KNOWLEDGE CO-PRODUCTION FOR CLIMATE CHANGE ADAPTATION

THE TRANSNATIONAL CASE STUDY OF WAVE

Figure 1: Brue Valley Living Landscape

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Summary

The present thesis is a final graduation assignment of the Water Management and Engineering department of the University of Twente. Water management in Europe is acknowledged to be susceptible to climate change impacts and vulnerabilities. As a response, climate change adaptation has emerged as a process by which strategies to moderate, cope with and take advantage of the consequences of climatic events are enhanced, developed, and implemented. However, water management is inconceivable without the mobilization and integration of different types of knowledge – that is, without *knowledge co-production* practices. Escaping a marginal approach that associates knowledge only with data, information and skills, a broader term is used instead. The thesis defines knowledge as substance and relations. Respectively products of knowledge are substantive and relational knowledge outcomes.

The European Commission funds and endorses knowledge co-production practices through transnational cooperation projects. However, the question to what extent do knowledge outcomes in transnational cooperation projects actually result from an interactive co-production process remains to be addressed. To answer the central question a working definition of knowledge co-production is used. Knowledge co-production is when active and equal agents co-create (new) substance and co-develop relationships to apply in their context. The research strategy uses a single case study to investigate what knowledge outcomes emerged and which are processes (i.e. causal mechanisms) that brought them into being. Building on the literature streams of knowledge co-production, social learning in natural resources management and transdisciplinary knowledge, causal mechanisms are; the project design, the interaction process and the participants. The next step is to develop a framework. The purpose of the framework is to assemble an approximation of causal mechanisms conditions that are sufficient or necessary for knowledge co-production in transnational cooperation projects. The study case selected is WAVE, a project for climate change adaptation whose main objective was to increase the value of water in countries of North West Europe. WAVE was launched in the previous programing period (2008-2013) of transnational cooperation projects. Data for the case study were collected through document analysis and interviews with participants from 5 European countries.

The knowledge co-production outcomes of WAVE are five in total. Substantive knowledge co-production outcomes are a landscape-scale conservation scheme and a communication strategy for water uses in agriculture. The relational knowledge outcomes are frames, trust and networking. The next step is to investigate how project design, interaction processes and participant conditions can explain knowledge co-production outcomes. Results are generated with the method of process tracing, -a backwards reasoning method, whereby starting from the outcome, potential evidence of causation is tested for the causal mechanisms of the framework. For the causal mechanism of project design is concluded that; themes of the project coupled with the needs of participants (reasons for co-production) can confirm why knowledge outcomes occurred. Also, a relevant condition for project design is selection of partners who represent open and inclusive organizational cultures. The causal mechanism of interaction process demonstrates that representativeness is the most important condition that explains co-production. Furthermore, during interaction processes good communication and capturing the interests of partners can play a significant role in knowledge creation and development. In the end, the leadership style of participants is also a relevant condition that explains knowledge co-production.

Finally, strategic recommendations to increase the added value from knowledge co-production in transnational cooperation projects are: i) including a joint measure in the project design ii) include more

knowledge systems during the interaction process and iii) endorse participants to co-develop learning tools through teambuilding exercises.

Overall knowledge co-production is a context-depended process which requires time investment to flourish. However, including and accepting different ways of knowing in water management can substantially improve the strategies for climate change adaptation.

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CHAPTER 1: **INTRODUCTION**

1.1 Background

Climate change is happening now and is expected to continue: temperatures are rising, rainfall patterns are shifting, ice and snow are melting and sea level is rising. Extreme weather and climate-related events result in hazards (i.e. floods and droughts) that will become more frequent and intense in many regions. Impacts and vulnerabilities of ecosystems, economic sectors, human health and well-being differ across Europe. Even if there are global efforts to counteract these externalities, climate change is inevitable and complementary actions to adapt to its impacts are needed (EEA, 2017). ***Climate change adaptation*** (CCA) has emerged as a process by which strategies to moderate, cope with and take advantage of the consequences of climatic events are enhanced, developed, and implemented (UNDP, 2011). However, dialogues on climate change adaptation in local, national, transnational and European Union (EU) levels are constrained by available resources and the need to serve designated constituencies (Feldman et al., 2009). As a consequence, knowledge for adaptation becomes marginalized, discipline and nationally rooted (Ingram, 2006). In this context, new modes of knowledge production are required that are better equipped to address urgent challenges and help humanity adapt (van der Hel, 2016). The concept of ***knowledge co-production*** can provide a possibility to overcome the conflict between different value positions as it is adaptable to multiple contexts, visions and perspectives (Bensaude Vincent, 2014). Moreover, knowledge co-production for climate change adaptation is acknowledged to serve the interrelationship between adaptation and other agendas at the level of both policy making and practical implementation of actions. Actions may for instance include technological measures, ecosystem-based measures, and measures addressing behavioural changes (Brugnach et al., 2012). In this respect, co-producing the adaptation agenda shares many of the fundamental principles that characterise debates concerning sustainable development from justice and equity to the need for holistic and long term thinking (Carter, 2011).

Knowledge co-production can be placed in a larger discourse on water management with supporters from research institutes to supranational organizations such as the EU. Yet academic research on the practices, processes and particularities are limited (Felt et al., 2012) encouraging at the same time for more empirical observations and additions on the field. This thesis investigates the outcomes and processes of knowledge co-production in a transnational study case about water management and climate change adaptation. The selected study case is WAVE (Water Adaptation is Valuable to Everyone), which was funded from **INTERREGIVB NWE (North West Europe),** a financial instrument of the European Union's Cohesion Policy which invests projects supporting transnational cooperation. The overall challenge of WAVE was to create conditions for a sustainable, regional development. The objective was to approach different (land use) functions in an integrated manner and use opportunities to equip the region for the consequences of climate change. Encouraging involved actors to learn from experiences and knowledge in other contexts and beyond national borders (Hachmann, 2008) forms a leading principle within this context. WAVE was launched among other transnational projects for managing risks and resources focusing on the adaptation of the expected spatial impacts of climate change (IVB, 2017). A number of evaluations were carried out to examine whether or not the transnational cooperation projects worked as intended and why. Nevertheless, knowledge co-production is not questioned and reviewed because evaluations focus more on technical products, the financial investments and impact assessments (Böhme, 2005). Therefore it becomes relevant to study to what extent knowledge co-production took place in transnational projects for climate change

adaptation by detecting the knowledge outcomes in relation to project components (such as participants, the way they interact, and the project design) which are not often reviewed in external evaluations.[1] Hence, the role and significance of knowledge co-production can be better understood and recommendations can be proposed on how different modes of knowledge production may benefit transnational cooperation.

This thesis draws specific attention to knowledge co-production outcomes from transnational cooperation projects and which were the processes or pathways (i.e. causal mechanisms) through which an outcome was brought into being. In order to explain a knowledge outcome I offer a hypothesis about how conditions retrieved from literature of social learning in natural resources management, co-production theory, transdisciplinary knowledge and transnational cooperation studies. Conditions are characterized as necessary or sufficient when they are subjected to a causal test. The empirical section of the thesis discusses, co-existing logics that support a different interpretation and implementation of knowledge co-production outcomes with the method of process tracing. The results generated contribute:

- To better understand the influence of project structures (design) of transnational cooperation projects on knowledge outcomes and to actively reflect on which factors may or may not support the achievement of their planned results. This understanding can also support project consultants in giving advice to projects and to formulate appropriate demands and standards for projects. Moreover, it can help with the selection of projects for funding, which is based on project applications and thus on their structural factors.

- To better understand the influence of the interaction processes of transnational cooperation projects on knowledge outcomes. Reflecting on how participants relate, helps to better understand the challenges of transnational cooperation and how these could be overcome and thus support the development of recommendations for projects. Thereby, it is particularly relevant to increase the understanding of the reciprocal relationships between the output and the input and between the output and the processes involved.

– To better understand the influence of participants on knowledge outcomes and take into consideration how the attitude of individuals may foster engaging in knowledge co-production. This understanding can advise organizations on how to train better their employees who engage in co-production processes.

1.2 Basic definitions

Knowledge was once perceived as an exclusive privilege of academia and society's elite (Edelenbos et al., 2011) , but the complexity and non-linearity (Pahl-Wostl, 2007a; Pahl-Wostl et al., 2007; Pahl-Wostl et al., 2010; Pahl-Wostl et al., 2011) of water related problems champion for integrated and collaborative approaches (Huxham et al., 2000). Historically water management has been relying on expert driven knowledge (Lejano et al., 2009) where decisions concerning the origins and solutions of a problem, hardly reflect the diversity of views, values and interests of multi-actor groups (Brugnach et al., 2012; Conca et al., 2006). Associating knowledge only with data, information and skills impedes inclusiveness (Ingram, 2013) and flexibility for climate change adaptation in water management.

[1] Private corporations, such as Royal Haskoning DHV, Ramboll and many others produce evaluations with baselines and targets for NW or Baltic Sea Region, for example visit: https://www.interreg-baltic.eu/fileadmin/user_upload/about_programme/Main_documents/2015.07.Final_report_Strategic_Evaluation_by_RMC.pdf

Knowledge, is the outcome of observation, experience, and social interactions among different actors (Nonaka et al., 1995). Following the work of Bouwen et al. (2004) , Brugnach et al. (2012) and Ingram (2013) a broad definition of knowledge is adopted, which escapes marginal approach related only with information, but expands to its relational nature. Looking at *knowledge* from a holistic perspective (Bouwen et al., 2004) we conceive it both as content (a body of statements) and as relations (Brugnach et al., 2011) which can be associated with learning processes in a group of people (Mostert et al., 2007) and the impact on the different ways of knowing an individual has (Buuren, 2009). Thus, in this thesis ***knowledge consists of substance, and relations (Bouwen et al., 2004).*** The content refers to "what" is known. This includes formal and systematic knowledge such as hard and quantifiable data (e.g., scientific information, measured data, etc.). The relational aspect pays attention to how substance originates as a result of relational processes and it refers to "who" is being included, or excluded, in problem understanding, and "how" those included relate to each other to define what the problem or issue of concern is (Brugnach et al., 2008).

A relational view of knowledge implies particular consideration on the processes of producing knowledge. Hachmann (2013) distinguishes between three types of knowledge processes evident in the context of transnational cooperation projects; exchange, transfer and co-production. Knowledge co-production is generated by the need to create new knowledge to solve a problem, under the assumption that all actors are an interdependent part of the history of the problem domain and are also co-responsible for its future (Brugnach et al., 2012). Knowledge co-production has many different definitions in academic publications. For instance Frantzeskaki et al. (2016) argue that co-production refers to the active involvement and engagement of actors in the production of knowledge that takes place in processes either emerging or being facilitated and designed to accomplish such active involvement. Hegger et al. (2012) considers joint knowledge production when scientists, policymakers and other societal actors cooperate in the exchange, production and application of knowledge. Due to the existence of multiple valid terminologies, I use the following working definition of knowledge co-production in the context of transnational water projects: ***Knowledge co-production occurs when active and equal participants in a transnational context co-generate (new) substance and co-develop relationships to apply in their context.***

Moving further with basic definitions, in order to document ***the products that emerge from a knowledge process, the term knowledge outcomes is used***. Depending on the mode of knowledge transmission (exchange, transfer, co-production), knowledge outcomes are characterized respectively. However, the main assumption is that knowledge outcomes do not derive arbitrarily in transnational projects; rather there are certain pathways –or processes that specifically trigger and explain them. The pathways, which in the thesis will be referred as ***causal mechanisms,*** are the relationships that bring knowledge outcomes into being. On the basis of an extensive literature review, I hypothesize that the project design(Dong et al., 2011; Knight et al., 2007; Wang et al., 2010) , the interaction process (Brugnach et al., 2011; Pahl-Wostl et al., 2007) and the participants (Vinke-de Kruijf, 2015) justify how knowledge outcomes occurred. Further details that support the selection and conditions that shape causal mechanisms are presented in chapter 3.

1.3 Research questions

In this section, the central research question of the thesis is addressed as well as the relevant sub-questions. The **central research question** is:

> "To what extent do the knowledge outcomes in transnational projects for climate change adaptation in the water sector result from an interactive co-production process and which causal mechanisms related to the project design, participants and the interaction process explain them? "

The **sub-questions** are:

1	According to literature, what are knowledge outcomes and which are necessary or sufficient conditions of causal mechanisms in order to establish them as knowledge co-production outcomes?
2	In the selected study case: a. What substantive knowledge outcomes emerged from and which of them are knowledge co-production outcomes? b. What relational knowledge co-production outcomes emerged from the projects interactions and activities? c. How substantive and relational knowledge co-production outcomes can be explained from the causal mechanisms?
3	What recommendations can be made to improve the added value from knowledge co-production in transnational projects for CCA in the water sector?

In order to "visualize" the central question and its core elements, I provide a scheme below (Fig.1) which is constructed from elements of the literature on policy implementation (Bressers, 2004) and own interpretation. The outer black shape represents the wider context of INTERREGIVB projects and the petrol shape the case specific context which I will investigate. Inside the petrol shape is where knowledge generation and utilization takes place. Within it, the light blue hexagon is the project design which includes the resources, the organizations which participate, goals it has to accomplish and so on. Incorporated in the project design, lies the interaction process as an inherent element for the project to run and actors to interact with each other. The light grey hexagons represent the participants who act as sources, conductors and receivers of knowledge. The arrows which connect them represent knowledge transfer (single black arrow), knowledge exchange (two light blue single side arrows) and knowledge co-production (dark blue double sided arrow). The outcomes from the project design, the interaction process and the participants are found in the brown box on the right. As explained before, knowledge outcomes can be exchanged, transferred or co-produced, but particular interest is on the co-produced ones. Finally, knowledge outcomes can provide a starting point for evaluation and reflection thus import feedback to project structures, knowledge development processes during interaction and the participants themselves.

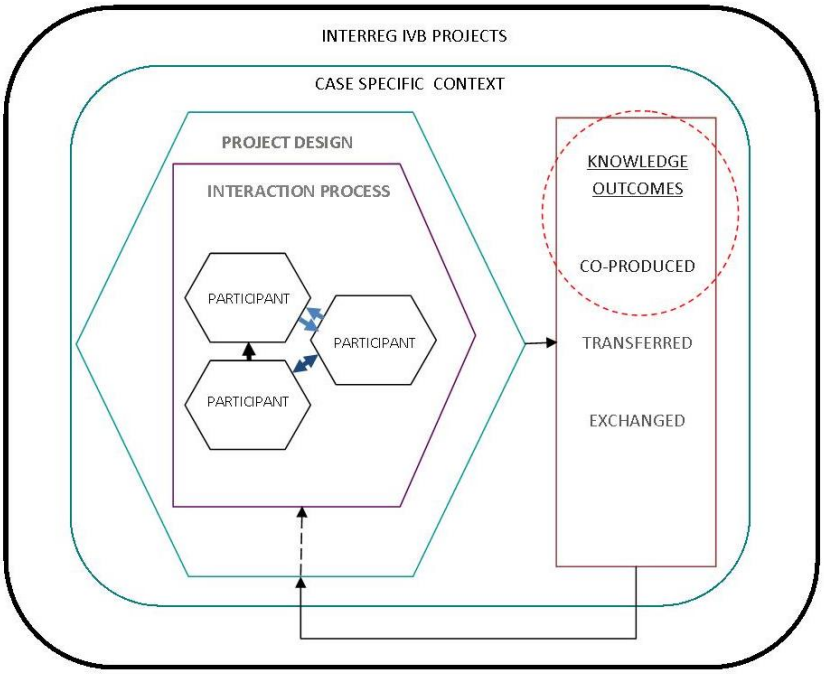

Figure 1: Schematic representation of a transnational project and the core elements of the co-production context. Adapted from (Bressers, 2004) and own interpretation

1.5 Report outline

The report is structured as it follows; the first chapter is the introduction to knowledge co-production in climate change adaptation and the research objectives. Next, I lay out the methodology I will employ to collect and analyze data. First I elaborate on the reasons WAVE is selected and the case study population. Next, I present briefly the need for a framework as a method to cluster raw data from document analysis and later transform its conditions to questions for the interviews I conduct. Data analysis uses the method of process tracing –a method of backwards reasoning, provided in the end of the methodology chapter. Chapter 3 is literature review on the theory of social learning in natural resources management, co-production and transdisciplinary knowledge, where I define knowledge outcomes and the causal mechanisms which can potentially explain them as knowledge co-production outcomes. The causal mechanisms are further schematized with conditions (i.e. indicators) that are assumed to be necessary or sufficient to explain knowledge co-production. Chapter 4 includes the description of the project, the description of partners and the interaction processes that took place during the project. In the following chapter, I demonstrate knowledge outcomes and select knowledge co-production outcomes to analyze with process tracing. By performing the tests of causation I explain how knowledge co-production outcomes were affected from the influence of project design, participants and interaction processes. Chapter 6 includes conclusions, discussion for the internal and external validity of the research and recommendations towards improving the added value from knowledge co-production in CCA projects for the water sector.

CHAPTER 2: **METHODOLOGY**

2.1 Research strategy

The present chapter describes the methods used in order to assemble a suitable research approach for the questions mandated in the thesis. The backbone of the research strategy is the case study analysis for which data are collected and analysed.

2.1.1 Case study analysis

This thesis employs the case study of a transnational European project for climate change adaptation for analysis on knowledge co-production outcomes and the pathways –or causal mechanisms which explain them. Case studies are often used in social and other sciences to gain a better understanding of complex processes in relation to their context. They provide the opportunity to apply different methodologies, such as desk studies, interviews, observations, focus group discussions and dialogue meetings, often in various combinations(Yin, 2013). Knowledge co-production is by itself a complex, heavily context-dependent phenomenon and, in combination with the main research question posed in this thesis (a "how" question), is very suitable for a case study approach. One characteristic of the study case analysis is labor-intensive data generation (semi-structured interview questions), a strategically selected sample (i.e. case selection) and qualitative data collection methods (e.g. documents and interviews). The holistic approach of case studies provides the opportunity to conduct in-depth analyses, to validate and to understand the role of knowledge co-production processes in the context of a transnational project.

2.1.2 Case selection

The case population from which WAVE is selected are the numerous EU cooperation projects. These projects are funded by a percentage of 50-80% from the EU and involve multi-disciplinary actors who represent organizations (i.e. public authorities, private firms, academics and NGO's) from different member states. Their collaboration can yield to the establishment of concrete actions or to the development of new policies and new adaption strategies (Böhme, 2005). In the program period 2007-2013 INTERREG IVB and FP7 projects were funded, which serve the objectives of the European Commission. INTERREG IVB Europe helps regional and local governments across Europe to develop and deliver better policy. By creating an environment and opportunities for sharing solutions, financiers aim to ensure that government investment, innovation and implementation efforts all lead to integrated and sustainable impact for people and place (Interreg_Europe, 2017). FP7 is the short name for the Seventh Framework Programme for Research and Technological Development. This is the EU's main instrument for funding research in Europe and it ran from 2007 to 2013 (FP7, 2017). A notable similarity between INTERREG IVB (and the consecutive IVC) and FP7 Environment projects is that they are implemented by a consortium of at least three partners of three different countries with a lead partner being responsible for the overall process (Vinke-de Kruijf, 2015). On the other hand, a difference between them is that the former projects are more practise -oriented whereas the latter research -oriented.

WAVE, is a project funded by **INTERREGIVB NWE**, a financial instrument of the European Union's Cohesion Policy. INTERREG North-West Europe (NWE) is a Programme of the European Union to promote the economic, environmental, social and territorial future of the North-West Europe area (IVB, 2017). Transnational cooperation is the core of the INTERREG IVB Programme. It allows partners from different

countries to work together on mutually beneficial projects to tackle issues that go beyond national borders. Moreover, transnational cooperation produces transferable working models, and speeds up the process of innovation through the sharing of knowledge and development costs. The collective benefits of such collaboration are invaluable; participating organisations acquire new skills, initiate effective working methods and increase their connections to European network. **INTERREGIVB NWE** invests € 355 million of European Regional Development Fund (ERDF) in activities based on the cooperation of organisations from eight countries: Belgium, France, Germany, Ireland, Luxembourg, The Netherlands, Switzerland and the United Kingdom (IVB, 2017).

Figure 2: North West Europe states in INTERREG (Interreg_IVB, 2014)

The objective of WAVE was to provide solutions and communication strategies for CCA in the water sector. To increase environmental sustainability, strengthen economic competitiveness, to and ensure territorial balance were the overall cross-cutting issues around which INTERREG IVB programmes circled around. In total, almost 9000 projects have been funded in the last program period, but only 60 projects concentrated on climate change adaptation (KEEP, 2017). The present work is built upon previous research on 7 projects INTERREG IVB and FP7 were focused on learning for CCA by Vinke-de Kruijf (2015). The previous selection was focused on transnational cooperation for projects recently completed in the previous investment period. This research was part of the research project Know2Adapt (Knowledge Transfer for Climate Change Adaptation) (know2adapt, 2013)aims to provide more insights into learning about climate change adaptation through international cooperation processes. In Know2Adapt the following criteria were applied to select case study projects:

1 Were implemented with the support of European cooperation programmes;
2 Focused on climate change adaptation actions specifically in water management;
3 Involved partners from at least three different European countries;
4 Use English as project language;

This research examines one of the projects that were studied in Know2Adapt. WAVE was selected for further investigation since:

1. Knowledge co-production should have occurred;
2. The case study analysis is already completed thus direct observation is not mandatory;
3. Data sources such as project documents, magazines, and websites were accessible from the previous research in Know2Adapt;
4. Most of the respondents are still employed in the same professional environment;

The above criteria portray WAVE as a potentially "influential" of the cross-case relationship where the effect under investigation (knowledge co-production) has probably occurred. The study does not aim at representativeness and at making inferences to the overall population of transnational cooperation projects

or to INTERREG projects. Instead it aims at a deeper understanding of the relevant process aspects, potential support factors and barriers and their causal relationships that are or can be relevant for knowledge co-production and transnational cooperation projects.

2.2 Data collection

Raw data were found in; the official project appraisal, the official communication strategy document, the project reports from the interaction meetings, the reports from the conferences, the official project magazine and the platform of SIC Adapt, the knowledge transfer and innovation evaluation platform. In order to gain a deeper insight from the interplay, written reports from the facilitators (Royal (HaskovingDHV, 2018) have been reviewed from the Joint Actions and the conferences. These data were reduced and completed with data that were collected from Vinke-de Kruijf (2015). The previous data set provided short project description, information for the participants, the interaction processes that took place and learning outcomes, relevant for the topic of knowledge, since they can be seen as a direct or indirect result of a knowledge process (Hachmann, 2013). The data provided are mostly qualitative, and quantitative units refer to the number of participants, interactions and budget spent

2.2.1 Framework

The collected data are reduced and clustered according to the proposed framework in the present thesis. The Framework Method for management and analysis of qualitative data has been used since the 1980s (Ritchie et al., 2013). The method originated from large-scale social policy research but is becoming an increasingly popular in water management too. The Framework Method sits within a broad family of analysis methods often termed thematic analysis or qualitative content analysis. These approaches identify commonalities and differences in qualitative data, before focusing on relationships between different parts of the data, thereby seeking to draw descriptive and/or explanatory conclusions clustered around themes (Gale et al., 2013). The framework proposed in the present thesis is constructed after a literature review in knowledge co-production, social learning in natural resources management and transnational cooperation researches. The elements of the framework are the causal mechanisms of project design, interaction process and participants. In an effort to contextualize the causal mechanisms, additional conditions are added which crystalize the shaping attributes of knowledge co-production. Next, the conditions are characterized as sufficient or necessary to explain knowledge co-production outcomes. As a final remark, conditions are transformed into questions asked into the selected partners who are interviewed for the thesis.

2.2.2 Interviews

Project managers and participants provide additional data sources. Eight interviews were conducted with representatives of five organizations involved in WAVE. The respondents were approached through email and participated willingly in an-one-hour interview. The questions of the interview were semi-structured, tailor-made for every partner. The nature of questions was mainly deducted from the elements of the framework. Additionally, interviews were used to validate the knowledge outcomes detected from the project's document analysis. I conducted one face-to-face interview and the rest via skype and phone. The contact language was English which the researcher and respondents are familiar with. Below there is a table with the codes, position, organization and country of the respondents. For confidentiality purposes respondents remain anonymous.

Table 1: WAVE respondents

Code	Position	Organization	Country
[I1]	Project leader	Waterschaap Regge en Dinkel (WRD) (now Verschoor)	Netherlands
[I2]	Project manager	Somerset city council (SCC)	United Kingdom
[I3]	Project manager	Institution d'Aménagement de la Vilaine (IAV)	France
[I4]	Project participant	Somerset city Wildlife Trust	United Kingdom
[I5]	Project participant	Institution d'Aménagement de la Vilaine (IAV)	France
[I6]	Project manager	Wasserverband Eifel-Rur (WVER)	Germany
[I7]	Project manager	Vlaamse Milieumaatschappij (VMM)	Belgium
[I8]	Project participant	Farming and Wildlife Advisory Group	United Kingdom

2.3 Data analysis

The main method for analysing data and producing further results is process tracing analysis. The basic function of the method follows below.

2.3.1 Process tracing analysis

Process tracing is a research method used to examine what causal mechanisms within a case explain the outcome of this case in either an inductive or deductive manner (Bennett et al., 2012). Following "within-case" logic, the aim is to detect whether a specific knowledge outcome is being explained by tracing back how causal mechanisms played a role in the creation of that outcome. The benefits of process tracing are twofold; on the one hand using this method enables us to explain how the conditions related to project design, interaction processes and participants influence knowledge co-production outcomes. On the other hand, conditions are classified as necessary or sufficient portraying the level of intensity on knowledge co-production outcomes (Gerring, 2007; Voorberg et al., 2014a). Contrasting with other methods, for instance statistical regression analysis, it provides the opportunity to examine the influence of multiple conditions (for instance previous collaboration, transparency and so on). Therefore, the analysis aspires to provide a better understanding on the process of knowledge co-production and thus, answer the central question of the thesis. Beach et al. (2013) outline three distinct types of process tracing; theory testing, theory building and explain-outcome. Each uses a different approach to analyzing how a specific cause (A) led to a given outcome (B). The present thesis falls into the third category because knowledge outcomes are known since the project has already finished. The table below demonstrates the three cases of process tracing.

Table 2: process tracing methods from (Beach et al., 2013, p. 45)

	Theory-testing	**Theory- building**	**Explaining outcome**
Purpose of analysis – Research situation	Situation 1 Correlation has been found between X and Y, but is there evidence that there exists a causal mechanism linking X and Y?	Situation 2 Build a plausible causa mechanism linking X:Y based on evidence in case	Situation 3 Explain particularly puzzling historical outcome by building minimally sufficient explanation in case study
Ambitions of study	**Theory- centric**	**Theory- centric**	**Case- centric**
Understanding of causal mechanisms	Systematic (generalizable within context)	Systematic (generalizable within context)	Systematic, non-systematic, (case specific) mechanisms and case-specific conglomerates
What are we actually tracing?	Single, generalizable mechanism	Single, generalizable mechanism	Case-specific, composite mechanism that explains the case
Types of inferences made	1) part of causal mechanism present/absent 2) causal mechanism is present/absent in case	Observable manifestations reflect underlying mechanism	Minimal sufficiency of explanation

Process tracing involves an in depth analysis of a single case. According to Punton (2015) a case in process tracing must include:

- The effect under investigation which in our case are knowledge outcomes
- The hypothesized cause, or in the proposed interpretation the project structure, the interaction process and the participants
- The process of events that link the hypothesized cause and effect (in this case the Joint actions, the conferences, the field visits etc)

The template of the process tracing analysis includes four tests of causation as seen in the table below from Bennett et al. (2012):

Table 3: process tracing-four tests for causation found in (Bennett et al., 2012, p. 4) adapted from (Van Evera, 1997, pp. 31-32)

		Sufficient to establish causation	
Necessary to establish causation		No	Yes
	No	**1. Straw in the wind**	**2. Smoking gun**
		i) **Passing**: Affirms relevance of hypothesis, but does not confirm it	i) **Passing** confirms hypothesis
		ii) **Failing**: hypothesis is not eliminated, but slightly weakened	ii) **Failing**: hypothesis is not eliminated but moderately weakened
		iii) **Implications for rival hypothesis**: Passing: slightly weakens them Failing: slightly strengthens them	iii) **Implications for rival hypothesis**: Passing: substantially weakens them Failing: moderately strengthens them
	Yes	**2. Hoop**	**4. Double decisive**
		i) **Passing**: affirms relevance of hypothesis but does not confirm it	i) **Passing**: Confirms hypothesis and eliminates others
		ii) **Failing**: Eliminates hypothesis	ii) **Failing**: eliminates hypothesis
		iii) **Implications for rival hypothesis**: Passing: moderately weakens them Failing: moderately strengthens them	iii) **Implications for rival hypothesis**: Passing: eliminates them Failing: substantially strengthens them

The categorization can be explained as follows: factors, subjected to a 'straw-in-the-wind' test only give valuable information that may favor the hypothesis but are not decisive. They provide neither a necessary nor a sufficient criterion for establishing a hypothesis or, correspondingly for rejecting it. For instance, sunny weather may be part of explanation why people are more happy, but it doesn't mean that people are unhappy if it's raining (Voorberg et al., 2014b).

Hoop tests, which are central to the discussion below, can eliminate alternative hypotheses, but they do not provide direct supportive evidence for a hypothesis that is not eliminated. They provide a necessary but not sufficient criterion for accepting the explanation. For instance oxygen is needed (necessary) for human labor, but it isn't a sufficient explanation why or how labor is conducted (Bennett et al., 2012). Smoking gun tests strongly support a given hypothesis, but failure to pass such a test does not eliminate the explanation. They provide a sufficient but not necessary criterion for confirmation. For instance lottery winners appear to be very cheerful when they found out they won a certain amount of money. As such it is a sufficient explanation of their cheerfulness. However, it is not necessary to win the lottery to be cheerful. Finally, doubly decisive tests confirm one hypothesis and eliminate others. They provide a necessary and sufficient criterion for accepting a hypothesis. Just one doubly decisive piece of evidence may suffice, whereas many straw in the wind tests may still be indeterminate "vis-a`-vis" alternative explanations (Bennett et al., 2012; Voorberg et al., 2014b).

To put in different words: "If a given hypothesis passes a straw-in-the-wind test it only slightly weakens the rival hypothesis (i.e. the phenomenon is more sufficiently explained by another independent variable). With hoop tests it moderately weakens them; with smoking-gun tests it substantially weakens them; and with doubly decisive tests passing eliminates them"(Collier, 2011). Ultimately, the analytical added value of process tracing is that it enables strong causal inferences to be made about how causal

processes work in real-world cases based on studying within-case mechanistic evidence. But process tracing is a single-case method, meaning that only inferences about the operation of the mechanism within the studied case are possible because this is the evidence gathered through tracing the process in the case(Beach, 2017).

The scheme below lays the steps I follow methodologically to answer the research questions. The research strategy is to employ a case study for analysis. The first research question is theoretical question answered from reviewed academic publications. The result is the framework which additional data are collected for. The second research question is responded with the contextual data from the WAVE archive and the interviews with partners. The method used to analyze data is process tracing. The results are the knowledge co-production outcomes. Finally the third point is to suggest recommendations towards improving the added value from knowledge co-production.

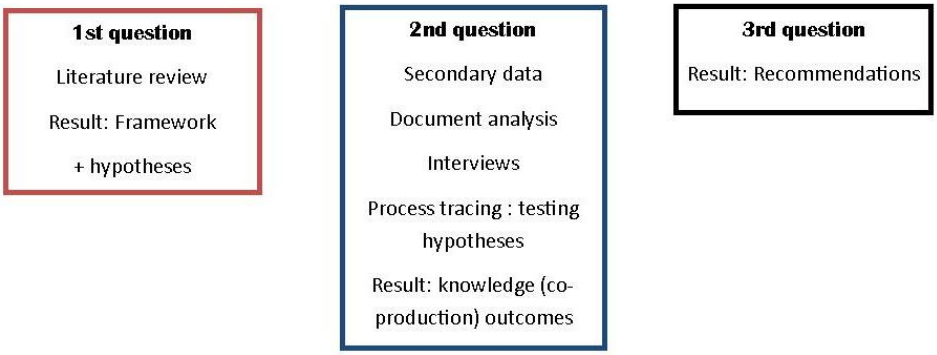

Figure 3: Research strategy

CHAPTER 3: KNOWLEDGE OUTCOMES AND CAUSAL MECHANISMS

The overall goals of this chapter are firstly to define what knowledge outcomes are, and then identify which causal mechanisms explain their production. In the end, I examine what conditions of the causal mechanisms can explain knowledge co-production. The bulk of the chapter is on critically evaluating fostering attributes of knowledge co-production as to identify the appropriate approach for investigating the first research question. Perhaps, before jumping into the knowledge outcomes and causal mechanisms, I reference below definitions of knowledge exchange, transfer and co-production.

- *Exchange applies when participants just provide information to other participants.*
- *Transfer occurs when participants discuss existing knowledge to understand and apply this knowledge in their own context. (Vinke-de Kruijf, 2015)*
- *Knowledge co-production is when active and equal participants in a transnational context co-generate (new) substance and co-develop relationships to apply in their context.*

3.1 Knowledge outcomes

In the last few years, prompted largely by the work of Jasanoff (2004) and Ingram (2013), numerous articles on the co-production of knowledge have appeared. For example Armitage et al. (2011) explores the influence of knowledge co-production on increasing adaptive capacity of natural systems. Another example is from Bidwell et al. (2013) who link effective decision making with the inclusion of multiple knowledge networks as a mean to reduce uncertainty for climate change adaptation. Furthermore Hachmann (2011) addressed the role of transnational knowledge development and learning process on how it may influence INTERREG project's ability to produce joint results. This renewed interest on the benefits of knowledge co-production in cooperation projects leads naturally to another question: where can evidence be found that new substantive and relational knowledge was generated and developed from the participants? Answering this question is quite challenging because there is no single theoretical model that is able to cover all relevant aspects of the knowledge creation and transmission processes in transnational projects (Hachmann, 2013). Instead a variety of theoretical contributions are helpful to understand and de-contextualize the role and processes of knowledge. Moreover, as explained in chapter 2, using process tracing –a backwards reasoning method, implies that analysis begins from outcomes and then traces back the causal mechanisms which can explain them. As a result, knowledge outcomes are the starting point for the enquiry into.

The present thesis defines knowledge as substance and relations that originate through interactions, thus knowledge outcomes are defined as substantive and relational respectively. Gerlak et al. (2011) attaches the process of knowledge conversion into new collective ideas or actions or relationships to the products of knowledge. Therefore detecting knowledge outcomes from transnational cooperation projects will assist in characterizing the knowledge processes which created them. Furthermore, knowledge outcomes may provide insights about the added value of a cooperation process. According to Colomb (2007) and EU cooperation program promoters (Louwers, 2013) *added value* is expressed in principles the EU desires for her members, for instance, cohesion, efficiency, cooperation, awareness and so on.

3.1.1 Substantive knowledge outcomes

Many authors in adaptation practices for water management (Von Korff et al., 2010; Wall et al., 2017; White et al., 2010) note the straightforward relationship of explicit knowledge (Nonaka et al., 1995) (data, information and skills) to tangible products and outcomes. Regarding this perspective adaptive solutions require a combination of information (know-what) and expertise (know-how) (Kogut et al., 1992) in order to "fit" in the context. Additionally Nyong et al. (2007) , Eakin et al. (2006) and Darroch et al. (2002) elaborate that changes in knowledge for adaptation can be detected into its dissemination and utilization into policies, practices and tools. Another example, from the scope of social learning denotes (Newig et al., 2010; Pahl-Wostl, 2002, 2007b; Pahl-Wostl et al., 2007) that social interaction can yield to technical outcomes that improve the adaptive capacity of natural and water systems. Again, substantive or "actionable" knowledge (Dewulf et al., 2005)outcomes orientate future strategies (Shotter, 2004) and establish connections between different knowledge holders and communities. Similarly, in the context of transnational projects , knowledge travels across distant geographical and cultural boundaries, thus improves its action- ability (Dewulf et al., 2005). Thereafter, in projects for climate change adaptation, substantive knowledge outcomes derive as a logic of consequence (March et al., 2006; Voorberg et al., 2014a) by interpreting data and information for the problem and by using skills for its solution.

In terms of substance, new knowledge in transnational projects can often be found in produced studies, concepts, strategies and plans and sometimes joint agreements (Hachmann, 2008). WAVE was a project which went beyond the "planning stage" therefore knowledge can also be manifested in implemented measures on the ground (Hachmann, 2013). Summarizing, the substantive knowledge outcomes of transnational cooperation projects can reveal the extent individual knowledge from the participants has been utilized and disseminated into the outputs of the project. The thesis embraces "outputs" as a generic term that encompasses many different types of collective changes in knowledge, which become visible on program strategies, policies and technical measures.

3.1.2 Relational knowledge outcomes

The second part of the definition of knowledge, relational, demands more effort to crystalize into measurable and comparable outcomes, as there can be many different, valid scopes. Relational aspects of knowledge derive from different ways of knowing an individual may have (Buuren, 2009; Edelenbos et al., 2011) and can be sensitive to power and political inferences (Bensaude Vincent, 2014) (Jasanoff, 2004). Relational knowledge appears in publications on collaborative settings (Bouwen et al., 2004; Goldstein et al., 2015; Heaton et al., 2016; Lejano et al., 2009) and participation in water management. Authors conclude that relational knowledge leads to connections and is reciprocal, not only because the parties involved know each other but also because it grows from interaction (Dewulf et al., 2005).

Regarding relational knowledge or as (Hachmann, 2013) refers "systemic knowledge", is about relationships and roles in the context of projects. At a minimum, this knowledge only exists at the individual level derived in group discussions, which have the potential to reach transnational reflexivity and become joint property of a partnership. This knowledge only develops due to transnational cooperation, it did not exist before and thus is not t*ransferred* but *developed*, a process of learning *with* each other.

Relational knowledge outcomes have been presented diversely in literature. According to the theory of social learning (Pahl-Wostl, 2007a; Pahl-Wostl, 2009; Pahl-Wostl et al., 2004) relational outcomes may benefit institutional and governance arrangements in water management. On the other hand, transdisciplinary theory (Jahn et al., 2012; Lang et al., 2012; Sigel et al., 2014; Tress et al., 2003) suggests

that relational outcomes of collaborations increase awareness and inclusiveness of policy makers, scientists and lay people towards sustainability and adaptation. However, transnational projects differ in terms of structure, content and participating agents. Using the aforesaid outcomes does not apply properly. Therefore it is assumed that generation of better relationships with other participants and stakeholders and understanding better/deeper climate change adaptation can be visible on:

- Frames: how an individual gives sense and meaning to information and derives from e.g., culture, social role, scientific discipline etc,
- Trust and commitment: firm belief in reliability and legitimacy of others, motivation, giving willingly resources e.g., time and money,
- Networking: creating connections, alliances, communities of practice.

Summarizing the above, the table below presents the relationship we expect to find in the outcomes.

Table 4: Expressions of knowledge outcomes and their relationship with knowledge development

Outcomes	Knowledge	Citations
Outputs	The extent to which knowledge becomes explicit and can be detected on the policies, pilot studies, tools	(Eakin et al., 2006; Edelenbos et al., 2011; Hegger et al., 2012; Huntjens et al., 2010; March et al., 2006; Mostert et al., 2007; Pahl-Wostl et al., 2007
Frames	The extent to which knowledge took a transformative character and re-shaped a perception	(Dewulf et al., 2005; Dewulf et al., 2009; Jahn et al., 2012; Lang et al., 2012; Pahl-Wostl et al., 2008)
Trust	The extent to which knowledge improves social ties and acknowledges credibility and legitimacy	(Chow et al., 2008; Ingram, 2008; Sol et al., 2013; Szulanski et al., 2004)
Networking	The extent to which knowledge becomes transnational and enforces cooperation	(Bidwell et al., 2013; Burgess et al., 2000; Chow et al., 2008; Feldman et al., 2009; Hachmann, 2008; Koppenjan et al., 2004; Lejano et al., 2009; Newig et al., 2010; Sol et al., 2013; Sørensen et al., 2009)

3.2 Causal mechanisms

Causal mechanisms are in other words, the processes or pathways through which an outcome is brought into being. An outcome is explained by offering a hypothesis about the cause(s) that typically bring it about. As such, a central ambition of the present thesis is to find knowledge outcomes (effect) of WAVE by discovering causes that potentially explain them. Consider an example: A rise in prices causes a reduction in consumption. The causal mechanism linking cause to effect involves the choices of the rational consumers who observe a rise in price; adjust their consumption to maximize overall utility; and reduce their individual

consumption of this good. In the aggregate, this rational behaviour at the individual level produces the effect of lower aggregate consumption(Michael Lewis-Beck 1989). Therefore the aim of the thesis is to explain how knowledge outcomes came into being and how they can be explained according to the hypothesized causal mechanisms of project design, interaction process and the participants. The causal mechanisms for knowledge co-production derive from synthesizing existing literature and a preliminary glance at transnational cooperation projects.

Previous research on learning (Vinke-de Kruijf, 2015) and co-production has paid attention to three pathways that link the development of knowledge with outcomes. The first are the project structures and strategies (Hachmann, 2013)(project design in the case of WAVE), the second is the interaction processes (Mostert et al., 2007; Pahl-Wostl et al., 2007) and the third are the participants of projects (Vinke-de Kruijf et al., 2014). Keeping under consideration that the method of process tracing will be used, more descriptive indicators -conditions for the causal mechanisms should be found. Specifically, conditions should be characterized as sufficient or necessary in order to perform the tests of causation.

3.2.1 Project design conditions

Project design is assumed to have a direct impact on the outputs and an indirect impact on the relational outcomes. On the one hand, co-production (Jasanoff, 2004; Ostrom, 1996) theory rarely uses project structures as a causal mechanism for knowledge development and on the other hand Gerlak et al. (2011) and Mostert et al. (2007) note than political and institutional inferences may work as a barrier for knowledge development in joint collaborations. However, for the purpose of this thesis, we consider that knowledge co-production takes place in a specific project environment, time and budget restricted in which developments merge for the purpose of a project goal (Koskinen et al., 2003). A typical project design of an EU program is shaped by the team of participants, the problem at hand, the types of solutions needed (i.e. policies, models) and the project objective. These three elements represent the "raison d etre" of the project and taken together help forming project knowledge that is a resource for targeted and rational action that can be found within a project's result and is subject to changes during its execution (Frantzeskaki et al., 2016; Hachmann, 2008). Below, I present a table with the potentially significant project conditions, I offer a short description, how the conditions potentially affect knowledge co-production and finally, I characterize them as sufficient or necessary for causal inference.

Table 5 : Project design conditions that explain knowledge co-production in transnational cooperation processes

C1:Project design conditions	Description	How the condition affects knowledge co-production	Sufficient or necessary	Citations
C1,1: Previous collaboration	Actors' previous experience in cooperation settings	Experience is considered as a significant resource for knowledge (co) development	Sufficient	(Vinke-de Kruijf, 2015) (Hachmann, 2012)
C1,2: Organizational culture	A system of shared assumptions, values, and beliefs, which governs how people behave and work in organizations	Organizational culture comprises the climate that informally and tacitly defines how the organization develops and uses	Necessary	(Dong et al., 2011; Shu-Mei, 2010; Zheng et al., 2010)

		knowledge, thus it has a significant effect on knowledge creation capability.		
C1,3: Reasons for co-production	The natural context (water system, infrastructure), the knowledge content	Actors acknowledge that i) the problem cannot be handled in isolation and ii) there is room for new knowledge generation	Sufficient[2]	(Huntjens et al., 2010; Pahl-Wostl, 2002; Voorberg et al., 2014a, 2014b)
C1,4: Project goals	Objectives, vision, strategy of the project	The clarity both of short- and long-term objectives provides guidance to the overall project process As there is a direct relationship between objectives and results, this relationship determines what and how things are done	Necessary	(Ayas et al., 2001; Hachmann, 2012; Slevin et al., 1987; Turner, 2009)

3.2.2 Interaction process conditions

Face-to-face interaction is considered the richest medium for knowledge co-production to occur, because it allows immediate feedback so that understanding can be checked and interpretations corrected(Koskinen et al., 2003). For interaction processes I examine two basic conditions; the quantity and the quality. Frequent interactions among project team members tend to produce interpersonal attraction, while also creating the accessibility to other team members' tacit knowledge (Koskinen et al., 2003). Consequently, the characterization of relations goes beyond materiality (i.e., the exchange of goods or information), to also include fundamental preferences and values in connecting to others. High relational qualities are of paramount importance in co-producing knowledge for action, which by being able to include a diversity of different actors, allows the co-creation of new possibilities for developing innovative and perdurable solutions to problems (Bouwen, 1998; Brugnach, 2017). The table below follows the same logic as table 5. Quality is assessed in 6 conditions.

Table 6: Interaction process conditions that explain knowledge co-production in transnational cooperation projects

C2: Interaction process conditions	Description	How the condition affects knowledge co-	Sufficient or Necessary	Citations

[2] This choice has been made by taking under consideration the project design of transnational cooperation projects, because the pilot and executed projects are local for every country. If there was a common water system, that condition would be necessary

		production		
C2,1: Quantity	Time (duration) and frequency of the joint meetings	Development of knowledge is dynamic, it can get more concrete and targeted with time	Necessary	(Hachmann, 2012; Sol et al., 2013)
C2,2: Quality (relationships)	How actors relate with each other	Good or bad relationships can affect co-production	-	-
C2,2,1: Meeting Interests	Needs and stakes addressed	Approaching interests with an integrated approach can stimulate knowledge co-production	Sufficient	(Gerlak et al., 2011; Jahn et al., 2012; Lejano et al., 2009)
C2,2,2: Ambiguity	Process that allows more than one interpretation (or a type of uncertainty)	Ambiguity has many coping strategies but embracing ambiguity fosters knowledge co-production	Sufficient[3]	(Brugnach et al., 2011; Brugnach et al., 2008; Brugnach et al., 2012; van den Hoek et al., 2014)
C2,2,3: Transparency	Clarity (no corruption)	Accountable decision making bodies that serve objectives democratically allow room for knowledge co-production	Necessary	(Ingram, 2006, 2013; Szulanski et al., 2004)
C2,2,4: Communication	Language, transferring information, open attitude	Communication is indispensable for knowledge sharing and co-production	Sufficient[4]	(Hachmann, 2012, 2013; Vinke-de Kruijf, 2015; Vinke-de Kruijf et al., 2014)
C2,2,5: Representativeness	Stand equally in a group	Is considered a principle[5] of co-production	Necessary	(Ingram, 2006; Jasanoff, 2004; Ostrom, 1996)
C2,2,6: Reciprocity	Mutual dependence	Reciprocity is developed	Sufficient	(Bouwen, 1998; Bouwen et al.,

[3] The scope under ambiguity is handled (ignoring, accepting, re-creating meanings) has different effects for knowledge
[4] In general, it is difficult to assess a project's communication retrospectively because the perception of communication can be rather subjective, but also because discussing and describing communication in a project requires interviewees to have a certain awareness of it and to reflect on the overall process
[5] The influencers of co-production Jasanoff (2004) and Ostrom (1996) define representativeness as a principle.

		informally in the absence of rules is one of the most important dynamics in collaboration		2004; Dewulf et al., 2009; Gray, 2004)

3.2.3 Participant conditions

The network of actors who participate in transnational projects appear to be very well embedded not only in their organizations but also in relevant governance networks (Vinke-de Kruijf, 2015) where by nature, multilateral processes of cooperation, exchange and learning (Böhme, 2005) take place. Furthermore, participants come from diverse professional (interdisciplinary), institutional (multi-level) and cultural (transnational) backgrounds take part and aim at finding (new) solutions to common problems for the regions concerned. The conditions for knowledge co-production relate to the roles a person can have in the co-production process and the working attitude (leadership style) that an individual has from his own professional experience and the organization he/she participates.

Table 7: Participant conditions that explain knowledge co-production in transnational cooperation projects

C3: Participant conditions	Description	How the condition affects knowledge co-production	Sufficient or necessary	Citations
C3,1: Distribuition and coverage of co-production roles	Roles in knowledge sharing and development are: sender, receiver, producer, adopter, observer	When the majority acts as active producers of knowledge then the process co-production	Necessary	(Hachmann, 2008, 2012, 2013; Voorberg et al., 2014a, 2014b)
C3,2: Leadership style	How a manager deals with different knowledge sources, how h/s distributes tasks, how h/s makes decisions	Integrative, collaborative styles embrace better knowledge co-production	Necessary	(Argote et al., 2000; Brugnach et al., 2012; Ingram, 2008)

3.3 Selecting a causal test

The process tracing template, as presented in the methodology chapter, involves 4 different tests of causation. Selecting the appropriate test according to publications on process tracing method, depends on; the knowledge basis of the researcher, the "clues" the study case offers and the potential implications for the rival hypothesis (Collier, 2011). In this direction, I use the distinction between necessary and sufficient conditions and for the former I perform hoop tests and for the later smoking gun tests (see table 3). However, for conditions that receive particular attention in publications and are embedded in the working definition for knowledge co-production, I perform double decisive test. For example a double decisive test is made for the condition "distribuition and coverage of co-production roles", "representativeness", because they are considered as principles for knowledge co-production in the thesis. Other double decisive tests are "project goals" and "quantity of interaction". Straw in the wind tests will be performed when the available and generated data from the interviews are not enough to establish causation between the knowledge

outcome and the condition. In this point I provide one example on how a hypothesis and its rival formulated and how they perform in the causal test.

Example:

Condition: Previous collaboration

Hypothesis: Substantive knowledge outcomes can be explained as knowledge co-production outcomes due to previous collaboration (i.e. the JAF project) between the participants. Previous collaboration has set a knowledge basis and relevant experience upon which new knowledge is co-created.

Rival hypothesis: Substantive knowledge outcomes are relevant only to the present collaboration either because the participant does not have prior experience on the topic, or the organization has not collaborated again in a transnational level.

Performing a smoking gun for this condition means:

a. Passing: Hypothesis is confirmed
b. Failing: hypothesis is not eliminated but somewhat weakened
c. Implications for rival hypotheses: Passing substantially weakens them. Failing somewhat strengthens them

The same process is followed for all the conditions presented in the tables 5,6 and 7. Every condition has a supporting and rival hypothesis. Below I present tables with the test selection for every condition, the main and rival hypothesis.

Table 8: Overview of causal tests, hypotheses and rival hypotheses for project design conditions

C1: Project design conditions	Test	Hypothesis	Rival hypothesis
C1,1: previous collaboration	Smoking gun	Previous collaboration has set a knowledge basis upon which new knowledge was created	Present collaboration is significant for knowledge development
C1,2: organizational culture	Hoop test	Organizational culture is endorsing knowledge co-production by being open, flexible, agile, team-driven processes	Organizational culture is inflexible, imposes control, employees think their opinion doesn't matter
C1,3: reasons for co-production	Smoking gun	The regional natural context is complex (i.e. involves many conflicting stakeholders, lacks hydrological data, there is not a concrete proposal for climate change adaptation) or the knowledge basis of the organization is not	The natural system does not require knowledge development or additions to be managed. The organization responsible can do it in isolation

		enough to manage the system, thus incentives to co-produce are stronger.	
C1,4: Project goals	Double decisive	The objectives, vision and strategy of the project state or recommend knowledge co-production as an approach	The objective, vision and strategy of the project states or recommends knowledge exchange or knowledge transfer

Table 9: Overview causal tests, hypotheses and rival hypotheses for interaction process conditions

C2: Interaction process conditions	**Test**	**Hypothesis**	**Rival hypothesis**
C2,1: Quantity	Double decisive	Time for project's interaction and activities was enough to co-develop (new) substance and develop relationships	Time for interaction and activities was not enough
C2,2: Quality	-	-	-
C2,2,1: Meeting interests	Smoking gun	During interaction partners developed reasons to engage, topics were stimulating, needs were addressed.	Every partner had different focus during the interaction, the topics of joint actions and workshops were not relevant, interesting
C2,2,2: Ambiguity	Smoking gun	Participants embraced diversity in terms of beliefs, values and assumptions regarding the natural and knowledge system. They co-created new meanings	Participants ignored differences in the values, beliefs, political backgrounds other participants had, did not consume any effort to create new shared meanings.
C2,2,3: Transparency	Hoop test	Deals, trade- offs, processes during interaction were controlled and open to every participant in the project.	During interaction there was not clarity , clear responsibilities, corruption
C2,2,4: Communication	Smoking gun	Language was understood open and concrete information provided, dialogue and reflection. Good communication means that dialogue is	Language not understood by everyone, not relevant information, not open dialogue actors did not understand each other, language was a barrier, managers and participants

		stimulating, working relationships are easy to manage and maintain, actors share relevant and concrete information.	cannot handle interaction
C2,2,5: Representativeness	Double decisive	Equal participation	Participants indicate that they were neglected or ignored during the process. It means that there are dominant participants whose decisions and beliefs matter more than others.
C2,2,6: Reciprocity	Hoop test	Participants were interdependent in order to understand and solve the problem at hand.	Absence of reciprocity means that participants work very individually, they are independent or they are not willing to collaborate.

Table 10: Overview causal tests, hypotheses and rival hypotheses for participant conditions

C3: Participant conditions	**Test**	**Hypothesis**	**Rival hypothesis**
C3,1: coverage and distribuition of co-production roles	Double decisive	The majority of participants act as producers of knowledge.	Roles in knowledge sharing are not equally distributed; there are more receivers than senders, more adopters than producers
C3,2: leadership style	Hoop test	Inclusive (towards different knowledge systems) leadership style. It means that managers and participants distribute equally tasks, make fair decisions, open in new ideas.	Leadership style of partners is strict, hierarchical and does not accept different knowledge systems.

CHAPTER 4: **WAVE**

4.1 Introduction to the case study

WAVE (Water Adaption is Valuable to everybody), is a transnational project, funded through the INTERREGIVB NWE cooperation program. This project's central objective was to prepare regional water systems for the potential impacts of climate change. This was achieved by strengthening the value of water, implying that particular attention was paid to aspects such as sustainable regional development, integrated land use and making use of opportunities. The project was implemented by a consortium consisting of six partners from five different NW European countries, Belgium, France, the Netherlands, Germany and the United Kingdom. The projects' duration was 5 years and 9 months, dated from 1/1/2008 to 31/10/2013. The budget spent was of €11 million with EU contribution of 50%.

Figure 4: Area of interest and WAVE partners

All activities and measures taken within the framework of the project contributed to the idea of climate resistant water systems. The concept was applied from three different perspectives: policy& planning, climate proof measures and public awareness. The benefits of this transnational cooperation expected to be visible on the regional level by creating balance between spatial planning and water management and by improving communication and awareness for the people. Finally, the role of knowledge for WAVE partners was to combine and make use of existing scattered knowledge (experience, models, knowledge and case studies) aimed to disseminate solutions and actions into the focus and other regions with similar problems.

4.2 The partners

Figure 5: IAV (Wave_end_report, 2013)

Institution d'Aménagement de la Vilaine (IAV) La Roche Bernard (FR)

IAV is a regional water management board in the Vilaine Valley, situated in the northwest in France. The River Vilaine flows through this Natura 2000 area before emptying into the Atlantic Ocean. The organization employs 30 people from which 10-15 were involved in WAVE. They are the smallest organization of all the participating ones in WAVE. Their budget share came up to 12% and the problems under their concern is sustainable marsh management, drainage and reservoir control (Project proposal, 2008; Vinke-de Kruijf, 2015). The outputs the organization managed to achieve were; (1.9) hydraulic model of marshes, management plan of the marshes (2013-2018) , pilot restoration of marshes (2.10) hydraulic surveys and maps for two rivers, model simulation of retention scenarios (including effects and cost-benefit assessments), investment plan for the two rivers , stakeholder discussions about the investment plans. From this organization 2 persons gave interviews.

Somerset County Council (SCC) Taunton (UK)

SCC is the county council of Somerset in the South West of England. The agricultural Somerset area is a rural county of rolling hills and large flat expanses of land. SCC has worked with partners from the Environment Agency, Somerset Wildlife Trust, and the Royal Society for the Protection of Birds (RSPB), the Somerset Drainage Boards Consortium (SDBC) and the Farming and Wildlife Advisory Group (FWAG) to deliver actions through this WAVE project. The organization employs 2000 people and 6 of them work specifically in the water sector. From the organization 10-15 people participated and their budget share was 21%. Their problems under concern were extreme floods and droughts, adaptive strategical decisions and risk planning, plus desired cultural and behavioral changes which should be addressed to the people(Project proposal, 2008; Vinke-de Kruijf, 2015). Their achievements were (1.4) a visualization tool on the effects of climate change on water system, (1.5) integrated assessment of Brue Valley, participatory assessment with the involvement of volunteers, (2.3) increase of hydrological connectivity, (3.3) demonstration sites with water at farms, collaboration with farmers (2.4) planning of new woodlands baseline for monitoring wetland restoration effects and (3.4) website and newsletters about project. From the UK, 3 people were interviewed in total , one project manager of SCC, one Farming and Wildlife advisory group and say Somerset Wildlife Trust the sub-partners of SCC.

Figure 6:SCC(Wave_end_report, 2013)

Figure 7: VMM (Wave_end_report, 2013)

Vlaamse MilieuMaatschappij (VMM) Erembodegem (BE)

The Vlaamse Milieumaatschappij (VMM) is the Environmental Agency of Flanders which focuses on flooding problems in the Denderbekken area, and specifically in the catchment area of the Molenbeek

(Zandbergen region), a tributary of the river Dender. The Molenbeek overflowed its banks several times in the recent past, causing considerable damage within the town limits of Geraardsbergen. To reduce the problems caused by flooding, the VMM had the task to create a large-scale overflow area within the WAVE project that will have a maximum capacity of approximately 300,000 m³ of water. The organization employs 1000-1500 people out of which 15 participated in WAVE. Their budget share was 15% and their main achievements were: to purchase data to better predict flooding, (2.9) construction of 2 controlled flood areas which was an innovative techniques using pre-loading masses), (3.7) intense communication regarding works and awareness raising of stakeholders with 4 information leaflets, 1 newspaper, 3 events and an-one-day forum event. From this organization one partner was interviewed.

Wasserverband Eifel-Rur (WVER) Düren (DE)

Figure 8: WVER (Wave_end_report, 2013)

WVER is a regional water authority which aims to work with the City of Düren and the lower-tier water boards involved improving circumstances for the local population. The Gürzenicher Bach flows through the suburbs of the city of Düren. The stream has its source in the Eifel region (Hürtgenwald) and enters Düren via the Gürzenich district, where it criss-crosses through the built-up area. In high-water periods, the stream tends to overflow its banks and flood the streets and homes nearby. The organization employs 500-600 people out of which around 10-15 participated in WAVE, their budget share was 12%. WAVE has brought climate change as a guiding catchment wide principle into the minds of the German water board staff and management. Such a principle was not present at the start of the project in 2008. The current planning process at WVER considers if a plan is climate safe for the future, is the proposed project climate friendly and can we safe CO2. For the German partner this is a completely new mind set and well as fundamental different approach to planning than before WAVE [FR, p. 11]. Their outputs were: (1.6) feasibility study, generation of energy from vegetation waste , (2.6) study on how to tackle stream restoration and a pilot stream restoration by throwing large pieces of dead wood in a river. Also they organized (1.6) stakeholder involvement in river planning and (3.5) communication about WAVE. From this organization one person was interviewed.

Waterschap Groot Salland (WGS) Zwolle (NL)

Figure 9: WGS (Wave_end_report, 2013)

This water board is involved in water management in the "lowland" of the Netherlands. That means that the area has polders and dikes. Waterschap Groot Salland takes a broad approach to water management and, like many water boards in the Netherlands, is greatly concerned with flood prevention. It employs 350 people from which 15 participated in WAVE. Their budget share was 16%. Their achievements included (1.7) a study on local climate preparedness f municipalities towards climate change, (2.8) construction of water storage area and (2.8) fish passages. Of course they also produced newsletters, meetings, information centers and the Dilemma Game which was done from one of their sub-partners. The contact partners from this organization were unable to give interviews.

Waterschap Regge en Dinkel (WRD) Almelo (NL)

Figure 10: WRD (Wave_end_report, 2013)

The water board focuses on policy-making and on flood prevention. Water retention is another important point of concern. The organization was the lead partner of the project and the biggest budget shareholder with 23%. The organization employs 350 people out of which 15 were involved in WAVE. Their problems were Problems regarding River Regge are: past canalization, ad hoc situation with different interest organization (nature conservation, tourism etc), lack of coherence. Solutions needed were; climate proof measures, stakeholder needs, monitoring communication (Project proposal, 2008; Vinke-de Kruijf, 2015) . Their achievements included; the (1.3) inspiration book "restoration in Regge", (2.2) stream restoration, with 2 included retention areas. They also (2.2) conducted stakeholder discussion for stream restoration and finally (3.2) an exhibition center about river Regge. Nowadays the name of the waterboard is Vechtstromer.

4.3 Project interactions and activities

Interactions occurred when participants of WAVE had the opportunity to connect and collaborate in order to generate substantive knowledge for the projects and develop (beneficial) relationships. Project interactions and activities are; joint meetings (Joint Actions and Job Rotations), cite visits and conferences. Joint Actions included workshops, presentations, and interactive dialogues on case studies relevant to the themes, mentioned in the bullet points below. Furthermore, the concrete results produced in WAVE were further funded and supported from the working packages (WP) responsible for: the implementation of works, reports and documents, policy guidelines, recommendations and finally communication materials. In total 24 actions were organized; WP1 on planning, WP2 on measures and WP3 about awareness: the people's perspective. Every thematic was further supported with transnational meetings, steering group meeting, publicity on project level and financial management, reporting and auditing. The facilitated topics of Joint Actions are presented below.

4.3.1 Joint actions

- JA 1.1: Improving integration of water management in spatial planning

The aim of this Joint action is to integrate the knowledge on the value of water into the spatial planning in policy or political process. Furthermore, all actors commonly agreed the need to pursue political support for climate proof regions. Partners had the opportunity to see the Dilemma Game which could be later used for municipality meetings with politicians. The joint action included a field trip in Kampen.

- JA 1.2: Regional risk analysis

One of the objectives in the WAVE project is improving the knowledge of risks, the predictability and adaptability of climate change, as people will therefore be less vulnerable to climate change. In this Joint Action all partners try to get a better insight in the risks for the water resources due to climate change. Partners prepared a homework assignment on how countries use cost/benefit analysis and then they shared their experiences on how the message from this action could be known and trusted. After the presentations, discussions followed were partners co-decided how to collaborate better with one another. Outcomes of this joint action were the sharing of contacts, information relevant to the topic of emergency

response and risk planning and the realization of similarities and differences between countries. Even though partners thought that the presentations were too many, they generally appreciated the joint action agenda.

- JA 2.1: Creating a spatial balance

An important question is which innovative measures can be taken to adapt to the effects of climate change at regional level, taking into account the physical conditions of the area and its water system. The objective of the Joint action was for partners to share their knowledge and cooperate on the basis of case studies of existing integrated plans on multifunctional land-use. The outcome of this joint action was a theoretical and practical framework with ideas on participation in the investment projects. Impressions from the workshop said: "it was hard work in an enjoyable environment with enthusiastic participants".

- JA 3.1: Emergency response plans and policies

The central theme of this project is how to cope sufficiently with 'extremes'. Differences between regions provide examples for other areas. Partners from SCC and IAV gave presentations on how to manage communication during crisis. These partners were also interviewed and their impressions about the workshop were very positive. They indicated that they enjoyed the reactions from their audience and everybody was very willing to make their own comments for consideration.

In total 14 joint action workshops were held, involving 60-70 people from different departments of the 6 project partner organizations. There was one combined workshop, JA 1.2 and JA 3.1 combined a workshop in May 2010 in Somerset (UK).

4.3.2 Job rotation

During WAVE two official job rotations were organized. In 2011 a German biologist and project leader from WVER spent 2 weeks at the French partner IAV to learn about fish migration and eel populations. This French knowledge greatly strengthened the know- how about fish populations of the German partner.

In 2012 the second job rotation saw a Dutch staff member of WGS spent 2 weeks in the United Kingdom to learn from SCC on how community participation and farmers advisory session are organized in Somerset also found in WAVE final report. Below follows a figure with the workshops and conferences.

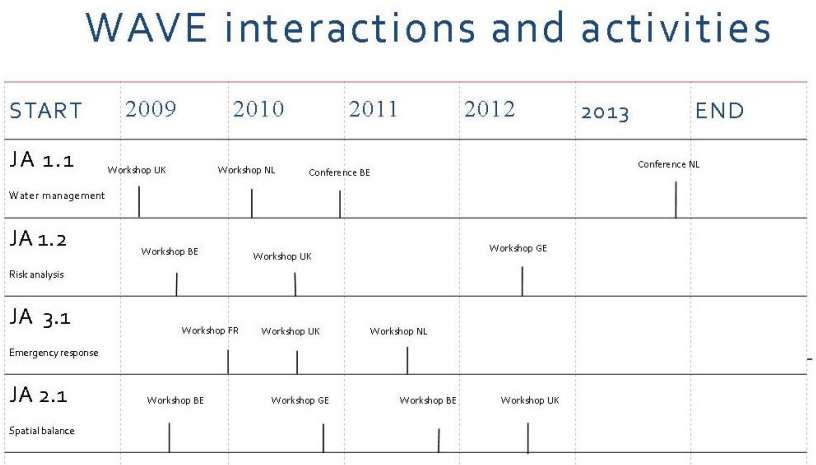

Figure 11: Overview of interactions and activities

CHAPTER 5: **RESULTS**

This chapter provides the results of the second research question. First section begins with substantive knowledge outcomes from which the co-produced will be subjected to process tracing analysis. Then, the relational knowledge outcomes are presented, which as mentioned in chapter 3, are developed; they did not exist before the transnational cooperation of WAVE thus they grow when partners interacted *with* each other (Hachmann, 2008). Afterwards the applied process tracing analysis examines the conditions which explain the extent partners developed them. Final section of the chapter elaborates on the conditions and their slight, moderate or substantial significance they had on the outcomes.

5.1 Substantive knowledge outcomes

For 5.5 years water authorities from 6 North West Europe regions worked together on 24 actions to adapt regional water systems to effects of climate change. The goal was to create a "wave" of solutions to make regional river catchments "climate proof" (Project proposal, 2008). The outputs of actions are the "evidence" of substantive knowledge outcomes. Table in Appendix 1 presents an overview of the outputs of WAVE (Wave_end_report, 2013). In the following part the most important substantive outcomes are briefly described. Selection of outcomes for discussion is based on the descriptions found in the final report of WAVE and the interviews with partners. Furthermore, the extent that the outputs are new or development of existing tools derive from the project cluster of SIC- ADAPT. The interventions of partners are titled according to the working package they were financed upon and to order of appearance in the final report of WAVE.

Substantive knowledge outcomes from wp1: planning

1.4 Action SCC: the visualization tool

The visualization tool is a website created by one of the outsourced sub-partners of the Environmental agency and the SCC. The website presents the impact that climate change and socio-economic scenarios would have on the landscapes of Somerset. The tool is a product of knowledge because it required technical skills (in programing and 3D design) and the implementation of data (water levels, geomorphological conditions, demographics etc.) into scenarios of climate change and socio-economic changes. The tool is considered as one of the significant outputs of WAVE. Moreover, influenced positively other WAVE participants, - VMM specifically which later used it again for their own context. However, the efforts to develop the tool belong to the outsourced consultancy agency and not to WAVE participants. The tool is only presented in the final report of the project Wave_end_report (2013), as an example of the influence that visualization has in raising awareness and informing citizens about climate change. The knowledge production process was initiated from the commissioner (project owner is the SCC), but development belongs to the employers of the consultancy agency [I8]. Therefore, the tool would be more suitable for a demonstration of knowledge transfer process rather than co-production. As a result, will not be subjected to test. Further evidence on that assumption is that none of the interviews with the British partners [I2][I4][I8], mentioned the visualization tool as a knowledge co-production outcome. Specifically, interview [I8] doubts the outcomes of the tool as socioeconomic scenarios seem to have a stronger negative impact on the landscape than climate change scenarios.

1.5 Action SCC: Brue Valley Master plan opportunity document

The purpose of the opportunity document was to plan landscape scale conservation in the Brue Valley over the next 10 years. The opportunities identified represent the building blocks of a more connected and functional landscape. It illustrates practical projects which would turn national public policy (e.g. landscape scale conservation and an ecosystem services approach) and conservation sector ambition (e.g. see South West Nature Map, Somerset BAP) into on-the-ground action and tangible results. The content of this document has been generated through a series of specialist workshops and meetings with partners from the environmental sector, technical mapping and habitat modelling. The partnership includes Natural England, the Environment Agency, and the Royal Society for the Protection of Birds (RSPB), the Somerset Drainage Boards Consortium, Somerset County Council, Somerset Environmental Records Centre, the Farming and Wildlife Advisory Group (FWAG), the Hawk and Owl Trust and the British Association for Shooting and Conservation (BASC). Project was funded from WAVE and Wetland Vision. The document also presents opportunities for projects which, taken together, would provide landscape-scale conservation and environmental benefits to the Brue Valley. It is designed to be used by conservation agencies and stakeholders to assist collaboration in identifying and pursuing mutually beneficial goals. The document is not designed as a tool for public engagement and its circulation is advised to be restricted to the conservation sector. It may, however, be used as a basis for the production of public consultation material in the future (Natural England, 2010)

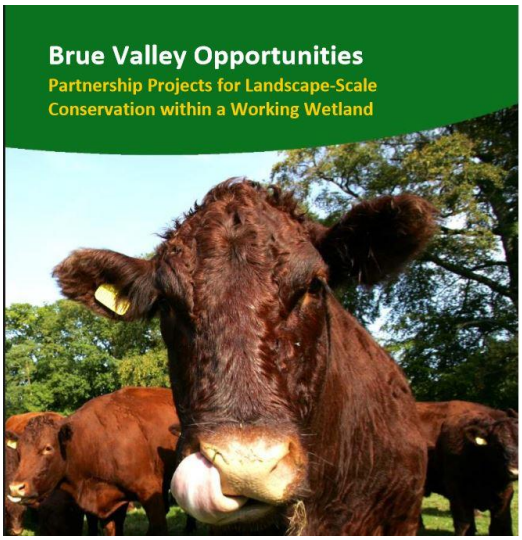

Figure 12: Cover Brue Valley Opportunities (Council, 2017)

The British partners who collaborated for creating the opportunity document have a long standing relationship in collaboration [I2]. Obviously, this document entails a sharing of substantive knowledge between the British partners. Moreover, in the interview [I8] is mentioned that other WAVE partners provided suggestions on the content of the document. Specifically, new additions of substantive knowledge were provided on the topic of managing farmland for economic and ecological gain. The respondent [I8] explained how the French and Dutch practises on the topic helped towards updating the content of the report and initiated consideration for alternative plans in the future. This is also confirmed from interviews with the non-British partners when they were asked how to describe their contribution in additions. This addition from the other partners provides indication for selecting action 1.5 opportunity document as a potential knowledge co-production outcome to be subjected into process tracing.

1.6 Action WVER Integrated planning lower course Rur and 1.7 Action WGS Planning East side Zwolle

The outcomes of these actions, are basically proposals for integrated spatial planning and water management in the regions of Eifel- Rur, Germany and Zwolle, Netherlands. The knowledge entailed on both outcomes is relevant to climate change adaptation and water management. Moreover, both outcomes use the stepping stone principle, which means that areas with particularly high ecological values or potential are selected, developed and protected on a regional scale [JA 2.1 Oct 2010]. The investment plans were presented initially in JA 2.1 May 2009 and the integration of the stepping stone principle was added

one year later in JA 2.1 Oct 2010. In the latter JA, the stepping stone principle was presented in detail, and was further explained with a mapping exercise, organized by the German partners. However, knowledge acquired from the exercise is a knowledge exchange process, because the expert shares his knowledge to the participants. The participants considered the exercise as an interesting learning experience [JA 2.1 Oct 2010], but their concluding remarks imply that they did not use that information on their own context. For example conclusions about the stepping stone approach are: "it's a good scientifically, well researched and complete method, but in practise the selected areas might not be available for the most desired development from a nature-point of view", "in Flanders a similar pragmatic approach is followed"." In France a more scientific method is applied but with more different parameters" and in the UK the stepping stone principle does not apply well to the natural river conditions. As a result, despite the similarities of the final outcomes 1.6 and 1.7 the knowledge process that connects them better is knowledge exchange and thus will not be subjected to process tracing analysis.

Substantive knowledge outcomes from wp2: measures

Action 2.2 WRG retention ponds (for water level control and storage in cases of extensive flooding.)

Retention ponds are used in the Netherlands before 2008 (Oosthen, 2006). They are one of the most environmental friendly measures against flood damage as they do not disturb natural habitat and do not use hard structures (such as dikes) that may create soil erosion in the long term future. However, substantive knowledge for their design and construction from the non-Dutch partners was not used. This is also confirmed from the interview with the project leader [I1]: "We already have a very strong technical background so we did not use new knowledge from partners". However, visiting retention ponds in Zwolle (hosted from WRG and WGS) was an exciting and inspiring experience for other partners. In interview [I3], the respondent mentions: "the field visits in the Netherlands was very educative as the Dutch are steps ahead in water management than us." Therefore, the retention ponds will not be subjected to process tracing because they were used as knowledge transfer process.

Action 2.7 Deadwood WVER and action 2.4 SCC Woodland planning

These two outputs can be considered as substantive knowledge outcomes. Their common knowledge foundation is the utilization of dead wood remains as a method to restore river banks in a cheap way. In most natural streams and rivers, dead wood is an abundant substrate with major effects on the in-stream environment (Hering et al., 2000). It has significant influence upon channel processes and thus determines, for example, bed form, cross-sectional shape, sinuosity and valley bottom landform (Montgomery et al., 2003) and even hydraulic exchange with the hyporheic and groundwater zones . Wood also provides refuge, habitat diversity and food for aquatic organisms and its presence enhances aquatic biodiversity (Mutz et al., 2006). However, the method exists before WAVE and the implementation approach from the two countries didn't portray similarities. The British partners used volunteers to assist with the activities whereas the German partner included range of relevant stakeholders to provide information about the benefits of the method. Therefore these two substantive outcomes do not include enough traces of co-production. Instead these actions were developed with knowledge exchange process.

Substantive knowledge outcomes wp 3: people

Action 3.2 WRD Regge exhibition, 3.5 WVER communicating WAVE and 3.4 SCC WAVE in Somerset

Regge exhibition dealt with informing local stakeholders about the role of the river, and the effects climate change can have on it. Prepared in 2009, the Regge exhibition centre was opened in 2011. However, when the lead partner [I1] was questioned about this outcome; he described it as a knowledge transfer process. Specifically, the team responsible for communicating climate change in Regge, rather used information from the British partners who "were very good in communicating with people and the media" [I1] and implemented them in the Dutch context. The interview [I1] describes the process of getting knowledge direct thus the element of co-production is omitted. Communicating WAVE in Germany consisted of informing local stakeholders in the project area about the investments in WP2 of WAVE. Since the work in WP2 where slightly delayed, the actions moved to 2012 when infoboards were placed (Wave_end_report, 2013). Also several press releases and coverage of the projects in regional media was achieved. Because this output is not discussed during the joint actions of WAVE which ceased in 2011 cannot be considered as a potential knowledge co-production outcome. Finally communicating WAVE in Somerset was somewhat reduced because the attention shifted to actual adaptation measures and works in river catchment, necessitated by extreme weather events. Summarizing, the three substantive knowledge outcomes will not be subjected to process tracing analysis.

Action 3.6 WGS –climate awareness game (Dilemma)

Figure 13: WAVE partners getting familiar with climate awareness game (JA 1.1March 2010)

A special way to raise awareness about climate change is through a game(WAVE_magazine_no.5, 2013). WGS has developed a climate game, and has had several game sessions with local politicians and toured the area to play the game at schools. The game however, was developed from one of the sub-partners of WGS (Podium) in JA 1.1 March 2010. The game however, did not result from a common realization of partners that such alternative methods may increase climate awareness. Therefore the knowledge and conceptualization belongs only to the Dutch partners responsible for its presentation. Nevertheless, the game was one of the most interesting outcomes according to the partners whereas is mentioned in JA 1.1 March 2010 "A simulation game is a useful tool to educate spatial planners and the public". As a further result, more organizations of WAVE considered to use climate awareness games in the future. In summary the climate game awareness game does not collect enough evidence as a knowledge co-production outcome and will not be subjected either in the process tracing analysis. The knowledge process that describes this outcome is transfer.

Action 3.3 SCC- farm water plans

This action aimed to help farms plan their water resources in a better way that mitigates the effects of wetter winters and drier summers (SCC, 2011). These Farm Water Management Plans covered water use, retention, quality and storage. Initially, farm water plans were presented in JA 2.1 Oct 2010 in order to demonstrate financing techniques and collaboration in multifunctional projects. Before the Somerset floods many individual farm meetings and farmer consultations were held and a number of water saving and storage demonstration sites were opened. Furthermore, farmers and stakeholders were informed about

possible small-scale water conservation measures. However, as revealed from interview [I8], communication with farmers is not an easy task. First of all, landowners and farmers lobby is a powerful one and when circumstances arise for land purchase (even from big private corporations like railway companies) they are very difficult to be persuaded. They resist even more strongly for climate change adaptation projects. Farm owners want to preserve their water levels in low heights under the assumption that this strategy protects their yield and land. Some powerful land owners initially agree to higher water levels, and accept public funds for their management choice later change their minds and pressure the drainage board to increase them again. However, the Somerset floods alerted the farmers towards changing their attitude. As interview [I8] recalls, attitudes changed when the British partners used the example of the Dutch project Room for the River to actually convince the farmers that alternative solutions are present. On this idea, more WAVE partners added their own viewpoints and helped SCC to bring again the Farm Water Plans into discussion. Therefore, the farm water plans are a potential knowledge co-production outcome to be subjected to process tracing.

5.1.1 Overview substantive knowledge outcomes

Summarizing, the substantive knowledge outcomes were exchanged, transferred and to some extent co-produced. Actions 1.6 and 1.7 are exchanged knowledge outcomes, because partners used the stepping stone principle and remained to provide information how the principle applies in different contexts. Likewise, actions 2.4 and 2.7 used a common method to restore the river banks naturally and knowledge was exchanged on different approaches used for implementation. Transferred knowledge outcomes are; 1.4 visualization tool, 2.2 retention ponds, 3.6 climate awareness game and actions 3.2, 3.4 and 3.5 with the methods of communicating WAVE. The first three outcomes (1.4, 2.2, 3.6) were transferred to other organizations as mentioned in Wave_end_report (2013). The actions 3.2, 3.4 and 3.5 were developed in collaboration but knowledge was taken direct from the British partners and was adapted into the Dutch context. Action 1.5 and 3.3 are considered the substantive knowledge co-production outcomes. As such, they will be subjected into process tracing.

5.2 Relational knowledge outcomes

Relational knowledge outcomes are expected to become visible on frames, trust and networking. As explained in chapter 3 relational knowledge outcomes are developed. The analysis below demonstrates the extent to which frames, trust and networking were co-produced.

Frames: The final report of WAVE states that partners, organization board members and politicians co-agreed in framing climate change as extreme weather event. This is a result concluded from JA 3.1 May 2010 where is quoted "It is not a topic that is appealing to the public, therefore it is not "politically sexy" (appealing)" (Wave_end_report, 2013). Instead the term of extreme weather events was suggested as more attention catching term also for the media. Next indication is assigning the role of the owner of climate change issues to regional authorities. Designating responsibilities for climate change issues is a progressive step towards de-centralizing decision making for climate change adaptation. However, the actual institutional differences between countries of North West Europe were obvious in WAVE. These differences are evident on how organization are funded and operate. In France water organizations such as the IAV still have to report to the Direction de l' Eau (water supervision board). In Germany, local water authorities of the Rur area report to the Lander government of the German state. UK is heavily influenced from the political decisions of the central government. For example, all interviews with the British partners, expressed their concern that funding was difficult to be found when the financial crisis of 2008-2010 started

happening. Similarly, they are now concerned about the negative consequences Brexit may have in water management for climate change adaptation. Nevertheless, this new framing approach in CCA influenced later more European countries and organizations to include climate proof measures into planning. Moreover, in WAVE magazine many partners report that WAVE changed substantially how they viewed climate change and how they included it in their organizations. For example the British project manager says: " I think that WAVE has contributed to a new way of thinking about how we can make the catchment areas in Somerset more climate-adaptable" (WAVE_magazine_no.5, 2013). Finally, the majority of respondents said that to some extent their frames for climate changed adaptation, changed, got deeper and it was depended on the influence that communication with other partners played.

Trust: trust and commitment developed for all the partners of the WAVE project, as it can be confirmed from all the interviews [I1-8]. Respondent [I2] mentions: "The results of cooperation have been appreciated ". Specifically partners showed confidence to the outcomes of WAVE and received satisfaction from their execution. The lead and European partners saw WAVE as an excellent opportunity for collaboration and confirmed that they would happily participate again in similar INTERREG projects. This information indicates an intension to commit in future to partners. During the project's interaction activities, partners developed the sense that their peers where honest and transparent in information sharing, thus credibility and liability amongst partners was genuinely developed. The level of trust and commitment was encouraged from the beginning of the project. Joint Actions had the open approach: "If one of the partners is leading a project it is important that the other parties involved feel committed towards the projects" [JA 2.1 May 2009]. No negative answers that doubted trust were mentioned in the interviews, therefore trust is a relational knowledge outcome that represents WAVE project and is subjected to process tracing.

Networking: this specific relational outcome developed effortlessly on many levels of participants of WAVE. From the early start of JA 2.2 October 2010 , the main message is "work together, what you can do what are you willing to do". Higher board members collaborated naturally and unintentionally for the needs of the project and cooperation grew stronger after the floods in Somerset (Wave_end_report, 2013). Respondents were very positive about networking creation. [I4] says: "I do have a very broad network of people because that is the nature of my job. I know that in terms of contacts from WAVE there is a reservoir of information". However, only interview [I8] connects networking with the shared budget. Nevertheless, due to the majority of supportive comments, networking is qualified for process tracing analysis. As a last comment, the success of networking becomes evident with the DROP and other INTERREG project as a follow up of WAVE.

5.2.1 Overview relational knowledge outcomes

Frames, trust and networking developed mainly from the project's interaction and activities. Activities that facilitated relational knowledge building are evident from the early start of the project. Participants were asked to present their issues of interest and co-design the themes of the workshops that followed. Furthermore, participants during the joint actions where encouraged to reflect, and note what information is relevant for them, what they want to improve and what information applies to their context. In fact, participation in transnational cooperation projects creates supranational networks potentially able to give rise to international knowledge transfers based on "relational" distance, going beyond geographical proximity. If geographical proximity is important for exchanging knowledge, participation in transnational cooperation projects can be a way of reconciling the need for "face to face" contacts (through the mobility of partners during and after the project) with knowledge sharing via interactions over long distances to co-

produce (Di Cagno et al., 2016). Summarizing relational knowledge outcomes were co-produced by partners because they collectively established the "rules of the game" (Brugnach et al., 2012).

5.3 Application of process tracing on knowledge outcomes

The process tracing method, as presented in the methodology chapter, involves 4 different tests of causation. Coupling the appropriate test which each condition depends on; the characterization conditions take (sufficient or necessary) and second, whether a condition belongs to the principles of the co-production definition. For conditions that clues are not enough to establish causation, I perform a straw in the wind test. Up to this step, I have codified the answers from the interviews and the evidence from the document analysis in a way that knowledge outcomes are the starting point. Then, as I explained in section 3.3 for every outcome there is hypothesis and its rival. If there are supporting factors (i.e. if there is a borderline that 5-8 interviews reply positively that trust was developed *with* each other because they felt they were dealing with the same problems, I interpret this information such as "partners develop trust due to reciprocity").

I symbolize the outcomes as:

S1: action 1.5 SCC Brue Valley opportunity document

S2: action 3.5 SCC farm water plans

F: Frames

T: Trust

N: Networking

Table 11 , 12, 13 present the results of the causal tests for process tracing analysis. The vertical column uses the abbreviations of the box above. For every knowledge outcome, I present whether the test passes or fails and then I explain what happens to the main and rival hypothesis. For the tests that in the first place not enough evidence was found to establish causation I perform a straw in the wind test

Table 11: Process tracing results for project design conditions

C1: Project design conditions	C1,1: previous collaboration	C1,2: organizational culture	C1,3: reasons for co-production	C1,4: Project goals
Test	**Smoking gun**	**Hoop test**	**Smoking gun**	**Double decisive**
S1	Fails the test	Passes the test	Passes the test	Fails the test
	Main Hypothesis is not eliminated	Main hypothesis is relevant	Confirms hypothesis	Main hypothesis is eliminated
	Rival is moderately strengthen	Rival moderately weakens	Rival hypothesis is substantially weaken	Rival hypothesis substantially strengthens
S2	Fails the test	Passes the test	Fails the test	Fails the test

	Main Hypothesis is not eliminated	Main hypothesis is relevant	Main Hypothesis is not eliminated	Main hypothesis is eliminated
	Rival is moderately strengthen	Rival moderately weakens	Rival is moderately strengthen	Rival hypothesis substantially strengthens
F	Fails the test	Fails the test	Passes the test	Passes the test
	Main hypothesis is not eliminated	Straw in the wind Main hypothesis not eliminated but slightly weakened	Main hypothesis is confirmed	Main hypothesis is confirmed
	Rival is moderately strengthen	Rival hypothesis is slightly strengthen	Rival hypothesis is substantially weakened.	Rival hypothesis is eliminated
T	Passes the test	Passes the test	Passes the test	Passes the test
	Confirms hypothesis	Main hypothesis is relevant	straw in the wind Main hypothesis is relevant not confirmed	straw in the wind Main hypothesis is relevant not confirmed
	Rival hypothesis is substantially weaken	Rival moderately weakens	Rival hypothesis is slightly weakened	Rival hypothesis is slightly weakened
N	passes the test	Passes the test	Passes the test	Passes the test
	Confirms hypothesis	Main hypothesis is relevant	Confirms hypothesis	Main hypothesis is confirmed
	Rival hypothesis is substantially weaken	Rival moderately weakens	Rival hypothesis is substantially weaken	Rival hypothesis is eliminated

Table 12: : Process tracing results for interaction process conditions

C2: interaction process conditions	C2,1: quanity	C2,2,1: meeting interests	C2,2,2: ambiguity	C2,2,3: transparency	C2,2,4: communication	C2,2,5: representativeness	C2,2,6: reciprocity
Test	**Double desicive**	**Smoking gun**	**Smoking gun**	**Hoop test**	**Smoking gun**	**Double decisive**	**Hoop test**
S1	Fails the test	Passes the test	Fails the test	Passes the test	Passes the test	Passes the test.	Passes the test
	Main hypothesis is eliminated	Confirms hypothesis	Main Hypothesis is not eliminated	Main hypothesis is relevant	Confirms hypothesis	Main hypothesis is confirmed	Main hypothesis is relevant
	Rival substantially strengthens	Rival hypothesis is substantially weaken	Rival is moderately strengthen	Rival moderately weakens	Rival hypothesis is substantially weaken	Rival is eliminated	Rival moderately weakens
S2	fails the test	Passes the test	Passes the test	Fails the test	Passes the test	Passes the test.	Passes the test
	main hypothesis is eliminated	Confirms hypothesis	Confirms hypothesis	main hypothesis is eliminated	Confirms hypothesis	Main hypothesis is confirmed	Main hypothesis is relevant
	Rival substantially strengthens	Rival hypothesis is substantially weaken	Rival hypothesis is substantially weaken	rival is moderately strengthen	Rival hypothesis is substantially weaken	Rival is eliminated	Rival moderately weakens
F	Passes the test	Passes the test	Fails the test	Fails the test	Passes the test	Passes the test	Passes the test
	Main hypothesis is confirmed	Confirms hypothesis	Main Hypothesis is not eliminated	Straw in the wind Main hypothesis is not eliminated but slightly weakened	Confirms hypothesis	Main hypothesis is confirmed	Main hypothesis is relevant

	Rival hypothesis is eliminated	Rival hypothesis is substantially weaken	Rival is moderately strengthen	Rival hypothesis slightly strengthens	Rival hypothesis is substantially weaken	Rival is eliminated	Rival moderately weakens
T	Passes the test	Passes the test	fails the test	Fails the test	Passes the test	Passes the test	Passes the test
	Main hypothesis is confirmed	Straw in the wind main hypothesis is not confirmed but relevant	Straw in the wind main hypothesis is not eliminated but slightly weakened	main hypothesis is eliminated	Confirms hypothesis	Main hypothesis is confirmed	Main hypothesis is relevant
	Rival hypothesis is eliminated	Rival hypothesis is slightly weakened	Rival hypothesis is slightly strengthened	rival is moderately strengthen	Rival hypothesis is substantially weaken	Rival is eliminated	Rival moderately weakens
N	Passes the test	Passes the test	Passes the test	Passes the test	Passes the test	Passes the test	Passes the test
	Main hypothesis is confirmed	Confirms hypothesis	Straw in the wind main hypothesis is not confirmed but relevant	Passes the test hypothesis is relevant	Confirms hypothesis	Main hypothesis is confirmed	Main hypothesis is relevant
	Rival hypothesis is eliminated	Rival hypothesis is substantially weaken		Rival moderately weakens	Rival hypothesis is substantially weaken	Rival is eliminated	Rival moderately weakens

Table 13: Process tracing results for participant conditions

C3: participant conditions	C3,1: Distribution and coverage of co-production roles	C3,2: Leadership style
Test	**Double decisive**	**Hoop test**
S1	Passes the test	Passes the test
	Main hypothesis is confirmed	Main hypothesis is relevant
	Rival hypothesis is eliminated	Rival moderately weakens
S2	Passes the test	Passes the test
	Main hypothesis is confirmed	Main hypothesis is relevant

	Rival hypothesis is eliminated	Rival moderately weakens
F	fails the test	Fails the test
	main hypothesis is eliminated	main hypothesis is eliminated
	Rival substantially strengthens	rival is moderately strengthen
T	Passes the test	Passes the test
	Main hypothesis is confirmed	Main hypothesis is relevant
	Rival hypothesis is eliminated	Rival moderately weakens
N	Passes the test	Passes the test
	Main hypothesis is confirmed	Main hypothesis is relevant
	Rival hypothesis is eliminated	Rival moderately weakens

Example of a double decisive test

Condition: quantity (time) of interactions

Test: Double decisive test because time is considered as a necessary condition for knowledge development and sharing.

Hypothesis: The quantity in terms of frequency and duration during the interaction process allowed time for new knowledge development, reflection, synthesis and suggestions.

Rival hypothesis: Time was restricted; Joint Actions did not have good time and task management.

- S1: The quantity of interactions can explain S1 as a knowledge co-production outcome

Evidence: WAVE organized a considerable amount of meetings thought a 5-year period. Joint Actions consisted of 4 series of thematic workshops, which were attended by 1-2 persons per partner (usually but not necessarily the same). Workshops had a length of 3-4 days and allowed for in-depth discussions and the exchange of knowledge with peers (i.e. persons with the same disciplinary background). At one occasion, workshops were partly combined (risk and emergency) so that persons of diverse disciplines could mix (e.g. hydrologists and emergency situation managers). One workshop was combined with a conference [JA 1.1, November 2010] (Vinke-de Kruijf, 2015).Comments from the previous research indicate that "Length of workshops was too short to develop new knowledge" .

Result: fails the test, hypothesis is eliminated and rival is substantially strengthened

- S2: The quantity of interactions can explain S2 as a knowledge co-production outcome

Evidence: following the evidence provided in the paragraph above, additional inputs from the interviews mention that: [I5] commented "more time and budget could improve the added value from WAVE". Moreover, interview [I8] and [I6] stress out that "we already have a heavy workload, therefore additional time for interaction would be good".

Result: fails the test, hypothesis is eliminated and rival is substantially strengthened

- F: The quantity of interactions can explain frames as a knowledge co-production outcome

Evidence: frames or differently new policy arrangements (Gray, 2004), in many reports of the Joint Actions the needs for policy improvements and better communication of the climate change adaptation agenda are found. For example, in JA 2.2 October 2010, the concluding remarks from partners are: policy making should be more conceptual and scientific. Furthermore, partners wandered "how WAVE can respond to EU policy requirements?" and thus proposed methods to deal with the unpredictability of EU's plans.

Result: passes the test and hypothesis is confirmed

- T: The quantity of interactions can explain trust as a knowledge co-production outcome

Evidence: trust and its foundations were created over an almost-ten –year relationship of collaboration between 5out of 6 partners. The amount of interaction from JAF (the predecessor of WAVE) and WAVE can explain this outcome. Even the German partners who initially where not motivated to participate, after JAF they were very enthusiastic to collaborate again [I6]. The enthusiasm and motivation may work as foundations for commitment thus can explain the causation.

Result: Passes the test , hypothesis is confirmed

- N: The quantity of interactions can explain networking as a knowledge co-production outcome

Evidence: similarly to trust, networking developed before and after the closing of WAVE. Thus the amount of interactions provided, the several visits to participating countries did indeed create professional relationships established from the first Joint Action 1.1 of WAVE. In the report partners conclude that they "should keep in touch" .

Result: passes the test and hypothesis is confirmed.

This illustrative example was performed for all the conditions and their assumed potential to explain knowledge c-production outcomes. Overall, project design conditions can explain with all positive tests S1, the Brue Valley opportunity document and Networking. They cannot explain the S2, the farm plans, because only one test passed. Also they can explain to moderate extent trust. Furthermore they can interpret to a slight extent frames. The substantive outcomes cannot be explained from quantity of interaction process whereas the relational can be interpreted. The quality of the interaction process can explain to the greater extent the substantive knowledge outcomes with only two test failing. However, the tests that failed are 2 smoking gun tests which strengthen the rival hypothesis and 2 hoop test which totally eliminate the hypothesis. The frames also can be justified from the interaction process with only one test failing. Then, trust can be totally explained from the quality of the interaction process with all tests passing. On the same page, networking can also be interpreted from the interaction process conditions. The participant conditions can explain the substantive knowledge outcomes and from the relational outcomes can justify networking and trust. Frames cannot be explained from the participant conditions because in their interviews frames for them did not change substantially. There is rather a deeper view on the issues of climate change adaptation.

5.4 Overview of results for causal mechanisms

5.4.1 Causal mechanism of project design

The smoking gun test for the condition of previous collaboration passes the test for trust and networking. The outcome of the test means that the main hypothesis is confirmed, and the rival hypothesis is substantially weakened. This means that trust and networking were influenced to a very big extent to the previous collaboration. However, this causation does not eliminate the contribution of the present collaboration either. The reason why this happened, is that previous collaboration involved the same context of partners who achieved collectively satisfying results. On the other hand, the smoking gun test fails to explain s1, s2 and frames. It means that s1, s2 and frames can moderately be explained from the previous collaboration. There is chronological evidence that makes smoking gun test fail. JAF was implemented from 2003-2007(JAF, 2003) and the s1 was introduced in 2009. Furthermore s2 cannot be explained due to difference in themes. JAF was focused more in flood management in river catchments and not so much in communicating with farm owners. Framing climate change adaptation was not a European high priority before 2008. In total the condition of previous collaboration is moderately weakened.

The condition of organizational culture is relevant to explain s1, s2, T and N. In practise this means that the system of values beliefs, vision and strategy of an organization is very relevant to the development of knowledge co-production. In the case of WAVE it translates that the participating organizations (water authorities, NGOs and knowledge institutes) were open to knowledge sharing and regarded transnational cooperation as beneficial. However, these organizations are not operating in a competitive market were pricing, profit and sales have primary importance. Therefore, it is not to the interest of the organization to border their knowledge to protect from competitors. However as it proves organizational culture is necessary to co-produce knowledge but is not proven sufficient without support from the governance system which they operate in. This explains why the organizational culture cannot explain the creation of new frames. Frames in this case were co-produced not only from the organizations that participated, instead they changed due to the influence of politicians and the general vision of INTERREG IVB projects which endorsed changes in policies and framing issues.

The condition reasons for co-production are confirmed to be conducive for all knowledge co-production outcomes except S2. From the perspective of substance, the test is successful because S1 is a complex landscape with different ecosystem services that need to be in balance. This setting was difficult to be handled in isolation from SCC therefore the additions from other partners were needed in order to find a management strategy for the Brue Valley. The inclusion of different knowledge systems was estimated that it can potentially reduce conflict between the stakeholders of the Valley and create better conditions for climate change adaptation. Furthermore, the new knowledge additions were desired because the project owner (SCC) recognized from the beginning that sharing knowledge with other Europeans would result in better measures [I2]. From the perspective of relations, the condition reasons for co-production translates as; the need to work and collaborate with other Europeans strengthens under the same problems and difficulties thus, promote the development of new frames trust and networking. The condition though complies to an extent with the initial motive for participation in an INTERREG project which by default encourages actors and makes them work together. However, this condition is tested from a "safe" scope because the regional investments are done individually by partners so securing support (with network, common frames and networking) can only give them precedence to their local context.

The condition project goals fail for S1 and S2. The reason that the test failed was because i) the results were predefined and ii) the general direction from the project proposal (Project proposal, 2008)endorsed partners to exchange knowledge. Knowledge co-production is not a project objective; neither is mentioned as a recommended approach. Therefore it cannot explain the S1 and S2. Despite that fact, knowledge co-production occurred. This means that regardless the vision and project deliverables, knowledge co-production can still occur, when other conditions are evident. However, the project's general vision was such to endorse the relational knowledge outcomes. of course, a project vision does not refer literally to F, T and N, but decision making was done horizontally, in terms that participants proposed the themes they wanted to discuss, they also commonly agreed what case studies they wanted to know about. Horizontal decision making is the element that makes the test pass.

Overall the causal mechanism of the project design can establish causation with relational knowledge outcomes. The condition that is mostly affirmative to explain knowledge co-production outcomes is reasons for co-production. It means that themes under discussion,(what is the natural setting, what are the problems, how can we finance interventions) is the most important driver knowledge co-production in the project design. Moreover, relevant to explain is the condition of organizational culture. This means that organizations are more likely to co-produce substance and relations when they are open to participation, collaboration, and different ways of knowing.

5.4.2 Causal mechanism interaction process

The condition of quantity fails for the substantive knowledge outcomes thus confirms the necessity of time in co-production processes. Time and organizational relationships evolve to the rhythm of the "market" that the organization operates in (Barbosa et al., 2014). It signifies that organizations of the public sector (especially water) depend heavily to collaboration with share and stake holders, thus can explain why the test is positive for the relational outcomes. Furthermore, the time devoted to WAVE (5,5 years) was enough to maximize capacity of networking arrangements. Nevertheless, for 5 of the WAVE partners their previous collaboration can also explain why the condition of time was enough to explain the relational outcomes, since this adds 5 more years in capacity building values.

The condition of meeting interests is confirmed for smoking gun test for all knowledge co-production outcomes and is relevant to trust with a straw in the wind test. This conveys that the ability of actors to co-produce and co-develop relationships depends on the extent that issues of concern are in the organizational agenda. Expressions of the agenda can be; facing the same difficulties in managing the natural system, complex network of stakeholders and so on. These common issues that water organizations face, initiated the motivation to engage with one another and as a result knowledge co-production was achieved.

The condition of ambiguity fails the majority of the causal tests thus it indicates insufficient efforts to embrace or resolve it. Instead participants co-existed within differences in values, beliefs and political issues. These differences whereas they were not noticed as a barrier, if actors had to collaborate on a joint issue, would come up more evident. Resolving ambiguity requires time and strong willingness for urgent reasons which in the case of WAVE were not inherent. However, relationships developed regardless of ambiguity and thus mean that in some cases the issue should be left as it is. More is not always better (Brugnach et al., 2011).

The condition of transparency is relevant for s1, trust and networking because liability and no corruption can actually foster people co-develop relationships. It is eliminated as a hypothesis for the s2 and f. failing the

test means that despite being necessary, cannot explain knowledge co-production and thus more conditions result for knowledge co-production outcomes to be developed.

The condition of communication passes all the tests and thus is confirmed to explained knowledge co-production in the level of substance and relationships. Although there may be some subjectivity on the level and quality of communication it means that is a mechanism that enforces the quality of relationships.

The condition of representativeness passes all the tests as well meaning that it is a necessary and sufficient condition to explain co-production. Who is included and who is excluded from the knowledge development process defines how knowledge develops and originates. Representativeness means that all actors contribute to knowledge development by participating in the interaction process that takes place. However, it is no panacea because farmers and other external stakeholders were only informed about the project. They were not asked to co-design or co-implement measures.

The condition of reciprocity is relevant for s2 and was more evident when the flooding in Somerset occurred. The condition of reciprocity is relevant to relational knowledge outcomes when participants face the same difficulties and also enjoy mutual benefits of cooperation. However, the motivations for reciprocity may depend on the practical benefits of transnational cooperation projects (i.e. the budget share) and not in genuine motivation for collaboration.

Summarizing the causal mechanism of interaction process can explain with greater confidence the relational knowledge outcomes (frames, trust and networking). Even though there are 4 straw in the wind tests involved there is relevance to the conditions. From all the conditions the ones that explain all the knowledge outcomes are communication and representativeness. The condition of meeting interests is also confirmed to the greater extent. Moreover, the condition of reciprocity is very relevant for knowledge co-production. The results mean that knowledge co-production fosters when the participants co-design i) decision making ii) co-adopt success factors iii) co- decide on uncertainties.

5.4.3 Causal mechanism of participants

The condition of coverage and distribuition of co-production roles can explain the substantive knowledge outcomes because actors said that all agents were active and contributed equally to knowledge development [I2-8]. The roles of co-production are not relevant to the generation of frames, because participants in higher level of organization administration and politicians helped to shape the new approach in communicating climate change adaptation. Furthermore, the effort participants placed for making the cooperation work, can also explain the generation of trust and networking. However, this condition is under a double decisive test, but in reality the contribution of all partners was not equal. If the test was applied for the transferred and exchanged outcomes, the results would be different.

The condition of leadership style is relevant to the substantive knowledge outcomes thus it means integrative leaders with open attitude towards knowledge have the potential to co-produce substance and relationships. However, the condition of leadership style may also be relevant to cognitive personal attributes of the participants. Therefore the style is only relevant to S1, S2, T and N. For frames, the leadership style and interests of politicians helped for that development thus the condition indicates that is only necessary and not sufficient.

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CHAPTER 6: **DISCUSSION AND CONCLUSIONS**

The present chapter provides discussion on the knowledge outcomes, the internal and external validity and the conclusion. Next, lay recommendations for improving knowledge co-production in transnational projects for climate change adaptation. In the end I elaborate final reflections and future research proposals.

6.1 Discussion

6.1.1 Knowledge outcomes in transnational cooperation projects

The present study aims to investigate the extent that knowledge outcomes in transnational projects for climate change adaptation result from project's interaction and activities and how outcomes can be explained according to the project design, the interaction process and participants. To accomplish the aim, the primary assumption made was that knowledge outcomes can be substantive and relational.

Selecting project outputs to identify substantive knowledge outcomes proved to be a useful approach. First because the research showed that substantive knowledge outcomes are different from products due to the fact they result from the project's interaction activities. Project deliverables and results have been discussed in other researches (Darroch et al., 2002; Nyong et al., 2007) as the expression of knowledge usage and dissemination. Second, the effort to identify the process of knowledge sharing for substantive outcomes enriched the understanding of how transnational cooperation projects actually work. Looking closer the persons involved for the development of the outcome, how outcomes were shared in the workshops (mapping exercise, presentation etc.), and what inspiration gave to other participants made clearer the role of knowledge in transnational cooperation projects. The results indicated that more substantive knowledge outcomes are a product of knowledge exchange and transfer, which is a pragmatic approach to the reality of transnational cooperation projects. This finding points the limitation that knowledge co-production is a process when in cases that not derives genuinely, requires effort, support and engagement.

The relational knowledge outcomes are frames, trust and networking. Enquiring into frames, was elucidative to understand how knowledge for climate change adaptation is communicated with the public and how the perceptions of participants evolved over time. This result added in understanding that knowledge for climate change adaptation that interfaces with citizens can be explained from the quality of interaction processes between public officials. However, other researches include the change of frames as i)a cognitive outcome , ii) examine re-framing as an inherent process of interactions (Jahn et al., 2012) and iii) as a barrier to knowledge co-production (Mostert et al., 2007). To continue, trust is a relational knowledge outcome that is relevant to the majority of conditions examined, but this yields some questions if this result correlates with reality. Although, other scholars regard trust as a procedural parameter,(Brugnach et al., 2011; Lejano et al., 2009), in this research trust and commitment signified more than the mere credibility of organizations, but the motivation of participants to keep collaborating in transnational level for the benefits of climate change adaptation in water management. In the end, networking is a goal generally encountered in the water and public sector, thus evaluating the conditions

which explain how this outcome occurs is applicable in other fields (i.e organization management, European relationships and administration).

6.1.2 Insights from causal mechanisms

Project design (structures) is applicable for understanding how knowledge outcomes result from a co-production process. The conditions that portray a strong causal dependence are organizational culture and reasons for knowledge co-production. Organization characteristics that shape an inclusive culture to different knowledge sources are openness and group thinking. Therefore, the attentive selection of partners from the beginning of the project increases the potential for knowledge co-production to occur. The reasons for co-production reflect how the needs of organizations comply with the themes of the project. The results of the research demonstrate that when organizations pursue enriching their knowledge base with others- within a project theme, substantive and relational outcomes manifest. In a specific project design, reasons for co-production ideally should be connected with the project goals and strategy. However, project goals despite being decisive, knowledge co-production developed on tacit assumptions which govern transnational cooperation projects.

Interaction process is essential to associate how interplay conditions support or oppose knowledge co-production. For the causal mechanism of interaction process the time rewarded for knowledge co-production was not a condition that passed all the tests. This is a result that interprets reality the way it is; time needed for co-producing new substance is long. The approximation from this result leads into the question: when time investment in knowledge co-production is really needed for? In the case of WAVE knowledge co-production was not in the official needs of the project, a more medium knowledge process – knowledge exchange was suggested from the financiers. Regardless, knowledge co-production is suggested to be essential when diametrically different knowledge systems – for instance indigenous knowledge and science, lay people and public officials' are in a collaborative setting (Brugnach et al., 2017; Dewulf et al., 2005; Nyong et al., 2007). Furthermore, knowledge co-production is more applicable to the content of general plans, design principles, safety acceptance and other parameters when multiple valid perspectives or incomplete knowledge fail to solve the problem (Davidson-Hunt et al., 2007; Wall et al., 2017). For instance, a high technology tool (i.e. a visualization tool) which requires expertize and technical skills doesn't essentially require knowledge co-production to be usable.

The quality of interaction process is a subpart of the causal mechanism that may raise oppositions for subjectivity. However, the selection of conditions proved encouraging. Results showed processes where interests are met, actors are represented and good communications co-exist, knowledge outcomes can be co-produced. In the research, a qualitative condition for interaction was (embracing) ambiguity. The analysis of process tracing failed to establish causation with knowledge outcomes. On the contrary, actors felt that they did not have many differences in values and believes. One reason for this inconsistency is the lack of a joint project, where participants would have to collaborate closely and share knowledge more into depth. Despite , ambiguity created from different vocabulary(Simonin, 1999) or different languages was not a significant barrier in knowledge development. However, some scholars (Craps et al., 2015) suggest knowledge co-production as a method to resolve or embrace ambiguity. In practice interactions between organizations and stakeholders for water management issues are more intense when they are not facilitated and the risk of conflict emerges.

The causal mechanism of participants can explain significantly relational knowledge outcomes. The present research didn't use learning tools for measuring cognitive ability. Instead, an approximation with relevant

conditions found in literature examined the effects of knowledge co-production. For example, the leadership style is rather an indicator to better understand how participants handle different knowledge sources and types in the transnational environment. The attention paid to the individual parameter was acceptable for knowledge co-production outcomes, but could be portrayed more satisfactory if the applicability of knowledge continues in individual tasks within organizations.

Overall the learning improvement of the research is on the process conditions that explain knowledge co-production. The methodology suggested was coupled with empirical observations in order to approximate reality as much as possible. The results of the research suggest that attention to the selection of partners based on organizations, holding open interaction processes and endorsing the benefits of collaboration is a catalyst to knowledge co-production in transnational cooperation projects. Furthermore, the extent that the interests of participants align or diverge can affect significantly the extent that knowledge co-production occurs. Another remark that was not applicable in the present research is the lack of a single measure. Instead a transnational project means multiple measures are implemented, and the sense of shared ownership (Jahn et al., 2012) did not apply in the case study. Concluding, the investigation of knowledge co-production through the causal mechanisms is a satisfactory approximation to understand the topic in depth, debate on different conditions and recognize the enablers and the barriers to knowledge sharing and development.

6.1.3 Internal validity

Reflection on internal validity is presented from the scope of methodology used, and the validity of data collected from the respondents.

6.1.3.1 Internal validity reflection on process tracing method

The main research strategies the research followed was i) case study analysis ii) framework and iii) process tracing. Case studies are satisfactory to understand a phenomenon in depth, but single case studies need attention to generalizing the results. Furthermore, selecting WAVE (an action- oriented project) with regional investments was demanding to analyze knowledge co-production because a joint measure would present more clearly the origins of knowledge development. Moreover, a complete framework that measures knowledge outcomes and knowledge co-production does not exist in literature. The most widely used, is the framework of Cash et al. (2003) which evaluates *successful* knowledge co-production. However, the aim of the research was not to evaluate success under the criteria of credibility, salience and, legitimacy. Instead the research focused to better understand the process or pathways of knowledge co-production. In defense for the specific selection of conditions, causation was established for the majority of both substantive and relational outcomes.

The benefits of process tracing are that it can be seen what it is about A that leads to B – how and why the intervention led to a specific outcome. In many impact evaluation methods, there is therefore a black box between the intervention and the outcome that remains closed (see Figure 13)

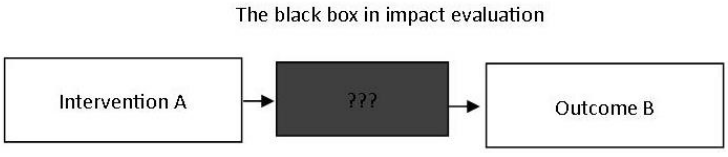

Figure 14: Illustration of process tracing in impact evaluation (Punton, 2015, p. 5)

Process tracing methods open up this black box, and the causal mechanism is what is inside. This mechanism can be understood as a force or a power – the thing that causes event A to give rise to outcome B. Using gravity as an analogy: if I drop a tennis ball and it falls to the ground, gravity is the 'mechanism' that explains why A (opening my hand) leads to B (the tennis ball falling)(Punton, 2015). On the other hand process tracing has some drawbacks. It is a method used mostly in political and social sciences. The template of process tracing can be adapted to each researchers own objectivity. And selecting a causal test for every hypothesis may guide misleading confirms and relevance.

6.1.3.2 Internal validity reflection on data collection and analysis

First, the interviews with participants were all recorded and processed according to the template of the proposed framework in chapter 3. In order to avoid biases from the semi-structured interviews, I asked open -end questions in the end of every interview. The questions of interviews are found in the appendix 2. Moreover, interviews remain anonymous for confidentiality reasons in order to ensure honest and meaningful answers. However, there is no insurance that all answers are a mirror of reality. The danger that partners remember little details or they generally enjoy collaborative projects may slightly weaken the importance of knowledge sharing practices. Furthermore, only 3 interviews were conducted with project participants from France and the UK. More project participants were not able to be reached. In addition, the research did not conduct an interview from the other Dutch partner (WGS) because the participant had changed working environment and was not able to remember details of the project, therefore he refused to give an interview. Lastly, the internal validity of the research can be self-doubted for the scope of the principal researcher whose interpretations may affect the objectivity of the research(Yin, 2013).

6.1.2 External validity

External validity refers to the transferability of our results to other study cases (Gerring, 2007). The present research can be adapted to the other projects from the case population. Furthermore, the research can be potentially tested to more sustainability topics (for instance green energy or transportation projects). One of the reasons is that similarities in context and purpose of the project allow the application of the framework and the method of process tracing as a causation building test. A limitation for the external validity could be the lack of the aspects of power and politics which are very influential parameters for knowledge co-production (Feldman et al., 2009). Furthermore, the research strategy can be applied for research settings about social learning and transdisciplinary knowledge between organizations and knowledge institutes. As a final remark, triangulation was used in the present research which means that more than one method was used to collect data on the same topic. The variety of methods (interviews, previous research in European cooperation projects, document analysis, framework, case study) is not necessarily to cross-validate data but rather to capture different dimensions of the same phenomenon (Gerring, 2007).

6.2 Conclusions

This study set out to support the conceptualization of knowledge co-production by investigating the outcomes the collaboration generated. It identified a variety of relevant conditions that impact on the projects' structures, the interaction process and the participants. Moreover, this study looked closer at the actual process taking place, which is, to the present day, usually treated as a 'black-box' in INTERREG and if at all loosely described as an "exchange of experiences" (Hachmann, 2012)

i. According to literature what are knowledge outcomes and which are the causal mechanisms?

Building on the streams of knowledge co-production, social learning in natural resources management and studies in transnational project a framework with causal mechanisms resulted. The framework can be regarded as an approximation portraying necessary and sufficient conditions to explain knowledge co-production outcomes. In total 13 conditions transformed into hypotheses and tested their causal relevance to substantive and relational knowledge outcomes. The answer to this question is that knowledge outcomes are substantive and relational. Substantive knowledge outcomes are outputs, and relational knowledge outcomes are frames, trust and networking. They can be explained from the causal mechanisms of project design, interaction process and participants.

ii. a. What substantive knowledge outcomes emerged from and which of them are knowledge co-production outcomes? b. What relational knowledge co-production outcomes emerged from the projects interactions and activities? c. How substantive and relational knowledge co-production outcomes can be explained from the causal mechanisms?

Research question 2 switched the focus to the WAVE project and identified the knowledge outcomes of the study. The conclusion is that there are 12 substantive knowledge outcomes (from which 4 exchange,6transferred) and 2 knowledge co-production outcomes which occurred only for one partner. The relational knowledge outcomes that occurred from all partners were trust and networking. Frames did also occur but they were influenced from during the process tracing analysis they are more oriented from the interaction process and project design. The most significant learning outcome is that the meeting of interests, representativeness and good communication are essential to offer better quality in project's interaction and activities for knowledge co-production to occur. Furthermore, representativeness is a very relevant condition for knowledge co-production in transnational cooperation projects. On the other hand project design is more applicable for knowledge co-production when there is careful selection of partners and the themes are relevant to organizations needs (i.e. previous collaboration and organizational culture). Lastly, the participant conditions (leadership style and coverage and distribuition of co-production roles) can explain substantive knowledge outcomes, trust and networking, but fall short to explain the emergence of new frames.

The next step was to examine whether the outcomes can be explained to the causal mechanisms with the method of process tracing. However, the study would have been less limited if it was a comparative study because more causal borderlines would increase the level of confidence to the results of process tracing. In all, the causal mechanisms present evidence that the conditions examined are able to explain the assumed knowledge outcomes with performing smoking gun tests which substantially weaken rival hypothesis. The general picture from the second research question is that substantive knowledge co-production outcomes occurred only for one partner. The conditions of causal mechanisms that can better explain them are interaction process and participant conditions. Specifically, the presence of reciprocity and communication can support co-created and co-developed knowledge outcomes.

ii. What recommendations can be made to improve the added value from knowledge co-production?

The third research question was concerned with proposing new inquiries for the case population the study case of WAVE belongs into. WAVE project studied and related the "knowledge pathways",causal mechanisms in other words, with the final relational knowledge outcomes and project outputs. This analysis attempted to link insights into knowledge co-production processes with the knowledge outcomes found in section 5.1. I elaborate recommendations in the following section 6.3.

6.3 Recommendations

The recommendations provided are structured towards improvements for the added value from knowledge co-production in WAVE and other transnational projects for climate change adaptation.

- **What can be done to improve the added value in project design conditions?**

A first proposal for transnational project would suggest put a strong emphasis on true cooperation in the sense of "joint working" and "joint designing" of the projects. Partners in the WAVE case seemed focused into their individual pilot projects, thus including *joint tasks* in the project strategy may have supported further new knowledge outcomes. A second suggestion is to include a clear "*product*" (for instance a framework, a model etc) that the project team will produce, based on the pilot project components. Furthermore, future projects can maximize the added value from knowledge co-production by setting project processes as simultaneously with relationship building activities.. Hence participants could devote time in generating new substance within the partnership. By extending the number and type of participants (and knowledge systems) (Puente-Rodríguez et al., 2016), as suggested in interview [I1] in gender and age groups could increase innovation and knowledge efficiency.In the end, even though INTERREG projects are critised for a lack to pay attention to learning by focusing more on the outputs, reinforcing the character of the project design may support knowledge co-production processes further in the future.

- **What can be done to improve the added value in interaction process conditions?**

An overall guideline is to generally embrace the complexity of transnational knowledge processing integrate new insights into the project's further process (and not only document them) to support the systematization and accessibility of knowledge. Next, the process of knowledge could be improved by including a target group for the new knowledge into the project. This action could potentially motivate partners to open their knowledge scope and hence embracing ambiguity further. Additionally, articulating participatory dynamics (i.e., interpretation-action-reflection) may assist to move the process further (Puente-Rodríguez et al., 2016). Such a technique might become mandatory in the near future to stabilize knowledge arrangements in the practices of transnational projects. Finally, project processes could invest more time into interactions, especially in complex cases where different stakes and interest collide over inclusive water management for climate change adaptation.

- **What can be done to improve the added value from the participant conditions**?

The central recommendation which aligns with improving the role of water managers from the public sector is to better train them in participatory settings. The role of public officials has been questioned if can perform as a "catalyst" in the co-production of knowledge (Maiello et al., 2013). Empirical findings stress out that environmental and water managers in the public sector, are usually bounded in administrative and bureaucratic routines, hence the benefits of participation and collaboration with and within the organization are difficult to be saved in the organizations DNA. A potential solution could come by exposing participants to social learning concept, as a process which could upgrade their role from r*ecognizing* policy objects, to co-producing and integrating new paradigms. Therefore, organizations could employ capacity builders to facilitate the inclusion if different ways of knowing and different knowledge types. This can be achieved by a facilitation team with other actors beyond the key stakeholders; (3) designing a phased approach with clear objectives Moreover, the abilities of participants could be improved by initiating the construction learning tools and use them with transnational partners. Concluding, the attitude of participants for improving the added value from knowledge co-production can be achieved with rewarding

new initiatives (Chow et al., 2008) and avoid work overloading hence allocating more patience for transnational cooperation

6.4 Reflections

The final message that I want to deliver with this research is about knowledge co-production and the role of the European commission. In conclusion, there is need for generative discourse for "who" knowledge in WAVE was produced for. The European Commission and the Lisbon Agreement reflect a demand for economic growth, measured homogeneously for the member states. These demands fall short in understanding the intersections of knowledge with environmental sustainability and culture. Furthermore, the priorities of the Lisbon agreement attack working rights under the pressure of efficiency in the economic sector. Moreover, the European Commission convey the sense that making environmental knowledge (and stabilizing it as "environmental information") within the EU is, in effect, a contribution to the making and constant re-ordering of Europe as an institutional and political entity which we may otherwise read about in the daily newspapers (Jasanoff, 2004; Waterton et al., 2004). The Commission's terms, legitimate policy agency is constituted only with official, representative political institutions and appointed administrative bodies, incorporating a highly formalized structure of political legitimacy which takes little account of the less tidy realities of de facto democratic deficits, public alienation from formal policy institutions and processes, and the rich and vibrant, if unofficial and oblique, tapestries of representative public life conducted through myriad agents of civil society (Waterton et al., 2004).

6.5 Future research

Future research could integrate the term of successful knowledge co-production to the existing proposed framework. This could expand the usability of the proposed framework and examine closer the application of co-produced outcomes in natural settings. Another suggestion is examining how knowledge co-production can reduce uncertainties and ambiguities in contemporary water management. Furthermore future research could be based in limitations of this study and perform a comparative analysis. A comparative analysis could increase the level of confidence in the process tracing analysis by providing a more diverse data base. Concluding, the concept of knowledge co-production is getting increasingly attention from organizations in the public and private sector, thus more empirical observations on the relationship of users (or clients) and networks can increase overall understanding and applicability of knowledge co-production.

References

Argote, L., Ingram, P., et al. (2000). Knowledge transfer in organizations: Learning from the experience of others. *Organizational behavior and human decision processes, 82*(1), 1-8.

Armitage, D., Berkes, F., et al. (2011). Co-management and the co-production of knowledge: Learning to adapt in Canada's Arctic. *Global Environmental Change, 21*(3), 995-1004.

Ayas, K., & Zeniuk, N. (2001). Project-based learning: Building communities of reflective practitioners. *Management learning, 32*(1), 61-76.

Barbosa, S. L., Rezende, S. F. L., et al. (2014). Relationships and knowledge in the firm internationalization process. *Revista de Administração (São Paulo), 49*, 129-140.

Beach, D. (2017). Process-Tracing Methods in Social Science: Interactive Factory.

Beach, D., & Pedersen, R. B. (2013). *Process-tracing methods: Foundations and guidelines*: University of Michigan Press.

Bennett, A., & Checkel, J. T. (2012). Process tracing: from philosophical roots to best practices. *Simons Papers in Security and Development, 21*, 30.

Bensaude Vincent, B. (2014). The politics of buzzwords at the interface of technoscience, market and society: The case of 'public engagement in science'. *Public understanding of science, 23*(3), 238-253.

Bidwell, D., Dietz, T., et al. (2013). Fostering knowledge networks for climate adaptation. *Nature Climate Change, 3*(7), 610.

Böhme, K. (2005). The ability to learn in transnational projects. *Informationen zur Raumentwicklung, 11*(12), 691-700.

Bouwen, R. (1998). Relational construction of meaning in emerging organization contexts. *European Journal of Work and Organizational Psychology, 7*(3), 299-319.

Bouwen, R., & Taillieu, T. (2004). Multi-party collaboration as social learning for interdependence: developing relational knowing for sustainable natural resource management. *Journal of Community & Applied Social Psychology, 14*(3), 137-153. doi:10.1002/casp.777

Bressers, H. T. (2004). 10. Implementing sustainable development: how to know what works, where, when and how. *Governance for sustainable development: The challenge of adapting form to function*, 284.

Brewin, P. (2010). *Water Level Management Plan* Retrieved from Somerset Levels and Moors http://www.somersetdrainageboards.gov.uk/media/South-Drain-WLMP-Brue-Approved-Apr-10.pdf

Brugnach, M. (2017). The Space in Between: Where Multiple Ways of Knowing in Water Management Meet. *Journal of the Southwest, 59*(1), 34-59.

Brugnach, M., Craps, M., et al. (2017). Including indigenous peoples in climate change mitigation: addressing issues of scale, knowledge and power. *Climatic Change : An Interdisciplinary, International Journal Devoted to the Description, Causes and Implications of Climatic Change, 140*(1), 19-32.

Brugnach, M., Dewulf, A., et al. (2011). More is not always better: Coping with ambiguity in natural resources management. *Journal of Environmental Management, 92*(1), 78-84.

Brugnach, M., Dewulf, A., et al. (2008). Toward a relational concept of uncertainty: about knowing too little, knowing too differently, and accepting not to know. *Ecology and Society, 13*(2), Art. 30.

Brugnach, M., & Ingram, H. (2012). Ambiguity: the challenge of knowing and deciding together. *Environmental Science and Policy, 15*(1), 60-71.

Burgess, J., Clark, J., et al. (2000). Knowledges in action: an actor network analysis of a wetland agri-environment scheme. *Ecological Economics, 35*(1), 119-132.

Buuren, A. v. (2009). Knowledge for governance, governance of knowledge: inclusive knowledge management in collaborative governance processes. *international public management journal, 12*(2), 208-235.

Carter, J. G. (2011). Climate change adaptation in European cities. *Current Opinion in Environmental Sustainability, 3*(3), 193-198. doi:https://doi.org/10.1016/j.cosust.2010.12.015

Cash, D. W., Clark, W. C., et al. (2003). Knowledge systems for sustainable development. *Proceedings of the National Academy of Sciences, 100*(14), 8086-8091.

Chow, W. S., & Chan, L. S. (2008). Social network, social trust and shared goals in organizational knowledge sharing. *Information & management, 45*(7), 458-465.
Collier, D. (2011). Understanding process tracing. *PS: Political Science & Politics, 44*(4), 823-830.
Colomb, C. (2007). The added value of transnational cooperation: Towards a new framework for evaluating learning and policy change. *Planning, Practice & Research, 22*(3), 347-372.
Conca, K., Wu, F., et al. (2006). Global Regime Formation or Complex Institution Building? The Principled Content of International River Agreements. *International Studies Quarterly, 50*(2), 263-285. doi:10.1111/j.1468-2478.2006.00402.x
Council, S. C. (2017). Brue Valley Opportunities. Retrieved from http://www.somerset.gov.uk/
Craps, M., & Brugnach, M. (2015). A relational approach to deal with ambiguity in multi-actor governance for sustainability. *WIT Transactions on Ecology and the Environment, 199*, 233-243.
Darroch, J., & McNaughton, R. (2002). Examining the link between knowledge management practices and types of innovation. *Journal of intellectual capital, 3*(3), 210-222.
Davidson-Hunt, I. J., & Michael O'Flaherty, R. (2007). Researchers, indigenous peoples, and place-based learning communities. *Society and Natural Resources, 20*(4), 291-305.
Dewulf, A., Craps, M., et al. (2005). How indigenous farmers and university engineers create actionable knowledge for sustainable irrigation. *Action Research, 3*(2), 175-192.
Dewulf, A., Gray, B., et al. (2009). Disentangling approaches to framing in conflict and negotiation research: A meta-paradigmatic perspective. *Human Relations, 62*(2), 155-193.
Di Cagno, D., Fabrizi, A., et al. (2016). The impact of relational spillovers from joint research projects on knowledge creation across European regions. *Technological Forecasting and Social Change, 108*, 83-94. doi:https://doi.org/10.1016/j.techfore.2016.04.021
Dong, W., Zhongfeng, S., et al. (2011). Organizational culture and knowledge creation capability. *Journal of Knowledge Management, 15*(3), 363-373. doi:10.1108/13673271111137385
Eakin, H., & Lemos, M. C. (2006). Adaptation and the state: Latin America and the challenge of capacity-building under globalization. *Global Environmental Change, 16*(1), 7-18.
Edelenbos, J., van Buuren, A., et al. (2011). Co-producing knowledge: joint knowledge production between experts, bureaucrats and stakeholders in Dutch water management projects. *Environmental science & policy, 14*(6), 675-684.
EEA. (2017). Climate Change Adaptation Retrieved from https://www.eea.europa.eu/themes/climate-change-adaptation/intro#tab-see-also
Feldman, D. L., & Ingram, H. M. (2009). Making science useful to decision makers: climate forecasts, water management, and knowledge networks. *Weather, Climate, and Society, 1*(1), 9-21.
Felt, U., Igelsböck, J., et al. (2012). Challenging participation in sustainability research. *The Journal of Deliberative Mechanisms in Science, 1*(1).
FP7. (2017). FP7 Europe. Retrieved from https://ec.europa.eu/research/fp7/index_en.cfm
Frantzeskaki, N., & Kabisch, N. (2016). Designing a knowledge co-production operating space for urban environmental governance [93_TD $ DIFF]—Lessons from Rotterdam, Netherlands and Berlin, Germany.
Gale, N. K., Heath, G., et al. (2013). Using the framework method for the analysis of qualitative data in multi-disciplinary health research. *BMC medical research methodology, 13*(1), 117.
Gerlak, A. K., & Heikkila, T. (2011). Building a theory of learning in collaboratives: Evidence from the Everglades Restoration Program. *Journal of Public Administration Research and Theory*, muq089.
Gerring, J. (2007). *Case study research : principles and practices*. New York :: Cambridge University Press.
Goldstein, B. E., Wessells, A. T., et al. (2015). Narrating resilience: Transforming urban systems through collaborative storytelling. *Urban Studies, 52*(7), 1285-1303.
Gray, B. (2004). Strong opposition: frame-based resistance to collaboration. *Journal of Community & Applied Social Psychology, 14*(3), 166-176.
Hachmann, V. (2008). Promoting learning in transnational networks. *disP-The Planning Review, 44*(172), 11-20.
Hachmann, V. (2011). From mutual learning to joint working: Europeanization processes in the INTERREG B Programmes. *European Planning Studies, 19*(8), 1537-1555.

Hachmann, V. (2012). *PROCESSES OF TRANSNATIONAL KNOWLEDGE TRANSFER AND LEARNING IN REGIONAL DEVELOPMENT* University of Luxembourg, Luxembourg
Hachmann, V. (2013). 7 Discovering the process perspective. *Learning Transnational Learning*, 218.
HaskovingDHV, R. (2018). Enhansing Society Together. Retrieved from https://www.royalhaskoningdhv.com/en-gb
Heaton, J., Day, J., et al. (2016). Collaborative research and the co-production of knowledge for practice: an illustrative case study. *Implementation Science, 11*(1), 20.
Hegger, D., Lamers, M., et al. (2012). Conceptualising joint knowledge production in regional climate change adaptation projects: success conditions and levers for action. *Environmental science & policy, 18*, 52-65.
Hering, D., Kail, J., et al. (2000). Coarse woody debris quantity and distribution in Central European streams. *International Review of Hydrobiology, 85*(1), 5-23.
Huntjens, P., Pahl-Wostl, C., et al. (2010). Climate change adaptation in European river basins. *Regional Environmental Change, 10*(4), 263-284.
Huxham, C., Vangen, S., et al. (2000). The challenge of collaborative governance. *Public Management an International Journal of Research and Theory, 2*(3), 337-358.
Ingram, H. (2006). Water as a multi-dimensional value: implications for participation and transparency : In response to the paper by Marco Schouten and Klass Schwartz, "Water as a political good: implications for investment" (see pp. 407-421). *International Environmental Agreements: Politics, Law and Economics, 6*(4), 429-433.
Ingram, H. (2013). No universal remedies: design for contexts. *Water International, 38*(1), 6-11.
Ingram, J. (2008). Agronomist–farmer knowledge encounters: an analysis of knowledge exchange in the context of best management practices in England. *Agriculture and Human Values, 25*(3), 405-418. doi:10.1007/s10460-008-9134-0
Interreg_Europe. (2017). Interreg Europe. Retrieved from https://www.interregeurope.eu/about-us/what-is-interreg-europe/
Interreg_IVB. (2014). Retrieved from http://4b.nweurope.eu/index.php?act=page&page_on=about&id=42
IVB, I. (2017). INTERREG IVB NW EUROPE. Retrieved from http://4b.nweurope.eu/index.php?act=project_detail&id=5451
JAF. (2003). 3B NWE Retrieved from http://3b.nweurope.eu/page/projet.php?p=31&id=452
Jahn, T., Bergmann, M., et al. (2012). Transdisciplinarity: Between mainstreaming and marginalization. *Ecological Economics, 79*, 1-10.
Jasanoff, S. (2004). *States of knowledge: the co-production of science and the social order*: Routledge.
KEEP. (2017). Keep.eu database. Retrieved from https://www.keep.eu/keep/
Knight, L., & Pettigrew, A. (2007). Explaining process and performance in the co-production of knowledge: a comparative analysis of collaborative research projects. *Proceedings of 'Organization Studies as Applied Science: The Generation and Use of Academic Knowledge about Organizations*, 7-9.
know2adapt. (2013). knowledge transfer for climate change adaptation. Retrieved from http://cordis.europa.eu/project/rcn/109262_en.html
Kogut, B., & Zander, U. (1992). Knowledge of the firm, combinative capabilities, and the replication of technology. *Organization science, 3*(3), 383-397.
Koppenjan, J. F. M., & Klijn, E.-H. (2004). *Managing uncertainties in networks: a network approach to problem solving and decision making*: Psychology Press.
Koskinen, K. U., Pihlanto, P., et al. (2003). Tacit knowledge acquisition and sharing in a project work context. *International journal of project management, 21*(4), 281-290.
Lang, D. J., Wiek, A., et al. (2012). Transdisciplinary research in sustainability science: practice, principles, and challenges. *Sustainability science, 7*(1), 25-43.
Lejano, R. P., & Ingram, H. (2009). Collaborative networks and new ways of knowing. *Environmental science & policy, 12*(6), 653-662.
Louwers, R. (2013). *12 reasons to engage (NWE in Action)*. Retrieved from

Maiello, A., Viegas, C. V., et al. (2013). Public managers as catalysts of knowledge co-production? Investigating knowledge dynamics in local environmental policy. *Environmental science & policy, 27*(Supplement C), 141-150. doi:https://doi.org/10.1016/j.envsci.2012.12.007

March, J. G., & Olsen, J. P. (2006). Elaborating the "new institutionalism". *The Oxford handbook of political institutions, 5*, 3-20.

Michael Lewis-Beck , A. B., Tim Futing Liao. (1989). Encyclopedia of Social Science Research Methods. *Sage Publications* Retrieved from http://www-personal.umd.umich.edu/~delittle/Encyclopedia%20entries/Causal%20mechanisms.htm

Montgomery, D. R., Collins, B. D., et al. (2003). Geomorphic effects of wood in rivers.

Mostert, E., Pahl-Wostl, C., et al. (2007). Social learning in European river-basin management: barriers and fostering mechanisms from 10 river basins. *Ecology and Society, 12*(1).

Mutz, M., Piégay, H., et al. (2006). Perception and evaluation of dead wood in streams and rivers by German students. *Limnologica - Ecology and Management of Inland Waters, 36*(2), 110-118. doi:https://doi.org/10.1016/j.limno.2006.01.001

Natural England, t. E. A., the Royal Society for the Protection of Birds (RSPB), the Somerset Drainage Boards Consortium, Somerset County Council, Somerset Environmental Records Centre, the Farming and Wildlife Advisory Group (FWAG), the Hawk and Owl Trust and the British Association for Shooting and Conservation (BASC). . (2010). *Brue valley opportunities* Somerset

Newig, J., Günther, D., et al. (2010). Synapses in the network: learning in governance networks in the context of environmental management. *Ecology and Society, 15*(4).

Nonaka, I., & Takeuchi, H. (1995). *The knowledge-creating company: How Japanese companies create the dynamics of innovation*: Oxford university press.

Nyong, A., Adesina, F., et al. (2007). The value of indigenous knowledge in climate change mitigation and adaptation strategies in the African Sahel. *Mitigation and Adaptation strategies for global Change, 12*(5), 787-797.

Oosthen, J. (2006). Dutch river defences in historical perspective. Retrieved from https://www.eh-resources.org/dutch-river-defences-in-historical-perspective/

Ostrom, E. (1996). Crossing the great divide: Coproduction, synergy, and development. *World Development, 24*(6), 1073-1087. doi:https://doi.org/10.1016/0305-750X(96)00023-X

Pahl-Wostl, C. (2002). Towards sustainability in the water sector–The importance of human actors and processes of social learning. *Aquatic Sciences-Research Across Boundaries, 64*(4), 394-411.

Pahl-Wostl, C. (2007a). The implications of complexity for integrated resources management. *Environmental Modelling and Software, 22*(5), 561-569.

Pahl-Wostl, C. (2007b). Transitions towards adaptive management of water facing climate and global change. *Water resources management, 21*(1), 49-62.

Pahl-Wostl, C. (2009). A conceptual framework for analysing adaptive capacity and multi-level learning processes in resource governance regimes. *Global Environmental Change, 19*(3), 354-365.

Pahl-Wostl, C., Craps, M., et al. (2007). Social learning and water resources management. *Ecology and Society, 12*(2).

Pahl-Wostl, C., & Hare, M. (2004). Processes of social learning in integrated resources management. *Journal of Community & Applied Social Psychology, 14*(3), 193-206.

Pahl-Wostl, C., Holtz, G., et al. (2010). Analyzing complex water governance regimes: the Management and Transition Framework. *Environmental Science and Policy, 13*(7), 571-581.

Pahl-Wostl, C., Jeffrey, P., et al. (2011). Maturing the New Water Management Paradigm: Progressing from Aspiration to Practice. *Water Resources Management : An International Journal - Published for the European Water Resources Association (EWRA), 25*(3), 837-856.

Pahl-Wostl, C., Tàbara, D., et al. (2008). The importance of social learning and culture for sustainable water management. *Ecological Economics, 64*(3), 484-495.

Project proposal, W. (2008). <*Signed revised proposel.pdf*>. Netherlands: Waterschaap Regge en Dinkel.

Puente-Rodríguez, D., van Slobbe, E., et al. (2016). Knowledge co-production in practice: Enabling environmental management systems for ports through participatory research in the Dutch Wadden

Sea. *Environmental science & policy, 55*(Part 3), 456-466. doi:https://doi.org/10.1016/j.envsci.2015.02.014
Punton, M. W., Katharina. (2015). *Applying process tracing in 5 simple steps* Retrieved from Brighton:
Ritchie, J., Lewis, J., et al. (2013). *Qualitative research practice: A guide for social science students and researchers*: Sage.
SCC. (2011). *Wave project, Somerset update*. Retrieved from SCC design and print
Shotter, J. (2004). Expressing and legitimating 'actionable knowledge'from within 'the moment of acting'. *Concepts and Transformation, 9*(2), 205-229.
Shu-Mei, T. (2010). The correlation between organizational culture and knowledge conversion on corporate performance. *Journal of Knowledge Management, 14*(2), 269-284. doi:doi:10.1108/13673271011032409
Sigel, K., Hagemann, N., et al. (2014). Insights regarding transdisciplinarity and knowledge transfer gained from two case studies on integrated water resources management in Ukraine and Mongolia. *Interdisciplinary Science Reviews, 39*(4), 342-359.
Simonin, B. L. (1999). Ambiguity and the process of knowledge transfer in strategic alliances. *Strategic management journal*, 595-623.
Slevin, D. P., & Pinto, J. K. (1987). Balancing strategy and tactics in project implementation. *Sloan management review, 29*(1), 33-41.
Sol, J., Beers, P. J., et al. (2013). Social learning in regional innovation networks: trust, commitment and reframing as emergent properties of interaction. *Journal of Cleaner Production, 49*, 35-43.
Sørensen, E., & Torfing, J. (2009). Making governance networks effective and democratic through metagovernance. *Public administration, 87*(2), 234-258.
SWMP. (2007). Somerset Water Management Partnership Retrieved from http://www.somerset.gov.uk/organisation/partnerships/somerset-water-management-partnership/
Szulanski, G., Cappetta, R., et al. (2004). When and how trustworthiness matters: Knowledge transfer and the moderating effect of causal ambiguity. *Organization science, 15*(5), 600-613.
Tress, B., Tress, G., et al. (2003). Interdisciplinarity and transdisciplinarity in landscape studies-the Wageningen DELTA approach *Interdisciplinary and Transdisciplinary Landscape Studies: Potential and Limitations/Bärbel Tress, Gunther Tress, Arnold van der Valk & Gary Fry* (pp. 8-15): WUR, Alterra.
Turner, J. R. (2009). The handbook of project-based management: leading strategic change in organizations (Vol. 452): McGraw-Hill.
UNDP. (2011). Climate change adaptation and development *Environment and Energy Group* Retrieved from chrome-extension://oemmndcbldboiebfnladdacbdfmadadm/http://www.undp.org/content/dam/undp/library/corporate/fast-facts/english/FF-Climate-Change-Adaptation.pdf
van den Hoek, R. E., Brugnach, M., et al. (2014). Uncovering the origin of ambiguity in nature-inclusive flood infrastructure projects. *Ecology and Society, 19*(2).
van der Hel, S. (2016). New science for global sustainability? The institutionalisation of knowledge co-production in Future Earth. *Environmental science & policy, 61*(Supplement C), 165-175. doi:https://doi.org/10.1016/j.envsci.2016.03.012
Van Evera, S. (1997). *Guide to methods for students of political science*: Cornell University Press.
Vinke-de Kruijf, J. (2015). Learning about climate change adaptation through European cooperation: a preliminary assessment of the WAVE project. *Institute of Environmental Systems Research, University of Osnabrück, Osnabrück, Germany. URL: https://www. usf. uni-osnabrueck. de/fileadmin/DE/Forschung/FG_REM/Research_Report_WAVE. pdf*.
Vinke-de Kruijf, J., Bressers, H., et al. (2014). How social learning influences further collaboration: experiences from an international collaborative water project. *Ecology and Society, 19*(2).
Von Korff, Y., d'Aquino, P., et al. (2010). Designing Participation Processes for Water Management and Beyond. Synthesis, part of a special feature on implementing participatory water management: recent advances in theory, practice and evaluation. *Ecology and Society, 15*(1).
Voorberg, W., Bekkers, V., et al. (2014a). Co-creation in social innovation: A comparative case-study on the influential factors and outcomes of co-creation.

Voorberg, W., Bekkers, V., et al. (2014b). The Keys to successful co-creation: an explanation using causal process tracing.

Wall, T. U., Meadow, A. M., et al. (2017). Developing evaluation indicators to improve the process of coproducing usable climate science. *Weather, Climate, and Society, 9*(1), 95-107.

Wang, S., & Noe, R. A. (2010). Knowledge sharing: A review and directions for future research. *Human Resource Management Review, 20*(2), 115-131.

Waterton, C., & Wynne, B. (2004). Knowledge and political order in the European Environment Agency. *States of knowledge: The co-production of science and social order*, 87-108.

Wave_end_report. (2013). doi:http://4b.nweurope.eu/index.php?act=project_detail&id=5451

WAVE_magazine_no.5. (2013). Waterschaap Regge en Dinkel and partners *A Wave of results, 5*.

White, D. D., Wutich, A., et al. (2010). Credibility, salience, and legitimacy of boundary objects: water managers' assessment of a simulation model in an immersive decision theater. *Science and Public Policy, 37*(3), 219-232.

Yin, R. K. (2013). *Case study research: Design and methods*: Sage publications.

Zheng, W., Yang, B., et al. (2010). Linking organizational culture, structure, strategy, and organizational effectiveness: Mediating role of knowledge management. *Journal of Business Research, 63*(7), 763-771. doi:https://doi.org/10.1016/j.jbusres.2009.06.005

Appendix 1

	Outputs	Partner	Description	Status
Work Package 1: Planning	Action 1.3 - Regge Masterplan	WRD	Master plan for the whole Regge catchment, needed because the effects of climate change requires a longer term view and planning	Cancelled: A complete master plan seemed unrealistic due to the detoriating economic situation so the decision was made to represent the shared vision in a picture book of the Regge
	Action 1.4– Climate change effects on flood risk management	SCC	A website with visualization of possible future floods in the Somerset project area.	Proved to be a powerful tool for both awareness of climate change and its potential effects in the region.
	Action 1.5 – Brue Valley	SCC	A plan for the area, based on socio-economic studies and wildlife and nature investigations.	First discussion with stakeholders failed, however after the floods the action secured additional national UK funding for the area and formed the basis of two new Interreg projects
	Action 1.6 - Integrated planning lower course Rur	WVER	future planning for the development and of lower course of the river Rur	Was presented as best practise example, with Other WAVE partners have studied the German analysis and will be taken similar actions.
	Action 1.7 – Planning East side Zwolle	WGS	Planned housing project of the municipality of Zwolle, to which the water infrastructure development of the waterboard was connected	Cancelled: was replaced with stream restoration and study on awareness of municipalities
	Action 1.9 – Vision for Vilaine marshes	IAV	An integrated longer term planning and vision	Cancelled: (due to bad weather) only the developed hydraulic model was used
Work Package 2: Measures	Action 2.2 - Regge measures: Visschebelt and Groene Mal	WRD	River restoration measures he creation of ecological zones and nature-friendly river banks	The waterboard created more retention areas than foreseen.
	Action 2.3 – King Sedgemoor	SCC	To restore vulnerable peat wetlands in Somerset and create interconnectivity between wetlands to enhance the resilience to climate change. Small-scale structures for water level control were	in 2010 the finished connectivity measures proved their worth during 2 local floods.

			installed, and valuable wetlands were protected	
	Action 2.4 – Woodland planting	SCC	Woodland planting schemes were executed at farms and also in communities. The action attracted a lot of volunteers, making it a real community-based action and showing that small scale local actions can contribute greatly to making rover catchments more climate-proof	Works were completed as scheduled in 2011.
	Action 2.6 – JKT-Julich project	WVER		Concluded in 2011 that the project could not be finished in the WAVE project period.
	Action 2.7 – Deadwood	WVER	Natural way of river restoration, bringing ecological conditions in the river to desired levels. The deadwood was placed at the end of 2010 and project monitoring revealed very positive improvements to the ecological situation	A cheap but successful way of river restoration.
	Action 2.8 – Emmertochtsloot	WGS	Fish passages and creating water storage areas	Cancelled: problems occurred and the planning phase was quickly followed by the realization phase of this investment in the local water systems around Zwolle aimed at making the rivers climate-proo
	Action 2.9 - Dender river	VMM	Technical plans were drawn up and approved in 2009, forming the basis for discussion with local stakeholders.	Careful communication with local stakeholders greatly helped the project implementation and local acceptance, highlighted by the Flemish partner as one of the main lessons learned through WAVE. RA
	Action 2.10 – River Meu	IAV	Upgraded hydrological maps and the investment plan	Cancelled: local opposition (politicians and farmers) to the investment plans blocked the project's implementation

Work package 3: communication	Action 3.2 – Regge exhibition	WRD	Informing local stakeholders about the role of the river, and the effects climate change can have on that river.	
	Action 3.3 – Farm water plans	SCC	with advising farmers on the use of water: on farm storage and retention.	
	Action 3.4 – WAVE in Somerset	SCC	In Somerset a website and newsletters about the WAVE projects were made, informing the local community	The action was somewhat reduced because the attention has shifted to actual adaptation measures and works in river catchment, necessitated by extreme weather events in Somerset on 2008-2010.
	Action 3.5 – Communicating WAVE	WVER	informing local stakeholders in the project area about the investments in WP2 of WAVE.	
	Action 3.6 – Climate awarenes	WGS	WGS has developed a climate game, and has had several game sessions with local politicians and has toured the area to play the game at schools.	Climate-table is placed at the information centre of the waterboard at Ramspol.
	Action 3.7 – Awareness extreme rainfall events	VMM	newsletters and has organized information-evenings for local stakeholders	

Appendix 2

Example of the interview protocol:

The first step is to make the appropriate introductions about myself and my work. I inform the interviewee how much time this interview will take and which are the main topics for discussion. I provide the definition of knowledge co-production and the structure of my questions in the categories; project design, interaction process and participants.

Part A

1. Do you believe that knowledge co-production in WAVE took place? Can you give me an example?
2. Did your previous collaboration (for JAF) encourage you positively in producing new knowledge or co-produce knowledge for WAVE?
3. Is your organizational culture encouraging you to co-produce knowledge with other people? Is participation and knowledge co-production in your organizations' DNA?
4. What did you accomplish in wave and how? Do you believe that you need to co-produce knowledge with others to address problems in your region from climate change adaptation?

Part B

1. How did you experience the interaction with other partners? Do you believe they were necessary to share knowledge?

2. How did you try to approach the interests of the rest partners? Do you believe that partners had similar or different interests when they participated in WAVE? Did you take into account different needs and resources from other partners?

3. Most of partners are water authorities, but everyone was coming from a different country, Did you notice diversity in values, beliefs, political position and background in your partners? How did you deal with different viewpoints from the partners and how did you manage that? ? ex How did you manage the fact that some of your partners didn't use the terminology of climate change adaption

4. To what extent did the interactions make you feel interconnected with the participants? Evaluating WAVE would you say the organization and your region became reflexive for CCA?

5. To what extent you believe that the facilitation from Royal Haskoving DHV promoted the transparency of the project? Do you believe that the rest of the partners were satisfied from their analysis of the JA? Did any organization show lack of reliability?

6. In your opinion, did the interactions in WAVE offered the opportunity for representativeness and equity? Do you believe that non-leading partners left outside from the process?

Part C

1. How would you describe your contribution to knowledge in WAVE? In your opinion did you share knowledge more or you received? Do you believe that you developed new knowledge in collaboration with other partners?

2. If you can recall the JA, in the end of every report there are the insights from the participants named "roots, flowers, shoots", do you agree they reflect knowledge co-production outcomes?

3. How do you describe your leadership style? How do you deal with different sources or knowledge networks?

Part D

1. In your viewpoint, to what extent wave changed "frame" issues for climate change adaptation in the water sector? Do you recall specific policy recommendations or changes in your day-to day work?
2. To what extent wave gave you the opportunity for networking? To what this network would be useful for you (and your knowledge base?)
3. To what extent you feel that wave increased the trust between participants? Did it increase the level of commitment to transnational cooperations?
4. In your viewpoint, what is the added value from WAVE project and how it can be improved?

5. In your opinion, which were the enablers and the barriers for knowledge in the WAVE project?

6. As a last comment, do you evaluate WAVE as a successful project in terms of knowledge co-production?

The protocol finishes with greetings and by asking the partners if they would use a copy of the thesis or the recordings.

Appendix 3

Condition	**Previous collaboration**	
Test	**Smoking dun**	
Outcome	**Evidence**	**Result**
S1	Water abstractions and other hydrological management issues near the South Drain Area of the Brue Valley, were governed from The Water Act (**2003**). The Water Act (2003) has introduced a new statutory framework for managing water resources. Under the Act the abstraction of up to and including 20 cubic metres per day from surface water or groundwater does not require a licence from the Environment Agency regardless of the purpose for which the abstracted water will be used. Abstractions above 20 cubic metres per day require a licence, issued by the Environment Agency. The Water Act (2003) also removes a range of exempt activities that currently do not require an abstraction or transfer licence. However, this section of the legislation has not yet been enacted (see the EA website for further information on licensing requirements under the Water Act (2003) (Brewin, 2010, p. 23). The JAF project (JAF, 2003)was launched from 2003-2007, and after the SCC initiated the Somerset Water Management Partnership (SWMP)which provides an opportunity for a group of stakeholders to meet together to consider water matters of significance affecting, or with the potential to affect, the communities, landscape, economy and ecology in the catchment areas of the Parrett, Brue, Axe and their tributaries. In **2009** the one of the aims and objectives of SWMP is "Ecosystem Services: Trade-off in ecosystem services of the Somerset Levels and Moors wetlands; Payments for Ecosystem Services; Brue Valley Ecosystem Services study"(SWMP, 2007).	Fails the test Min hypothesis is not eliminated Rival hypothesis is moderately strengthen
S2	The JAF project was focused on land and water management plans for rivers, lakes and waterways and not on communication with farmers and landowners. The farm water plans are more focused in water storage and retention methods. The description of JAF says that: The objective is to develop a joint approach to manage flooding, in particular in catchment areas at particular risk from heavy rainfall. The partnership will endeavour to achieve its goals by improving spatial planning to promote multifunctional land use, restoring rivers to enhance water storage capacity, implementing new technologies to link groundwater and surface water management, and increase public awareness and support for innovative policy solutions. (JAF, 2003)	Fails the test Main Hypothesis is not eliminated Rival is moderately strengthen
F	Climate change adaptation was only starting to receive attention in 2008 (at the beginning of WAVE). Climate change was interesting, but not really a theme. [I1], Climate change was no theme at WVER before WAVE,[I6] At the start of WAVE, climate change adaptation was an aspect that was considered but not a large issue [WGS]., Years ago, the words 'climate change' were avoided as it had not been 'proved'.[I7] Already in the beginning, IAV realized that other organizations were for more advanced and doing more to actually adapt to climate change[I3] from(Vinke-de Kruijf, 2015). The JAF project was focused in flooding risks (JAF, 2003).	Fails the test Main hypothesis is not eliminated Rival is moderately strengthen

T	Participants acknowledge that trust pre-existed due to the previous successful collaboration [I2], [I6], [I7], [I1]. For example [I2] replies in the question; "Even though I participated only for the last year (in JAF), the impressions were very positive. It encouraged collaboration and trust. It evolved to a long standing collaboration. Only IAV was not involved, thus the evidence is enough.	Confirms hypothesis Rival hypothesis is substantially weaken
N	The participants who knew each other from JAF [I2], [I4], [I6], [I7] were very willing to collaborate again with the Dutch partners. For example [I6] replies: "because we liked it very much with JAF… And in the first project in the beginning when it was me and my colleagues at first nobody wanted to go…but after one year everybody wanted to go". The willingness to collaborate again was also mentioned in interview [I1]. The condition of previous collaboration is not relevant to participants [I3] and [I5] who took place for the first time in INTERREG project. As a result [I3] and [I5] interviews associate their expanded networking with the present collaboration.	Confirms hypothesis Rival hypothesis is substantially weaken

Condition	**organizational culture**	
Test	**hoop test**	
Outcome	**Evidence**	**Result**
S1	All respondents [I1-8] replied that their organizations often engages in knowledge sharing processes either domestically or internationally and stimulate their members to participate in transnational settings. For example the Dutch partner [I1] says about the history of the organizational culture of waterboards in the Netherlands: "most of the of the water boards where very small in the past, but if you have people and knowledge you have the ability to go abroad (meaning INTERREG projects with European partners)." He continues: "our chairman is Stephan Kooks who was yesterday on the Dutch television he was talking about water strategy of adaptation… and he is also a professor in the University of Twente and he does water management and he also did European projects for water governance and about how water management and people can go in a good way and not only in the technical way but more inclusive. "	Passes the test hypothesis is relevant Rival moderately weakens
S2	Informing farmers on sustainable agricultural management is one of the "everyday fights" all participating organizations have [I1-8]. The farmers' associations in UK are a particular stakeholder group which often lacks willingness to compensate land (or water levels) for climate change adaptation. Similar problems are encountered for instance IAV's action was cancelled due to locals and farmers opposition(Vinke-de Kruijf, 2015). Despite the difficulties, the outcome was achieved because other partners contributed actively [I8]. The presence of WVER received importance despite language difficulties. Furthermore the SWMP and IAV planned joint action "Parc naturel regional des Marais du Contentin et du	Passes the test hypothesis is relevant Rival moderately weakens

	Bessin, Normandy - project ideas for collaborative work" (SWMP, 2007)	
F	Not enough to establish causation	straw in the wind test
T	The legitimacy of organizations was never doubted from the respondents. The Dutch management of the overall project received unanimously good reviews [I2], [I3], [I6]. Trust was built on the basis of integrity within and with organizations	Passes the test hypothesis is relevant Rival moderately weakens
N	Interviews conclude that their organizational culture encourages networking [I1], [I2], [I6], [I7]. The organizations regardless of their size engages with many stakeholder groups, therefore networking and capacity building is on their agendas. WRD cooperates well with stakeholders in the region and with other regional water authorities. WVER has a good overview of stakeholders; VMM cooperates with other organizations in different contexts. VMM cooperates with provinces and municipalities on project basis. With other regions (Brussels, Wallonia) and neighbouring countries (Netherlands, Germany, France) cooperation occurs within the contexts of the implementation of the EU Floods Directive, WRD has regular contacts with province, municipalities, LTO, nature organizations and other water authorities (Vinke-de Kruijf, 2015)	Passes the test hypothesis is relevant Rival moderately weakens

Condition:	**reasons for co-production**	
Test:	**smoking gun test**	
Outcome	**Evidence**	Result
S1	The aspect of S1 that was co-produced was the socio economic study. In [JA 2.1 May 2009] SCC presented the approach, upon which new knowledge was added from other partners. British partners describe those additional insights from other partners where open-minding. [I2], [I4], [I8] (WAVE_magazine_no.5, 2013)	Passes the test Confirms hypothesis Rival hypothesis is substantially weaken
S2	The British partners [I8] says that they knew better than others (the Dutch for instance) how to speak the farmers language. Furthermore, for resolving this issue, more political willingness and more resources would be more effective than WAVE.	Fails the test Main Hypothesis is not eliminated Rival is moderately strengthen
F	The frames resulted from WAVE, are policy recommendations towards the owner of climate change and communicating climate change adaptation. the first change can be counted as a policy recommendation, which was one of the primary thematises of WAVE. in the conference November 2010 the message from Eddy Moors is: "include climate change adaptation at the start f the projects, invest in knowledge via co-creation, use integrated approach, assure the decisions are permanent as soon as possible. [Conf Nov 2010	Passes the test Confirms hypothesis Rival hypothesis is substantially weaken.
T	not enough to establish causation	will be re-tested with straw in the wind test

N	Networking was developed due to conditions that stimulate partners' co-produce knowledge. Networking is a development condition that passes through the JA, the min place that knowledge takes place. Actors co-agree on ides for next workshop, because they want to see what happens in "one case". In JA [2.1 My 2009] is suggested. "Wht tools re we using,?" "Close the gap between the project manager and the project " "Utilise shared experiences to lobby for change with respect to wider European policy – change at the policy level in Europe. We should be proactive in helping to shape the policy instead of reactive in the implementation. Mind"	Passes the test Confirms hypothesis Rival hypothesis is substantially weaken

Condition	**goals of the project**	
Test	**with double decisive test**	
Outcome	**Evidence**	**Result**
S1	Proposal for Brue valley Living Landscape is in the project proposal (Project proposal, 2008) thus a straightforward relationship with project structures and vision. However, the appraisal advises to exchange knowledge in order to better integrate their solutions to the regions. Thus co-production cannot be explained	Fails the test Main hypothesis is eliminated Rival hypothesis substantially strengthens
S2	Even if there is an expected straightforward relationship, the plans were achieved despite the project goals. The outcomes was achieved because the circumstances of flooding in Somerset motivated the farmers to collaborate with the SWMP [I8] (SCC, 2011)	Fails the test Main hypothesis is eliminated Rival hypothesis substantially strengthens
F	Recommending policies is one of the project goals (WP1) but the extent these policies reframe issues cannot be predetermined from the project goals. In the project appraisal is stated that: the cooperation of partners within WAVE before will lead to a higher degree of adaptation because of the input (knowledge, experience, views) of others. The various partners are confronted with the same problems but with different physical, social, political and juridical circumstances. There is a lot of added value with transnational cooperation enables the partners to 1) introduce new ideas, views and knowledge to local planning processes and results and thus increase their value and 2) enhance their performance through improvements in efficiency, productivity, quality of for example policy, spatial measures and awareness raising activities.	Passes the test Main hypothesis is confirmed Rival hypothesis is eliminated
T	Not enough data to establish causation	Straw in the wind
N	core to the vision of the project is the reinforcement of collaboration and further cohesion amongst European countries (Project proposal, 2008; SCC, 2011; Wave_end_report, 2013; WAVE_magazine_no.5, 2013)	Passes the test Main hypothesis is confirmed Rival hypothesis is eliminated
Overall		

Straw in the wind tests

Condition		Result
Organizational culture	F Frames emerged despite the presence of a supporting to co-production culture literature pays attention to the organizational culture that explains emerging frames Participants respond that the way they work did not change very much in their organization	Fails the test Main hypothesis not eliminated but slightly weakened Rival hypothesis is slightly stronger
Reasons for coproduction	T Trust emerged despite the reasons for co-production It means that reasons for co-production had little to do with the development of trust. The natural context in every region is difficult but however, participants appreciated any kind of information	Passes the test Main hypothesis is relevant not confirmed Rival hypothesis is slightly weakened
Project goals	T Trust emerged despite of the project goals It means that even if trust cannot be a condition in a project was developed from the partners	Passes the test Main hypothesis is relevant not confirmed Rival hypothesis is slightly weakened

Condition	**quantity**	
Test	**double decisive test**	
outcome	**Evidence**	**Result**
S1	WAVE organized a considerable amount of meetings thought a 5-year period. Joint Actions consisted of 4 series of thematic workshops, which were attended by 1-2 persons per partner (usually but not necessarily the same). Workshops had a length of 3-4 days and allowed for in-depth discussions and the exchange of knowledge with peers (i.e. persons with the same disciplinary background). At one occasion, workshops were partly combined (risk and emergency) so that persons of diverse disciplines could mix (e.g. hydrologists and emergency situation managers). One workshop was combined with a conference [JA 1.1, November 2010] (Vinke-de Kruijf, 2015).Comments from old and new interviews indicate that “Length of workshops was too short to develop new knowledge” [I5]	fails the test main hypothesis is eliminated rival substantially strengthens
S2	Following the evidence provided in the paragraph above, additional inputs from the interviews mention that: [I5] commented “more time and budget could improve the added value from WAVE”.	fails the test main hypothesis is eliminated rival substantially

		strengthens
F	For developing relationships and getting a deeper perspective towards CCA, participants considered time as adequate. For example, interview [I4] says that the cite visits provided insights on how others manage water, thus positive feedback could come in their own organization.	Passes the test Main hypothesis is confirmed Rival hypothesis is eliminated
T	Trust and its foundations were created over an almost-ten – year relationship of collaboration between 5 out of 6 partners. The amount of interaction from JAF and WAVE can explain this outcome. In the project appraisal it is said that: "this project capitalizes on JAF and the JAF extension project. Within JAF the partners experiences the advantage and the added value of transnational cooperation. Furthermore JAF has provided WAVE with a sound basis of: 1) organizational structure and effective cooperation arrangements 2) experience in transnational working 3) instruments and tools for management, monitoring and administration which will be applicable again in WAVE. WAVE builds on this success.	Passes the test Main hypothesis is confirmed Rival hypothesis is eliminated
N	Networking is developing process evolved over time. Using the same evidence as above.	Passes the test Main hypothesis is confirmed Rival hypothesis is eliminated

Condition	**meeting interests**	
Test	**smoking gun test**	
Outcome	**Evidence**	**Result**
S1	The majority [I1-8] was very satisfied with the topics covered. They considered the topic as relevant and useful. For example: Yes our interests were addressed, with INTERREG we opened on minds we received many benefits from the cooperation" [I3]	Passes the test Confirms hypothesis Rival hypothesis is substantially weaken
S2	Same as above. For example "it was very educative for the members of our organization". [I6]	Passes the test Confirms hypothesis Rival hypothesis is substantially weaken
F	Frames were co-synthesized in [JA May 2.1 2009] on the topic "What is the added value of public participation in your project?" Participant's quotes: Participation is nice, but the biggest problem now is that means are limited. Participation also involves a risk that the necessity of the project will be the topic of discussions. You have to find the right people: those who make the project better. It should not be consultation by the numbers but by representation of the stakes at hand	Passes the test Confirms hypothesis Rival hypothesis is substantially weaken
T	not enough evidence to establish causation	Straw in the wind
N	Networking was a gradual result developed on the topics emergency response and communication of crisis. in JA 3.1 My 2010 (Emergency response) says:" Make different	Passes the test Confirms hypothesis Rival hypothesis is

	organizations (water board managers, fireman, red cross, witness of past floods) tell the same message	substantially weaken

Condition	**ambiguity**	
Test	**smoking gun test**	
Outcome	**evidence**	**Result**
S1	Differences in values, believes and language did not have a significant role [I2], [I6], [I7], [I8] towards achieving this outcome. Differences were merely acknowledged on the level of vocabulary were kept under the terminology the British partners had, no new meanings	Fails the test Main Hypothesis is not eliminated Rival is moderately strengthen
S2	The practices followed to achieve this outcome where very intensive [I8]. (farmers view)Ambiguity and conflict were present in that process which were not resolved until the flood events of Somerset. After the event, efforts to convince and co-create solutions to an extent indicate that there was willingness and motivation between partners and stakeholders to accept their differences and co-agree on sustainable agriculture practises. (could be also compromise own observation)	Passes the test Confirms hypothesis Rival hypothesis is substantially weaken
F	The frames changed towards the ownership of climate change. This is a step towards resolving a kind of ambiguity that comes due to the institutional differences countries have towards who is the owner f climate change adaptation. however, the second change in frames (communicating climate change adaptation) is rather a trick towards capturing the attention of the public	Fails the test Main Hypothesis is not eliminated Rival is moderately strengthen
T	Not enough evidence to establish causation	Straw in the wind
N	Not enough evidence to establish causation	Straw in the wind

Condition	**transparency**	
Test	**hoop test**	
Outcome	**Evidence**	Result
S1	Transparency was mentioned unanimously from all the participants [I1-8] for example [I3]: "Yes the facilitation was very helpful. The Dutch managed the project in a very transparent way"	passes the test Passes the test Main hypothesis is relevant Rival moderately weakens
S2	There is no transparency in the British context (the decisions of the Drainage Board is to keep using the technique to rivers regardless the suggestions for more adaptive solutions)	fails the test main hypothesis is eliminated rival is moderately strengthen
F	Not enough evidence to establish causation	Straw in the wind
T	Same evidence as S1	passes the test Passes the test hypothesis is relevant Rival moderately weakens

N	In [JA 1.2 May 2010] participants were asked to interview each other on the following questions: – who are you and what do you do 80% of your working time? - who are you and what is your passion for water? –who are you and what do you want to learn during the wave workshop? – who re you and what is the most interesting part of the program and why?	passes the test. Passes the test hypothesis is relevant Rival moderately weakens

Condition	**communication**	
Test	**Smoking gun**	
Outcome	**Evidence**	**Result**
S1	Communication receives excellent remarks from all interviews [I1;8] for example[I3]: "Yes it was very good, everybody was very honest and open"	Passes the test Confirms hypothesis Rival hypothesis is substantially weaken
S2	Likewise the same explanation as above	Passes the test Confirms hypothesis Rival hypothesis is substantially weaken
F	In [JA 3.1 May 2010] : all government organizations have to communicate one message, flood risk communication and climate change communication re brother and sister: so work together	Passes the test Confirms hypothesis Rival hypothesis is substantially weaken
T	In [JA 3.1 May 2010] common lessons learned are: Use experience- Get local – Be better known and trusted	Passes the test Confirms hypothesis Rival hypothesis is substantially weaken
N	In [JA 3.1 May 2010] common lessons learned are: Use new combinations of partners. Bringing communications and technical people together. Find out what channel of communications works best with your audience.	Passes the test Confirms hypothesis Rival hypothesis is substantially weaken

Condition	**representativeness**	
Test	**double decisive test**	
Outcome	**Evidence**	**Result**
S1	This is a strength of the project: a wide range of persons of the partner organizations participated in multiple activities.(Vinke-de Kruijf, 2015)	Passes the test. Main hypothesis is confirmed Rival is eliminated
S2	WRD participants stayed involved over a longer period of time and attended multiple activities, WVEM stayed involved throughout the project and participated in project meetings as well as the Joint Actions on spatial planning(Vinke-de Kruijf,	Passes the test. Main hypothesis is confirmed Rival is eliminated

	2015). Representation was done likewise for other partners, the majority was represented thought the project	
F	Participants generally support a change in mindset [I2] (WAVE_magazine_no.5, 2013) and working methods [I6].	Passes the test Main hypothesis is confirmed Rival is eliminated
T	The [Nov Conf 2010] states: Initially every country has different expressions of climate change (in France there will be drought, in the Netherlands and in the UK floods etc) but the report builds the following :"in order to find solutions that ensure we keep our feet dry and have profitable fields, we must be inspired" , "platforms that stimulate discussion", "dialogues and tools to inspire cooperation" . these statements result in the common success factors which were synthesized collectively from all participants [JA 2.1 2009]	Passes the test Main hypothesis is confirmed Rival is eliminated
N	Participants generally support that everyone was equal during the project activities. [I1-8] For example [I7]: (what happens is…)"The most common is your knowledge to make (become) stronger and work together on topics and details. Your cooperation and knowledge are more (become) stronger"	Passes the test Main hypothesis is confirmed Rival is eliminated

Condition	**Reciprocity**	
Test	**Hoop test**	
Outcome	**evidence**	**Results**
S1	"there was not a lot of cross-over of what we and they were doing." [I8]	Passes the test Main hypothesis is relevant Rival moderately weakens
S2	Interviews [I1;8] were very satisfied from reciprocity for example : "yes (reciprocity and reflexiveness) when we did the site visits, when we saw how others do proposals… the workshop on topography was very stimulating) [I4]	Passes the test Main hypothesis is relevant Rival moderately weakens
F	In [Conf Nov 2010] is said: "there are two problems if CCA, i) nobody is responsible ii) is not appealing to the public. However the sense of urgency among WAVE partners creates a need for: to raise political interest and tools for communication", "the scope of water management become broader" because these statements	Passes the test Main hypothesis is relevant Rival moderately weakens
T	"it generated quite a lot of trust and desire to continue, so we actually did this success projects not only with the same partners, with some of wave partners and some new partners we did the wow, which was a value of working of dry land I think and we also did drop drought adaptation"[I8]	Passes the test Main hypothesis is relevant Rival moderately weakens
N	Participants generally support reciprocity [I2], [I3], [I5],[I6], [I7]. For example [I5]: "…we realized that for more ambitious projects (like river restoration in Holland) we can't do it with NGOs leading in the UK. We need to do more than advocate and persuade, we need to expand"	Passes the test Main hypothesis is relevant Rival moderately weakens

Straw in the wind test

Meeting interests	T During joint actions there are not specific team building exercises, but in the end of every workshop participants co-decide what topics they want to cover next time, specific issues of problems they want to discuss. There is a very democratic decision making, very cooperative which mainly builds on the topic under consideration	Passes the test Main hypothesis is relevant but not confirmed Rival hypothesis slightly weakened
Ambiguity	T Trust grows despite the presence of ambiguity Good cooperation was also a resulted of the shared budget. It cannot be assumed that it was only the process that actors enjoyed. The extent that ambiguity was handled is not enough to lead to trust	Fails the test Main hypothesis is not eliminated but slightly weakened Rival hypothesis slightly strengthens
	N Networking grows despite the presence of ambiguity Yes that is possible because networking can be developed for strategic interests (financial support, capacity building) thus participants can develop networks regardless of values and beliefs	Passes the test Main hypothesis is relevant but not confirmed Rival hypothesis slightly weakened
Transparency	F Frames were co-developed despite the presence of transparency. Frames are presented in the [Conf Nov 2010] …" politicians don't know all the answers either". "Mind adaptation may be more important than climate change adaptation" Reflections from politician in European parliament. However was only invited to the conference. These statements cannot establish causation	Fails the test Main hypothesis is not eliminated but slightly weakened Rival hypothesis slightly strengthens

Condition	**Distribuition and coverage of co-production roles**	
Test	**Double decisive**	
Outcome	**Evidence**	**Result**
S1	Participants characterize the roles of others and themselves as active [I2], [I3], [I4], [I5] and useful [I1], [I6], [I7], [I8]. There was no mention of non-active partners	Passes the test Main hypothesis is confirmed Rival is eliminated
S2	The same evidence as above applies to the outcome.	Passes the test Main hypothesis is confirmed Rival is eliminated asses the test
F	Respondents viewpoints for climate change adaptation changed more from the contribution of the Dutch partners. For example [I5] says that he uses the Dutch example when he wants to motivate good results.	fails the test main hypothesis is eliminated rival substantially strengthens

T	: The participants considered the roles of participants contributory for the development o trust. For example, in interview [I5] is mentioned that "the choice of the partners is also very important for the results of the project".	Passes the test Main hypothesis is confirmed Rival is eliminated
N	The participants considered the accountability and usesfulnes transnational collaboration has in networking. Also as mentioned in wave magazine no5, making good results starts with making good friends	Passes the test Main hypothesis is confirmed Rival is eliminated

Condition	**Leadership style**	
Test	**Hoop test**	
Outcome	**Evidence**	**Result**
S1	participants describe their leadership style as open to new knowledge sources and types. For instance "*I want to listen different opinions and learn how water management issues are addressed globally [I3]", [I2] describes himself as Collaborative leader who synthesizes knowledge and can draw conclusions*	Passes the test Main hypothesis is relevant Rival moderately weakens
S2	Evidence: project knowledge was discussed within SCC and other organizations especially after the 2014 flood events (Vinke-de Kruijf, 2015) likewise the openness and willingness of partners to engage collectively contributed new ides for the farm water plans.	Passes the test Main hypothesis is relevant Rival moderately weakens
F	Frames resulted because others contributed to them (the attitude of politicians does not present a leadership style because they have different motives and stakes)	Fails the test Main hypothesis is eliminated Rival hypothesis moderately strengthens
T	Participants associate the level of trust with others thus is co-developed [I2;7] . for example : I think yea the people you need and the way tell the story and somebody can explain very well. I think the first one is the most important.[I6]	Passes the test Main hypothesis is relevant Rival moderately weakens
N	Participants generally agree that networking is a part of their job [I1;8]	Passes the test Main hypothesis is relevant Rival moderately weakens