Governance and performance in four types of agri-food open innovation projects

Mersiha Tepic, Dr. S.W.F. (Onno) Omta, Dr. Jacques Trienekens and Dr. Frances Fortuin
Department of Business Administration, Wageningen University
P.O. Box 8130, 6700 EW Wageningen, The Netherlands
Mersiha.Tepic@wur.nl

Abstract

It is the aim of the present paper to analyse how inter-organizational performance of open innovation projects is affected by governance. It is emphasized that under different combinations of environmental and behavioural uncertainty, the combination of structural and relational governance mechanisms lead to highest inter-organizational performance. Four types of innovation networks, established on the basis of a literature study, are analysed on the basis of in-depth case-studies. Data are collected through semi-structured interviews in 18 sustainability-oriented open innovation projects in the agri-food industry. It is concluded that a medium to high level of formalization has a positive relationship with inter-organizational performance, irrespective of innovation uncertainty and network heterogeneity. Competence trust and outcome-related inter-organizational performance, and compliance trust and inter-organizational performance in terms of the quality of the cooperation process show positive relationships. Compliance trust, on the basis of previous cooperation, is the highest in networks with low innovation uncertainty and low network heterogeneity.

Key Words: Inter-firm collaboration, formal and relational governance, agri-food industry

Introduction

Sustained firm performance is dependent on continuous change and improvement. An important solution to the challenges which the Dutch agri-food sector faces is innovation. New products and exploitation of new markets, in combination with sustainability-oriented practices throughout the chain, can strengthen the competitive position of the Dutch agri-food companies. Such radical innovations bring along uncertainties and challenges. Inherent to innovation is uncertainty about the tasks to be undertaken to achieve the innovation goals, uncertainty about the outcomes and uncertainty about market potential of the innovations. Uncertainty complicates governance of innovation networks because reduces the number of possible agreements which can be made at the start of the project. This reduced possibility for ex ante planning, compels partners to ex post negotiation which creates space for conflict and misunderstandings. For companies that invest a lot of time, effort and resources in innovation projects, it is essential to manage the uncertainties involved to increase the chance of profit generation from innovation investments.

*Consumer trends, such as the increased attention to health issues and sustainable ways of food production demand innovative food and production processes (*Dijkman, ABN Amro, 2009. If agri-food companies ought to exploit the first-mover advantage of sustainability-oriented chains, they need to adopt an integral approach, cooperate with their chain partners and assure top-down (governmental) and bottom-up (customers/consumer organisations) support. Therefore, inclusion of different stakeholders in the innovation processes is considered important for success.

The open innovation platform offers possibilities to include these partners, create new ideas and embark on different resources and knowledge (Marinova and Philimore, 2003). While access to and use of the knowledge and skills from customers, suppliers, competitors, universities and other organisations through open innovation (Chesbrough, 2003) offers opportunities, it brings along additional challenges to the innovation process. For example, differences among partners in terms of differing interests, capacities and views may bring about difficulties with regards to appropriation of innovation, prioritisation of project activities and agreements compliance issues.

In order to find out how governance affects performance, we need to take into account the open innovation circumstances in which the partners operate. The combination of environmental and behavioural uncertainty sets the stage in open innovation networks. In this paper, four types of innovation networks, created on the basis of a combination of environmental and behavioural uncertainty, are analysed. The questions is how governance mechanisms can be employed to deal with the challenges created by the combination of these conditions, in a successful way. It is argued that the combination of structural (formal agreements and administrative rules and organisation) and relational (trust and commitment) governance mechanisms improves coordination and performance of innovation networks. While previous research has touched upon the combination of informal and formal governance mechanisms (Poppo and Zenger, 2002), it predominantly took place in the field of medium to high-tech sectors. This study aims to explore whether these previous findings apply to a low to medium technology field, such as agriculture.

In the second Section, innovation uncertainty and network heterogeneity, and the challenges which emanate from these two features of innovation networks are described. Subsequently, the theoretical perspectives which yield insight into governance of these challenges are addressed, followed by exploration of governance mechanisms required in four types of networks to deal with different combinations of innovation uncertainty and network heterogeneity. The third Section elaborates on the study population and data collection methods. In the fourth Section, comparison between the successful and less successful projects, within the four types of networks, is done to allocate *effective governance* (Dyer and Singh, 1998) mechanisms for the four types of innovation networks. The process-oriented, case-study approach to the analysis gives the opportunity to compile in-depth information about the developments within the collaboration during the entire project. In the fifth Section, results from the literature study and results from the empirical part of the research are jointly discussed.

2.1 Innovation uncertainty

Innovation is a process of creative destruction, where the quest for profits pushes to innovate constantly, by breaking old rules to establish new ones (Schumpeter, 1934). It is a *process of interrelated sub-processes, such as conception of a new idea, invention of a new device, and development of a new market* (Myers and Marquis, 1969). Innovation processes are usually organised in the form of projects. As not all project go through the same stages of the innovation process, differences in the level of uncertainty exist among different projects. For example, innovations in an early stage of development usually cope with greater unresolved demand, technological and resource uncertainties. Uncertainty is determined by the extent of (in)ability to determine what to pursue, how to pursue and whether the pursuit is likely to be profitable (Sapienza and Gupta, 1994). One of the most important dimensions of uncertainty, in settings of innovation, is of environmental nature (Williamson, 1989) and is concerned with market uncertainty or demand uncertainty (Burgers *et al.*, 1993). While firms are able to react to demand

uncertainties, they are not able to eliminate it because customer preferences are unstable or changing continuously (Beckman *et al*., 2004). *The primary consequence of environmental uncertainty is an adaptation problem, meaning difficulties with modifying agreements to changing or unforeseen circumstances* (Rindfleisch *et al*., 1997, p.31).

2.2 Network heterogeneity

Open innovation *assumes that firms can and should use external as well as internal ideas and paths to the market, as they look to innovate* (Chesbrough, 2007). Innovation in this open system often takes place in the context of a network, which *is a collection of nodes and ties representing some relationship, or lack of relationship, between the nodes* (Burt, 2005). In this study, the focus is on innovation networks which are distinguishable due to their specific nature characterized by *conversion of information from diverse sources into useful knowledge about designing, making and selling new products and processes* (Küppers and Pyka, 2002, p.3). Despite the major advantages of open innovation, inter-organisational cooperation adds complexity to innovation processes. Especially in heterogeneous circumstances, it is difficult to establish a priori whether partners will behave in an opportunistic or a self-interest seeking way. The lower density of ties decreases the possibility for observation of behaviour directly and increases asymmetry in information exchange. It generates difficulties with regards to verifying whether compliance with established agreements has occurred. Even if the operations or actions can be measured, the information gathering and processing costs may be too high. The different backgrounds and interests of actors, as well as the differences in their capabilities and knowledge complicate the cooperation process and increase coordination costs. Omta and Van Rossum (1999) introduce the 'dark side of cooperation' which emphasises fear of leakage of skills, experiences and competencies that form the basis of the competitiveness of a firm, leakage of information and insights about possible new markets and future possibilities, hidden administering costs of setting up and monitoring of a collaboration, creation of a rival or creation of dependency on a key partner, as potential challenges to governance. Next to the monitoring difficulties, behavioural uncertainty complicates governance also by constituting difficulties in safeguarding specialised knowledge or information against leakage or opportunistic misuse. When any kind of specificity in the assets or resources is employed in an exchange, the chance for opportunistic behaviour or misuse increases. In addition, as new knowledge and information is created during the cooperation, appropriation of knowledge or conversion to property rights becomes an additional challenge to governance. Accordingly, it needs to be studied how to cope with the downside of cooperation.

2.3 Governance perspectives

The structural perspective is grounded in transaction cost (Williamson, 1985) and contract theory, with the assumption is that rational behaviour governs exchanges. Rational behaviour may entail opportunistic or self-interested behaviour, however it can be managed by *formalisation or interference in collaborative endeavours*" (Vlaar *et al*., 2007; Poppo and Zenger, 2002). The main difference between the structural and the relational perspective lies in the basic assumption whereupon the two streams of theories are based. While the arguments and propositions of transaction cost theory start with the assumption of self-interested behaviour of the human being, the relational view bases its arguments on the assumption of a 'social' human being, who is able to trust and who can be trusted. The criticism on the structural, contract-cantered perspective is that it focuses on the economic aspects of exchange and neglects the social context within which the relationship is embedded. Combining the structural and relational

perspective offers the opportunity to dismiss this critique and optimalise governance. For example, rational commitment (Cullen and Johnson, 2000), which is based on calculated self-interest or gain and constitutes a structural incentive, can be complemented by attitudinal commitment. From the relational point of view, attitudinal commitment, or the value of relationship as an asset which yields high returns, generates the incentive to participate and abide to the agreements made. Secondly, control through the means of law, structure and planning, which stems from the structural perspective, can be strengthened through the presence of trust, and vice versa. As Vlaar *et al*. (2007) concluded, "*when there is an initial experience of high level of trust in inter-organisational relationships, establishment of higher level of formal coordination and control may be regarded as symbols of shared values and articulation of communal norms and customs. Formalisation in this case is regarded as a signal of commitment*" (Vlaar, *et. al*., 2007, p. 420). Thirdly, while the structural perspective allows for the necessary adaptation through the means of arbitration, internal dispute settlement, and changes in the planning made at the start of cooperation, the relational view complements this by emphasising that due to the value attached to the relations, partners adapt to one another's needs and are willing to accept temporary periods of inequity (Madhok, 1995). Because the mechanisms from both perspectives entail different strengths, formal or structural and informal or relational mechanisms are integrated in this study (see table 1).

	Structural	Relational
Incentive	Rational commitment Calculated self-interest	Attitudinal commitment value of relationship as asset which yields high returns
Control	Neoclassical contract law Formalisation of coordination	Trust
Adaptation	Arbitration, internal dispute settlement, changes to planning	mutual orientation and acceptance of temporary inequity in the relationship due to value attached to relation and reputation

Table 1 Distinguishing attributes of theoretical perspectives on governance

2.4 Governing innovation uncertainty and network heterogeneity

Relationships between organization in a network are maintained either informally, through norms of reciprocity and trust, or formally, through existence of contracts, rules, and regulations (Provan et. al., 2007, p.503). Also Grandori (1997) indicates that effective governance systems can be obtained by combining formal and informal governance mechanisms. Vlaar et. al. (2007) argue that *when there is an initial experience of high level of trust in inter-organizational relationships, establishment of higher level of formal coordination and control may be regarded as symbols of sharing values and articulation of communal norms and customs. Formalization in this case is regarded as a signal of commitment* (Vlaar, et. al., 2007, p. 420). Consequently, it is argued in this paper that formal and informal governance can strengthen each other.

The transaction cost perspective posits that structural arrangements are key to the organizational design needed to manage uncertainty (Williamson 1989). As Jones *et al*. (1997) argue, when customized, complex tasks are the subject of cooperation, the desirable and necessary continuity, the need for safeguarding and coordinating exchanges, as well as adaptive capabilities inhibits parties from using market mechanisms. In addition, weaker appropriability makes coordination and administrative control less costly than emphasis on market mechanisms or neoclassical contracting. The structural perspective offers the possibility for a certain extent of administrative control. The network of partners is able to design dispute settlement machinery, employ central planning, etc. in order to refrain from setting up detailed and complex contracts ex ante and resort to judicial procedures, in case dispute resolution is needed. The mechanisms

proposed by the relational view are expected to strengthen the adaptation capacities of governance in settings of innovation. The value of relationships is that shared expectations and trust induce desirable behaviour and reduce the need for monitoring (Ouchi, 1980). When expectations are shared and partners trust each other to a great extent, there is a sense of obligation to fulfil one's obligations and promises, not to free-ride, cheat or mislead the partners. The partners are able to trust each other that there will be no disclosure of partners' specialized information or knowledge to third parties. This reduces the level of behavioural uncertainty. In addition to trust, the information sharing and reputational effects help to deal with the monitoring difficulties created by the heterogeneity of autonomous parties taking part in the inter-organisational innovation projects. The information sharing, increasing knowledge about one another, augments the value of the relationships which on its part enhances the propensity to adapt to one another, creates trust and entices a common interest and shared expectations. The latter facilitate tolerance of both, partial goal conflict and temporary periods of inequity in the relationship. Due to the reduction of friction, efficiency is attained (Madhok, 1995).

As Jones *et al*. (1997) argue, it is not a single condition, but a combination of conditions, which propel particular governance mechanisms. In the empirical part of research, the effect of the combination of the two conditions of inter-organisational innovation settings, innovation uncertainty and network heterogeneity, will be explored. For this purpose, four types of innovation networks are distinguished (see table 2). In addition, Table 2 gives a systematic overview of the governance mechanisms which are expected in the different types of network.

Type 1 **Innovation uncertainty low** **Network heterogeneity low**	**Type 2** **Innovation uncertainty low** **Network heterogeneity high**
• low environmental uncertainty ➢ contract law and the invisible hand mechanism ➢ legal agreements • low behavioural uncertainty ➢ high compliance and competence trust ➢ high attitudinal and rational commitment	• low environmental uncertainty ➢ legal agreements • high behavioural uncertainty: ➢ trust-building activities ➢ high competence trust ➢ high rational commitment
Type 3 **Innovation uncertainty high** **Network heterogeneity low**	**Type 4** **Innovation uncertainty high** **Network heterogeneity high**
• high environmental uncertainty: ➢ formalisation of coordination ➢ adaptive internal agreements • low behavioural uncertainty: ➢ high level of compliance and competence trust ➢ high attitudinal and rational commitment	• high environmental uncertainty ➢ adaptive internal agreements • high behavioural uncertainty ➢ legal agreements ➢ active trust-building ➢ high competence trust ➢ high rational commitment

Table 2 Types of networks and expected governance mechanisms

2.5 Inter-organizational performance

In order to determine which governance mechanisms are more successful in different types of networks, we look at inter-organizational performance of innovation projects which take place in networks of actors. Collaboration in the setting of innovation is related to two aspects, content and process. On the one hand, the collaboration aims at a number of objectives, and on the other hand, a number of indirect, process-related aspects play a role in the collaboration. Because governance mechanisms are needed to manage inputs and outcomes, as well as the collaboration process, including coordination and adjustment of activities of interdependent parties, it is meaningful to look at measures of outcome performance as well as measures indicating the performance of the process of cooperation (Ariño, 2003; Kumar and Nti, 1998). This entails that

inter-organizational performance is assessed on the basis of rational (economic or strategic) as well as cognitive processes of the participants in open innovation projects (De Rond, 2003). Outcome performance captures the effectiveness and efficiency of a relationship, including the degree of overall performance satisfaction, the extent to which strategic goals are fulfilled, and parties' adherence to schedules and budgets (see Ariño, 2003; Hoang and Rothaermel, 2005). Process performance, instead, pertains to the relational quality of the collaboration (Ariño, et al., 2001), entailing ease or efficiency of cooperation (Luo, 2002), the extent to which conflicts prevail in the relationship, and partners' satisfaction with coordination and communication processes (Poppo and Zenger, 2002).

The relationship between governance and inter-organizational performance is one where an appropriate balance between the elements which are being formalized and which are not being formalized needs to be found. On the one hand, the setting of objectives and the negotiation process which precede the final contract contributes to a better mutual understanding among the parties. It could even lead to increased trust towards the organization of the project because the partners have a more clear idea about the expectations and the process of the project. On the other hand, formal governance can cause rigidity and leave little room for flexibility and creativity. In addition, restrictions on the level of formalization are also placed by the possibility to pre-plan. Therefore, too much formalization can create a rigid cooperation and innovation process, while too little formalization might generate disorder and lack of clear focus (in terms of outcomes and process) (Katz and Kahn, 1966; Luo, 2002). Our expectation is formulated in accordance with the argument by Vlaar (2006) that the relationship between formalization and inter-organizational performance could be depicted by an inverted U-shape (see Figure 1).

Without an initial level of trust among potential partners, collaboration in the setting of innovation would become a very difficult endeavor, because uncertainty would lead to a situation where the partners continuously question the motives and competences of their partners. Trust is required so as to assure that knowledge and information is shared, and potential conflicts and differences are more easily resolved. Despite its advantages, a too high level of trust can also be disadvantageous, if it is accompanied by naiveté (Vlaar, 2006). Even under conditions of trust, it is impossible to exclude opportunistic behavior completely. Therefore, trust can have a negative effect when it takes away the tendency to guard against opportunistic behavior and assess the behavior of others. Furthermore, too much trust can also refrain partners from thinking in terms of chances and opportunities which means that they miss out on occasion of possible profit, etc. *As too low or too high levels of trust can have a negative effect on inter-organizational performance, it is expected that an intermediate level of trust is most effective in open innovation settings* (see Figure 1).

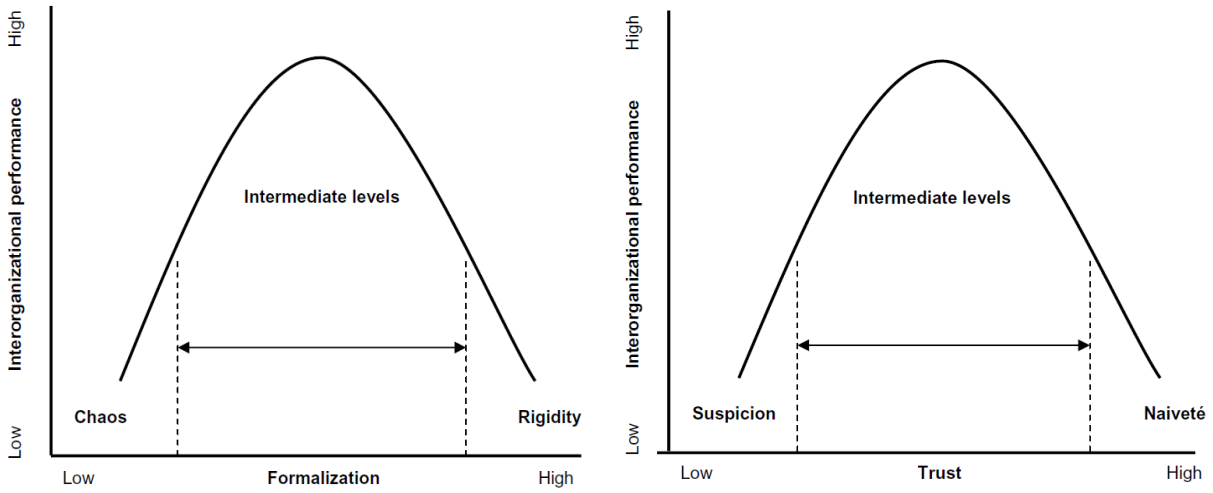

Figure 1 Inter-organizational performance and formalization; inter-organizational performance and trust (Vlaar, 2006)

Methods

Study population

The projects range from cooperation among chain partners who try to integrate sustainability-oriented practices into their business to projects which try to build a network of partners from a particular region and establish a new arena for innovative ideas and sustainability-oriented cooperation. These public-private partnerships are part of a sustainability-oriented program, where cooperation among universities, (semi-) governmental organisations and private sector actors is one of the central aspects. The number of participants per project range from 6 to 50 organisations. There are 6 projects with 9 or less participating organizations and companies, 3 projects with 10 to 14 participants, 5 projects with 15 to 19 members, 1 project with 20 to 24 and 3 projects with 30 participants or more. In most of the projects small entrepreneurs and companies are taking part and only a few large companies are participating. As most projects include two or three knowledge or research institutes and the number of companies fluctuates, the ratio knowledge institutes-entrepreneurs is more or less fifty-fifty in smaller projects and around one to twelve in the larger projects. Participants include growers, cattle-farmers, processors, producers, cooperatives or other umbrella organisations, retailers, engineering companies, knowledge institutes, intermediaries, (management and marketing) consultancies and governmental and societal organizations, such as animal welfare organisations. The average project budget size is between 900,000 and one million euro. On average, the projects take 3 to 4 years. At the time of data collection, the projects were recently completed or in an advanced stage of completion.

Data collection

Interviews were conducted with project leaders from 18 innovation projects in the agri-food sector, in the period from June to August 2009. The in-depth interviews, comprising 32 open questions, were complemented with 33 7-point Likert scale statements in order to enable a more systematic analysis of the concepts from our model (see Appendix for an overview of the measures used in this study). The function of project leader was chosen for the interviews,

because it is this partner who has the best overview of the situation in the project. In those cases where we were not able to acquire sufficient information from the project leader, other participants were approached to complete the picture.

With the intention to improve the validity of the data collected from the projects, we triangulated the information collected through interviews with investigation of initial agreements, meeting notes and existing evaluation documents. The two-hours lasting interviews were recorded and transcribed. As companies do not prefer to reveal their failures or discomforts in the context of inter-firm innovation, we had to assure that the information presented cannot be traced back to the particular project.

Data analysis

In order to answer the 'how' questions and acquire understanding on complex relational processes, we have chosen for the multiple case-studies approach. First of all, non-parametric Spearman rank correlations tests have been performed in order to acquire insight into the type of relationship between the different variables. Secondly, a comparison test in combination with Kruskal Wallis tests were carried out to get insight into the mean scores and standard deviation of the different groups, as well as the non-parametric significance of differences among the groups. Thirdly, a number of cases are compared on the basis of more in-depth information, including quotes from the interviews.

Results

In the following part first of all the differences in governance mechanisms in the four types of networks will be laid our, followed by the differences in performance levels.

Type 1 Low uncertainty-Low heterogeneity	
N = 7	
Trust proportion previous cooperation	4.7 (1.4) †
Trust compliance	4.4 (1.4)
Trust competence	6.3 (0.8)
Commitment attitudinal	4.6 (1.5)
Commitment rational	5.3 (1.3)
Formalization internal	6.9 (2.4)
Formalization legal	1.7 (1.8)

Type 2 Low uncertainty – High heterogeneity	
N = 6	
Trust proportion previous cooperation	2.2 (0.8) †
Trust compliance	4.8 (1.8)
Trust competence	6.3 (0.5)
Commitment attitudinal	5.2 (1.2)
Commitment rational	5.5 (1.4)
Formalization internal	7.5 (2.9)
Formalization legal	3.7 (4.3)

Type 3 High uncertainty – Low heterogeneity	
N = 3	
Trust proportion previous cooperation	3.0 (3.0)
Trust compliance	4.7 (2.3)
Trust competence	5.0 (2.6)
Commitment attitudinal	3.3 (1.2)
Commitment rational	4.7 (2.5)
Formalization internal	7.8 (3.4)
Formalization legal	1.3 (2.3)

Type 4 High uncertainty – High heterogeneity	
N = 2	
Trust proportion previous cooperation	3.5 (2.1)
Trust compliance	3.5 (2.1)
Trust competence	4.5 (0.7)
Commitment attitudinal	3.7 (1.9)
Commitment rational	3.0 (1.4)
Formalization internal	8.3 (1.8)
Formalization legal	0.0 (0.0)

Table 3 Comparison tests governance in four types of networks mean (standard deviation); † Dunnett's T3 sig. 0.05

Formalisation

Results from Table 3 show that internal formalisation is the highest in case of high heterogeneity and high uncertainty about the market potential. However, on the scale from 0 to 13, all of the projects score 7 to 8 points in terms of internal formalisation. This indicates that a medium level of formalization is of importance for all types of networks. Legal agreements are the highest under low uncertainty and high heterogeneity. This indicates that partners are willing to commit formally when uncertainty about market potential is low, especially when there is a high diversity of actors so as to assure that they appropriate results from the cooperation. However, because of the very limited amount of legal agreements made in the projects in our sample, it is not possible to make any reliable statements in this respect.

Trust

The post-hoc test shows that a significant difference in the level of trust, in terms of the proportion of partners with whom previous cooperation has taken place, is to be found between the group with low level of innovation uncertainty/low network heterogeneity and the group with low level of innovation uncertainty/high network heterogeneity (see table 3). Under conditions of low innovation uncertainty, it is network heterogeneity which discriminates between high and low levels of trust. Compliance trust does not show any pattern of differences, while results do point towards a specific direction in the case of competence trust. The latter is lower in networks with a lower level of uncertainty about the market potential of the innovation.

Commitment

The results in Table 3 indicate that attitudinal and rational commitment are higher in case of low uncertainty about the market potential. However, the largest difference in rational commitment is between network type 4 (high uncertainty/high network heterogeneity) and the remaining networks. This designates that it is the combination of the level of innovation uncertainty and network heterogeneity which leads to reduced rational commitment.

Performance

Type 1 Low uncertainty-Low heterogeneity		**Type 2 Low uncertainty – High heterogeneity**	
N = 7		N = 6	
Performance overall	4.6 (2.4)	Performance overall	4.2 (1.7)
Performance skills	5.4 (1.1)	Performance skills	5.2 (1.8)
Performance cost/benefit	4.0 (1.7)	Performance cost/benefit	4.7 (1.9)
Performance continue coop	5.9 (0.9)	Performance continue coop	5.8 (1.0)
Performance QCP	4.3 (1.0)	Performance QCP	4.9 (1.0)
Type 3 High uncertainty – Low heterogeneity		**Type 4 High uncertainty – High heterogeneity**	
N = 3		N = 2	
Performance overall	3.3 (1.2)	Performance overall	3.0 (0.0)
Performance skills	4.3 (2.1)	Performance skills	4.5 (2.1)
Performance cost/benefit	4.3 (1.5)	Performance cost/benefit	3.0 (1.4)
Performance continue coop	5.7 (1.5)	Performance continue coop	4.0 (2.8)
Performance QCP	4.3 (1.0)	Performance QCP	3.6 (0.5)

Table 4 Comparison tests performance in four types of networks mean (standard deviation)

Table 4 presents a more elaborate overview of the differences in scores on the several performance measures among the four types of networks. The overall performance, established on the basis of information from semi-structured interviews using five indicators (see Appendix I), is highest in networks with a low level of uncertainty about the market potential of the innovation. Also performance in terms of expectation to benefit from skills, capabilities or knowledge acquired during the project is the highest in networks with low uncertainty. The level of satisfaction with the cost/benefit ratio of time and money invested in the project is the lowest in the most complex networks, type 4 networks. Also continuation of cooperation with a number of partners, as a follow-up to the current project, is most likely when partners have cooperate in a setting outside the combination of high uncertainty and high network heterogeneity. Results show the same result for quality of the cooperation process. The extent of satisfaction with the resources engaged in the cooperation process, the manner in which the project was managed, the working relationship among the partners in the project and the partners' responsiveness to problems or inquiries is the lowest in when cooperation has taken place in conditions of low uncertainty and low network heterogeneity.

Governance mechanisms and performance

In the following section, the governance mechanisms and inter-organizational performance will be discussed and analysed on the basis of a number of cases which typify the four different types of networks. For type 1 and type 2 network, a comparison is made between a successful and less successful project in order to illuminate the differences and the elements which are key to attain successful innovation projects. Unfortunately, there are no successful projects in our dataset with high level of uncertainty about the market potential of the innovation. Because we can learn from mistakes and failures, we will discussed and draw lessons from the less successful projects in the case of type 3 and type 4 network. Table 7, in Appendix I, gives a schematic overview of the measurement of performance of the 6 projects analysed in more depth, below.

Type 1 Low uncertainty-Low heterogeneity				
	Higher performance		Lower performance	
	Start project	During project	Start project	During project
Trust	+++	+++	+	+
Commitment	+++	+++	++	+
Formalisation	++	++	+	+

Type 2 Low uncertainty – High heterogeneity				
	Higher performance		Lower performance	
	Start project	During project	Start project	During project
Trust	++	+++	++	-
Commitment	+	++	++	++
Formalisation	+++	+++	+	+

Type 3 High uncertainty – Low heterogeneity				
	Higher performance		Lower performance	
	Start project	During project	Start project	During project
Trust			++	+
Commitment			+/-	+/-
Formalisation			++	-

Type 4 High uncertainty – High heterogeneity				
	Higher performance		Lower performance	
	Start project	During project	Start project	During project
Trust			+/-	+/-
Commitment			-	-
Formalisation			+	1½ +

Table 5 Trust, commitment and formalisation ; +++ high; ++ medium; + low; - absent

Type 1 Network – Low uncertainty and low heterogeneity

In the successful project, mutual knowledge and understanding developed during previous cooperation and the continued adaptation to one another led the relationship to develop towards more trust, giving more space to informal governance mechanisms. *The partners acknowledged each other's valuable contribution. The increased contact and communication resulted in turning their differences into an advantage. Trust is an important complementary to the*

agreements made. The combination of formal agreements and high level of compliance and competence trust at the start of the project which has been upheld during the entire process of cooperation and innovation, combined with a high level of commitment, led to the successful outcome of the project. The importance of commitment is stressed by the project leader. *It is important to work with partners who are not only motivated by financial gains but are also passionate about the work to be done, the goals and the success to be achieved*. The project leader points out that commitment and a smooth transition from one phase to the other was safeguarded by involvement, at an early stage of the process, of partners who would be needed in the later stages of the process, assuring co-ownership of the project ideas and activities.

The goals in this project are continuous because of the long-term character of the project. The goals set for this project, such as isolation of a new gen in fruit, are attained, but they represent a few components of the final aim. The partners learned much in terms of presentation and communication of advantages of this new product. Furthermore, the establishment of cooperation and engagement with new organizations and actors opened the door for new possibilities. In terms of the cooperation process, they have enjoyed the cooperation with the main partner, as at some point they even *started to complement each other in the project activities in an organic way*. Furthermore, there is satisfaction with the resources engaged in the project and the reactions of the partners to questions or problems. Despite the positive experience with the cooperation process, the departure of one of the partners due to mutual dissatisfaction, sharpened the attention of the project leader towards careful assessment of value of individual contributions.

In the less successful project, no transition from formalisation to more informal governance mechanisms was made, because of the low strength of social mechanisms to take over governance functions. In absence of previous cooperation, the continuous questioning of each other's commitment obstructed the development of relationships. As the project leader said: In this project there was no doubt about the competencies among the partners, but there was a lot of doubt concerning hidden agendas and commitment. There is always one party which initiates the idea and starts to search partners who possess the necessary competencies for the project. However, there must be a clear gain present, which assures commitment for each of the partners involved. Especially at the start of the project, it is important to find out what the strategy of the other partners is, acquainting oneself with the ambitions of the partners and learning what one can expect from the other. Therefore, it is important to assure commitment of the upper echelon management. Even when you are dealing with a company/organization with a very good track-record and a high commitment at face value, in reality the commitment can be very low because there is no support from the management in the company. Absence of increase in trust n this project was due to the low level of alignment of interests and motivations, and the absence of clarity of commitment on the level of upper echelon management. Furthermore, a re-organisation at the lead company led to a decrease in the energy level of the project activities. In addition, the change in the direction of the objectives led to decrease in commitment by some of the partners. Due to the enduring commitment of the initiator-entrepreneur, some of the goals were achieved, but not as intended.

The goals have been partially achieved. *Some of the issues developed have been successful, for example the development of sustainability trajectories with suppliers, including quality labels and requirements for suppliers. The other goals, such as development of a full sustainability strategy for the company and cooperation with a societal organization, has been less successful,*

as the societal organization involved decreased interest in and prioritization of the project. The *societal organizations involved reached a limit to their level of commitment at some point*, because some of the aspects in the project became too intertwined with *the internal considerations and strategic decisions* which complicated the cooperation process. Furthermore, *most of the research performed and knowledge developed was done upon insistence by the knowledge institute and the intermediary organization involved* which was not considered very useful by the practice-oriented partners. The project leader is very dissatisfied with the cooperation process, because it was *not sufficiently demand-driven*. The intermediary organization used the project as a sort of experiment instead of facilitating its progress and success. Furthermore, there were some *power-struggles and shift in leadership*. *At the start of the project it was the intention that all the parties would contribute to the strategy of the company, but in reality the company was the one who determines the course* because this is the partner which implements and bears the final costs.

Type 2 Network – Low uncertainty and high heterogeneity

In the successful project, partners were carefully selected and considerable attention was given to formalisation of objectives, tasks, etc. Although commitment and growth of trust gave room to informal governance, planning and agreements retained an important governance function. This was exemplified by the increased attention to formalisation of terms of access to the network. During the concept development and technical implementation phases, adjustments to the initial agreements were made, indicating that planning and structuring remained an important aspect of governance throughout the entire project. Despite the trust-building activities, such as visits to each other's organisations, three partners left the project because they were not sufficiently convinced of the potential of the innovation goal. Their departure only raised the overall level of trust, because only the committed partners remained. The level of commitment grew as the direction of the objectives was becoming more clear. The time and effort spent by the project leader in the coordination and assurance of progress, contributed to the necessary information exchange, mutual understanding and problem-solving.

Overall, the project is considered successful. The entrepreneurs consider the project as successful when the new, intended company is physically in place and when it is profitable and self-sustainable. For the entrepreneurs the highest possible attainment of sustainability-oriented goals is not the most important issue, but the return on the financial investments made. The goals set for this project, which constitute a fraction of the entire pool of aims, are successfully achieved. As the project is in the phase of acquiring the building permit, there is still a way to go before the final aims of the entrepreneurs are attained. For the intermediary organization, the complete list of the intended sustainability aims matters. They consider the sustainability aims and all the positive side-effects as realized, though there is always a discrepancy between the starting picture and the final achievements due to the changes and developments which occur during the project. All in all, the project is in congruence with the initial goals and ideas of the intermediary partner. The partners have learned a lot in terms of collaboration and management of such complex open innovation projects. They indicate a high level of satisfaction with the resources engaged, the cooperation with the project partners and their reactions to questions or problems. Especially the role of the project leader is highly valued, as without its involvement, the project may have had a less successful outcome. For example, the project leader played a major role in coordination and stimulation of communication, information exchange and task division among the entrepreneurs.

In the less successful project, partners were selected on the basis of their expertise or track record in the specific field, from the network of the project initiators. Similar backgrounds were considered during the selection in order to put people together where dynamics emerges to come to something new. All parties were involved from start of the project in order to assure co-ownership of the project. Presence of commitment was evident because all entrepreneurs were looking for new opportunities and willing to undertake something new. The idea screening, concept development and business analysis phases were marked by a low level of formal agreements. The gross of the agreements were of an informal nature based on trust, friendship or social relations. According to the project leader, formal agreements do not congruence with innovation processes, but a lesson learned is that the investment (whether it is in the form of money, working hours or knowledge) needs to be clearly defined at the start of cooperation. When it was supposed to enter the technical implementation phase, the project stagnated due to deterioration in trust and commitment. The project leader said: If you want to attain communal interest, you have to keep in mind the separate interests of all the parties and remain honouring them. The carefully built and developed cohesion on which the partners have been working to increase the level of trust, has been destroyed when the stake of one another was not recognized any more. That is what has happened in this project. While the project leader indicates that more formalisation was not possible and necessary, it might be the case that formalization could have influenced the outcome in a positive way.

The fact that research has been done which has brought the innovation to a next level is considered as successful in project, but because the intended goals, implementation and execution of the initial design, was never realized, the project is considered as unsuccessful. The project has failed on two aspects. First of all, the organization of the legal and financial aspects failed, inhibiting any commercial prospect. More specifically, the failure was made at the consortium formation stage because this never turned into an actual success. Secondly, the communication and knowledge management constituted a problem. For a good knowledge flow it is important to build a network which collaborates, but in this case research was executed in separate corners, lacking actual collaboration. Despite all the energy and effort put into knowledge creation and development of the concept, the project stagnated because the differences among the partners eclipsed the commonalities. *The reason why things did not go as planned is mainly due to the inter-cultural differences and perhaps the lack of sufficient commercial emphasis*. The collaboration process did result in a lot of lessons about the way in which this type of projects is ought to be managed. The network, the actors and the right entrepreneurs are important because they are the attention seeker for the entire project. The entrepreneurs need the other stakeholders, but they must be the leaders of the project if it is to result in success.

Type 3 Network – High uncertainty and low heterogeneity

In the less successful project, only two parties, which did not cooperate previously, assumed an active and committed role in the project. The relationship among the rest of the partners stagnated, despite their common participation in a platform where they were able to communicate and gain knowledge about one another. This project demonstrates that previous relations do not necessarily lead to better results in terms of cooperation. Compliance trust and competence trust became very low, because most of the partners did not fulfil their promises and did not exhibit the specialized competencies which they were expected to posses and deliver. Only the small entrepreneur and one of the knowledge institutes demonstrated a high level of commitment to the

project activities. The other partners did not assign priority to the project, because of small gains involved for these parties. Their low commitment was reflected by absence of any assistance during very difficult and crucial times for the progress of the project. The project demonstrates how important calculative, but also affective commitment is for an innovation project. At the start of the project very little agreement were made. Only rough aims and plans were agreed upon and as the project progressed, the agreements were given with even less attention. The two active partners managed the project in an organic way, dealing with circumstances as they came along. The low level of formalisation omitted the partners from sufficient negotiation, discussion and alignment, at the start of the project, depriving them of assurance of commitment which would have induced effort to relationship development and trust building.

The main goal, development of knowledge with regards to growing of a new plant, was achieved but with great difficulties. If the necessary adaptations were not made, none of the goals would have been achieved. The part of research related to processing, production and commercialization possibilities, was less successful. Scaling-up, which was also part of the goals, has gained potential, but outside of the current project set-up. It has some feasibility only due to the effort put in by the entrepreneur in the project to find new partners willing to take risk in the field of scaling-up and commercialization. There is a very low level of satisfaction with the cooperation process. The entrepreneur, and at the same time the project leader, feels that the other partners have left him in the dark at most difficult times in the process when he needed their help and support. For example, the parties did not give any support in the resolution of the conflict with the stakeholders who objected the execution of the experiment at the location selected. The project leader is especially not amused about the fact that at the point when he arranged everything and things started to turn to more success, the other partners started to show their involvement again.

Type 4 Network – High uncertainty and high heterogeneity

In this less successful project, where the integral community approach was supposed to have a central role, path-dependency obstructed the progress because the partners could not leave the established roles. Previous cooperation between governmental agencies, societal organizations and entrepreneurs, as well as between the countryside and urban areas, was limited. The established ways of informal communication, hierarchy and power-balances impeded the development of competence trust in the unconventional roles and tasks the partners were supposed to assume. The rhetorical question by the project leader how to force people to comply to the agreements made, indicates that the level of compliance trust was also low in this project. The idea generation and screening phases in this project, which included a lot of brainstorming and compiling of ideas for practical projects between unconventional partners, did not allow for financial commitment at the start. However, the problem is that even after three years of the project, actual commitment in terms of financial investment by the entrepreneurs remained very limited. Furthermore, the financial problems of one of the main partners and the change in project leadership did not contribute to continuance and coherence in project activities. The project did not result in success, despite the increase in specificity of agreements, with more tangible objectives and increased clarity for practice-oriented partners. The main reason for little success was the low level of trust and commitment.

A number of small innovative initiatives have been started in the region, as was intended, and the outlook of the entrepreneurs has changed to some extent. However, these are minor steps in

progress when compared to the initial aims set for this project. Due to uncontrollable occurrences, such as the financial problems of one the main partners, changes in the project leadership and commitment in terms of confidence that a new concept of unconventional alliance would work, the project became limitedly successful. The main problem is related to the lack of commitment by partners to make the necessary financial investments. Because there is no actual execution and implementation of the plans, the project is not considered as very successful. *There are quite some possibilities,* according to the project leader, *but the set-up of the project is too big and it was not based on the initiative of an entrepreneur, but mainly on the initiative of the regional government in cooperation with knowledge institutes*. It required a lot of effort to keep the project alive in these conditions of low commitment and high level of distrust among the partners to collaborate in new settings with changed roles. As a consequence, there is a low level of satisfaction with the cooperation process.

Conclusions

Overall performance is the highest in projects with low innovation uncertainty, which is not surprising considering the fact that there is a greater tendency of failure in highly complex and uncertain innovation trajectories. In conditions of high uncertainty and high network heterogeneity, the cooperation becomes even more complicated as shown by the lowest scores in terms of the cost/benefit ratio of time and money spent on the project and quality of the cooperation process. The unsuccessful high heterogeneity networks, Type 2 and Type 4, show that the socio-cultural differences among the different project partners have inhibited partially the innovation process. The most commonly mentioned reason for lower performing projects is the lack of commitment by one of the partners, either to realize the sustainability-oriented goals or to assure the necessary financial investment. Also lack of project leadership by a (capital-intensive) entrepreneur is mentioned as reason for lower performance. It is remarkable that most of the lower performing projects mention the absence of implementation and commercialization as the main indicator of lower performance, while the partners in the higher performing projects accept the fact that they did not reach their final aim. The latter made a much more realistic picture concerning their expectations at the start of the project, which did not result in disappointment due to miscalculations. This indicates that deliberation, in the form of formalization, at the start of the project is useful to set straight the expectations and acquire insight into the actual possibilities, in conditions of heterogeneity. The result that performance, in terms of acquiring useful skills and knowledge from collaboration, is the highest in networks with low innovation uncertainty is surprising as it would be expected that partners learn most from highly uncertain innovation trajectories. However, the case-study analysis shows that most of the respondents indicate that they have learned something from the entire process, even the lower performing ones. The difference between the higher and lower performing projects is related to the reason that they mention as ground for drawing these lessons. Partners from higher performing projects refer to positive, unexpected gains, such as new contacts which opened the door for new possibilities. Partners from the lower performing projects mention only their dissatisfactions with the collaboration process and the way these have taught them how *not to do* things.

The expectation, as set out in Table 2, that internal formalization is important for each type of network is reflected by the results which show a medium level of internal formalization in all types of networks. However, the expectation that legal formalization is less important for Type 3 network, see Table 2, could not be rejected or supported because of the generally low level of legal formalization in the projects under study. The case-study analysis shows that in networks

with a low level of innovation uncertainty, formalization is somewhat higher in the higher performing projects. This observation indicates a tendency of a positive relationship between a medium to high level of formalization and inter-organizational performance. Results from this research are in congruence with the expectation that a too low level of formal governance is not beneficial for the inter-organizational cooperation (Vlaar, 2006). However, as there are no cases of extreme levels of formalization in the present set of projects, it is difficult to conclude that too much formalization is harmful to the innovation process. As the dataset does not include high performing projects in conditions of high uncertainty, it is not possible to conclude that partners are more inclined to formalize the innovation process in low uncertainty because a higher level of confidence about the potential success of the project. Furthermore, the case-studies show a slightly higher effort toward formalization in the more heterogeneous networks, while in the more homogeneous networks, slightly more emphasis is put on the organic approach of cooperation. All in all, when all partners are involved in the process of formalization at the start of the project, conflicts and misunderstandings are avoided later on in the project. Through deliberation and negotiation, a lot of information on the interests and expectations is exchanged, enabling the parties to detect presence or absence of actual commitment to the project. This creates stability of the network, reducing the amount of time and effort needed to search and select new partners, in case of attrition of participants.

According to theoretical expectations, rational commitment should be especially important in high uncertainty networks (see Table 2). The fear of foregoing the benefits and profits from the innovation should function as an incentive for partners to abstain from opportunistic behaviour, as the latter could lead to expulsion from the project. In contrast, the comparison tests and the case studies show that commitment is higher in successful, lower innovation uncertainty projects. The lowest rational commitment in high uncertainty/high heterogeneity networks testifies that highly risky and complex projects lead to lower reluctance to commit to the innovation projects. While it was expected that attitudinal commitment is higher in low network heterogeneity (see Table 2), the results show that attitudinal commitment is the highest in case of low innovation uncertainty which indicates that heterogeneity and attitudinal commitment are not related. A possible explanation for this is that attachment of value to cooperation is related to performance of the project. In the higher performing project with low and high heterogeneity, commitment was high or increasing, while in the lower performing, high and low heterogeneity projects, commitment was questioned, absent or destroyed over time. In low and high heterogeneity networks, positive development of relationships is necessary to allow trust and commitment to increase. Commitment to a relationship grows when all partners experience a growing amount of benefits from the cooperation.

Theoretical expectation was that competence trust would be especially important in the highly heterogeneous networks and that competence and compliance trust would be high in low heterogeneity networks (see Table 2). Results show that previous cooperation is the highest in projects with low level of uncertainty and low network heterogeneity. Case study analysis shows the highest level of compliance trust in the successful, more homogenous network, as previous cooperation has increased the knowledge about partners' reliability in terms of compliance with promises and agreements made. It is surprising that partners who have cooperated previously do not engage in more uncertain innovation trajectories. The fact that previous cooperation is more frequent in the lower heterogeneity projects is in line with expectations. The fact that results show that competence trust is generally lower in conditions of high innovation uncertainty may

be related to the fact that the partners do not know exactly which competencies they will need in the future to attain the aims of the project. Case-study analysis shows that despite trust-building activities in the heterogeneous network, the level of competence trust was the highest in the more homogenous network where the partners *started to complement each other in the project activities in an organic way*. The lower performing, low and high heterogeneity projects do not show any remarkable difference in the level of trust. The trust-building in the high heterogeneity, less successful project was destroyed by the *loss of respect for the interests, position and point of view of one another*. In the lower heterogeneity network, increase in trust remained absent because of continued *suspicion about hidden agendas and commitment of certain partners*. Previous cooperation and inter-organizational performance are not necessarily related. Overall performance and expected benefits from skills and knowledge gained from cooperation show the same pattern of scores as competence trust. This directs to the conclusion that a relationship exists between competence trust and outcome-related inter-organizational performance. Compliance trust and performance indicators related to the cooperation process show similar pattern in scores which points towards a relationship between compliance trust and inter-organizational performance in terms of the quality of the cooperation process.

Appendix I

Concept	Operational definition
Network heterogeneity	Types of organizations classified according to categories of International Standard Industrial Classification (ISIC) list, where the economic activities are subdivided in a hierarchical, four-level structure of mutually exclusive categories. The number of different types of organizations used as measure of heterogeneity. (Monge, et al., 1998)
Innovation Uncertainty (Market potential) 7-points Likert scale	Certainty is high that there will be a market for the outcome/innovation of the project. . (Lippman & Rumelt, 1982; Sapienza and Gupta, 1994; Zaltman, Duncan and Holbeck, 1973)
Rational commitment 7-points Likert scale Semi-structured questions	Willing to make additional investments in the project, if needed. (Cullen et al., 2000) General commitment in the project established using indicators such as time investment in the project by individual partners, support from management, origin ideas from entrepreneurs, from researchers (governmental or societal organizations) or common ownership of the project aims; time and effort put in the coordination by the project leader.
Attitudinal commitment 7-points Likert scale *Average presented in Table 6*	We would drop the current partners if we would come across parties with better project ideas. There is a strong sense of loyalty among the partners. Continuation of cooperation with the current partners is more or less self-evident. (Ring and Van de Ven 1992; Muthusamy and White, 2005)
Formalization **Internal** **Legal** inventory of agreements	aims, task division, time planning, organizational structure (such as foundation of a steering committee), decision-making rights and progress assessment criteria (see Table 1) Investment of resources, extension clauses, punitive sanctions on non-compliance, conflict resolution, procedures for termination of the cooperation and criteria for entrance of new members, (intellectual) property rights and confidentiality agreements (see Table 2) (Gulati, 2007; Omta and Van Rossum, 1999; Parkhe, 1993; Vlaar, Bosch and Van den Volberda, 2007; Sobrero and Schrader, 1998)
Trust Previous cooperation	Indication per partners whether previous cooperation in any kind of project has taken place. (Heide and John, 1992; Klein Woolthuis, 1999; Claro, 2004)
Compliance Trust 7-points Likert scale	The three key partners always fulfill their promises.
Competence Trust 7-points Likert scale Semi-structured interviews	The key partners have specialized capabilities that add value to the project. Trust on the project level established on the basis of examples provided by the project leader and explanations about the development of trust over time. (Golden and Powell, 2000; Claro, 2004; Heide and John, 1992; Cullen et al., 2000)
Inter-org. performance 7 point Likert scale Overall performance established on the basis of Information from semi-structured interviews Quality cooperation process *Average presented in Table 6*	We expect to benefit from skills, capabilities or knowledge acquired during the project to a great extent. The cost/benefit ratio of time and money invested in the project is satisfactory. Continuation of cooperation with a number of partners will follow-up this project. (Kumar et al., 1995; Zollo et al., 2002; Kogut 1991; Straub et al., 2004) The performance on the following five categories has been rated per project, resulting in a score of performance from 1 to 7: extent (amount and degree) of research and practice-oriented (initial/adapted) aims achieved; follow-up projects or actions; interest from external parties for the results of the project; satisfaction with the cooperation process; change towards more openness and long-term collaboration (Ariño, 2003; Luo, 2002; Poppo and Zenger, 2002; Hollander, 2002; Omta and van Rossum, 1999). Extent of satisfaction with the resources engaged in the cooperation process; the manner in which the project was managed; the working relationship among the partners in the project; partners' responsiveness to problems or inquiries (Ariño, 2003; Luo, 2002; Poppo and Zenger, 2002)

Appendix II

Type 1 Low uncertainty-Low heterogeneity		
Project	Higher performance	Lower performance
Overall	+++	1½ +
Goals	+++	++
Follow-up	++	++
Interest	++	-
Cooperation process	+++	+
Change towards openness	++	+

Type 2 Low uncertainty – High heterogeneity		
Project	Higher performance	Lower performance
Overall	+++	+
Goals	+++	+
Follow-up	+++	++
Interest	+	+
Cooperation process	++	+
Change towards openness	+++	+

Type 3 High uncertainty – Low heterogeneity		
Project	Higher performance	Lower performance
Overall		+
Goals		1½ +
Follow-up		++
Interest		+
Cooperation process		- / +
Change towards openness		+

Type 4 High uncertainty – High heterogeneity		
Project	Higher performance	Lower performance
Overall		+
Goals		+
Follow-up		++
Interest		+
Cooperation process		+
Change towards openness		1½ +

Table 7 Performance per project included in the case-study analysis, established on the basis of the five categories of "overall performance" (see Appendix I)

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