor j is given here. Figure I.1 shows the perceived intention factor θ_i for each belief set of actor j. The determination of the utility for each of the alternative strategies that j can choose $\tilde{s}_j$ is shown in Appendix I for $s''_j = 4, s'_j = 4$. This belief set results in rewarding behavior because the kindness term is positive. Note that actor j is unable to choose $s_j < -2$, because this would lead to an impossible material payoff. A selection of the resulting strategy landscapes is shown in Figure I.3.

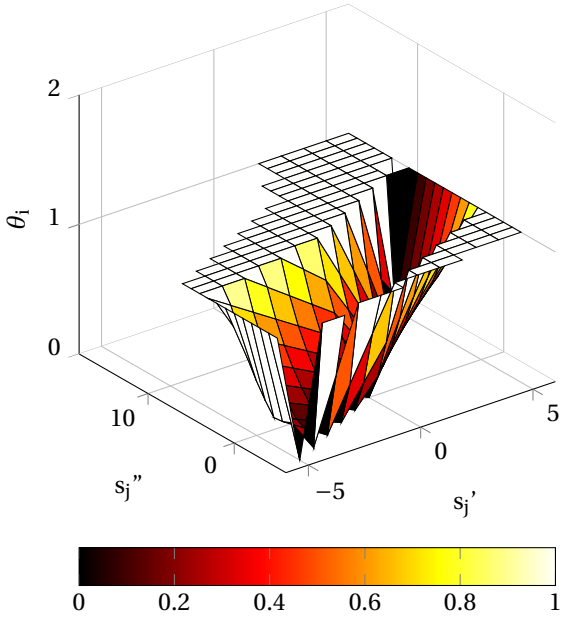


Figure I.1: Intention factor landscape θ_i of actor j for each belief set and $\varepsilon_j = 0$.

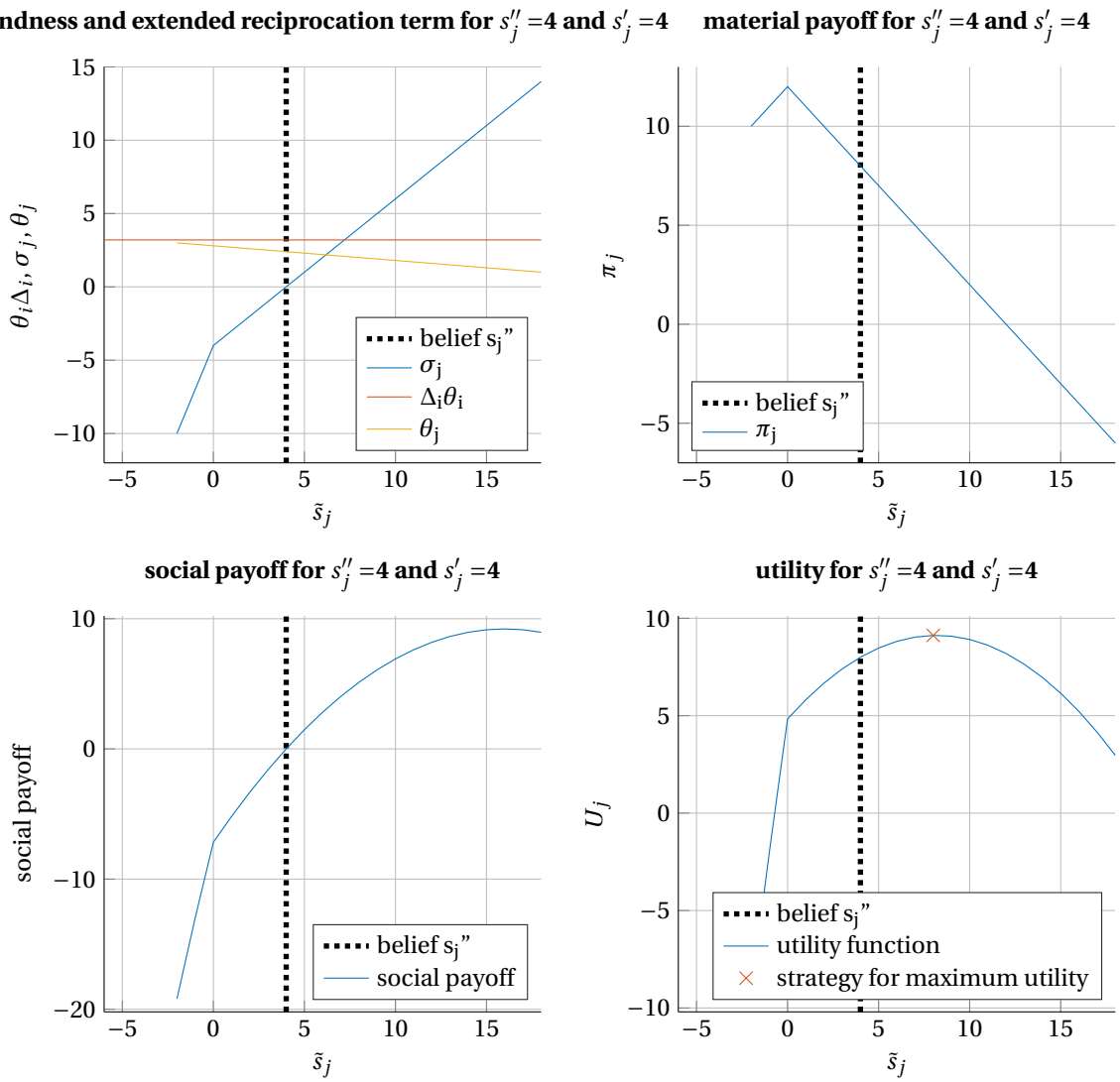


Figure I.2: Determination of the utility function of actor j with $s''_j = 4, s'_j = 4, \rho_j = 0.2$. Shown are the kindness term $\Delta_i\theta_i$, reciprocation term σ_j and target intention θ_j in the top left figure. The top right figure shows the material payoff π_j for all alternative strategies $\tilde{s}_j$ that j can choose. The social payoff is shown in the bottom left figure and the utility, the sum of the material and social payoff, is shown in the bottom right figure.

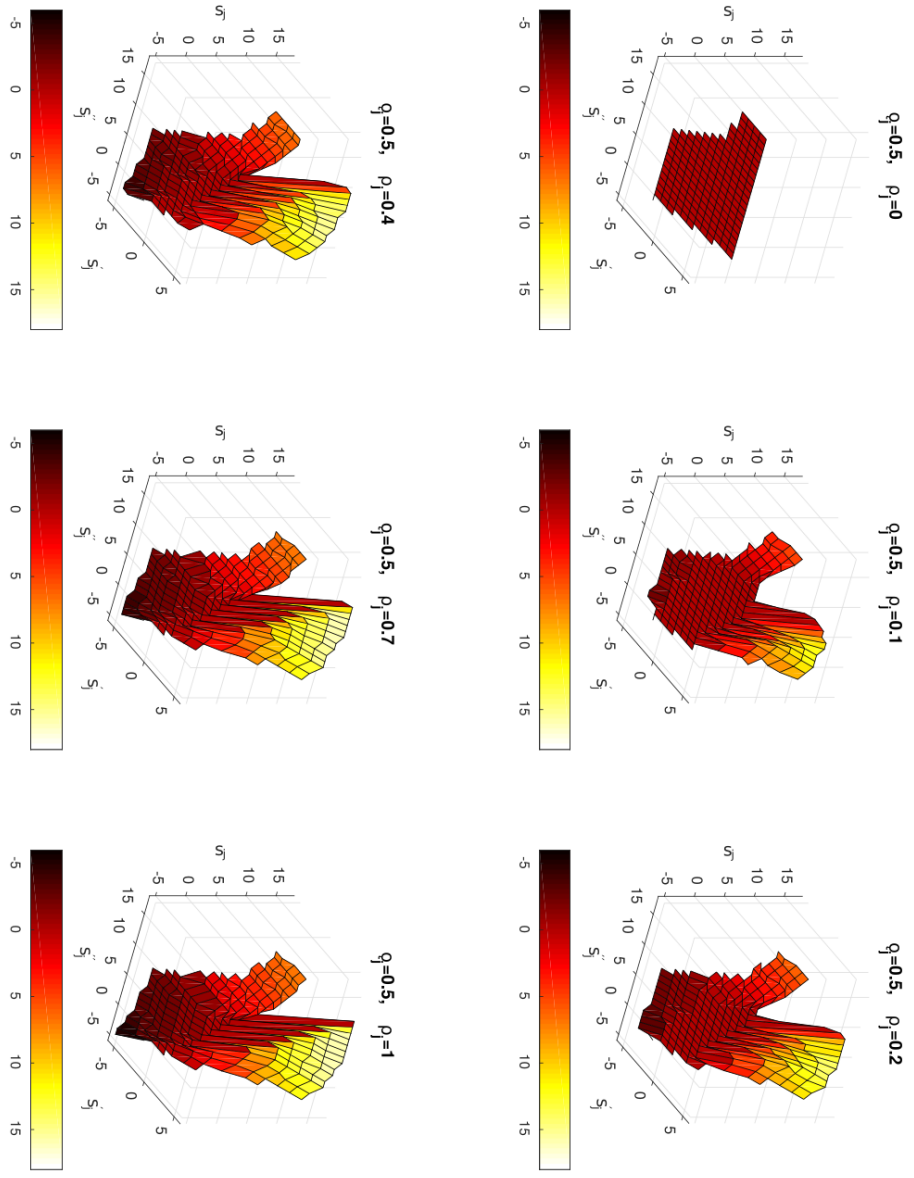


Figure I.3: Strategy landscapes for increasing ρ.

J

NETWORK MODEL OF RECIPROCITY MATLAB CODE

files	function
`reciprocity.m`	Main file in which simulation parameters are set. It calls all other files.
`createRandomGraph.m`	Function to create a random network.
`connectCommunities.m`	Function to connect two groups of actors.
`MGfun`	Function to calculate the strategy landscapes for an actor.
`Falk2008MG.m`	Function containing the actual reciprocity network model. If, for example, the Monte Carlo Simulation consists of 1000 runs, then this function is called 1000 times. The results of this function are aggregated in `reciprocity.m`.
`prepareNetwork.m`	Calculates the coordinates of actors in preparation for a network plot.
`plotStabilization2.m`	Plots the convergence of the system and calculates at which time step the simulation conforms with the convergence criterion.
`plotNetwork.m`	Plots the network and a visual representation of the actor personalities (ρ and ε)
`plotdyad.m`	Plots dyadic interaction (mean strategies) of two specified actors.
`plotPoints.m`	Calculates the material payoff statistics and plots the group and total material payoff distributions.

RECIPROCITY.M

```
%% RECIPROCITY NETWORK MODEL
%RECIPROCITY is a script to analyze reciprocity on networks.
%  It defines a random network and runs the reciprocity model using Monte
%  Carlo Simulation. It can save the network, actors and results and plots
%  he outcome of the simulation.

tic
clearvars;
close all;

%% DECLARE VARIABLES
%network parameters
N=[4 4];                %number of actor in communities [residents developers]
p=[0.8 0.8]; % probability of edge creation per community
rho=0.8; %fraction of connections between communities

%model parameters
useSavedNetwork=0;      %use network from last run [1,0]
useSavedActors=0;       %use actor parameters from last run [1,0]
saveResults=0; %save results of run [1,0]
runsmax=5;              %how many times should I run the model?
tmax=10;                %how many time steps should I use for each run?
noise=0.2;              %fraction of noise that works on the system
stableCondition=1E-3;   %condition to be met for stabilization

%% CREATE NETWORK
disp('Creating network...')
if useSavedNetwork==1
   load('network')
   disp('Network parameters loaded')
else
    if N(2)==0
        A = createRandomGraph(N(1),p(1),0);
    else
        A1 = createRandomGraph(N(1),p(1),0);
        A2 = createRandomGraph(N(2),p(2),0);
        A = connectCommunities(A1,A2,rho);
    end
end

% Create a unique index for every dyad a function of actors Ai and Aj
dyadid=zeros(size(A));
counter=1;
for i=1:length(A)
    for j=1:length(A)
        if A(i,j)==1
           dyadid(j,i)=counter;
           counter=counter+1;
        end
    end
end
dyadid=sparse(dyadid);
clear A1 A2 counter

%% RUN RECIPROCITY MODEL

%prepare Monte Carlo Simulation

%variables to save data of each run:
pointsMCS=zeros(runsmax,tmax,length(find(A)),2);
regMCS=zeros(runsmax,tmax,sum(N),3);

%retrieve strategy landscapes for all possible combinations rho and epsilon
rhorange=0:0.1:1;           %range of reciprocity parameters rho
erange=0;                %range of pure outcome parameters epsilon
slsi=zeros(length(rhorange),length(erange),13,25);  %strategy landscapes initiating actor
slsj=slsi;                                          %strategy landscapes responding actor

for i=1:length(rhorange)*length(erange) %make this parfor if it takes much time
    [I,J]=ind2sub([length(rhorange),length(erange)],i);
    [slsitemp,slsjtemp]=MGfun(rhorange(I),erange(J));
    slsi(I,J,:,:)=slsitemp+7;   %add seven to prevent negative indices
    slsj(I,J,:,:)=slsjtemp+7;
end

%  retrieve material payoff matrices and calculate outcome term matrix
%  Delta
mp=zeros(2,13,25);                      %material payoff actor i (1), and actor j (2)
[~,~,mpi,mpj]=MGfun(1,1);
mp(1,:,:)=mpi;
mp(2,:,:)=mpj;
Delta=sign(squeeze(mp(2,:,:).*(mp(2,:,:)>-Inf).*(mp(2,:,:)<Inf)-mp(1,:,:)));
Delta(isnan(Delta))=Inf;
```

```
%create or load actor parameters
if useSavedActors==1
    load('actors')
    disp('Actor parameters loaded')
else
    %create random initial beliefs, load strategy landscape to
    %prevent impossible initial beliefs.
    beliefs=zeros(numel(find(A)),2);        %initial belief [dyadid,beliefs]
    [lscape]=MGfun(1,1);
    [I,J] = find((lscape<Inf).*(lscape>-Inf));
    for i=1:length(beliefs)
        [Ai, Aj]=find(dyadid==i);
        if Ai<=N(1) && Aj>N(1)      %i is resident, j is developer
            [I,J] = find(Delta==1);
            dyadindex=randi(length(I),1);   %pick random point in strategy landscape
            beliefs(i,1)=J(dyadindex);        %save first order belief
            beliefs(i,2)=I(dyadindex);        %save second order belief
        elseif Ai>N(1) && Aj<=N(1)  %i is developer, j is resident
            [I,J] = find( (Delta==0) + (Delta==-1) );
            dyadindex=randi(length(I),1);   %pick random point in strategy landscape
            beliefs(i,1)=J(dyadindex);        %save first order belief
            beliefs(i,2)=I(dyadindex);        %save second order belief
        else
            [I,J] = find((lscape<Inf).*(lscape>-Inf));
            dyadindex=randi(length(I),1);   %pick random point in strategy landscape
            beliefs(i,1)=J(dyadindex);        %save first order belief
            beliefs(i,2)=I(dyadindex);        %save second order belief
        end
    end

    % transform second order beliefs from -6:6 to -6:18
    beliefs(:,2)=((beliefs(:,2)-7)>0).*((beliefs(:,2)-7).*3)...
      +7 + ((beliefs(:,2)-7)<=0).*(beliefs(:,2)-7) ;

    %All actors are assigned a random number between 1 and
    %numel(rhorange*erange)
    %this number corresponds to the indices in rhorange and erange, and they
    %can be used to obtain the correct strategy landscapes in slsi and slsj.
    %The indices for actor N are found using
    %[I,J]=ind2sub([length(rhorange),length(erange)],Asls(N)). The strategy
    %landscape is subsequently obtained by slsi(I,J,:,:).
    Asls=randi(length(rhorange)*length(erange),sum(N),1);

end

% USER CHOSEN ACTOR STRATEGY LANDSCAPES AND BELIEFS MUST BE DEFINED HERE

%run simulation using parfor loop
disp('Running simulation...')
parfor run=1:runsmax
    [reg, hp, points]=Falk2006MG(A,N,tmax,beliefs,dyadid,slsi,slsj,Asls,mp,noise);
    regMCS(run,:,:,:)=reg;
    pointsMCS(run,:,:,:)=points;
end

%% PREPARE PLOT OF NETWORK
if useSavedNetwork==0       %define network coordinates
    disp('Preparing network plot...')
    %xy are the x and y coordinates of the nodes
    xy=prepareNetwork(A,N);
end

%% SAVE NETWORK AND ACTORS FOR FUTURE SIMULATIONS
% Parameters saved in network.mat: adjacency matrix 'A', community sizes 'N', actor
%initial beliefs 'beliefs', actor strategy landscape id 'Asls',
%network plotting coordinates 'xy'.
if useSavedNetwork==0       %save network
    save('network','A','N','xy','dyadid');
    disp('Network parameters saved')
end
if useSavedActors==0
    save('actors','beliefs','Asls')
    disp('Actor parameters saved')
end
if saveResults==1
    save('results','regMCS','pointsMCS','-v7.3')
    disp('Result saved')
end

%% PLOT RESULTS IN FIGURE ENVIRONMENT
disp('Plotting results...')

%plot network and actors
plotNetwork(N,A,xy,rhorange,erange,Asls)

%% PLOT STABILIZATION
%stable is the time step that a stable system is reached
xdata=1:tmax;
stablestart=max([2 ceil(max(max(dyadid))/sum(N))]);
[stable,fitresult,gof]=plotStabilization2(xdata,pointsMCS,...
stableCondition,stablestart);

%% PLOT DYADID INTERACTION
%plot exchanges on dyad
plotdyad(regMCS,dyadid,beliefs)

%% FIGURE WITH POINTS DISTRIBUTIONS
pointStats = plotPoints(pointsMCS,N,dyadid,stable);

%% WRAP UP
clear k network ids colorDUT i j mpi mpj
toc
```

CREATERANDOMGRAPH.M

```
function [A] = createRandomGraph(N,P,dir)
%RandomGraph creates an (directed) adjacency matrix A from a number of
% vertices N and probability P that two vertices are connected. A
% contains 0 when vertices are not connected and 1 if two vertices are
%connected. The returned adjacency matrix A is a sparse matrix, the
% full matrix can be obtained using full(A).

if dir ~= 0 && dir ~=1
     disp('Wrong input! dir must have a value of either 0...
      (undirected) or 1 (directed). Undirected graph returned.')
     dir = 0;
end

%Create random graph adjacency matrix
A = rand(N)<=P .* (ones(N)-eye(N));

if dir == 0
    %copy upper triangle to lower triangle
    A = triu(A) + triu(A)';
end

% make sparse matrix
A = sparse(A);

end
```

CONNECTCOMMUNITIES.M

```
function [A] = connectCommunities(A1,A2,rho)
%CONNECTCOMMUNITIES(A1,A2,RHO) connects two independent communities described by
%adjacency matrices A1 and A2 according to the variable rho. Rho is the
%probability of edge creations between two actors of different communities.

N1=length(A1);       % number of actors in community 1
N2=length(A2);       % number of actors in community 2
Aconnect=zeros(N1,N2);  %matrix containing all new connections

% loop all entries in Aconnect and connect actors with probability rho
for i=1:N1*N2
   if rand<rho
      [I,J]=ind2sub(size(Aconnect),i);
      Aconnect(I,J)=1;
   end
end

%paste Aconnect in the adjacency matrix A
A = sparse([full(A1) Aconnect; Aconnect' full(A2)]);
end
```

MGFUN.M

```
function [si,sj,mpi,mpj] = MGfun(rhoi,epsiloni)
%MGfun calculates the strategy landscape of an actor with rhoi and epsiloni
%   Every actor has a 'personality' described by the reciprocity parameter
%   rhoi and the pure concern parameter epsiloni. This function calculates
%   the strategy landscape and the material payoff matrices for an actor
%   that is applicable to the moonlighting game. The strategy landscape
%   contains the strategies that an actor would choose to play when he
%   holds any first order belief and second order belief towards another
%   actor.

%% DECLARE VARIABLES
res=1;                      %resolution of strategies
points=12;                  %initial amount of points that all actors are endowed with
a=-points/2:res:points/2;       %range of second order beliefs
b=-points/2:res:points/2*3;     %range of first order beliefs
[B,A] = meshgrid(b,a);
si=zeros(size(A));              %strategies of actor i for each belief set
sj=zeros(size(A));              %strategies of actor j for each belief set

Tij=zeros(length(a),length(b));         %intention factor of actor i as perceived by actor j
Tji=zeros(length(a),length(b));         %intention factor of actor j as perceived by actor i

%actor parameters for the initiating actor i and the responding actor j
rhoj=rhoi;        %reciprocal preference actor j
epsilonj=epsiloni;    %pure outcome parameter actor j

%display progress in command window [0,1]
display=0;

%% PREPARE CALCULATION
% calculate material payoff matices for both actors for the moonlighting game
%G=give, P=passive, T=take GG + GP + GT + PG + PP + PT + TG + TP + TT
mpi=((-A+B) .* (A>0).*(B>0)) + ((-A) .* (A>0).*(B==0)) + ((-A-abs(3.*B)) .* (A>0).*(B<0))...
    + ((B) .* (A==0).*(B>0)) + (0 .* (A==0).*(B==0)) + ((-abs(3.*B)) .* (A==0).*(B<0))...
    + ((abs(A)+B) .* (A<0).*(B>0)) + ((abs(A)) .*(A<0).*(B==0)) + ((abs(A)-abs(3.*B)) .* (A<0).*(B<0));
mpj=((3.*A-B) .* (A>0).*(B>0)) + ((3.*A) .* (A>0).*(B==0)) + ((3.*A-abs(B)) .* (A>0).*(B<0))...
    + ((-B) .* (A==0).*(B>0)) + (0 .* (A==0).*(B==0)) + ((-abs(B)) .* (A==0).*(B<0))...
    + ((-abs(A)-B) .* (A<0).*(B>0)) + ((-abs(A)) .*(A<0).*(B==0)) + ((-abs(A)-abs(B)) .* (A<0).*(B<0));

% remove impossible points where either total points i or j is negative (make them Inf)
mpi= mpi ./ ((mpi+points)>=0) ./ ((mpj+points)>=0);
mpj= mpj ./ ((mpi+points)>=0) ./ ((mpj+points)>=0);

%calculate Delta_j and Delta_i (to double check: D_i+D_j must be zero)
Dj=mpi-mpj;
Di=mpj-mpi;

%% DETERMINE GHOST PAYOFF MATRIX AND GHOST OUTCOME TERM MATRIX
% this makes sure that i and j can choose all strategies.
mpighosti = mpi .* (mpi>-Inf) .* (mpi<Inf);
mpighostj = mpighosti;
mpjghosti = mpj .* (mpi>-Inf) .* (mpi<Inf);
mpjghostj = mpjghosti;
Dighosti = Di .* (mpi>-Inf) .* (mpi<Inf);
Dighostj = Dighosti;
Djghosti = Dj .* (mpi>-Inf) .* (mpi<Inf);
Djghostj = Djghosti;

for m=1:length(a)
    mintempi=min(mpighosti(m,:));
    minindexi = find(mpighosti(m,:)==min(mpighosti(m,:)));
    maxtempi=max(mpighosti(m,:));
    maxindexi = find(mpighosti(m,:)==max(mpighosti(m,:)));
```

```
    mintempi2=min(Dighosti(m,:));
    maxtempi2=max(Dighosti(m,:));
    for n=1:length(b)
        if isnan(mpighosti(m,n))        %check if entry is NaN
            if n > maxindexi
                mpighosti(m,n) = maxtempi;
                mpjghosti(m,n) = mpj(m,maxindexi);
                Dighosti(m,n) = mintempi2;
                Djghosti(m,n) = Dj(m,maxindexi);
            elseif n < minindexi
                mpighosti(m,n) = mintempi;
                mpjghosti(m,n) = mpj(m,minindexi);
                Dighosti(m,n) = maxtempi2;
                Djghosti(m,n) = Dj(m,minindexi);
            end
        end
    end
end

for n=1:length(b)
    minindexj = find(mpighostj(:,n)==min(mpighostj(:,n)));
    maxindexj = find(mpighostj(:,n)==max(mpighostj(:,n)));
    for m=1:length(a)
        if isnan(mpighostj(m,n))        %check if entry is NaN
            if m > minindexj
                mpighostj(m,n) = mpi(minindexj,n);
                mpjghostj(m,n) = mpj(minindexj,n);
                Dighostj(m,n) = Di(minindexj,n);
                Djghostj(m,n) = Dj(minindexj,n);
            elseif m < minindexj
                mpighostj(m,n) = mpi(maxindexj,n);
                mpjghostj(m,n) = mpj(maxindexj,n);
                Dighostj(m,n) = Di(maxindexj,n);
                Djghostj(m,n) = Dj(maxindexj,n);

            end
        end
    end
end

%% PERCEIVED INTENTION FACTORS Tji and Tij
% create matrices containing ones at the belief set for different situations
Tij1 = Tij;
Tij2 = Tij;
Tij3 = Tij;
Tij4 = Tij;
Tji1 = Tji;
Tji2 = Tji;
Tji3 = Tji;
Tji4 = Tji;

%The perceived intention Tji is calculated in four different ways, the
%following code makes four matrices with ones at the locations where one of
%the four ways of calculating the intention term must be used.
for m=1:length(a)
    for n=1:length(b)
        s2i=m;
        s1i=n;
        if Dj(s2i,s1i)>0
            if mpi(s2i,s1i)==max( mpi(s2i,:).*...
             (mpi(s2i,:)>-Inf).*(mpi(s2i,:)<Inf) )  %situation 1
                Tji1(s2i,s1i)=1;
            elseif (mpi(s2i,s1i)>-Inf) && (mpi(s2i,s1i)<Inf) %situation 2
                Tji2(s2i,s1i)=1;
            end
        elseif Dj(s2i,s1i)<0
            if mpi(s2i,s1i)==min( mpi(s2i,:).*...
             (mpi(s2i,:)>-Inf).*(mpi(s2i,:)<Inf) )       %situation 4
                Tji4(s2i,s1i)=1;
            elseif (mpi(s2i,s1i)>-Inf) && (mpi(s2i,s1i)<Inf)
                Tji3(s2i,s1i)=1;                                %situation 3
            end
        end
    end
end
%Determine maximum and minimum values for the denominator of the perceived
%intention term
[x,y]=find(Tji1);
maxvals = ones(1,length(a));
for i=1:length(x)
    maxvals(x(i))=Di(x(i),y(i));
end

[x,y]=find(Tji4);
minvals = ones(1,length(a));
for i=1:length(x)
    minvals(x(i))=Di(x(i),y(i));
end

% repmat to make them the same size as outcome term in preperation for the
% matrix multiplication
maxvals = repmat(maxvals',1,length(b));
minvals = repmat(minvals',1,length(b));

%calculate Tij for every of the four situations
Tji = Tji1 .* 1 +...
        Tji2 .* Dj ./ minvals +...      %Dj>0
            Tji3 .* 1-(Dj./maxvals) +...  %Dj<0
                Tji4 .* 1;

%remove impossible outcomes and make values smaller than epsilon_i equal to
%epsilon_i, and values larger than one 1
Tji= Tji ./ ((mpi+points)>=0) ./ ((mpj+points)>=0);
Tji=Tji-(Tji<epsilonj).*Tji+(Tji<epsiloni).*epsiloni - Tji.*(Tji>1) + 1 .*(Tji>1);

%The same code as above but now for Tij
for m=1:length(a)
    for n=1:length(b)
        s2j=n;
        s1j=m;

        %Create matrices Tij1, Tij2, Tij3 and Tij4 containing ones at the
        %four situations. These will be used later to calculate Tij by
        %matrix operation.
        if Di(s1j,s2j)>0                                        %situation 1 and 2
            if mpj(s1j,s2j)==max(mpj(:,s2j).*...
             (mpj(:,s2j)>-Inf).*(mpj(:,s2j)<Inf))  %situation 1
                Tij1(s1j,s2j) = 1;
            elseif mpj(s1j,s2j)>-Inf && mpj(s1j,s2j)<Inf        %situation 2
                Tij2(s1j,s2j) = 1;
            end
        elseif Di(s1j,s2j)<0                                    %situation 3 and 4
            if mpj(s1j,s2j)==min(mpj(:,s2j).*(mpj(:,s2j)>-Inf)) %situation 4
                Tij4(s1j,s2j) = 1;
            elseif mpj(s1j,s2j)>-Inf && mpj(s1j,s2j)<Inf        %situation 3
                Tij3(s1j,s2j) = 1;
            end
        end

    end
end

%Determine maximum and minimum values for the denominator
[x,y]=find(Tij1);
maxvals = ones(1,length(b));
for i=1:length(x)
    maxvals(y(i))=Di(x(i),y(i));
end

[x,y]=find(Tij4);
minvals = ones(1,length(b));
for i=1:length(x)
    minvals(y(i))=Di(x(i),y(i));
end

% repmat to make them the same size as outcome term in preperation for the
% multiplication
maxvals = repmat(maxvals,length(a),1);
minvals = repmat(minvals,length(a),1);

%calculate Tij for every situation
Tij = Tij1 .* 1 +...
        Tij2 .* Dj ./ minvals +...      %Di>0
            Tij3 .* (Dj./maxvals) +...  %Di<0
                Tij4 .* 1;

%remove impossible belief sets (make them inf) and make values smaller than
%epsilon_j equal to epsilon_j and values larger than one 1
Tij=Tij-(Tij<epsilonj).*Tij+(Tij<epsilonj).*epsilonj - Tij.*(Tij>1) + 1 .*(Tij>1);

%% STRATEGY LANDSCAPE FOR ACTOR I (INITIATING ACTOR)
%calculate the strategy for each belief set (a,b)
for m=1:length(a)
    for n=1:length(b)
        s2i=m;
        s1i=n;

        %only calculate if material payoff exists,
        %othewise make impossible combinations of strategies Inf
        if mpi(s2i,s1i)==Inf || mpi(s2i,s1i)==-Inf
            si(s2i,s1i) = Inf;
        else
            if display==1
            %print some useful information
            disp(' ')
            disp('ACTOR I')
            disp(['rho_i=' num2str(rhoi)])
            disp(['Belief set actor i: si'''=' num2str(a(s2i)) ', si'''=' num2str(b(s1i))])
            disp(['Expected payoffs according to belief set:...
              \pi_i=' num2str(mpi(s2i,s1i)) ', \pi_j=' num2str(mpj(s2i,s1i)) ])
            if Dj(s2i,s1i)<0
                disp('Actor j is perceived unkind.')
            elseif Dj(s2i,s1i)>0
                disp('Actor j is perceived kind.')
            elseif Dj(s2i,s1i)==0
                disp('Actor j is perceived neither kind nor unkind.')
            end
            disp(['Tji=' num2str(Tji(s2i,s1i)) ])
            end

            %calculate reciprocal intentions for actor i Tii (weights the reciprocation term)
            if Dj(s2i,s1i)<0
                Tii=-(Dighosti(:,s1i)-Dighosti(1,s1i))./Djghosti(end,s1i);
            elseif Dj(s2i,s1i)>0
                if Djghosti(end,s1i) == 0  %for point, a=6,b=12, where Delta_j=0 (unable to divide by zero)
                    Tii = Djghosti(:,s1i)./Djghosti(end-1,s1i)+1;
                else
                    Tii=-(Dighosti(:,s1i)-Dighosti(end,s1i))./Djghosti(1,s1i);
                end
            elseif Dj(s2i,s1i)==0

                Tii = 1-( (mpighosti(:,s1i)-mpjghosti(end,s1i)));
               Tii=Tii-Tii(1);
            end

            %Determine function sigma_i for a given (a,b) and all alternative strategies of i
            %using the ghost material payoffs
            sigma_i = mpjghosti(:,s1i) - mpj( s2i,s1i );

            % calculate social payoff for actor i
            spi= rhoi .* Dj(s2i,s1i) .* Tji(s2i,s1i) .* sigma_i .* Tii;

            % calculate utility for all strategies that i can choose
            Ui=mpighosti(:,s1i) + spi;

            % choose strategy with maximum utility
            sitemp = find(Ui==max(Ui));
            if length(sitemp)~=1     %determine maximum payoffs
                mpmax=zeros(length(sitemp),1); %when two maximum utilities
                for i=1:length(sitemp) %with equal value exist
                   mpmax(i) =  mpighosti(sitemp(i),s1i) .* mpjghosti(sitemp(i),s1i);
                end
                sitemp = sitemp(mpmax==max(mpmax));
```

```
            %More than one equal maximum utility with equal product of material
            %payoffs: choose strategy closest to second order belief:
            if length(sitemp)~=1
                if Dj(s2i,s1i)<0
                    sitemp = sitemp(1);
                elseif Dj(s2i,s1i)>0
                    sitemp = sitemp(1);
                elseif Dj(s2i,s1i)==0
                    sitemp = sitemp(1);
                end

            end
        end

        %save chosen strategy as a function of beliefs
        si(s2i,s1i) = a(sitemp);

        if display==1
            disp(['Actor i chooses strategy: si=' num2str(si(s2i,s1i))])
        end
    end
end

%% STRATEGY LANDSCAPE FOR ACTOR J (RESPONDING ACTOR)
for m=1:length(a)
    for n=1:length(b)
        s2j=n;
        s1j=m;

        %make impossible combinations of strategies Inf
        if mpi(s1j,s2j)==Inf || mpi(s1j,s2j)==-Inf
            sj(s1j,s2j) = Inf;
        else

            if display==1
                disp(' ')
                disp('ACTOR J')
                disp(['rho_j=' num2str(rhoj)])
                disp(['Belief set actor j: sj''''=' num2str(b(s2j)) ',...
                  sj''=' num2str(a(s1j))])
                disp(['Expected payoffs according to belief set:...
                  \pi_i=' num2str(mpi(s1j,s2j)) ', \pi_j=' num2str(mpj(s1j,s2j)) ])
                if Di(s1j,s2j)<0
                    disp('Actor i is perceived unkind.')
                elseif Di(s1j,s2j)>0
                    disp('Actor i is perceived kind.')
                elseif Dj(s1j,s2j)==0
                    disp('Actor i is perceived neither kind nor unkind.')
                end
                disp(['Tij=' num2str(Tij(s1j,s2j))])
            end
            % Determine Tjj as perceived by j for all alternatives of j
            % (weights the reciprocation term)
            if Di(s1j,s2j)<0
                Tjj=-(Dj(s1j,:)-Djghosti(s1j,1))./Dighosti(s1j,end);

            elseif Di(s1j,s2j)>0
                Tjj=1-(Dj(s1j,:)-Djghosti(s1j,end))./Dighosti(s1j,1);

            elseif Di(s1j,s2j)==0
                Tjj = fliplr(mpjghostj(s1j,:) .* rhoj);
            end

            % Determine function sigma_j for a given (a,b) and
            % all real alternative strategies of j
            % Note that the ghost payoffs are not used because j responds to a
            % real action by i s_i.
            sigma_j = mpi(s1j,:) - mpi(s1j,s2j);

            % calculate social payoff
            spj= rhoj .* Di(s1j,s2j) .* Tij(s1j,s2j) .* sigma_j .* Tjj;

             % calculate utility
            Uj=mpj(s1j,:) + spj;

            Uj= Uj.*(Uj>-Inf).*(Uj<Inf);

            % choose strategy with maximum utility
            sjtemp = find(Uj==max(Uj));
            if length(sjtemp)~=1        %determine maximum payoffs when
               %two maximum utilities with equal value exist
                mpmax=zeros(length(sjtemp),1);
                for i=1:length(sjtemp)
                   mpmax(i) =  mpjghostj(s1j,sjtemp(i)) .* mpighostj(s1j,sjtemp(i));
                end
                sjtemp = sjtemp(mpmax==max(mpmax));

            end

            %save chosen strategy as a function of beliefs
            sj(s1j,s2j) = b(sjtemp);
            if display==1
                disp(['Actor j chooses strategy: sj=' num2str(sj(s1j,s2j))])
            end
        end

    end
end
```

FALK2008MG.M

```
function [reg, hp, points] = Falk2006MG(A,N,tmax,beliefs,dyadid,slsi,slsj,Asls,mp,noise)
%FALK2006 Implementation of a NETWORK theory of reciprocity
%

%% PREPARE SIMULATION
rhorange=0:0.1:1;             %range of rho's
erange=0;               %range of epsilons
displayprogress=0;          %display progress [0,1]

%% ACTOR INITIAL CONDITIONS AND STRATEGY LANDSCAPES
% use numel(find(A)) to only obtain the entries where actual connections
% exist. Retrieve dyad idenfitication number using dyadid(i,j).

%The variable Delta is zero for Delta_i=Delta_j=0, -1 for Delta_j>0 and
%Delta_i<0, and 1 for Delta_j<0 and Delta_i>0.
Delta=sign(squeeze(mp(2,:,:).*(mp(2,:,:)>-Inf).*(mp(2,:,:)<Inf)-mp(1,:,:)));
Delta(isnan(Delta))=Inf;

epert=sum(N);                   % N exchanges per time step
numdyads=length(find(A));       %number of connections in the network
strat=zeros(1,2);                  %strat stores the strategies played by players i and j
strattemp=strat;                   %temporary strategy
reg=zeros(tmax,epert,3);           %without beliefs [timestep,exchange,[dyadid s_i sj]]
points=zeros(tmax,length(find(A)),2);%points per time step per dyadid per actor
hp=zeros(size(mp,3),numel(find(A)));%history profile of dyadid(Ai,Aj) (i's history towards j)

%create matrix containing the minimum and maximum possible strategies that
%actors can play given the other players strategy. sjminmax(si) contains
%the minimum and maximum strategies that j can play given si and similar
%for siminmax(sj).
sjminmax=zeros(13,2);
sisjminmax=squeeze((mp(1,:,:)<Inf).*(mp(1,:,:)>-Inf));
for i=1:length(sjminmax)
    sjminmax(i,1)=find(sisjminmax(i,:),1);
    sjminmax(i,2)=find(sisjminmax(i,:),1,'last');
end

dyadcheck=zeros(numel(find(A)),1);      %array containing zeros for dyads that never played before.

[x,y]=find(A);  %index of actor in the adjacency matrix

%% I WANT TO PLAY A GAME...
j=1;
timestep=1;
for i=1:tmax*epert          %loop monte carlo time steps
    %% Randomly pick dyad
    %randomly pick one connection from the adjacency matrix and extract
    %indices, the x-index becomes actor i (initiating), the y-index becomes
    %actor j (responding)

    n=randi(numdyads,1);
    Ai=x(n);        %Ai is the vertical index in A of the initiating actor i
    Aj=y(n);        %Aj is the horizontal index in A of the responding actor j

    if displayprogress==1
        disp(' ')
        disp(['ROUND ' num2str(i) ', EXCHANGE ' num2str(j)])
        disp(['actor ' num2str(Ai) ' -> actor ' num2str(Aj)])
    end
    %% Determine beliefs of actor i
    if dyadcheck(dyadid(Ai,Aj))==0  %if no exchanges yet, do not update beliefs
        if displayprogress==1
        %   disp(['Beliefs actor i: ' num2str(beliefs(dyadid(Ai,Aj),:))])
            disp(['First exchange between actor ' num2str(Ai) ' and actor ' num2str(Aj)])
        end
        %the second order belief must be a value between 0 and 13, so
        %the belief has to be transformed from -6:18 to -6:6
        beliefstemp = round(((beliefs-7)<=0).*beliefs + ((beliefs-7)>0).*(((beliefs-7)./3)+7));
     elseif rand<=noise && Ai<=N(1) && Aj>N(1)  %actor i is exposed to noise, randomly update beliefs
        % Ai is resident initiating, Aj is developer responding
        % The beliefs of Ai are a random belief set for which Delta_j<0
        % holds. This means that the residents expect a
        % disadvantageous outcome.
        %SET RESIDENT BELIEF
        %find indices of random points, pick one random point and save in
        %beliefs
        [I,J] = find(Delta==1);
        randombelief=randi(length(I),1);   %pick random point in the strategy landscape
        beliefs(dyadid(Ai,Aj),1)=J(randombelief);   %save first order belief 1:25
        beliefs(dyadid(Ai,Aj),2)=I(randombelief);   %save second order belief 1:13
        beliefstemp = beliefs;              % Do not transfrom, but just save beliefs in beliefstemp

        if displayprogress==1
            disp('actor i is exposed to noise')
        end
     elseif rand<=noise && Ai>N(1) && Aj<=N(1)
        %Ai is developer initiating, Aj is resident responding
        % The beliefs of Ai are a random belief set for which
        % Delta_j>=0 holds. This means that the developers expect equal
        % or advantageous outcome.
        %SET DEVELOPER BELIEF
        [I,J] = find( (Delta==0) + (Delta==-1) );
        randombelief=randi(length(I),1);   %pick random point in the strategy landscape
        beliefs(dyadid(Ai,Aj),1)=J(randombelief);       %1:25
        beliefs(dyadid(Ai,Aj),2)=I(randombelief);       %1:13
        beliefstemp = beliefs;  % Do not transfrom, but just save beliefs in beliefstemp
        if displayprogress==1
            disp('actor i is exposed to noise')
        end

    else        %subsequent rounds, update belief (first second order, then first order)
        % Normalize history profile distribution and make cumulative distribution
        %The second order
        %belief must be a value between 0 and 13, so
        %the belief has to be transformed from -6:18 to -6:6

        %now find history profiles of Ai towards all the neighbors
        if (Ai<=N(1) && Aj<=N(1)) || (Ai>N(1) && Aj>N(1))       %both actors belong to same community
            nbi=find(A(Ai,:));
            hpi=sum(hp(:,dyadid(Ai,nbi)),2);
        else                                                    %both actors belong to other community
            hpi=hp(:,dyadid(Ai,Aj));
        end

        h_pdf=hpi./sum(hpi);
        h_cdf=cumsum(h_pdf);
        beliefs(dyadid(Ai,Aj),2)=find((h_cdf-rand)>0,1);

        %transfrom from -6:18 to -6:6
        beliefstemp = round(((beliefs-7)<=0).*beliefs + ((beliefs-7)>0).*(((beliefs-7)./3)+7));
```

```
        %Now find the first order belief.
        %smin and smax are the minimum and maximum possible strategies,
        %ranging from -6:18
        smin=sjminmax(beliefstemp(dyadid(Ai,Aj),2),1);
        smax=sjminmax(beliefstemp(dyadid(Ai,Aj),2),2);

        if (Ai<=N(1) && Aj<=N(1)) || (Ai>N(1) && Aj>N(1))
            nbj=find(A(Aj,:));
            hpj=sum(hp(smin:smax,dyadid(Aj,nbj)),2)';
            if displayprogress==1
                disp('Actors from same community')
            end
        else
            hpj=hp(smin:smax,dyadid(Aj,Ai))';
            if displayprogress==1
                disp('Actors from different community')
            end
        end

        %define probability distribution using the history profile of
        %actor j
        if sum(sum(hpj))-=0                             %use real history profile
            h_pdf=[zeros(1,smin-1)...
                hpj ./ sum(hpj)...
                    zeros(1,25-smax)];
            if displayprogress==1
                disp('actor i uses unconditional history profile')
           end
        else                                            %uniform history profile
            h_pdf=[zeros(1,smin-1)...
                ones(1,smax-smin)./sum(ones(1,smax-smin))...
                    zeros(1,25-smax)];
            if displayprogress==1
                disp('actor i uses uniform history profile')
            end
        end

        %Update first order belief of actor Ai (0:25)
        h_cdf=cumsum(h_pdf);
        beliefs(dyadid(Ai,Aj),1)=find((h_cdf-rand)>0,1);
     end

    %% Determine strategy of actor i
    % The strategy landscape has size [13x25], so first enter beliefstemp, then
    % beliefs.
    [I,J]=ind2sub([length(rhorange),length(erange)],Asls(Ai));
    strat(1)=slsi(I,J,beliefstemp(dyadid(Ai,Aj),2),beliefs(dyadid(Ai,Aj),1));

    if displayprogress==1
        disp(['s_i'''=' num2str(beliefstemp(dyadid(Ai,Aj),2)-7) ',...
          s_i''=' num2str(beliefs(dyadid(Ai,Aj),1)-7)])
        disp(['Actor i chooses strategy ' num2str(strat(1)-7)])
    end

    %% Determine beliefs of actor j
    %update belief actor j according to chosen strategy of i
    %first find all the indices of the possible responses that j can give
    %to the chosen strategy of i
     smin=sjminmax(strat(1),1);
     smax=sjminmax(strat(1),2);

    if dyadcheck(dyadid(Aj,Ai))==0 %if history profile is empty, do not update beliefs
        %if current second
        %order belief of j is inconsistent with the current strategy of i,
        %then choose the nearest strategy of j as the second order belief of
        %j. Also make the first order belief equal to the strategy chosen by i.
        if smin>beliefs(dyadid(Aj,Ai),2)
            beliefs(dyadid(Aj,Ai),2)=smin;
        elseif smax<beliefs(dyadid(Aj,Ai),2)
            beliefs(dyadid(Aj,Ai),2)=smax;
        end
        beliefs(dyadid(Aj,Ai),1)=strat(1);

    elseif rand<=noise && Ai<=N(1) && Aj>N(1)           %actor j is exposed to noise
        %Ai is resident initiating, Aj is developer responding
        % The second order belief of Aj is a random belief for which
        % Delta_i>=0 holds. This means that the developers expect equal
        % or advantageous outcome.
        %SET DEVELOPER BELIEFS
        [I,J] = find( (Delta(strat(1),:)==0) + (Delta(strat(1),:)==1) );
        randombelief=randi(length(I),1);%pick random point in the strategy landscape
        beliefs(dyadid(Aj,Ai),2)=J(randombelief); %save second order belief 1:25
        if displayprogress==1
            disp('actor j is exposed to noise')
        end
    elseif rand<=noise && Ai>N(1) && Aj<=N(1)           %actor j is exposed to noise
        %Ai is developer initiating, Aj is resident responding
        %SET RESIDENTS BELIEF
        [I,J] = find( Delta(strat(1),:)==-1 );
%pick random point in the strategy landscape
        randombelief=randi(length(I),1);
        beliefs(dyadid(Ai,Aj),1)=J(randombelief);
        beliefs(dyadid(Aj,Ai),2)=J(randombelief); %save second order belief 1:25

        if displayprogress==1
            disp('actor j is exposed to noise')
        end

    else          %subsequent rounds: update beliefs
        %same procedure as first order belief of actor i, but using real
        %strategy strat(1) instead of first order belief beliefs(dyadid(Aj,Ai),1)
        % first transfrom i's strategy from -6:6 to -6:18
        strattemp=((strat-7)>0).*((strat-7).*3) +7 + ((strat-7)<=0).*(strat-7);

        if (Ai<=N(1) && Aj<=N(1)) || (Ai>N(1) && Aj>N(1))
            nbj=find(A(Aj,:));
            hpj=sum(hp(smin:smax,dyadid(Aj,nbj)),2)';
            if displayprogress==1
                disp('Actors from same community')
            end
        else
            hpj=hp(smin:smax,dyadid(Aj,Ai))';
            if displayprogress==1
                disp('Actors from different community')
            end
        end

        %create history profile
        if sum(sum(hpj))-=0             %use real history profile
            h_pdf=[zeros(1,smin-1)...
                hpj./sum(hpj)...
                    zeros(1,25-smax)];
            if displayprogress==1
                disp('actor j uses unconditional history profile')
            end
        else                            %use uniform history
            h_pdf=[zeros(1,smin-1)...
                ones(1,smax-smin)./sum(ones(1,smax-smin))...
                    zeros(1,25-smax)];
            if displayprogress==1
                disp('actor j uses uniform history profile')
            end
        end

        %update second order belief of actor j towards i
        h_cdf=cumsum(h_pdf);
        beliefs(dyadid(Aj,Ai),2)=find((h_cdf-rand)>0,1);
    end

    %% Determine strategy of actor j
    %strategy landscape has the size [13x25], the first entry is the actual
    %strategy played by i strat(1), the second entry is the
    %second order belief of actor j beliefs(dyadid(Aj,Ai),2). The
    %transformed belief is thus not needed to determine the strategy that j
    %will choose.
    [I,J]=ind2sub([length(rhorange),length(erange)],Asls(Aj));
    strat(2)=slsj(I,J,strat(1),beliefs(dyadid(Aj,Ai),2));

    if displayprogress==1
        disp(['s_j''=' num2str(strat(1)-7) ', s_j'''=' num2str(beliefs(dyadid(Aj,Ai),2)-7)])
        disp(['Actor j chooses strategy ' num2str(strat(2)-7)])
        disp(' ')
    end
    %% update history profile and save round in registry
    %The strategy by i must be -6:6, so it has to be transformed from -6:18
    %first before saving to the history profile.
    strattemp(1)=(( strat(1)-7)>0).*((strat(1)-7).*3) +7 ...
        + ((strat(1)-7)<=0).*(strat(1)-7) ;

    %save strategy of i in the history profile by adding 1, 1/2 or 1/3 to the corresponding entry/entries in hp.
    if strattemp(1)-7<0
        hp(strattemp(1),dyadid(Ai,Aj) )=...
        hp(strattemp(1),dyadid(Ai,Aj) )+1;
    elseif strattemp(1)-7==0
        hp([strattemp(1) strattemp(1)+1],dyadid(Ai,Aj) )=...
        hp([strattemp(1) strattemp(1)+1],dyadid(Ai,Aj) )+(1/2);
    elseif strattemp(1)-7==18
        hp([strattemp(1)-1 strattemp(1)],dyadid(Ai,Aj) )=...
        hp([strattemp(1)-1 strattemp(1)],dyadid(Ai,Aj) )+(1/2);
    else
        hp([strattemp(1)-1 strattemp(1) strattemp(1)+1],dyadid(Ai,Aj) )=...
        hp([strattemp(1)-1 strattemp(1) strattemp(1)+1],dyadid(Ai,Aj) )+(1/3);
    end

    %save strategy of j in the history profile by adding one to the corresponding entries in hp.
    hp(strat(2),dyadid(Aj,Ai) )=hp(strat(2),dyadid(Aj,Ai) )+1;

    %check that dyad is used
    dyadcheck([dyadid(Ai,Aj) dyadid(Aj,Ai)])=1;

    %calculate the amount of points that actor i and actor j receive/lose,
    %and save them in points. There is one entry per MCS time step,
    %but actors could play more games during one MCS time step, the amount
    %of points in (i,k) is therefore the total amount of points that actor k
    %receives/loses at time step i.
    points(timestep,dyadid(Ai,Aj),1)=mp(1,strat(1),strat(2));
    points(timestep,dyadid(Ai,Aj),2)=mp(2,strat(1),strat(2));

    %save results in registry
    reg(timestep,j,:)=[dyadid(Ai,Aj) strat(1) strat(2)];

    %increment j and timestep
    if j==epert
        j=1;
        timestep=timestep+1;
    else
        j=j+1;
    end
end %end of monte carlo simulation time step/N
end %end of function
```

PREPARENETWORK.M

```
function [ xy ] = prepareNetwork( A,N )
%prepareNetwork returns the x and y coordinates of actors for a plot
%   Input are the adjacency matrix A and the variable N. N is an 1x2
%   variable with the size of the first group in N(1) and the size of
%   the second group in N(2).

% first create a cell array with node identification numbers, and array xy
% to save the coordinates in.
ids =arrayfun(@num2str, 1:length(A), 'UniformOutput', false);
xy=zeros(sum(N),2);

% determine coordinates of nodes using Biograph (using triu(A) makes sure no double edge is shown)
if N(2)==0      %one group
    bg = biograph(triu(A),ids);
    dolayout(bg)    % get coordinates from biograph algorithm
    for i=1:sum(N)
        xy(i,:) = bg.Nodes(i).Position; %save in xy
    end
else            %two groups
    bg1 = biograph(triu(A(1:N(1),1:N(1))),ids(1:N(1)));
```

```
    bg2 = biograph(triu(A(N(1)+1:sum(N),N(1)+1:sum(N))),ids(N(1)+1:sum(N)));
    bg1.LayoutType = 'radial';  %'equilibrium' or 'radial'
    bg2.LayoutType = 'radial';  %'equilibrium' or 'radial'
    dolayout(bg1)   % get coordinates from biograph algorithm
    dolayout(bg2)   % get coordinates from biograph algorithm
    for i=1:N(1)
        xy(i,:) = bg1.Nodes(i).Position;    %save in xy
    end
    for i=1:N(2)
        xy(N(1)+i,:) = bg2.Nodes(i).Position;   %save in xy
    end
    %the communities are made distinct here by shifting them apart from
    %each other.
    xy(N(1)+1:sum(N),2)=-xy(N(1)+1:sum(N),2);
    xy(:,2)=1.5*xy(:,2);
    xy(1:N(1),1)=xy(1:N(1),1)+200;
end
end
```

PLOTSTABILIZATION2.M

```
function [stable,fitresult,gof] = plotStabilization2(xdata, pointsMCS,...
stableCondition,stablestart)
%plotStabilization2 plots the stabilization of the system and calculates
%when the system becomes stable

%% Fit: 'plotStabilization2'.
pointstime=mean(squeeze(sum(sum(pointsMCS,4),3)));
[xData, yData] = prepareCurveData( xdata(stablestart:end),...
 pointstime(stablestart:end) );

% Set up fittype and options.
ft = fittype( 'power2' );
opts = fitoptions( 'Method', 'NonlinearLeastSquares' );
opts.Display = 'Off';
opts.StartPoint = [0 0 0];

% Fit model to data.
[fitresult, gof] = fit( xData, yData, ft, opts );
curveFit=fitresult.a.*xData.^fitresult.b+fitresult.c;
dcurveFit=diff(curveFit);
stable=xData(find(abs(dcurveFit)<stableCondition,1))+1;
figure( 'Name', 'plotStabilization2' );
semilogx(xdata,pointstime)
hold on;
semilogx(xData,curveFit,'LineWidth',2);
hold on;
semilogx(xData(1:end-1)+.5,dcurveFit)
hold on;
scatter(stable,curveFit(stable),200,'x')
hold on;
text(stablestart+1,curveFit(2),{[' \leftarrow ' num2str(fitresult.a)...
    't^{' num2str(fitresult.b) '}+' num2str(fitresult.c)],...
     ['     R^2=' num2str(gof.rsquare)]})
legend('\pi','power fit','d\pi/dt', 'Location', 'NorthEast')
xlabel t
ylabel('$\bar{\pi}$','Interpreter','latex')
grid on
```

PLOTNETWORK.M

```
function [  ] = plotNetwork(N,A,xy,rhorange,erange,Asls )
%plotNetwork plots the network

%define colors of nodes (RGB values for blue and orange) and names
numdyads=numel(find(A));
nodecolors=[[0 166 214]./255;[214 100 0]./255];
labels = num2str((1:size(xy,1))','%d');
names = [repmat({'residents'}, N(1),1); repmat({'developers'}, N(2),1)];

figure('Color',[1,1,1])
[edge(1,:),edge(2,:)]=gplot(A,xy);
for i=1:numdyads
    edgeindex=[1+3*(i-1) 2+3*(i-1)];
    plot(edge(1,edgeindex),edge(2,edgeindex),'Color',...
     [.4 .4 .4],'HandleVisibility','off')
    hold on;
end
gscatter(xy(:,1),xy(:,2),names,nodecolors,'..',25,'on')
text(xy(:,1),xy(:,2), labels, 'horizontal','left', 'vertical','bottom')
axis square
axis off

% plot rho and epsilon for each actor
[I,J]=ind2sub([length(rhorange),length(erange)],Asls);
labels = num2str((1:length(I))','%d');
figure()
gscatter(rhorange(I),erange(J),names,nodecolors,'xo.',5,'on')
hold on;
text(rhorange(I),erange(J), labels, 'horizontal','left', 'vertical','bottom')
grid on
axis square
axis([min(rhorange)-.1 max(rhorange)+.1 min(erange)-.1 max(erange)+.1])
xlabel('$\rho$','Interpreter','latex')
ylabel('$\varepsilon$','Interpreter','latex')
title('\rho and \epsilon for each actor')
end
```

PLOTDYAD.M

```
function [] = plotdyad( regMCS,dyadid,beliefs )
%plotDyad plots the dyadic interaction of two actors

tmax=size(regMCS,2);
[I, J]=find(dyadid,1);
plotactors=[J I];
dyad1=full(dyadid(plotactors(1),plotactors(2)));
dyad2=full(dyadid(plotactors(2),plotactors(1)));

%find indices of all exchanges dyad1 in regMCS
dyadindex=regMCS(:,:,:,1)==dyad1;  %indices of all exchanges of dyad1
strat1=regMCS(:,:,:,2);         %all strategies of initiating actors
strat2=regMCS(:,:,:,3);
strati=strat1.*dyadindex;
sumstrati=sum(strati,3)./sum(dyadindex,3);  %this averages strategies if
stratj=strat2.*dyadindex;
sumstratj=sum(stratj,3)./sum(dyadindex,3);
s1i=beliefs(dyadid(J,I),1);
s2i=beliefs(dyadid(J,I),2);
s1j=beliefs(dyadid(I,J),1);
s2j=beliefs(dyadid(I,J),2);

figure('Color',[1,1,1]);
subplot(4,2,1)
semilogx(nanmean(sumstrati)-7,'Color',[1 0 0],'Linewidth',2)
hold on;
semilogx(nanmean(sumstrati)-nanstd(sumstrati)-7,'Color',[1 .5 .5],'Linewidth',1)
hold on;
scatter(1,s2i-7,50,[0 0 0],'filled','d')
hold on;
scatter(1,s1i-7,50,[0 0 0],'filled','s')
hold on;
semilogx(nanmean(sumstrati)+nanstd(sumstrati)-7,'Color',[1 .5 .5],'Linewidth',1)
axis([1 tmax -6 18])
grid on
xlabel('t','Interpreter','latex')
ylabel('$\bar{s}_i$','Interpreter','latex')
title(['actor ' num2str(plotactors(1)) ' average initiating strategies'])
legend('s_{i}','\sigma_{s_{i}}','s_{i}''''','s_{i}''','Orientation','horizontal')

subplot(4,2,3)
semilogx(nanmean(sumstratj)-7,'Color',[1 0 0],'Linewidth',2)
hold on;
%the following beliefs are incorrect
semilogx(nanmean(sumstratj)-nanstd(sumstratj)-7,'Color',[1 .5 .5],'Linewidth',1)
hold on;
scatter(1,s2j-7,50,[0 0 0],'filled','d')
hold on;
scatter(1,s1j-7,50,[0 0 0],'filled','s')
hold on;
semilogx(nanmean(sumstratj)+nanstd(sumstratj)-7,'Color',[1 .5 .5],'Linewidth',1)
axis([1 tmax -6 18])
grid on
xlabel('t','Interpreter','latex')
ylabel('$\bar{s}_j$','Interpreter','latex')
title(['actor ' num2str(plotactors(2)) ' average responding strategies'])
legend('s_{j}','\sigma_{s_{j}}','s_{j}''''','s_{j}''','Orientation','horizontal')

% create strategy distributions at set time steps
% strattime=[5 round(tmax/2) tmax];    %vector containing time steps of
%which the strategy distribution should be plotted
X=-6:18;

YMAX=0;
subplot(4,2,2)
for i=1:length(strattime)
    Ni=hist(sumstrati(:,strattime(i))-7,X);
    plot(X,Ni./sum(Ni),'Color', [1 1-i/length(strattime) 1-i/length(strattime)] )
    hold on;
    if max( Ni./sum(Ni) )>YMAX
        YMAX=max( Ni./sum(Ni) );
    end
end
xlabel('$s_i$','Interpreter','latex')
ylabel('$P(s_i)$','Interpreter','latex')
axis([min(X) max(X) 0 YMAX*1.2])
title(['actor ' num2str(plotactors(1)) ' initiating strategy distributions'])
legend(num2str(strattime'))

subplot(4,2,4)
for i=1:length(strattime)
    Nj=hist(sumstratj(:,strattime(i))-7,X);
    plot(X,Nj./sum(Nj),'Color', [1 1-i/length(strattime) 1-i/length(strattime)] )
    hold on;
    if max( Nj./sum(Nj) )>YMAX
        YMAX=max( Nj./sum(Nj) );
    end
end
xlabel('$s_j$','Interpreter','latex')
ylabel('$P(s_j)$','Interpreter','latex')
legend(num2str(strattime'))
axis([min(X) max(X) 0 YMAX*1.2])
title(['actor ' num2str(plotactors(2)) ' responding strategy distributions'])

dyadindex=regMCS(:,:,:,1)==dyad2;
strati=strat1.*dyadindex;
sumstrati=sum(strati,3)./sum(dyadindex,3);
stratj=strat2.*dyadindex;
sumstratj=sum(stratj,3)./sum(dyadindex,3);

subplot(4,2,5)
semilogx(nanmean(sumstrati)-7,'Color',[1 0 0],'Linewidth',2)
hold on;
semilogx(nanmean(sumstrati)-nanstd(sumstrati)-7,'Color',[1 .5 .5],'Linewidth',1)
hold on;
scatter(1,s2i-7,50,[0 0 0],'filled','d')
hold on;
scatter(1,s1i-7,50,[0 0 0],'filled','s')
hold on;
semilogx(nanmean(sumstrati)+nanstd(sumstrati)-7,'Color',[1 .5 .5],'Linewidth',1)
axis([1 tmax -6 18])
grid on
xlabel('t','Interpreter','latex')
ylabel('$\bar{s}_j$','Interpreter','latex')
title(['actor ' num2str(plotactors(2)) ' average initiating strategies'])
legend('s_{j}','\sigma_{s_{j}}','s_{j}''''','s_{j}''','Orientation','horizontal')

subplot(4,2,7)
semilogx(nanmean(sumstratj)-7,'Color',[1 0 0],'Linewidth',2)
hold on;
```

```
semilogx(nanmean(sumstratj)-nanstd(sumstratj)-7,'Color',[1 .5 .5],'Linewidth',1)
hold on;
scatter(1,s2j-7,50,[0 0 0],'filled','d')
hold on;
scatter(1,s1j-7,50,[0 0 0],'filled','s')
hold on;
semilogx(nanmean(sumstratj)+nanstd(sumstratj)-7,'Color',[1 .5 .5],'Linewidth',1)
axis([1 tmax -6 18])
grid on
xlabel('t','Interpreter','latex')
ylabel('$\bar{s}_i$','Interpreter','latex')
title(['actor ' num2str(plotactors(1)) ' average responding strategies'])
legend('s_{i}','\sigma_{s_{i}}','s_{i}''''','s_{i}''','Orientation','horizontal')

YMAX=0;
subplot(4,2,6)
for i=1:length(strattime)
    Ni=hist(sumstrati(:,strattime(i))-7,X);
    plot(X,Ni./sum(Ni),'Color', [1 1-i/length(strattime) 1-i/length(strattime)] )
    hold on;
    if max( Ni./sum(Ni) )>YMAX
        YMAX=max( Ni./sum(Ni) );
    end
end
xlabel('$s_j$','Interpreter','latex')
ylabel('$P(s_j)$','Interpreter','latex')
axis([min(X) max(X) 0 YMAX*1.2])
title(['actor ' num2str(plotactors(2)) ' initiating strategy distributions'])
legend(num2str(strattime'))

subplot(4,2,8)
for i=1:length(strattime)
    Nj=hist(sumstratj(:,strattime(i))-7,X);
    plot(X,Nj./sum(Nj),'Color', [1 1-i/length(strattime) 1-i/length(strattime)] )
    hold on;
    if max( Nj./sum(Nj) )>YMAX
        YMAX=max( Nj./sum(Nj) );
    end
end
xlabel('$s_i$','Interpreter','latex')
ylabel('$P(s_i)$','Interpreter','latex')
legend(num2str(strattime'))
axis([min(X) max(X) 0 YMAX*1.2])
title(['actor ' num2str(plotactors(1)) ' responding strategy distributions'])

figure()
subplot(2,1,1)
semilogx(nanmean(sumstrati)-7,'Color',[1 0 0],'Linewidth',2)
hold on;
semilogx(nanmean(sumstrati)-nanstd(sumstrati)-7,'Color',[1 .5 .5],'Linewidth',1)
hold on;
scatter(1,s2i-7,50,[0 0 0],'filled','d')
hold on;
scatter(1,s1i-7,50,[0 0 0],'filled','s')
hold on;
semilogx(nanmean(sumstrati)+nanstd(sumstrati)-7,'Color',[1 .5 .5],'Linewidth',1)
axis([1 tmax -6 18])
grid on
xlabel('t','Interpreter','latex')
ylabel('$\bar{s}_i$','Interpreter','latex')
title(['actor ' num2str(plotactors(1)) ' average initiating strategies'])
legend('s_{i}','\sigma_{s_{i}}','s_{i}''''','s_{i}''','Orientation','horizontal')

subplot(2,1,2)
    semilogx(nanmean(sumstratj)-7,'Color',[1 0 0],'Linewidth',2)
hold on;
semilogx(nanmean(sumstratj)-nanstd(sumstratj)-7,'Color',[1 .5 .5],'Linewidth',1)
hold on;
scatter(1,s2j-7,50,[0 0 0],'filled','d')
hold on;
scatter(1,s1j-7,50,[0 0 0],'filled','s')
hold on;
semilogx(nanmean(sumstratj)+nanstd(sumstratj)-7,'Color',[1 .5 .5],'Linewidth',1)
axis([1 tmax -6 18])
grid on
xlabel('t','Interpreter','latex')
ylabel('$\bar{s}_j$','Interpreter','latex')
title(['actor ' num2str(plotactors(2)) ' average responding strategies'])
legend('s_{j}','\sigma_{s_{j}}','s_{j}''''','s_{j}''','Orientation','horizontal')

end
```

PLOTPOINTS.M

```
function pointStats = plotPoints(pointsMCS,N,dyadid,stable)
%plotPoints plot the points distrubtions per group, actor and total. It
%returns the statistics of the points distributions
pointStats=zeros(3,6);
%rows 1-2: comm 1 mean, mean confidence interval, comm 1 sd, sd conf. int.
%rows 3-4: comm 2 mean, mean conf. int., comm 2 sd, sd conf. int.
%rows 5-6: total mean, mean conf int., total sd conf. int.
runsmax=size(pointsMCS,1);
tmax=size(pointsMCS,2);
plottimesteps=sum(N)^2;

if isempty(stable)
    sumpointsMCS=pointsMCS;       %all time steps added
    disp('Warning: payoff plots of all (including non-stable) time steps')
else
    if tmax-plottimesteps<stable  % tmax-sum(N)^2<stable
     %correct mean of stable time steps
        sumpointsMCS=squeeze( pointsMCS(:,stable:end,:,:) );
        disp('Warning: payoff plots of less than N^2 time steps')
    else
        sumpointsMCS=squeeze( pointsMCS(:,tmax-plottimesteps:end,:,:) );
        disp('payoff plots of N^2 time steps')
    end
end

%now transform the points per dyad to the points per actor per time step
pointsactors=zeros(runsmax,size(sumpointsMCS,2),sum(N));     %[runs, timestep, actor]
for i=1:sum(N)*sum(N)
    %retrieve indices of actors
    [I,J]=ind2sub(sum(N),i);
    %check if actors played towards each other
    if dyadid(I,J)~=0
        pointsactors(:,:,I)=pointsactors(:,:,I)+sumpointsMCS(:,:,dyadid(I,J),1);
        pointsactors(:,:,J)=pointsactors(:,:,J)+sumpointsMCS(:,:,dyadid(I,J),2);
    end
end

[I, J]=find(dyadid,1);
plotactors=[J I];
%now retrieve points where actors where initiating and responding to
%each other.
pointsi=sumpointsMCS(:,:,dyadid(plotactors(1),plotactors(2)),1)...
+sumpointsMCS(:,:,dyadid(plotactors(2),plotactors(1)),2);
pointsj=sumpointsMCS(:,:,dyadid(plotactors(1),plotactors(2)),2)...
+sumpointsMCS(:,:,dyadid(plotactors(2),plotactors(1)),1);

dista1d=fitdist(reshape(pointsi,[numel(pointsi),1]),'normal');
dista2t=fitdist(reshape(pointsactors(:,:,I),[numel(pointsactors(:,:,I)),1]),'normal');
dista2d=fitdist(reshape(pointsj,[numel(pointsj),1]),'normal');
dista1t=fitdist(reshape(pointsactors(:,:,J),[numel(pointsactors(:,:,J)),1]),'normal');

XMIN=min([min(pointsi); min(pointsj); min(pointsactors(:,:,I));...
 min(pointsactors(:,:,J))]);
XMIN=XMIN+round(.5*XMIN);
XMAX=max([max(pointsi) max(pointsj) max(pointsactors(:,I)) max(pointsactors(:,J))]);
XMAX=XMAX+round(.5*XMAX);

%plot points of one dyad (two actors)
binsize=0.1;
figure('Color',[1,1,1]);
hold on
plot(XMIN:binsize:XMAX,normpdf(XMIN:binsize:XMAX,dista1t.mu,dista1t.sigma),'b','LineWidth',1)
    plot(XMIN:binsize:XMAX,normpdf(XMIN:binsize:XMAX,dista1d.mu,dista1d.sigma),':b','LineWidth',2)
plot(XMIN:binsize:XMAX,normpdf(XMIN:binsize:XMAX,dista2t.mu,dista2t.sigma),'r','LineWidth',1)
plot(XMIN:binsize:XMAX,normpdf(XMIN:binsize:XMAX,dista2d.mu,dista2d.sigma),':r','LineWidth',2)
legend(['actor ' num2str(plotactors(1)) ' \pi_{total}'],...
     ['actor ' num2str(plotactors(1)) ' \pi_{dyad}'],...
    ['actor ' num2str(plotactors(2)) ' \pi_{total}'],...
    ['actor ' num2str(plotactors(2)) ' \pi_{dyad}'])
xlabel('$\pi$','Interpreter','latex')
ylabel('$P(\pi)$','Interpreter','latex')
title(['actors ' num2str(plotactors(1)) ' and ' num2str(plotactors(2)) '...
 dyadic and total material payoff distributions'])

%plot totalpoints communities
pointsc1=sum(pointsactors(:,:,1:N(1)),3);
pointsc2=sum(pointsactors(:,:,N(1)+1:sum(N)),3);
plotpointsc1=reshape(pointsc1,[numel(pointsc1),1]);
plotpointsc2=reshape(pointsc2,[numel(pointsc2),1]);

%calculate fractions per quadrant (clockwise)
outcome=zeros(4,1);
for i=1:length(plotpointsc1)
   if plotpointsc1(i)>=0 && plotpointsc2(i)>=0      %mutual advantage
        outcome(1)=outcome(1)+1;
   elseif plotpointsc1(i)>=0 && plotpointsc2(i)<0   %residents advantage
        outcome(2)=outcome(2)+1;
   elseif plotpointsc1(i)<0 && plotpointsc2(i)<0    %mutual disadvantage
        outcome(3)=outcome(3)+1;
   else                                             %developers advantage
        outcome(4)=outcome(4)+1;
   end
end
outcome=outcome./sum(outcome).*100;

distc1=fitdist(plotpointsc1,'normal');
distc2=fitdist(plotpointsc2,'normal');

[c1mu, c1sd, c1muci, c1sdci]=normfit(plotpointsc1);
[c2mu, c2sd, c2muci, c2sdci]=normfit(plotpointsc2);

XMIN=min([min(min(min(pointsc1))) min(min(min(pointsc2)))]);
PLOTMIN=XMIN;
XMIN=XMIN+round(.5*XMIN);
XMAX=max([max(max(max(pointsc1))) max(max(max(pointsc1)))]);
PLOTMAX=XMAX;
XMAX=XMAX+round(.5*XMAX);

figure('Color',[1,1,1]);
plot(XMIN:binsi{\tinyze:XMAX,normpdf(XMIN:binsize:XMAX,distc1.mu,distc1.sigma))
hold on;
plot(XMIN:binsize:XMAX,normpdf(XMIN:binsize:XMAX,distc2.mu,distc2.sigma))
legend('residents','developers')
xlabel('$\pi$','Interpreter','latex')
ylabel('$P(\pi)$','Interpreter','latex')
title('material payoff distribution per community')

[xData, yData] = prepareCurveData( plotpointsc1, plotpointsc2 );
% Set up fittype and options.
ft = fittype( 'poly1' );
% Fit model to data.
[~, ~] = fit( xData, yData, ft );

figure('Color',[1,1,1]);
hold on;
plot([XMIN XMAX],[0 0],':k')
plot([0 0],[XMIN XMAX],':k')
scatter(xData,yData,'.')
text(PLOTMAX,PLOTMAX,[num2str(round(outcome(1),2,'significant')) '%'])
text(PLOTMAX,PLOTMIN,[num2str(round(outcome(2),2,'significant')) '%'])
text(PLOTMIN,PLOTMIN,[num2str(round(outcome(3),2,'significant')) '%'],'HorizontalAlignment','right')
text(PLOTMIN,PLOTMAX,[num2str(round(outcome(4),2,'significant')) '%'],'HorizontalAlignment','right')
xlabel('\pi_{res}')
ylabel('\pi_{dev}')
XMIN=-150;
XMAX=150;
axis([XMIN XMAX XMIN XMAX])
axis square
grid on
```

```
round(pointStats,2,'significant');
plottotalpoints=reshape(sum(pointsactors,3),[numel(pointsactors(:,:,1)),1]);
disttotal=fitdist(plottotalpoints,'normal');
[totalmu, totalsd, totalmuci, totalsdci]=normfit(plottotalpoints);

figure('Color',[1,1,1]);
plot(XMIN:XMAX,normpdf(XMIN:XMAX,disttotal.mu,disttotal.sigma))
xlabel('$\pi$','Interpreter','latex')
ylabel('$P(\pi)$','Interpreter','latex')
title('total material payoff distribution')

pointStats(1,:)=[c1mu c1muci(1) c1muci(2) c1sd c1sdci(1) c1sdci(2)];
pointStats(2,:)=[c2mu c2muci(1) c2muci(2) c2sd c2sdci(1) c2sdci(2)];
pointStats(3,:)=[totalmu totalmuci(1) totalmuci(2) totalsd totalsdci(1) totalsdci(2)];
pointStats=round(pointStats,3,'significant');
```

K

CODE VERIFICATION

K.1. STRATEGY LANDSCAPES

Figure K.1 shows the strategy landscapes of actor i and j for $\rho = 0$. For actor i it is almost everywhere equal to $s_i = -6$, and for actor j equal to $s_j = 0$, because these strategies lead to the highest material payoff. There are also values $s_i \neq -6$ These occur when there are alternative strategies which yield a higher material outcome.

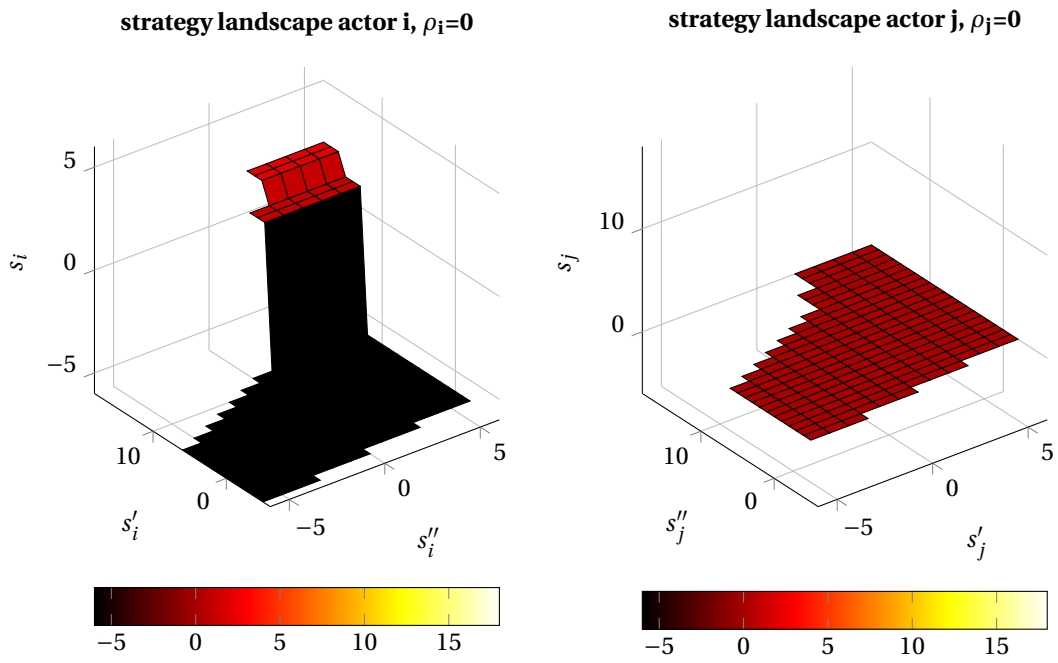


Figure K.1: Strategy landscapes of actor i and j for $\rho = 0$.

When an actor responds kind, then $s > s''$, when an actor responds unkind, then $s < s''$. This is checked by taking the strategy landscapes representing a strongly responding actor ($\varepsilon = 1, \rho = 1$), and subtracting the second order belief from the actual strategies. For kind responses, $s - s'' > 0$, for unkind responses $s - s'' < 0$. This is shown in Figure K.2.

K.2. DYAD

Dyadic interaction is verified by assigning extreme reciprocity parameters to the actors ($\rho_i = 1$ and $\rho_j = 0$). Figure K.3 shows that actor 1 tries to be reciprocal, while actor 2 behaves unreciprocal. When both actors are assigned $\rho = 0$, both act nonreciprocal, see Figure K.4. This latter situation is however a special case of both

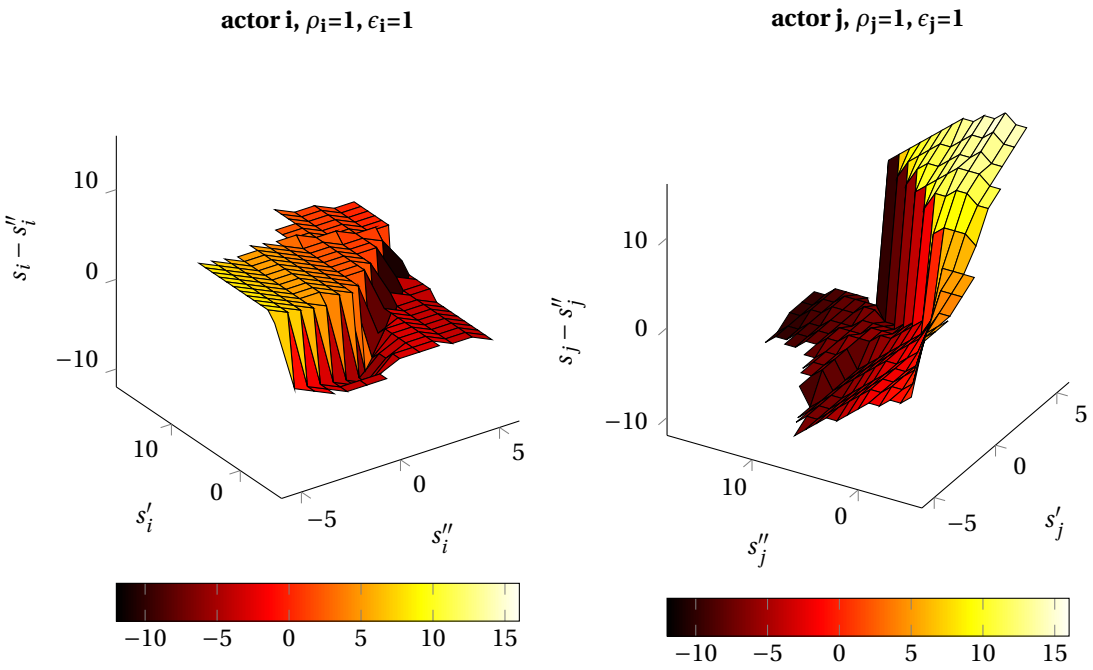


Figure K.2: $s - s''$ for actor i and actor j with $\rho = 1$ and $\varepsilon = 1$. For kind responses $s - s'' > 0$ and for unkind responses $s - s'' < 0$.

actors having the same reciprocity parameter (so $\rho_i = \rho_j$). Figure K.5 shows that for actors with $\rho_i = \rho_j = 0.5$, the average strategies converge to the equal values. This is the case for every $\rho_i = \rho_j$. Finally, in Figure K.6 and Figure K.7 the convergence of the mean points per time step and the mean strategies of the actors are shown for 10,000 time steps (no noise), as to show that the history profiles indeed direct the system to stability and do not allow for divergence.

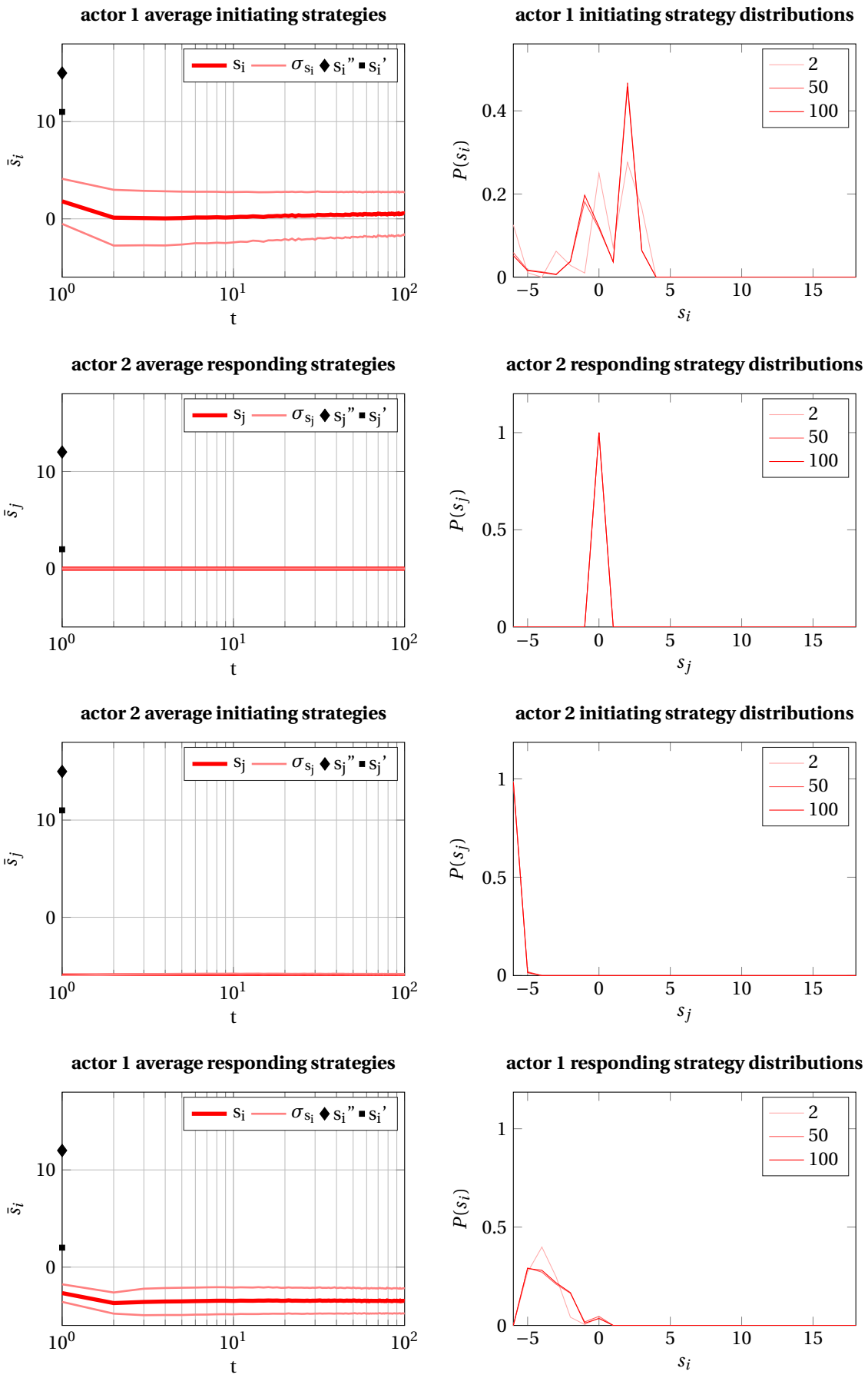


Figure K.3: Actors i and j average initiating and responding strategies. $\rho_i = 1$, $\rho_j = 0$ 10,000 runs, 100 time steps, $t_c = 35$ $(1E-3)$. Actor parameters $\rho_i = 0, \rho_j = 1$ give identical but opposite results.

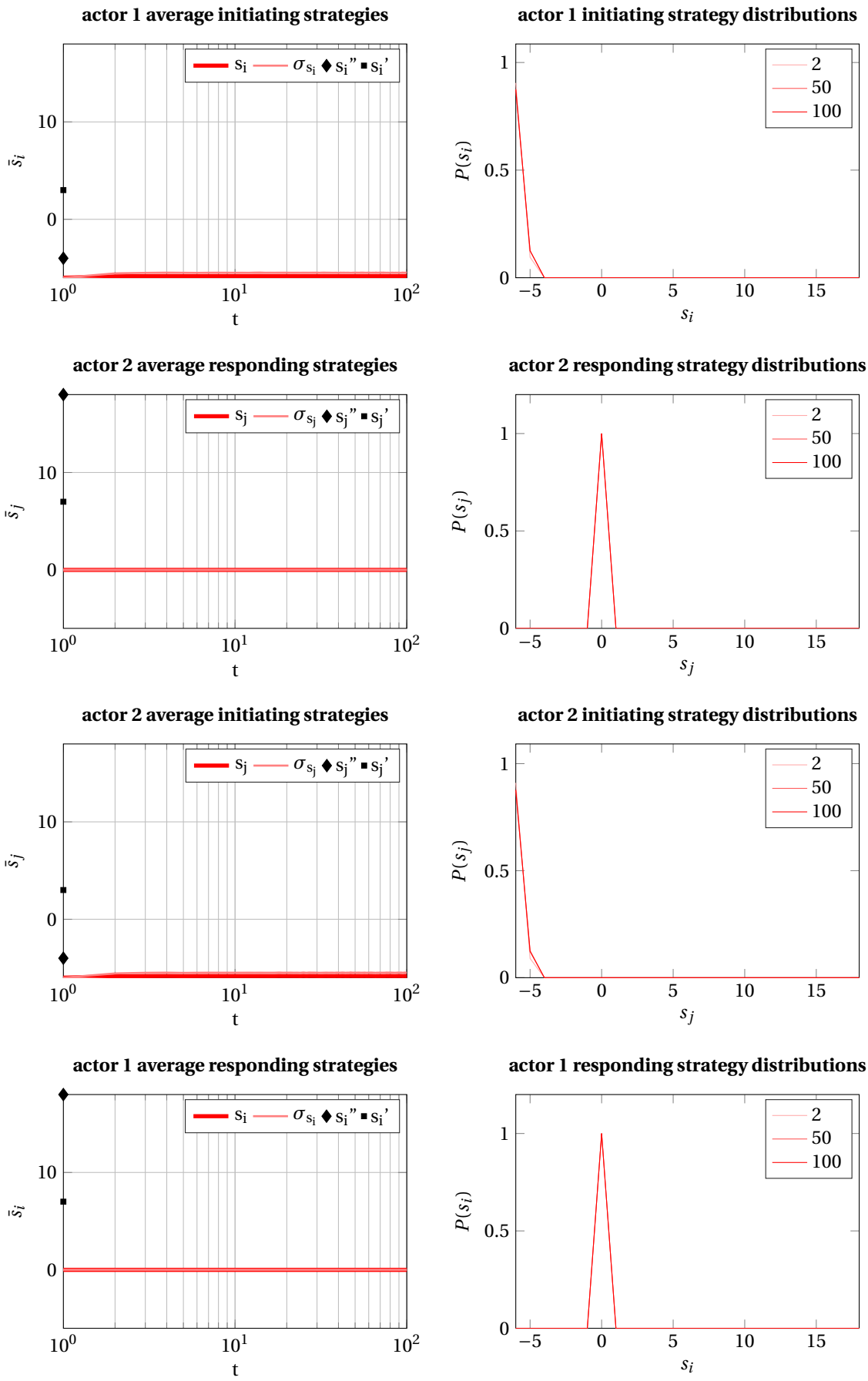


Figure K.4: Actors i and j average initiating and responding strategies. $\rho_i = 0$, $\rho_j = 0$ 10,000 runs, 100 time steps, $t_c = 3$

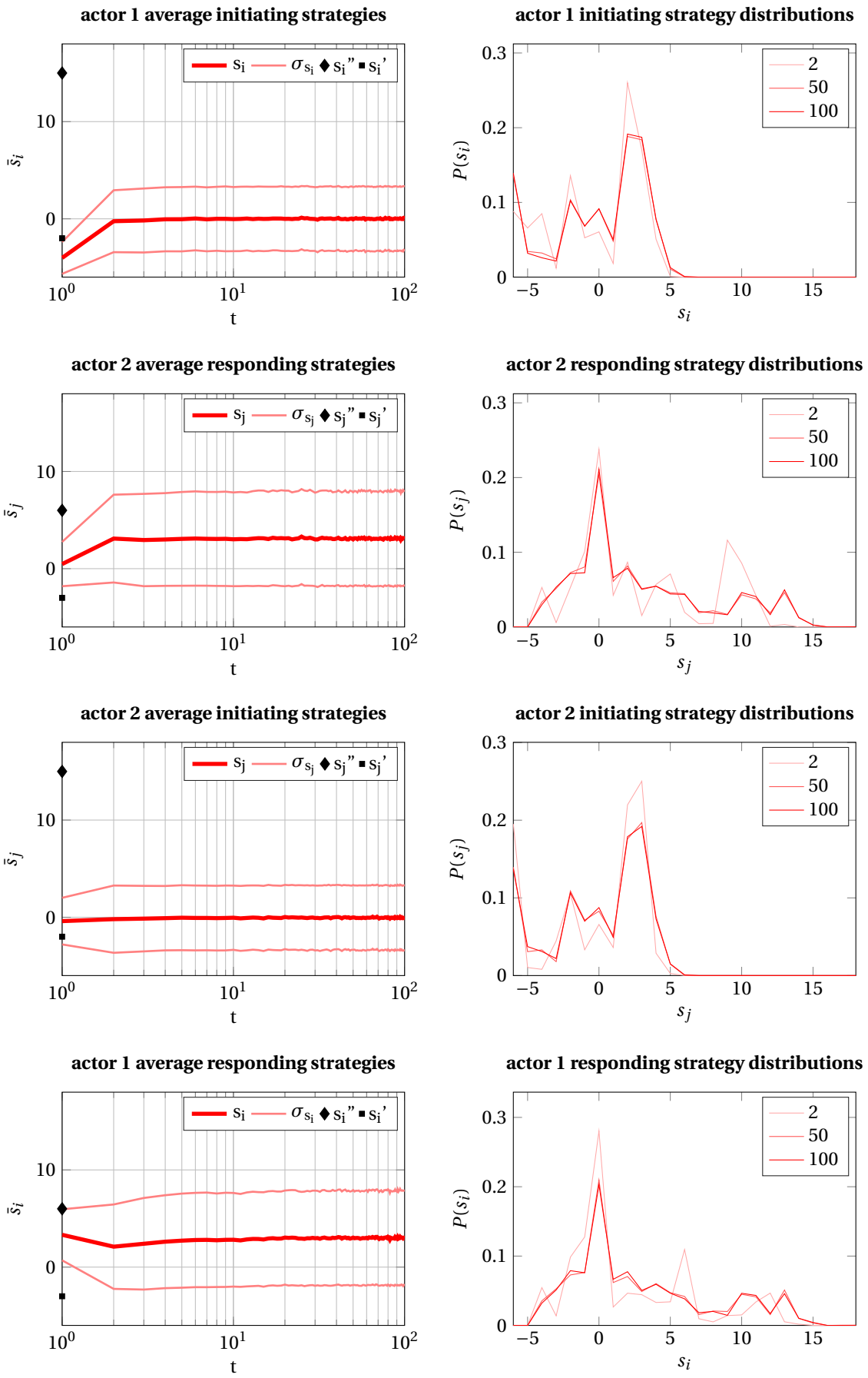


Figure K.5: Actors i and j average initiating and responding strategies. $\rho_i = 0.5$, $\rho_j = 0.5$, 10,000 runs, 100 time steps, $t_c = 39$

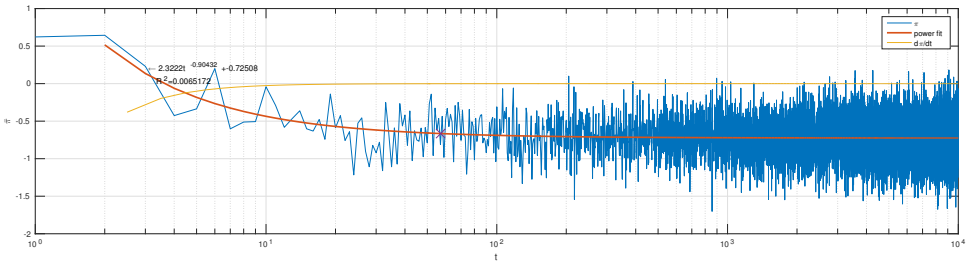


Figure K.6: Convergence plot of dyadic interaction for 10,000 time steps. $\rho_i = 0.1$, $\rho_j = 0.5$, 1000 runs, $\nu = 0$.

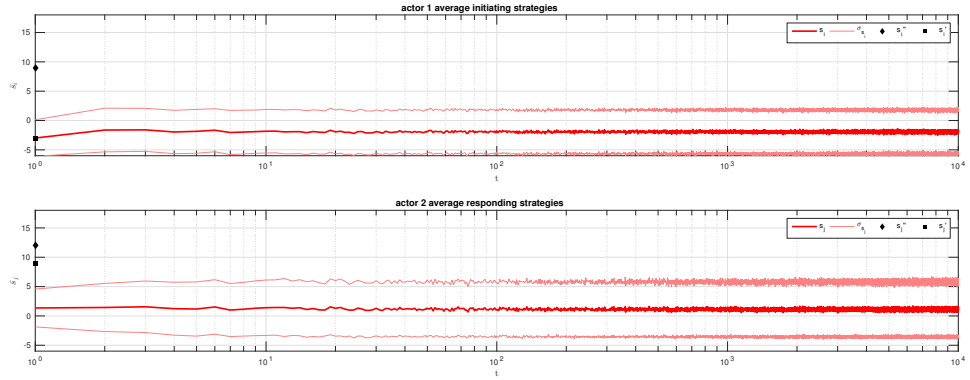


Figure K.7: Actors i and j average initiating and responding strategies. $\rho_i = 0.1$, $\rho_j = 0.5$, 1000 runs, 10,000 time steps, $\nu = 0$.

		$\bar{s}$		μ, SD
		initiating	responding	
actor 1	dyad	$s_1 = -1.00$	$s_1 = 2.86$	$\mu = 1.46, \sigma = 6.69$
	1D lattice	$s_1 = -0.97$	$s_1 = 2.83$	$\mu = 1.11, \sigma = 5.86$
	triad	$s_1 = -1.02$	$s_1 = 2.77$	$\mu = 0.78, \sigma = 5.04$
actor 2	dyad	$s_2 = 0.58$	$s_2 = 2.50$	$\mu = -0.74, \sigma = 6.51$
	1D lattice	$s_2 = 0.50$	$s_2 = 2.57$	$\mu = -0.56, \sigma = 5.80$
	triad	$s_2 = 0.44$	$s_2 = 2.56$	$\mu = -0.47, \sigma = 5.00$

Table K.1: $\rho_1 = 0.2, \rho_2 = 1, \rho_3 = 0.4$, 10,000 runs. Strategies are averaged over last 10 time steps.

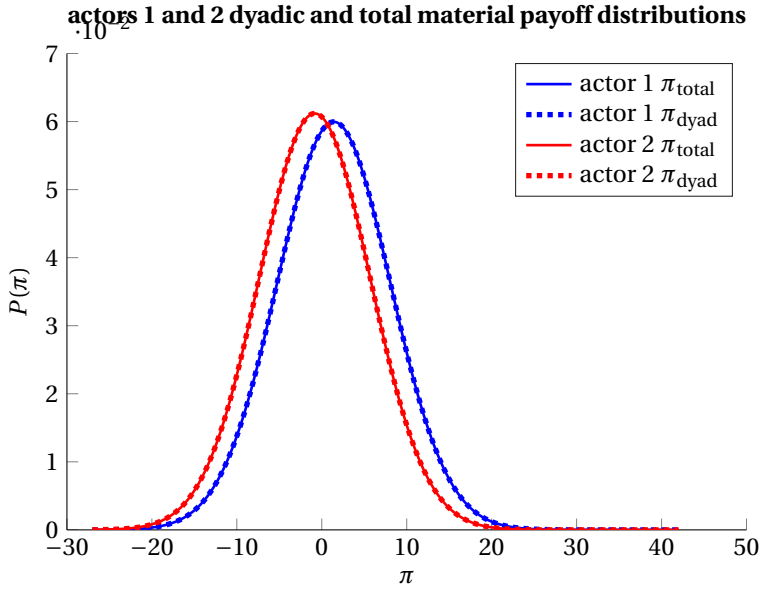


Figure K.8: Actors 1 and 2 material payoff distributions per time step in a dyad.

K.3. 3-ACTOR 1D LATTICE AND TRIAD

The influence of a third actor ($\rho = 0.4$) on the received material payoff of actor 1($\rho = 0.2$) and 2($\rho = 1$) is verified here. Figure K.8, Figure K.9 and Figure K.10 show the material payoff distributions of actors 1 and 2 embedded in a dyad, 1D lattice and triad. The actors have a different reciprocity parameter to make the changes clear. In Figure K.8 the total material payoff distribution and the dyad material payoff distribution (only earned through the interaction with the other actor) are equal. In the 1D lattice, actor 2's dyadic and total material payoff distributions differ because actor two is connected to actor 3. For actor 1, both distribution are the same, but different than Figure K.8 because of the indirect effect of actor 3. Finally, in Figure K.10, also the dyad and total material payoff distribution of actor 1 are not equal. The means and standard deviations of the distributions, as well as the average strategies of actor 1 and 2 for the three situations are tabulated in Table K.1.

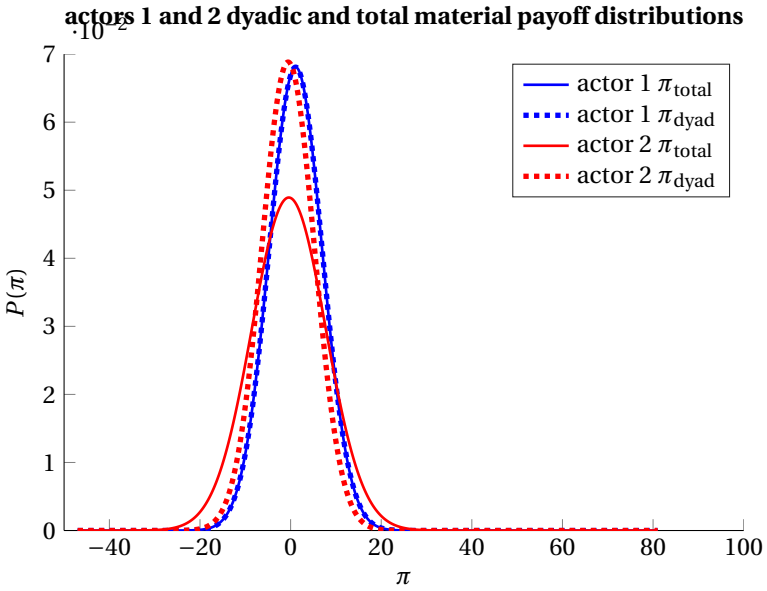


Figure K.9: Actors i and j material payoff distributions per time step in a 1D lattice consisting of 3 actors.

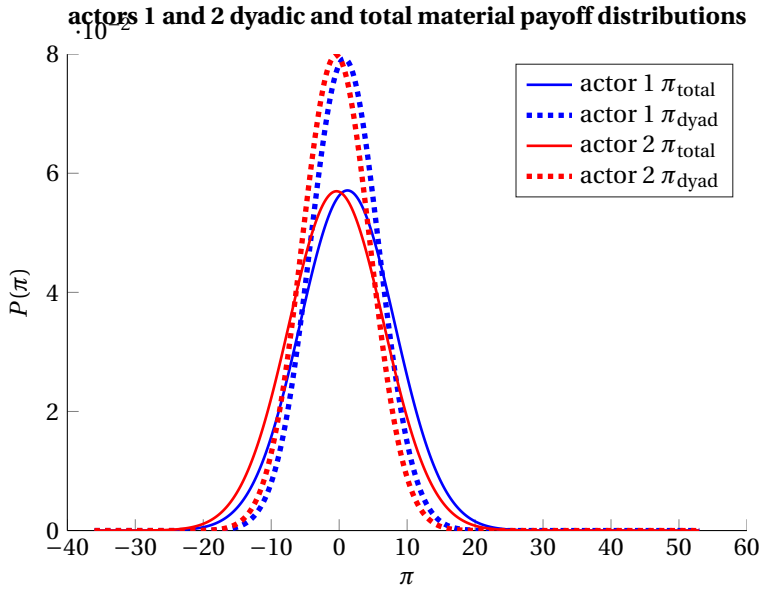


Figure K.10: Actors i and j material payoff distributions per time step in a triad.

K.4. NETWORKS

The material payoff distributions of two equal but unconnected communities must be the same. In Figure K.11 the material payoff distributions of two fully connected networks with 11 actors ($\rho_1 = 0, \rho_2 = 0.1 ... \rho_{11} = 1$) are shown.

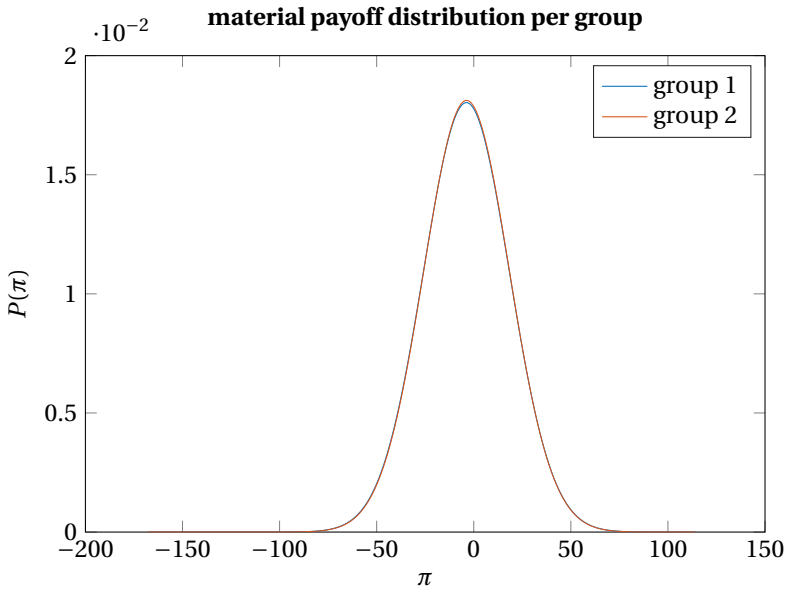


Figure K.11: Groups 1 and 2 (both N=11 fully connected networks) material payoff distributions per time step (100 runs).