Preface

This study is written at Food Valley organization in Wageningen and is carried out as a master thesis for the Management Studies Group of the Wageningen University. I worked approximately eight months on the topic of innovative alliances carried out in different types of industries. Although this research was very interesting, it was a long story to come at the completion stage.

I want to thank my supervisors Frances Fortuin from Food Valley organization and prof. Onno Omta from the Management Studies Group of Wageningen UR in advance. They supported me in the previous period. In particular, I greatly appreciate their intensive support during the data analysis. This support was more than I could expect, and therefore again I am very thankful for so much support. Moreover, I would like to thank Philipp Garbade for his support during the preparation of the online questionnaire and data collection process and for being a pleasant colleague.

I would like to thank Food Valley organization for the opportunity to carry out the thesis within their company. For me it was really nice to taste the ambiance of innovation, food, and sociability. In addition, I have experienced several events due to being part of the Food Valley organization.

Furthermore, I have to thank my family and friends who encouraged me to complete this thesis.

Last but certainly not least, I am very grateful for all respondents who participated in this study. It would not have been possible to do this research without the support of the respondents. In particular, I want to thank the respondents that were willing to also do an open interview.

Veen, May 2012

Abstract

This study seeks to identify the key performance indicators for collaboration in innovation alliances (open innovation projects), carried out in high-tech and non high-tech sectors. The differences for IP/Innovation protection, innovation competences, and collaboration in innovation alliances in successful, in-between, and failed alliances are investigated. Special attention is put on comparing the high-tech and non high-tech agrifood companies with other high-tech and non high-tech companies. It has already been determined that agrifood companies can rely on the principles of innovation management developed to a large extent in high-tech companies. However, the question remains whether the high-tech and non high-tech agrifood sectors can also rely on the principles of open innovation, developed by other high-tech and non high-tech companies.

First, the theoretical background is studied in order to describe the high-tech and non high-tech sectors. After that, the conceptual model is established through a literature review. The conceptual model tests the influence of alliance antecedents, alliance partner assessment, alliance agreements, and the alliance execution on alliance performance. Subsequently, the conceptual model is tested by surveying five high-tech companies, four of which are agrifood, and thirty-one non high-tech companies, of which nineteen are agrifood. The industries that belong to the high-tech sector are chemicals and electronics. The seed industry belongs to the high-tech agrifood sector. The industries that belong to the non high-tech sector are software development, gas distribution, truck development, machinery, and road construction. Non high-tech agrifood industries include food manufacturing companies.

The results can be divided into two different parts. The **first part** of the results indicates the key performance indicators for collaboration in innovation alliances. We find that especially complementary resources and alliance complexity are points that companies should be aware of in innovation alliances. If the resources of alliance partners are too different from each other, cognitive distance may cause the innovation alliance to fail. Additionally, complex innovation alliances with a large number of departments involved may experience lower alliance performance. Furthermore, exchange of technical equipment seems to be more successful in innovation alliances compared to exchange of technical know-how. Finally, a positive interaction effect is found between cooperation performance and innovation performance.

The **second part** of the results focuses on comparing the high-tech and non high-tech agrifood companies with other high-tech and non high-tech companies. Firstly, it turned out that high-tech and high-tech agrifood are comparable with respect to IP/Innovation protection and innovation competences. Therefore, the comparison analysis for collaboration in innovation alliances is made with the high-tech including high-tech agrifood companies, non high-tech and non high-tech agrifood companies. The comparison analysis on **IP/Innovation protection methods** show that patents/breeders rights are extensively used in high-tech companies. Moreover, speed of gaining market share is important for high-tech companies. As expected, non high-tech agrifood companies indicated that confidentiality is very important to the business. A recipe should be kept confidential because it determines the uniqueness of the food product. The comparison analysis with respect **to innovation competences** show that non high-tech agrifood companies already rely on the principles of innovation management developed by high-tech industries. Remuneration policies are used less

frequently in non high-tech agrifood companies. Finally, the comparison analysis of collaboration in innovation alliances demonstrates differences between the high-tech, non high-tech, and non high-tech agrifood sectors. Lower scores were identified for non high-tech agrifood companies in the extent to which alliance agreements were made. Moreover, significant correlations could be found between cooperation performance and innovation performance, as well as between technical equipment and cooperation performance, for high-tech and non high-tech alliances only.

From the first part of the results, it is concluded that companies should pay attention to the following aspects in order to achieve a successful alliance: not too complementary of resources, reduce alliance complexity to reduce the number of departments involved. In addition, it will also be worthwhile to exchange technical equipment in combination with technical know-how.

For the second part of the results, it can be concluded that high-tech and high-tech agrifood belong to one sector, the high-tech sector. Furthermore, non high-tech agrifood companies can learn from innovation alliances carried out in the high-tech sector when it comes to drawing up confidentiality agreements at the very beginning of the alliance. Furthermore, it is recommended to exchange to more extent technical equipment and to do better alliance partner assessment.

Key words; Alliance performance, innovative alliance, open innovation

MANAGEMENT SUMMARY

To date, companies have to operate in highly competitive markets. To do so, consumer demands have to be met in a situation of fast changing social as well as cultural traditions. Innovation development is one of the strategic choices that companies should implement in order to survive in these highly competitive markets. The phenomenon of *'open innovation,'* or collaboration with external partners, is widely accepted. Three open innovation strategies can be defined; 'inside-out', 'outside-in' and 'coupled process'. The 'coupled process' implies sharing or exchanging complementary resources in order to jointly develop innovation. Research on this topic is more and more focused on this open innovation strategy. It is easy to imagine how sharing unique resources and capabilities may turn out in a fruitful cooperation resulting in the desired innovation.

Although there is extensive literature on the concept of open innovation, there are still gaps in empirical evidence about management of open innovation between different types of industries. Researchers previously held the belief that open innovation was only applicable in high-tech industries. The high-tech industry is seen as a fast moving industry where collaboration is seen as one of the requirements to operate in such an environment. However, Sarkar and Costa (2008) advocate for more empirical research about open innovation principles in the agrifood industry. Moreover, Batterink (2009) recommends that it will be interesting to investigate the management of open innovation in low- and medium-tech industries to which agrifood companies belong. However, it has to be argued that certain agrifood companies may also belong to the high-tech sector. According to Omta *et al.* (2011), seed companies can be seen as high-tech companies because comparisons were found in the area of product or process innovation development. It takes about 6 to 12 years in the seed industry to launch a new product on the market; this time frame is comparable with those of high-tech industries. In addition, the R&D investments are comparable with respect to percentage of turnover (25% for seed companies). Moreover the failure rate of innovations for both sectors seems high; one out of twenty breeds reaches the market. On the other hand, there are also agrifood companies that produce food ingredients and/or food consumer products. These agrifood companies are seen as non high-tech agrifood companies. Non high-tech companies which also belong to this category are software or truck development companies. To summarize, four different types of sectors are distinguished in this study; the high-tech, high-tech agrifood, non high-tech, and the non high-tech agrifood sectors. We propose the following research question to close the gap by identifying key performance indicators for innovation alliances and comparing high-tech and non high-tech agrifood companies with other high-tech and non high-tech companies. Therefore, we propose the following research question:

"Can agrifood companies learn from other high-tech and non high-tech companies regarding innovation and the management of open innovation projects, carried out in innovation alliances?"

One way to conduct an open innovation project is through an '*innovation alliance'* with one or more partners. Companies can pursue innovation alliances when they want to implement the innovation strategy *'coupled process.'* Alliances occur in different forms. Therefore, the following definition is proposed for an innovation alliance:

> *An innovation alliance is defined as a private partnership that meets the following criteria: (1) a shared goal (partners are working together to achieve a certain goal, one is not able to reach a certain goal without the other), (2) shared risks, costs, and revenues (dependency and synergy are really important in this case), (3) frequently real cooperation, and (4) joint decision making (all partners must be willing to take decisions together and making compromises to deal with unexpected circumstances)*[1]

One can imagine that it is hard to meet every arrangement made at the beginning of the alliance. However, the definition clearly shows that it is always *'doing it together'*. Due to difficulties in partnerships caused by unclear defined innovation goals, lack of trust, and cultural diversity, it needs closer investigation to the key performance indicators for intensive partnerships like innovation alliances. The innovation alliance development trajectory can be divided into five phases:

(1) The first phase refers to the **alliance antecedents**: complexity of the innovation and the alliance, the focal company innovation competences, the alliance experience, and size of the company.
(2) Subsequently, the next phase is **'alliance partner assessment'**. During the search for the most appropriate partner the following aspects need to be kept in mind: level of complementarity and risk mitigation. Partner's resources should be complementary in order to develop the innovation together. In this way, every company is able to contribute to the innovation when complementary resources are used. Risk mitigation plays also a role in the partner assessment phase. Elements that play a role in risk mitigation are risk assessment, previous experience with alliance partners, and IP/innovation protection. Risk assessment implies the risk reduction on leaking essential information. IP/Innovation protection is one of the possibilities to protect a company's IP from being stolen by the alliance partner.
(3) Next, after thorough alliance partner assessment, **alliance agreements** have to be drawn up before the start of the alliance. Agreements should be made for the investments needed, about division of outcome, governance agreements, for monitoring the process, and confidentiality agreements. Confidentiality agreements can be used to reduce risk of leaking essential information. This is because it is not always possible to find the alliance partner where risk of leaking essential information is relatively low.
(4) The **execution phase** of the alliance consists of three elements which are seen as important to the quality of the collaboration. These elements are communication intensity, level of knowledge transfer, and level of compliance.
(5) Finally, the **alliance performance** is measured as innovation performance and cooperation performance. Innovation performance determines the extent to which products, processes, and knowledge are developed. Cooperation performance indicates whether the focal company was willing to re-invest in the alliance or to re-collaborate with the partner concerned.

---

[1] *Adapted from:* De Man, A.-P. (2006). Alliantiebesturing: Samenwerking als precisie-instrument. Stichting Management Studies (SMS), Den Haag, Van Gorkum.

The five phases together form the innovation alliance development trajectory, resulting in a time framework. However, the conceptual model was developed through testing the influence of the innovation alliance development trajectories that represent the first four phases in the time framework on alliance performance.

To answer this research question, a mixed methodology was proposed for this study. This methodology implies the use of qualitative as well as quantitative data. Mainly, the quantitative data in this study is supported by the qualitative data gathered from five open interviews. The research questionnaire is developed based on a questionnaire that was used in previous studies on innovative collaborations. Completed questionnaires were received from five high-tech companies, four of which were high-tech agrifood, and thirty-one non high-tech companies, of which nineteen were agrifood companies. The research questionnaire consisted of 65 questions divided into three different parts. Aspects such as innovation competences, IP/Innovation protection, and the collaboration process were assessed in advance by the research questionnaire.

The hypotheses were tested using the statistical methods Spearman rank correlations and regression analysis. In addition, averages, t-tests, and standard deviations were used for the analyses of key performance indicators and comparison analysis for the high-tech and non high-tech agrifood with other companies from high-tech and non high-tech-tech sectors. The reliability and validity of this study was tested by performing principal component analysis (PCA) and reliability tests. From the PCA, five factors could be derived which are cognitive distance, level of knowledge transfer, level of compliance, cooperation performance, and innovation performance. Furthermore, with reliability tests Cronbach's $\alpha > 0.69$ could be obtained for innovation competences, investment agreements, governance agreements, and communication intensity. In addition, several individual items were also used in the statistical analysis.

The total study sample includes 36 companies and 41 completed questionnaires. Five companies filled in the online questionnaire two times, for a successful alliance as well as for one failed alliance. In addition, three types of different alliances could be obtained: successful (N=29), in-between (N=5), and failed (N=7) alliances. Based on the OECD industry classification companies were divided into the high-tech, high-tech agrifood, non high-tech, and non high-tech agrifood sector, which need further explanation. In the high-tech industry companies from the chemical and electronics industry were included, while companies from the seed industry were included in the high-tech agrifood sector. The non high-tech sector consists of companies from the software development, gas distribution, truck development, machinery, and road construction industry. The non high-tech agrifood sector is divided into companies that produce food ingredients and food consumer products. In Table M.1 the types of alliances are divided into the four different sectors.

Table M.1 Data-set divided into successful, in-between, and failed innovation alliances.

Sector	**Successful**		**In-Between**		**Failed**	
High-tech	1		0		1	
High-tech: Food	3		0		1	
Non high-tech	10		1		3	
Non high-tech: Food	15		4		2	
Total	29	(71%)	5	(12%)	7	(17%)

The data analysis was focused on two different parts. The first part provides an overview of the key performance indicators for innovation alliances. The second part shows the differences between high-tech and non high-tech agrifood companies, and other high-tech and non high-tech companies.

In **Part I** it was proposed to investigate the key performance indicators for innovation alliances using data from successful and failed alliances. However, it was shown that five successful alliances performed less compared to the remaining successful alliances. Therefore, we also distinguish in-between alliances.

Alliance complexity, cognitive distance, previous experience, and exchange of equipment turned out to be important for the overall alliance success. It is recommended for companies that are going to start an innovation alliance to involve more alliance partners but reduce the number of departments and employees involved. This reduces the complexity of the alliance which is positively related to alliance performance. Certain cognitive distance is seen as valuable for the overall alliance success. However, it has to be mentioned that in some cases the resources of alliance partners are too complementary. This can be related to innovation complexity. It turned out that the level of innovation complexity could hamper the alliance progress as a result. Therefore, it is recommended to work with partners that deliver complementary resources while simultaneously dissociating from complex innovations. Furthermore, exchange of tangible resources seems to have more positive influence on alliance performance. It turned out that, in particular, exchange of technical equipment contributed positively to alliance performance, whereas technical know-how was found to be negatively related to cooperation performance. Cognitive distance and exchange of technical know-how can be related to the absorptive capacity of the focal company. It can be concluded that companies had difficulties with understanding scientific information in failed alliances.

Part II focused on the differences in IP/innovation protection, innovation competences, and the collaboration process in alliances among the high-tech and non high-tech agrifood, and other companies from the high-tech and non high-tech sectors. It was found that the group means for both the high-tech and high-tech agrifood sector were similar. Therefore, it was decided to transform both group means into a group mean that represents that high-tech sector as a whole.

It turned out that the innovation protection methods 'speed of gaining market share' and 'patents/breeders rights' are very important for the high-tech sector. For the non high-tech agrifood industry, confidentiality of recipes was highly important because it determines the uniqueness of the food product. Due to these findings, it was determined that the principles of innovation management developed by high-tech industries are applied to a great extent also in non high-tech agrifood companies. However, from Spearman rank correlations it turned out that non high-tech agrifood companies have difficulties with implementing management of open innovation. A significant, positive interaction was found between innovation and cooperation performance for high-tech and non high-tech companies. For the non high-tech agrifood companies this interaction was not found. Therefore, it is recommended for non high-tech agrifood companies to improve cooperation performance which results in better innovation performance. Interestingly, from the Spearman rank correlations it turned out that innovation competences should be better developed. This is striking when considered with the finding that non high-tech agrifood companies already implement the management of innovation competences to large extent. However, this suggests that non high-tech agrifood companies should put their house in order before they can manage external innovation processes in a good manner. Finally, it is recommended for the non high-tech agrifood companies to draw up confidentiality agreements and show more commitment to the alliance through fulfilling promises made.

Further research is recommended in the area of open innovation management. Longitudinal studies are proposed to investigate whether implementation of open innovation principles developed by high-tech industries has a positive effect on the open innovation practices of agrifood companies. Furthermore, another recommendation is given for investigating differences in management of open innovation among different types of partners. The management of innovative alliances may differ between partnerships with customers or competitors. Moreover, it is recommended to conduct more research on the way knowledge institutes share resources with partners because it may be possible that partnerships with customers or competitors differ in management and because it was found that exchange of technical know-how is negatively related to alliance performance whereas exchange of technical equipment is positively related.

Table of Contents

Chapter 1 Introduction 15

1.1 Objectives and research questions 18
1.2 Research background 19
1.3 Thesis structure 19

Chapter 2 Theoretical Background 21

2.1 Innovation 21
2.2 Open Innovation 22
2.3 Open innovation and innovation alliances 24
2.4 Innovation among different types of industries 25
2.5 Innovation in high-tech and non high-tech sectors 26

2.5.1 Innovation in agrifood 27
2.5.2 Innovation alliance practices 28

Chapter 3 Theoretical Framework 31

3.1 Conceptual model 31
3.2 Alliance antecedents 34

3.2.1 Complexity 34
3.2.2 Focal company competences 34

3.3 Alliance partner assessment 36

3.3.1 Risk mitigation 36
3.3.2 Level of complementarity 38

3.4 Alliance agreements 40
3.5 Alliance execution 42

3.5.1 Communication intensity 42
3.5.2 Level of knowledge transfer 42
3.5.3 Level of compliance 43

3.6 Alliance performance 43

3.6.1 Cooperation performance 43
3.6.2 Innovation performance 44

3.7 Concluding remarks 44

Chapter 4 Research Methods 45

4.1 Data collection 45

4.1.1 Research Methodology 45
4.1.2 Desk research 45

4.1.3 Operationalization of the conceptual model 46
4.1.5 Sample selection & survey setup 51
4.1.4 Data collection process 51

4.2 Methods of data analysis 52

4.2.1 Quantitative analysis 52
4.2.2 Qualitative analysis 53

4.3 Discussion and limitations 53

Chapter 5 Baseline description 55

5.1 The Companies 55
5.2 The innovation alliances 57
5.3 Study sample; reliability and validity 58

Chapter 6 Empirical results 65
Part 1 Key performance indicators 65

6.1 Key performance indicators 65
6.2 Key performance indicators at statement level 70
6.3 Spearman rank correlations; relationships among research variables 72
6.4 Factors related to alliance performance 75
6.5 Hypotheses testing 77

6.5.1 Alliance antecedents 77
6.5.2 Alliance partner assessment 78
6.5.3 Alliance agreements 79
6.5.4 Alliance execution 79
6.5.5 Alliance performance 80

§ **6.6 Concluding remarks** 82

Part 2 An empirical assessment of high-tech and non high-tech sectors 83

6.7 In-house capabilities 83

6.7.1 IP protection 83
6.7.2 Innovation competences 85

6.8 Collaboration in innovation alliances 86
6.9 Comparison at statement level 90
6.10 Spearman rank correlations; relationships among research variables 91
6.11 Concluding remarks 92

Chapter 7 Discussion, Conclusions and Recommendations 95

7.1 Discussion and limitations 95

7.2 Conclusions 96

7.2.1 Key performance indicators for collaboration in innovation alliances 96

7.2.2 High-tech versus non high-tech alliances 98

7.2.3 Overall conclusion 99

7.3 Recommendations 100

References 101

Appendix 1 Interview Guide: Introduction 107

Appendix 2 Interview Guide: Questionnaire 108

Appendix 3 Principal component analysis 113

Appendix 4 Regression analysis (Enter-method) 114

Appendix 5 Spearman rank correlation matrix 116

List of figures and tables

List of figures		*Page*
Figure 2.1	'Closed Innnovation model' (left side), 'open innovation model' (right side)	22
Figure 2.2	Open innovation strategies	22
Figure 2.3	Various forms of open innovation projects and alliances.	23
Figure 2.4	New product development among different types of industries, ranked to technological and marketing activities.	26
Figure 3.1	Overview of the alliance development trajectory (conceptual model).	33
Figure 6.*1*	Key performance indicators for innovation alliances.	69
Figure 6.2	Group means for the high-tech (N=6) and non high-tech sector (N=35).	89

List of tables		*Page*
Table 2.1	Industry classification to technological level.	25
Table 2.2	R&D expenditure as percentage of sales	28
Table 3.1	Formal and Informal IP protection methods	37
Table 4.1	Operationalization of the conceptual model.	47
Table 5.1	Classification of the industries participating in this research, ranked according to sector (N=41).	55
Table 5.2	Classification of participating companies according to size classes (N=41).	56
Table 5.3	Data-set divided into successful, in-between, and failed innovation alliances.	57
Table 5.4	Structure research variables, ranked to the alliance development trajectories.	60
Table 6.1	Mean scores of the research variables, ranked by level of success of innovation alliances: successful (N=29), in-between (N=5), and failed (N=7).	68
Table 6.2	Mean scores for individual research variables, ranked by level of success of innovation alliances: successful (N=29), in-between (N=5), and failed (N=7).	70
Table 6.3	Spearman rank correlation matrix with the research variables.	74
Table 6.4	Stepwise linear regression with innovation performance as the dependent variable (N=41).	75
Table 6.5	Stepwise linear regression with cooperation performance as the dependent variable (N=41).	76
Table 6.6	Hypotheses tested through Spearman rank correlations and regression analysis	81
Table 6.7	Mean scores for the individual research variables regarding innovation IP/Innovation protection, ranked to the high-tech (N=6), non high-tech (N=14) sector, and non high-tech agrifood (N=21) sector.	84
Table 6.8	Mean scores for the individual research variables regarding innovation competences, ranked to the high-tech (N=6), non high-tech (N=41), and non high-tech agrifood (N=21) sector.	86
Table 6.9	Mean scores of the research variables, ranked to high-tech (N=6), non high-tech (N=14), and non high-tech food (N=21).	87
Table 6.10	Mean scores of the individual items, ranked to high-tech (N=6), non high-tech (N=14), and food (N=21).	90

Chapter 1 Introduction

To date, the market environment in which businesses operate is highly competitive and complex. High-tech industries have to deal with 'shortened product life cycles', 'increasing costs' and 'keeping up with the pace of development of new products, processes and technologies.' Therefore, the need for open innovation is greater than ever (Vrande van de *et al.*, 2009; De Rochemont, 2010). Also non high-tech companies such as food and beverage producing companies have to deal with a strong competitive market. Competing within this sector means that companies have to enhance the production capacity while simultaneously reducing costs. The focus on enlarging the production capacity and cost reduction ensures that these companies get competitive advantage. But to date, these activities of the high-tech industry as well as the agrifood industry have led to an increased burden on the environment. Companies recognized that enlarging the production capacity and cost reduction will only ensure competitive advantage in the short run. Due to the increased environmental burden, companies have to adopt a more sustainable way of producing.

To achieve production in a more sustainable way, companies have to innovate, leading to new products and technologies. Innovation can be defined as the way organizations *"Create value by developing new knowledge and/or using existing knowledge in new ways"* (Jamrog, 2006). The importance of innovation is demonstrated in a survey by Microsoft and PRTM Management Consultants of more than 200 leading executives at global firms in a variety of industries. Most of the firms believe in the potential of innovation to eventually deliver breakthrough benefits to their business (Mohammad and Romeri, 2009).

The way of innovating or the management of innovation (Chesbrough, 2003) is based on the openness of the innovation outcome and the innovation process. The innovation outcome and process can be open or closed. A 'closed innovation strategy' is based only on internal capabilities whereas an 'open innovation strategy' also depends on the help of external capabilities. Chesbrough (2003) describes a 'closed innovation strategy' as the input of human capital that is sourced from inside the corporate boundaries. The 'open innovation strategy' is the use of external capabilities from a certain partner. The outcome of open innovation is based on establishing external paths for the commercialization of the innovation. Todeva and Knoke (2005) claim that when companies operate using open innovation strategies this will often bring them a competitive advantage that can be defined as the key to operate in a strong competitive environment. The definition of an 'open innovation strategy is "*The practice of leveraging the discoveries of others: companies need not and indeed should not rely exclusively on their own R&D"* (Chesbrough and Crowther, 2006).

Using open innovation strategies will strengthen the competitive position of a company. The collaboration enables firms to achieve advantage or avoid competition. The collaboration can result in collective benefits and these benefits can be created faster, at lower costs, with greater flexibility, and with less risk than "going it alone" (Larsson *et al.*, 1998). Open innovation is a broad term and therefore different strategies can be distinguished to differentiate between the different open innovation strategies that are used. According to Gassmann and Enkel (2004), three strategies can be applied when it comes to open innovation. The first strategy is the *"outside-in process"* which means that the company enhances internal knowledge by integrating customers and suppliers, or through the sourcing of external knowledge, among other options. An alternate strategy is the "*inside-out* *process"* and this means that knowledge and/or intellectual property will be transferred to the outside environment. The final strategy is the *"coupled process."* This process is focused on using complementary resources from two or more firms. The strategy that can be used for the innovation to be developed can be chosen using the open innovation matrix developed by Fortuin (2007). The choice for a certain open innovation strategy is based on the competitive impact of company's technology and the in-house capabilities. The technologies developed by the company can be distinguished either as emerging technologies, pacing technologies, key technologies or base technologies. To choose for a certain technology, questions to be answered are: '*Does the technology have the potential for competitive differentiation', 'Could it become critical to the firm?' 'What is its market value?'* The other side of the table consists of the categories weak, moderate, and strong. These categories determine the strength of the in-house capabilities for the technology chosen.

Furthermore, based on a study of thirty-two high technological collaborations, Fortuin and Omta (2008) conclude that high technological collaborations have its limits. Fear and distrust were seen as the most important problems encountered. According to Ruitenburg (2011), "*the great challenge of open innovation is how to retain the value for one's company. How can one make sure that knowledge (or at least: its commercially applicable outcomes related to one's own business) remains exclusively one's own property – and thus valuable? How do companies protect knowledge so that they can enjoy the fruits of their own research (Fortuin and Omta, 2008)?"* Therefore, there is continuous stress between the company and the alliance partner. When alliance partners are not able to find a balance in providing and retaining information, the innovative output of open innovation projects will be influenced negatively which shows the dark-side of open innovation. Therefore, it can be concluded that open innovation is not always applicable and one should aware of the disadvantages.

One of the characteristics of the "coupled process" open innovation strategy is the establishment of an alliance with complementary partners (Gassmann and Enkel, 2004). Alliances can be formed with different kind of partners, for instance 'horizontal' between competitors or 'vertical' with customers, suppliers, and other value-adding partners. It can be argued that collaboration with external parties can lead to increase of selling or buying power and barriers for competitors to enter the market (Johnson *et al.*, 2009; Sluyts *et al.*, 2011). An alliance enables firms or partners to build strategic capability and to create complementary assets. Lin *et al.* (2009) state that when firms form an alliance the partners should be sufficiently differentiated to provide missing elements or complementary capabilities. To achieve complementary resources, the innovation should consider the input of internal company capabilities and external capabilities of the partner. This includes the case where the internal capabilities of the focal company and the external capabilities of the external partner are of equal importance (Cervantes and Backer, 2008). The combination of a "coupled process" open innovation strategy and working together on an innovation is defined as an "innovation alliance." To investigate collaboration in innovation alliances it will be worthwhile to gain a deeper understanding of the key performance indicators for such open innovation projects.

Much research is done regarding alliances, for instance: *"What are the antecedents of multi party alliance performance"* (De Rochemont, 2010), *"The dynamics of alliance conditions in the alliance development process"* (Das and Teng, 2002), *"Dynamics of open innovation in the food industry"* (Sarkar and Costa, 2008), and *"Open innovation in the Agri-Food sector"* (Vanhaverbeke *et al.*, 2007). For example, in the study of De Rochemont (2010) a sample of 170 Dutch SME's was used to investigate which antecedents influence the performance of a multi-party alliance. As it turned out from this study, a healthy financial climate, trust and social commitment, clear task definition and decision-making process, are important to the multi-party alliance performance. These investigations provide clear insight into the development and performance of open innovation projects like alliances. However, no empirical evidence is provided so far about the management of innovation alliances within the agrifood sector, using the high-tech sector for comparison. Researchers often associate open innovation with strong-growing, technology-intensive industries, such as the computer and the pharmaceutical industry (Sarkar and Costa, 2008; Vrande van de et al., 2009). High-tech companies recognize that not all the ideas that were generated within the organization were as successful as expected. Examples are *Lucent*, *3Com*, *IBM*, *Intel* and *Millenium Pharmaceuticals* (Dahlander and Gann, 2010). However, there are success cases where an open innovation model also works in traditional mature industries, like the agrifood industry. When examining the agrifood industry there are many actors from different areas involved in the entire food supply chain. Therefore, it is imaginable that open innovation management should be a widespread practice in food value chains and networks (Sarkar and Costa, 2008). Given that many actors from different sectors are involved in the production of food it is difficult for the agrifood industry to meet all the heterogeneous requirements of customers, end-customers, and legislators. Huston and Sakkab (2006) demonstrate with several real-life cases that Procter & Gamble was able to gain more profit from an innovation by collaborating with external parties than if they developed the innovation using their own R&D department. In addition, these studies show that agrifood companies can manage innovations by the open innovation business model as well as companies from the high-tech industry do. Due to the differences in market one can imagine that there will be difference in innovations and the process of alliance formation. Moreover, America (2011) found that agrifood companies have to catch up with respect to high-tech companies. According to the author agrifood companies can learn from high-tech companies when it comes to collaboration and the way innovation processes are arranged with suppliers. Agrifood companies are more conservative and they think more vertically. However, (Omta et al., 2011) found similarities between the high-tech industry and the seed industry. They found that seed companies could be seen as high-tech agrifood. The food manufacturing companies are seen as no high-tech. However, non high-tech companies can also originate from other industries. These 'other industries' include for instance the software or truck development industry. To summarize, four different types of sectors can be distinguished; the high-tech, high-tech agrifood, non high-tech, and the non high-tech agrifood sector.

These interesting findings lead us to the question*: "Can agrifood companies learn from other high-tech and non high-tech companies when it comes to innovation alliances?"* Based on five real life cases in the agrifood industry, Vanhaverbeke et al. (2007) conclude that it is more valuable to be part of a network than to go it alone. This is due to sharing of risks and the possibility to receive special awards. Also a stronger competitive position is developed when a company is connected to a network consisting of companies with the same purpose. These results show that non high-tech agrifood companies were able to implement open innovation in networks. But still there is a gap of empirical support when it comes to differences in open innovations projects between high-tech and non high-tech sectors with special attention given for agrifood.

§ 1.1 Objectives and research questions

This study aims to give deeper understanding about the key performance indicators for collaboration in innovation alliances. Innovation alliances are partnerships between companies which lead to innovative products or processes. We will begin by having a closer look at the key performance indicators for innovation alliances because it helps to gain a deeper insight in the innovation alliance development trajectory. Literature is gathered about innovation alliances and questions related to this process have been translated into a research questionnaire. Literature has shown that open innovation projects are valuable for the agrifood industry (Vanhaverbeke et al., 2007; Sarkar and Costa, 2008), but the evidence for supporting the open innovation model is mostly taken from high-tech industries (Chesbrough, 2003). According to Batterink (2009), low- and medium-tech firms are closing the gap with high-tech firms in adopting an open innovation strategy. Therefore, it will be interesting to direct more research to management of open innovation in agrifood companies. The focus of this study is on how the performance of innovation alliances is influenced. Therefore, we investigated differences in innovation competences, IP/Innovation protection, and the innovation alliance development trajectory from high-tech, high-tech agrifood, non high-tech and non high-tech agrifood companies. Because we want to be clear in presenting differences in the aspects mentioned, we decided to define the sectors as high-tech and non high-tech where for both sectors special attention is given for agrifood companies. Identifying differences in innovation competences, IP/Innovation protection, and management of open innovations projects among high-tech and non high-tech companies could be useful for agrifood companies to perform better in open innovation projects. Due to the expected differences in the management of open innovation the following research question is derived:

"Can agrifood companies learn from other high-tech and non high-tech companies regarding innovation and the management of open innovation projects, carried out in innovation alliances?"

To answer the main research questions several sub-research questions are developed. The collaboration in innovation alliances will be studied in more detail to determine the key performance indicators. Therefore, the following sub-questions are developed:

<u>*Innovation alliance development trajectory*</u>
<u>A1:</u> What are the most important alliance antecedents that contribute to alliance performance?
<u>A2:</u> What are the key performance indicators for selecting alliance partners that contribute to alliance performance?
<u>A3:</u> What are the key performance indicators in the start-up phase which contribute to alliance performance?
<u>A4:</u> What are the key performance indicators in the execution phase that contribute to alliance performance?

The abovementioned research questions are related to the innovation alliance development trajectory. It is highly important to understand the alliance development trajectory in general. To investigate this empirically the key performance indicators will be related to the alliance performance to determine their contribution to the overall alliance success.

To investigate differences in innovation competences, IP/Innovation protection, and management of open innovation, we distinguish between high-tech, high-tech agrifood, non high-tech, and non high-tech agrifood companies. In order to analyze these differences the following sub research-questions are developed:

Differences between high-tech and non high-tech sectors
B1: Which differences can be found with respect to innovation competences and IP/Innovation protection?
B2: Which differences can be found with respect to the innovation alliance development trajectory?
B3: How will these differences influence the alliance performance in the high-tech, high-tech agrifood, non high-tech, and non high-tech agrifood sectors?
B4: When differences are found, are these instructive for the agrifood industry, and if so, in what way?

Because this study is conducted in various industries we have chosen to split the industries into the high-tech and non high-tech sectors. Obviously, special attention is given to the agrifood sector because it is expected to be low-tech which demands for more research in the management of open innovation and especially in an innovation alliance. Although the seed industry is expected to be different from the non high-tech agrifood industry, this has to be investigated in more detail. At the end of this study we have gained deeper understanding in the management of open innovation in the high-tech, high-tech agrifood, non high-tech, and non high-tech agrifood companies. This may result in learning certain lessons for non high-tech agrifood companies in particular.

§ 1.2 Research background

This study is written at Food Valley organization in Wageningen and is carried out as a master thesis for the Management Studies Group of the Wageningen University. Food Valley organization stimulates the Dutch agrifood sector and especially the companies located within a circle of 20 kilometers around Wageningen. Food Valley is involved in one of the EU projects[2] to foster innovation in the Dutch agrifood sector. This thesis will be part of this program and is carried out in collaboration with Philipp Garbade, who is currently working on his PhD thesis in the area of open innovation management.

§ 1.3 Thesis structure

Chapter 2 provides an overview about innovation, management of open innovation, innovation alliances, and the practices of open innovation among various industries. Subsequently, in Chapter 3 the innovation alliance development trajectory is presented which is developed using several elements which have been established by literature. Furthermore, these elements were used for the formation of the conceptual model. This conceptual model forms the basis of this study and is tested using the developed hypotheses. Next, Chapter 4 describes the research methodology and provides the operationalization of the research variables. In Chapter 5 the baseline description of the participating companies is given. Furthermore, the findings of this study are presented in Chapter 6. These findings are used for answering the research questions. Finally, in Chapter 7 respectively, the discussion and conclusion will be presented followed by the recommendations.

[2] Food Valley organization is involved in the Netgrow project that is focused on enhancing the innovativeness of food SMEs. The purpose is to develop a toolbox that can support SMEs to achieve higher business success and business performance.

Chapter 2 Theoretical Background

Working together in innovation alliances is already implemented in many sectors. The concept itself refers to the phenomenon open innovation which first named as such by Chesbrough (2003). In Section 2.1 we will provide a deeper understanding of the concept of innovation and in Section 2.2 the concept of open innovation will be discussed. Furthermore, Section 2.3 elaborates on the concept open innovation and innovation alliances. Next, in Section 2.4 innovation among different type of industries is discussed and subsequently in Section 2.5 the practices of innovation in high-tech and non high-tech sectors are presented. Also, the practices of innovation alliances are addressed for high-tech and non high-tech sectors in Section 2.6.

§ 2.1 Innovation

Researchers and entrepreneurs see innovation as one of the main sources for achieving competitive advantage and as essential for the company growth. Innovation is a broad term and different categories can be used to explain innovation. The most important categories for explaining innovation are (1) the type of innovation, (2) the degree of innovativeness, (3) the level of disruptiveness (Zakić *et al.*, 2008).

The type of innovation refers to whether it is a process, product/service, or strategy innovation. The degree of innovativeness of the innovation is either more incremental or more radical. Incremental innovations are useful to improve the performance of a product (Hippel, 1994), while a radical innovation is completely new to the market. Additionally, an innovation can be either sustaining or discontinuous/disruptive. This is in relation to the level of disruptiveness. The sustaining type of innovation can be either incremental or radical but the disruptive innovation, as described by Christensen (2003), is always semi-radical or radical. The difference that Christensen (2003) made between these two types of innovation is that radically new innovations do not always have a significant impact on the industry, while disruptive innovations per definition have an input on the industry (Baker, 2002).

The management of such innovations is described by Chesbrough (2005). In the past, companies relied on their internal R&D to carry out the innovation, regardless of the type of innovation. Many industries considered the internal R&D capabilities as the capabilities which would keep the company alive. Nowadays, companies recognize the need for including external capabilities, because the environment in which they operate has changed dramatically. Knowledge and technology are still used to improve the competitive position of the firm; however, firms cannot longer do it on their own. Chesbrough (2003) refers to the paradigm shift, from a closed to an open innovation model. These models are visualized in Figure 2.1. Open innovation is a broad concept and therefore this study will focus on the collaboration process in innovation alliances and simultaneously looking to the impact of the in-house capabilities of a company on its innovation alliances. The in-house capabilities are defined as innovation competences and IP/Innovation protection. Especially innovation competences are related to innovation management principles that companies need in order to conduct innovation development.

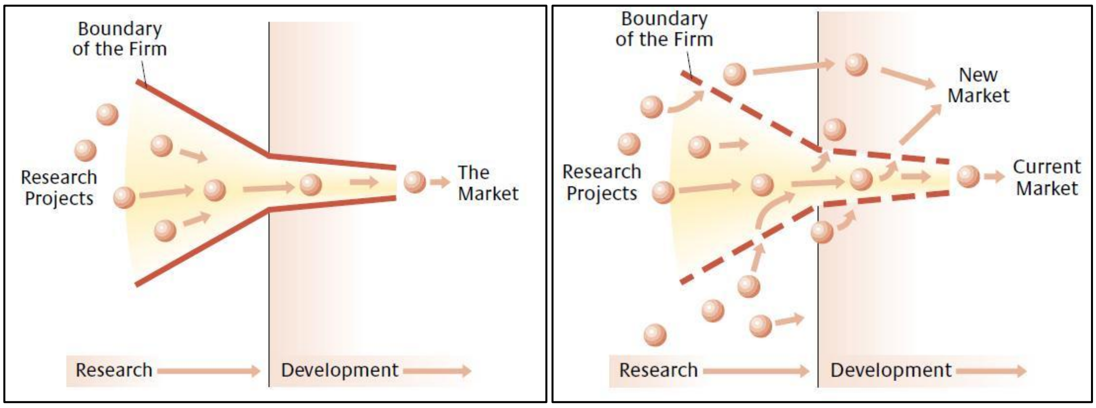

Figure 2.1 'Closed innovation model' (left side), 'open innovation model' (right side), (Chesbrough, 2003; Gassmann and Enkel, 2004).

§ 2.2 Open Innovation

Open innovation is already widely implemented by firms. Large firms would traditionally rely on internal R&D capabilities to create new products and processes. Companies believed that this was the 'right way' to bring new ideas to the market. In fact, the R&D department was seen as one of the strategic assets of the company which could be used as the entry barrier for potential competitors.

Before implementing open innovation in a company, the following question has to be answered: *"Alone or together?"* This is one of the strategic choices that companies have to make when thinking about the company's future. Companies should not rely on their own power to maintain their vitality and competitive capacity of a company. To keep up with the pace of technology development, innovation of products, processes, and services, external knowledge is needed. The knowledge that is required for innovation is often not available in-house. A partnership, innovating together with external partners, could be defined as an open innovation project. As can be seen from Figure 2.3, different forms of open innovation projects are possible. But first it will be helpful to explain the different forms of open innovation strategies. Gassmann and Enkel (2004) illustrate the open innovation strategies in Figure 2.2. The figure indicates three different open innovation strategies, the outside-in process, the inside-out process and the coupled process, as already noticed in Chapter 1. The coupled process is the strategy where companies work together in an alliance and share complementary resources. Because this study is focused on the 'coupled process' open innovation strategy we will not further elaborate on the other open innovation strategies.

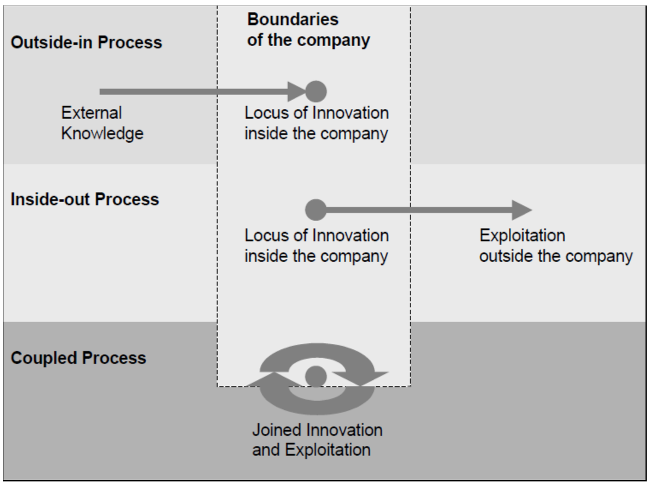

Figure 2.2 Open innovation strategies (Gassmann and Enkel, 2004).

Figure 2.3 gives an overview of the cooperation forms that belong to alliances and which of the various forms belong to open innovation projects. Joint ventures and contractual alliances are the most common alliances. A joint venture is a company in itself, because the partners create a new business in which each partner has a certain percentage of the market shares. Contractual alliances are based on agreements made at the beginning which result in many different types of alliances, each having their own unique form of control. Since the purpose of this study is to identify key performance indicators for collaboration in innovation alliances, the focus will be on innovation alliances where the alliance partners are working together with complementary knowledge and technologies, to develop a new product or process innovation. Using Figure 2.3, our study will focus predominantly on contractual alliances or alliances on equal basis and the open innovation strategy for such alliances is defined as a 'coupled process'.

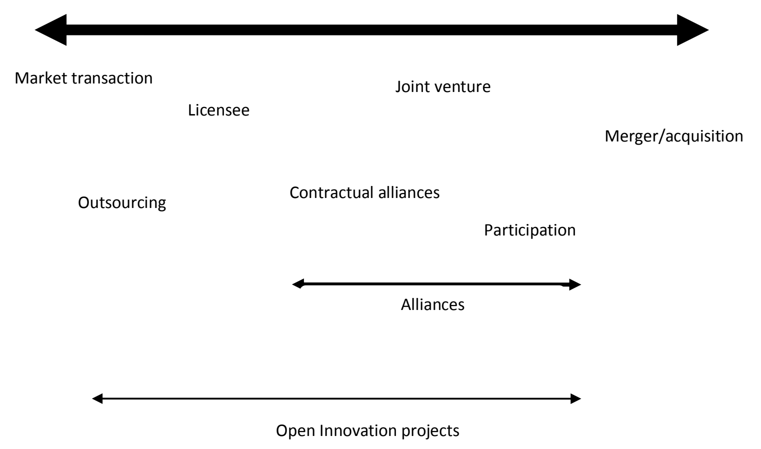

Figure 2.3 Various forms of open innovation projects and alliances. Adapted from Gassmann and Enkel (2004) and De Man (2006).

§ 2.3 Open innovation and innovation alliances

According to De Man (2006), goals that companies can pursue by the formation of an alliance are increasing efficiency, access to a new markets (segments), meeting specific customer demands, spreading R&D risks and limiting of competition. The ways to achieve alliance goals are combinations of competences, combination of capacity and combination of power. Through combining competences, the innovation potential can be increased and combining capacity means that large risks can be reduced. Furthermore, enlarging power and limiting competition both cope with gaining competitive advantage.

But first of all, the question is whether a company is able to collaborate. Literature illustrates that the failure rate of alliances is 60 percent within the first two years of operation. According to Das and Teng (2000) *"The instability of alliances refer to major changes or dissolutions of alliances that are unplanned from the perspective of one or more partners"*. Elmuti and Kathawala (2001) point at the probable risks and problems that are faced in strategic alliances. Cultural differences, lack of trust, lack of clear goals and coordination problems are examples of reasons for the failure of alliances. Therefore, it will be interesting to know which aspects play an important role in collaboration in innovation alliances. According to Figure 2.3 there are several different cooperation forms. Since this study attempts to identify critical success factors for the collaboration process within alliances it is necessary to give a definition of an 'innovation alliance' Adapted from De Man (2006):

> *An innovation alliance is defined as a private partnership which meets the following criteria: (1) <u>a shared goal</u> (partners are working together to achieve a certain goal; one is not able to reach a certain goal without the other), (2) <u>shared risks, costs, and revenues</u> (dependency and synergy are really important in this case), (3) <u>frequently real cooperation</u>, and (4) <u>joint decision making</u> (all partners must be willing to take decisions together and making compromises to deal with unexpected circumstances).*

For companies searching for external partners these can be universities, contract research institutes (knowledge institutes), ingredient suppliers, machinery and equipment manufacturers, customers, firms in the same industry (competitors), and firms in other industries (Jolink, 2009). The collaboration with potential partners can be seen in two perspectives. Firstly, the collaboration can be between partners who operate in the same supply chain. According to Arranz and Arroyabe (2008), companies that cooperate with partners from the same supply chain are often suppliers and customers who help to overcome market and technological risks. It is important to mention that there are fewer risks to cooperation with customers and suppliers compared to cooperation with competitors because the latter may benefit from a firm's intellectual property. According to Ruitenburg (2011), trust plays an important role in an alliance and it is influenced both by communication and IP protection. Therefore, it is possible that protection of IP/Innovation will make it more secure to collaborate with competitors. In addition, the innovation purpose can differ amongst the different types of partners. While cooperation with customers and suppliers is mainly due to lack of market and technological knowledge, cooperation with competitors is predominantly focused on exploiting economies of scale and sharing innovation costs (Batterink, 2009).

§ 2.4 Innovation among different types of industries

It can be argued that open innovation is recommended for companies, because it often brings them a competitive advantage. According to Schreurs (2011), collaboration is a 'must' in the world of high technology. For example, production of advanced technologies needs the involvement of external partners, because companies cannot do it on their own. This is because products, technologies, machinery, and systems are too complex to be developed by one company. Likewise, it became more and more important to innovate in collaboration with suppliers, competitors, customers, or knowledge institutes in other industries as well.

According to Cáceres *et al.* (2011) the firm size and the sector in which a company operates influences sources of variety in innovation. The variety of innovation is expressed in different factors like "R&D and patents," "internationalization," and "human capital." This means that the innovative performance of a firm is influenced by the size and sector of activity. The factors of variety that were most influenced by size and sector were "R&D," "training," and "collaboration." In addition, Pavitt (1984) suggests that sectors have different innovation patterns. The author investigated different sectors regarding innovation and came up with three different categories. The categories show differences in principal activities and these can be categorized as supplier dominated, production intensive, and science based.

The typical core sectors within the category **supplier dominated firms** are traditional sectors of manufacturing, agriculture, construction, informal household production, and many professional, financial, and commercial services. These sectors have predominantly weak internal R&D capabilities. The innovations for these companies are mostly developed and delivered by their suppliers. The ways to protect and trade their products are mainly trademarks and advertisements. Therefore cutting costs is an important issue within these sectors. The second category, **production intensive firms,** is mainly dominated by bulk producers of steel and glass, specialized suppliers in machinery instruments, and food products. Patents, know-how, and process secrecy are used to protect their products. The last category includes **science-based firms** which are represented by the chemical and electronic/electrical sector. In these sectors, R&D activities play an important role because of the rapid development in technologies. Protection of products and applications by patents is perceived as important in these sectors. In conclusion, based on these differences in innovation patterns, it is expected that distinction can be made between high-tech and non high-tech sectors when it comes to in-house capabilities, defined as innovation competences and IP/Innovation protection. The differences in the innovation aspects mentioned are explained in more detail in Section 3.2.1 and 3.3.1.

The classification of industries can also be made according to the technological level, following the four OECD categories high-tech, medium high-tech, medium low-tech, and low-tech (Batterink, 2009). Table 2.1 indicates that agrifood companies have been classified to the low-tech industry. One of the arguments used for this classification is that food innovation must be handled very carefully, because we all (consumers) have to deal with health in

Table 2.1 Industry classification to technological level (Batterink, 2009).

High-tech	
	Pharmaceuticals
	Electronics
Medium high-tech	
	Basic chemicals
	Machinery
	Car and transport
Medium low-tech	
	Petrol
	Plastics
	Basic metal prod.
Low-tech	
	Food
	Textile
	Paper
	Printing and publishing

contrast to products from the high-tech industry. Therefore the non high-tech sectors operate in a slow moving market while the high-tech sectors in fast moving markets where innovation after innovation occurs. However, we have to mention that the development time of radical innovations in the high-tech sectors take about six to twelve years, which can be seen as a relatively long time (Omta et al., 2011). The fast changes in the high-tech market are predominantly due to the fact that when a certain innovation is introduced in the market, the succeeding innovation already is under development. The time period between the first and the succeeding innovation can be relatively short.

In conclusion, due to different innovation patterns and technological level among industries, differences can be found with respect to the technological level of innovations and the different innovation patterns among industries. These differences suggest that the open innovation activities may also differ among different industries. In next section we will gain a deeper insight in the differences in innovation and innovation alliances between high-tech and non high-tech sectors.

§ 2.5 Innovation in high-tech and non high-tech sectors

From previous section we have seen that differences can be distinguished regarding innovation between different industries. As can be seen from Table 2.1 the non high-tech companies include the companies that belong to the medium-high-tech, medium-low-tech, and low-tech sectors.

As introduced in Chapter 1, differences in innovation competences, IP/Innovation protection, and management of open innovation projects are expected when comparing high-tech with non high-tech sectors. Therefore, it is also expected that product and process innovation are different. For the high-tech industry it is expected that the innovations will be more radical compared to innovations from the non high-tech sector. This relates to the fact that the technological level of the high-tech industry is perceived as higher compared to non high-tech industries. Furthermore, the money spent on research and development as a percentage of sales seems to be much higher compared to non high-tech sectors.

Another example is the difference in new product development across different industries. The activities around new product development can be divided into technical and marketing activities. Figure 2.4 shows the different balance of activities over a variety of sectors. It becomes clear that the high-tech sectors have a stronger focus on technical activities while non high-tech sectors focus more on marketing activities. This different balance of activities around new product development can be related to the degree of innovativeness of particular innovations.

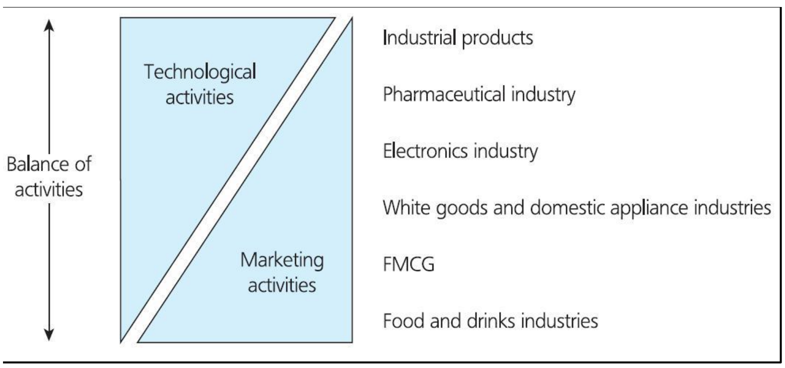

Figure 2.4 New product development among different type of industries, ranked to technological and marketing activities (Trott, 2005).

§ *2.5.1 Innovation in agrifood*

In Chapter 1 we explained that the seed industry belong to the high-tech sector. Food manufacturing companies belong to the non high-tech sector. Below, the differences will be explained in more detail between high-tech and non high-tech agrifood industry.

High-tech agrifood

Predominantly, the requests for patents (breeders rights) through the seed industry show similar numbers compared to the patent requests in the high-tech industry. Moreover, the expenditure on R&D as percentage of turnover for the seed industry is approximately 25%. Therefore, seed companies are considered as high-tech companies which belong to the absolute world class (Omta et al., 2011). Also new product development shows similar time periods, approximately six to twelve years. Therefore, the seed industry is expected to be high-tech.

Non high-tech agrifood

The age of the non high-tech agrifood industry is equal to the age of civilization and many processes are thousands of years old, such as brewing and baking. Nowadays, the non high-tech agrifood industry has evolved into a modern industry that produces high volumes of food products. The entire food chain involves production, harvesting, processing, manufacturing, and distribution (Jolink, 2009). 'Marketing' is very important to force consumers to buy food products. In the 1920s the USA introduced marketing as a theoretical approach to analyze entrepreneurial activities. Marketing was at first integrated in industries other than agrifood while the application of marketing is a major contributing factor to innovation. Reasons for this phenomenon were that the non high-tech agrifood industry production activities were driven by the supply of the agricultural firms. Later on, from the 1950s, this supply-based strategy changed towards a demand-based strategy where the consumer became more and more important (Linnemann and Van Boekel, 2007).

The type of innovations in the non high-tech agrifood industry can be seen as quite conservative (Sarkar and Costa, 2008). As described by Fryer and Versteeg (2008) *'the food industry is highly innovative in terms of products, but much less so in terms of processes'.* This is explained by the low margins that the industry must adopt, which lead to unwillingness to invest in new technologies (Earle, 1997). Innovation in the non high-tech agrifood industry is more gradual compared to high-tech industries, which are characterized by more breakthrough innovations.

Furthermore, the ultimate innovation in the non high-tech agrifood industry is a new or improved consumer product. The food processing companies want to keep or to increase their market share and maintain leadership in their markets. Therefore, non high-tech agrifood companies are focusing more on product innovations compared to other industries. However, when examining the type of innovations that are introduced by the European Food Industry, only 2.2% of the product innovations are classified as radical product innovations. The rest consists predominantly of me-too, seasonal, and substitute innovations which are all considered as incremental innovations (Jolink, 2009).

Finally, from Table 2.2 it can be seen that non high-tech agrifood companies invest 1.5 percent from sales into research and development whereas the pharmaceutical or automotive industries invest 9 percent or higher into R&D. These figures indicate that the high-tech industry has a broader focus on innovation because they have money to discover, develop, and commercialize new ideas.

Table 2.2 R&D expenditure as percentage of sales (Trott, 2005).

Sector	**R&D expenditure**
Pharmaceuticals	18
Electrical and electronics	10
Aerospace	9
Automotive	9
Chemicals	7
Engineering	8
Food	1.5

§ *2.5.2 Innovation alliance practices*

When producing totally new food products it might be necessary to implement new processes. Such processes should deliver products that show significant advantages relative to a conventionally processed product. Before a new process can be introduced, the following requirements are necessary (Fryer and Versteeg (2008):

- the process should deliver a product that meets the consumer needs;
- to satisfy the regulator and the manufacturer, information should be available on how to safely produce the product;
- the process should be easy to implement, easy to handle, and cost effective over commercial timescales to produce the product.

The requirements show that the degree of innovativeness in a company is dependent on the competences in the techniques, the resources available for implementation, and the level of knowledge (Earle, 1997). Because non high-tech agrifood companies operate in traditional ways, they are often not able to implement totally new processes and are forced to use external resources. Sarkar and Costa (2008) demonstrate in their review of open innovation practices, that non high-tech agrifood companies already implement open innovation strategies as a strategic choice. The purpose of open innovation projects such as innovation alliances is to develop a particular product or process innovation together with external partners. The difference in innovation alliances between high-tech and non high-tech sectors could be explained by the degree of technological uncertainty. Shenhar *et al.* (2002) classified four distinct projects with respect to technological uncertainty; low-tech, medium-tech, high-tech, and super high-tech projects. We would like to make the bridge between these projects and the innovation alliances in the high-tech and non high-tech sectors. Projects in the 'degree of technological uncertainty' are expected to be managed differently. Therefore, we expect differences in the innovation alliance development trajectories by comparing alliances carried out in high-tech and non high-tech sectors.

Furthermore, Fortuin and Omta (2009) investigated the extent to which non high-tech agrifood processing companies can rely on the principles of innovation management developed in high-tech industries to improve their innovation performance. The empirical findings from this research show that non high-tech agrifood companies can rely on the principles of innovation management developed by high-tech companies. Therefore, it could be expected that non high-tech agrifood companies also can rely on the principles of open innovation management developed by high-tech companies. However, it will be difficult to address the elements in which both sectors will differ with respect to management of open innovation. Batterink (2009) investigated the extent to which low- and medium-tech companies adopt open innovation compared to the high-tech sector. The study found that low-tech industries such as the non high-tech agrifood industry already pursue open innovation strategies. Therefore, it is interesting to investigate the innovation alliance development trajectory in high-tech and non high-tech sectors to test empirically differences between high-tech and non high-tech sectors. Due to difficulties in determining important elements of open innovation management we developed the conceptual model based on several theories about open innovation management. In Chapter 3, the elements forming the conceptual model are explained in more detail.

Chapter 3 Theoretical Framework

Given that this study aims at identifying key performance indicators for innovation alliances in the high-tech and non high-tech sectors, the most important elements for the innovation alliance development trajectory are derived from literature. These elements were used to develop the conceptual model and furthermore they formed the basis of the research questionnaire. In Section 3.1 the conceptual model is presented. To provide a graphical overview of the content of this chapter the conceptual model is presented at the beginning. Sections 3.2 up to Section 3.6 describe the elements presented in the conceptual model.

§ 3.1 Conceptual model

We have seen that cooperation form and type of partners both influence the way of collaborating. To achieve our research objectives, we began by mapping the innovation alliance development trajectory to include all important aspects for collaboration in innovation alliances. Subsequently, this resulted in a time framework. This model should be applicable for innovation alliances carried out with different type of external partners. In addition, because we want to have a deeper understanding of the differences between high-tech and non high-tech sectors, the conceptual model is developed in such a way that it can be used to analyze partnerships across different sectors.

In this study the elements related to alliance performance have been chosen from literature. These elements have been chosen because they were perceived as highly important for the overall alliance success. Innovation competences and IP/Innovation protection are related to specific characteristics from the company itself. The other elements deal with collaboration in innovation alliances.

When the innovation alliance is finished, different aspects play a role in the realization of the innovation. Therefore, we consider the research variables innovation performance and cooperation performance as the ones which indicate the alliance performance perceived by the participating company. In the conceptual model, the other elements can be seen as the links because those elements are linked to alliance performance either positively or negatively.

The innovation alliance development trajectory is considered to consist of five phases which are visualized in Figure 3.1:

1. *alliance antecedents*
2. *alliance partner assessment*
3. *alliance agreements*
4. *alliance execution*
5. *alliance performance*

Highly important to indicate is that the influence of the elements, which belong to the first four phases, is investigated on alliance performance. This time framework consists of elements that follow each other in time. However, since this study is cross sectional the elements are investigated simultaneously. Therefore, this time framework is considered to be also the conceptual model for this study.

In the following sections, the elements presented in Figure 3.1 will be discussed. Elements linked to alliance performance as well as interrelationships between elements are constituted through development of hypotheses which are presented after each section.

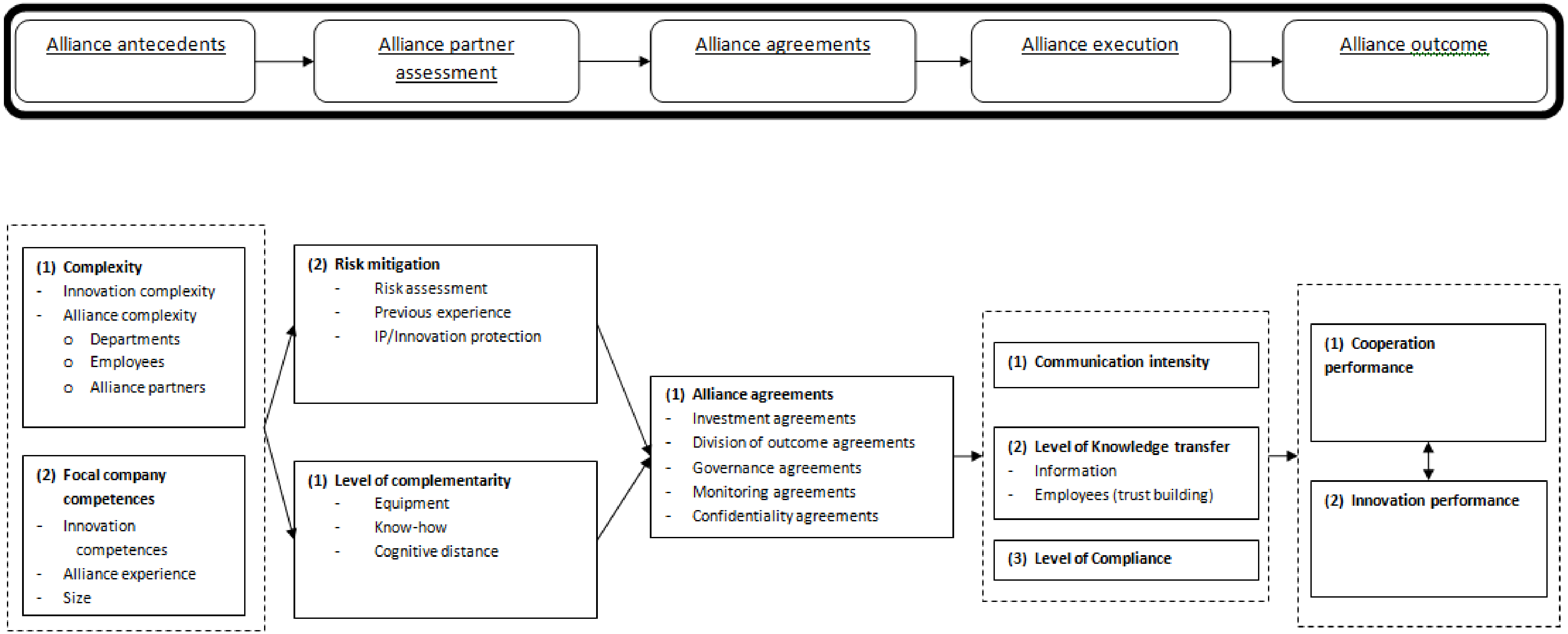

Figure 3.1 Overview of the alliance development trajectory (Conceptual model).

§ 3.2 Alliance antecedents

For the search of external partners, a company needs to investigate the potential and uncertainty of the innovation. When too many uncertainties arise a company can be advised to discharge the innovation project. Next to the innovation potential and uncertainty, firms have to think about their internal competences and the external competences needed for the innovation. The capabilities that are used to manage the internal R&D processes can also be used to run the innovation alliance. It will always be difficult for companies to make choices whether to do the innovation in collaboration with external partners, to do it in-house, or to in- or outsource the innovation. Fortuin (2007) developed the open innovation matrix that can be used as a management tool. It can support companies to make decisions about strategies in relation to innovations. Furthermore, the innovation needs investments, and it will be worthwhile to think about what is possible in relation to the investment costs needed. Costs are always important because they show whether it makes sense to carry out the innovation. It will always be difficult to estimate the investment costs, however; these add value to the innovation and help to achieve the innovation goals when doing thorough investment estimates. Furthermore, the following alliance antecedents, explained below, are perceived as highly important to the overall alliance success.

§ *3.2.1 Complexity*

Complexity is defined as one of the alliance antecedents. Moreover, in this study complexity is divided into innovation complexity and alliance complexity. **Innovation complexity** determines the extent to which the project is new to the company. Normally, radical innovations are more difficult to develop compared to incremental innovations. Therefore, it is expected that the level of innovation complexity will have negative effect on the alliance performance. Furthermore, **alliance complexity** has effect on the alliance performance. Alliance complexity can be explained by the number of employees, departments, and alliance partners involved in the innovation alliances. Gerritsma and Omta (1998) identified ten parameters that determine the content of a R&D project. Two firms from the electronics industry were included in the analysis. For example, a number of different product types to be produced and the ratio of the items needed and the number of suppliers were part of the parameters. Furthermore, three performance measures were used which were development costs, development hours, and time to market. For this study we expect that the more employees involved in the alliance, the more difficult to increase the alliance performance. This also applies for the number of departments and companies involved in the alliance. This expectation could be in line with the results found in the research of Gerritsma and Omta (1998) because they found that the development costs and development hours increases the complexity of R&D projects. Thus, the following hypothesis is developed for both innovation complexity and alliance complexity:

Hypothesis 1: The level of complexity is negatively associated with alliance performance.

§ *3.2.2 Focal company competences*

In the past several studies have been carried out regarding innovation and business performance which were concentrated on the internal characteristics of the company. These results showed that firms behaved differently and that some firms were more successful than others. This researcher came to the following conclusion "T*he firm and how it used its resources is seen as the key influence on innovation"* (Trott, 2005). The author investigated several studies in order to determine that pursuing innovations is one of the challenges that businesses face. Issues that will arise are technical problems and not having the right equipment, for example. Likewise, managing those innovation processes is also one of the challenges for companies. What we can seen from the conclusion of Trott (2005) is that the management of innovation is critical to success. According to Bergsma (2010), innovation management is mostly investigated using study populations or case studies from high-tech multinationals with large R&D departments. It can be argued that innovation management can differ among industries or size of company. Looking to the R&D investments, high-tech companies spend more money on the development or improvement of new products. Batterink (2009) found in a sample of 686 innovative firms that currently the management of innovation has an inter-organizational dimension. It implies that managing innovation require competences which are crucial for the company (Batterink, 2009). Therefore, we can argue that it is highly important for firms to have the adequate competences to manage innovations.

The competences to conduct innovation processes are distinguished as the in-house R&D competences or in-house capabilities by Fortuin (2007) and Batterink (2009). **Innovation competences** for innovation processes include, for example, cross-functional meetings which involve departments such as marketing, production and procurement. An example is uncovering or satisfying the needs of the consumers (tasks of a marketing department) which can be valuable information for the R&D department. It can be expected that high-tech companies are used to work according to the principles of innovation management. We have defined the principles of innovation management as follows:

- Cross-functional meetings which involved several departments, to discuss new product/technology ideas
- A present organized 'stage gate' innovation process with "go / no go" moments or change moments
- The existence of an compensation policy to stimulate and motivate R&D employees
- Formulated Key Performance Indicators for the innovation projects
- Captured experiences for every innovation project to have key lessons for coming innovation projects

It is expected that these aspects play an important role in the internal innovation processes of companies. Cross functional meetings foster the communication quality because all employees in the same company will speak the same (technical) language. Such meetings involve R&D, manufacturing, and marketing department which improves the development of new ideas. Furthermore, Cooper *et al.* (2001) developed a 'stage gate' model to improve the control of internal innovation processes. The innovation process is split up into stages while the gates represent the decision points, the "go / no go" moments where different departments are involved. Next, a remuneration policy could be helpful to stimulate and motivate R&D employees which could foster innovation. Key performance indicators (KPI) are used to record outputs and resources used for the innovation projects. This can help to provide insight into the efficiency of the innovation process (Fortuin, 2007). Finally, captured innovation experiences from earlier projects could be used for future innovation projects.

Furthermore, we expect that **alliance experience** have an effect. It is plausible to argue that prior alliance experience could help to perform better in partner assessment which could be positively related to alliance performance. Therefore, in itself, it can be expected that companies that have prior alliance experience the better the company will perform in alliances.

Finally, the **company size** is also considered to be one of the focal company competences. Large firms are expected to have more experience with R&D because they are more professional. Also, we suppose that large firms have the advantage over small firms when it comes to the management of open innovation. Large companies should have more experience with managing innovation processes from which they can benefit during open innovation projects such as innovation alliances. Therefore it is expected that firm size influences the alliance performance that needs to be controlled.

Hypothesis 2: The level of focal company competences is positively associated with alliance performance.

§ 3.3 Alliance partner assessment

The alliance partner assessment is important for the focal company because, if carried out carefully, it will lead them to the most appropriate partner. Bailey *et al.* (1998) highlight factors that are responsible for the success or failure of a close collaboration with external partners. These factors are "*compatible organizational cultures*", "*high levels of commitment*", *"closely matched aims"*, *"the flexibility of the agreement"*, and *"a consistency of position"*. It can be expected that the alliance partner assessment has a great impact on the alliance performance. The difference between an appropriate partner and an inappropriate partner is also showed by Fortuin and Omta (2008). The authors point at the following aspects that determine the most appropriate partner: complementarity and cognitive distance, the willingness of a partner to invest in the innovation, risk, cultural diversity, and commitment. Additionally, the authors also demonstrate the factors that determine less suitable partners: large overlap between resources, too large a difference in business cultures, and depending companies. Therefore, the following elements are seen as highly important in case of thorough alliance partner assessment.

§ *3.3.1 Risk mitigation*

Partner companies that are very familiar to companies have already built up a reputation. The company knows with what type of partner they are dealing with. This is one of the advantages companies have when searching for appropriate partners for the innovation to be developed. Therefore, **previous experience** is expected to be positively associated with alliance performance.

Although companies have to assess partners before starting an alliance, they should also think about reducing the risk of leaking essential information. Protection of IP/Innovation is one of the possibilities to reduce the risk of leaking essential information but sometimes it is not possible to protect everything. The focal company should ask themselves how risky it will be to collaborate with a certain partner. Therefore, **risk assessment** is supposed to be very important for a successful alliance.

The level of **IP/Innovation protection** may determine to which extent the focal company can collaborate with external parties. It can be expected that companies that have better protect of their IP/Innovation will be more willing to collaborate with external parties. Moreover, it is expected that a high level of IP/Innovation protection will reduce the risk of leaking essential information. By protecting IP/Innovation such as product or process innovations companies can parry competition which can be seen as an innovation competence or part of the in-house capabilities. Because innovation is so important in competitive markets, protecting IP/Innovation is even more important. Intellectual property may include the human-, structural-, and relational capital of a company (Päällysaho and Kuusisto, 2008). Competences and technical know-how belong to human capital and a company's internal and external processes (information and communication systems) and intellectual property rights to the structural capital. Protection can be described as *"The process by which entrepreneurs can retain the uniqueness and value of their technological competences" (Ruitenburg, 2011).* There are several ways to protect IP, for example through confidentiality, complexity of the technology, trademarks, and patents (Veliyath and Sambharya, 2011). The protection of IP/Innovation can be divided into two different methods; the formal and informal methods. Päällysaho and Kuusisto (2008) give an overview of the protection methods of IP/Innovation which are presented in Table 3.1. It can be expected that companies that have protected their intellectual property using formal methods, the relation with an external partner will be made easier because knowledge that will be shared is protected and the chance of stealing IP/Innovation is low.

Table 3.1 Formal and Informal IP protection methods (Päällysaho and Kuusisto, 2008).

Formal methods	Semi-formal methods	Informal methods
1.Copyrights	1.Non-competition	1.Secrecy
2.Patent	2.Confidentiality	2.Publishing
3.Utility model	3.Recruitment freeze	3.Restricted access to information
4.Design right	4.Employee inventions	4.Database and network protection
5.Trademark		5.Division of duties
		6.Customer relationship management
		7.Efficient sharing of information
		8.Documentation
		9.Fast innovation cycle
		10.Complex product design
		11.Technical protection
		12.Productised service packages
		13.Circulation of staff between tasks
		14.Trade organisation membership
		15.Loyalty building among personnel

According to Trott (2005), intellectual property becomes an increasingly important aspect of innovation. Innovations almost always require financial investments and in return are expected to gain profit on the short or long term. Therefore, it can be argued that protection of IP/Innovations is very important. Hanel (2006) argued that due to the increasing importance of IP/Innovation protection, the management and human resources that are involved are part of the companies' competitive strategies. Some companies already have employees with special expertise in the area of IP/Innovation protection. This suggests that IP/Innovation protection is perceived as highly important for businesses. Päällysaho and Kuusisto (2008) argue that a combination of formal and informal protection provide the most effective protection for innovations. Norman (2002) showed that a company protects IP/Innovation to a higher extent when the capabilities being shared with an external partner are highly core and tacit. The study sample consisted of 61 companies from the communication and services industry. However, implementing formal and informal protection methods is not always possible. Hanel (2006) demonstrated that there are significant differences in the effectiveness, use, and strategies of IP/Innovation methods among different industries. The high-tech industry, consisting of semiconductors, computer, and communication equipments, uses IP/Innovation protection methods to a great extent compared with other industries. The reason for such an aggressive use of patents is that those companies need IP/Innovation protection to advance their technology or sell their technology legally. Therefore, it can be expected that high-tech sectors will use patents more extensively compared to non high-tech sectors.

Moreover, it can be argued that using formal methods to protect IP/Innovation is more costly compared to informal methods (Trott, 2005). Having a product or process innovation can simply be kept secret. A great example is the confidentiality of the Coca-Cola recipe. Therefore, we expect that non high-tech sectors will protect its innovations by confidentiality to greater extent compared to the high-tech sectors. This more extensive use of patents/breeders rights can be coupled to the R&D expenditures as percentage of sales. It is plausible to argue that the more investments made in particular innovations the higher the importance of protecting this innovation using (in-) formal IP protection methods.

For the non high-tech agrifood industry the IP/Innovation method that mostly used is 'confidentiality'. Food products are produced according to recipes. That guarantees a constant quality. In many cases the recipe also determines the uniqueness of the food product. Because it is possible to produce me-too products[3], the unique recipe is very important to the company. Therefore, it is expected that non high-tech agrifood companies will use confidentiality extensively as the IP/innovation protection method.

Based on the information above, we expect that the level of previous experience, risk assessment, and IP/Innovation protection will influence the alliance performance positively. Therefore, the following hypothesis is developed:

Hypothesis 3: The level of risk mitigation is positively associated with alliance performance.

§ *3.3.2 Level of complementarity*

In the innovation alliance, technical equipment and technical know-how can be exchanged to develop the product or process innovation. The innovation to be developed together needs **technical equipment** and/or **technical know-how** from the focal company and the alliance partner. However, it could be possible that an imbalance is present between exchange of technical equipment or technical know-how. However, this should not be a problem because it will be more important to have complementary resources. Johnson *et al.* (1996) define complementarity of resources within alliances as the unique strengths and resources that will be provided by the partners. Complementarity within alliances can be seen as an important factor because unequal contribution in alliances may lead to a failed collaboration (Johnson et al., 1996). The partner in the innovation alliance can be seen as an important external source of knowledge because their contribution is important for the alliance's success. The resource profile of the alliance partner must be appropriate for a company otherwise the partner is worthless. Cohen and Levinthal (1990) found that overlap is needed between resource profiles of both the firm and the alliance partner. This overlap ensures that new information will be incorporated more easily. Overlap between resource profiles might enhance the collaboration process in innovation alliances because the interpretation of new information is made easier. Furthermore, Das and Teng (2002) argue that a diverse resource profile positively influences the innovation performance in alliances because of the need for each other. Nooteboom et al. (2005) explain this diverse resource profile in terms of the *"Cognitive distance between the firms that hold these different resources"* or *"resource heterogeneity".* According to

[3] The same product as an existing one, but produced by another company

Nooteboom et al. (2005), the organizational focus of a firm is determined along a specific path which indicates that groups of firms operate in different technological environments. These different environments create to certain extent cognitive distance between firms. They also define this as *"The basis for resource heterogeneity across firms"*. The difficulty is to determine the optimal level of cognitive distance that should be present between firms. Cognitive distance can be related with absorptive capacity because the new information can be incorporated in the firm only when they are able to apply it in the right way. In this study cognitive distance is seen as the difference in expertise, research area, and technology between the focal company and alliance partner. Moreover, the ability to absorb scientific information which is difficult to understand for firms belongs to cognitive distance. When companies are not able to absorp certain scientific information, the cognitive distance is too large. So the absorptive capacity is strongly related to the cognitive distance because the same cognitive distance is perceived differently by companies because of the absorptive capacity. As can be seen from Figure 3.2 cognitive distance is shown as function of alliance performance. This indicates that alliance performance will be dependent on cognitive distance present between alliance partners. The optimal cognitive distance gives the highest possible level of alliance performance. Too little and too much complementarity decreases the alliance performance.

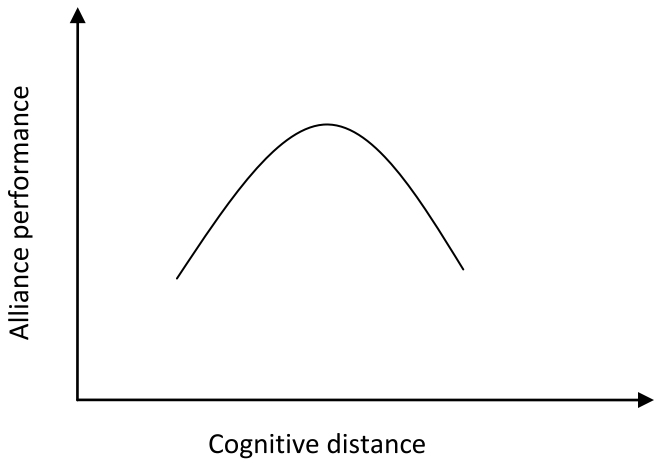

Figure 3.2 Optimal level of cognitive distance. Adapted from Nooteboom et al. (2005)

As we have seen from literature, complementary resources are related to cognitive distance and absorptive capacity of the partner. Moreover, some overlap is needed between resources of alliance partners. It is expected that a high level of a diverse resource profile will inhibit innovation. Therefore, we arrive at the following hypothesis:

Hypothesis 4: The level of complementarity shows an inverted U-shape with alliance performance.

§ 3.4 Alliance agreements

After the alliance partner assessment, when partners have agreed on the collaboration, alliance agreements have to be drawn up. De Man (2006) refers to the combination of legal, economical, and social control mechanisms which are focused on the coordination and monitoring on the contribution from partners, their managerial tasks, and the division of outcome of their combined activities. Alliance agreements should be drawn up at the very beginning of the alliance, before the execution phase. Questions like, *"What is the ratio in financial resources that partners have to invest in the alliance?,"* have to be answered before the alliance can begin. As one can imagine, both companies benefit from the developed innovation. To avoid conflicts, it will be efficient to make agreements about the outcomes of the innovation. Drawing up alliance agreements is expected to be important for a 'smooth run' of the alliance. Furthermore, a company will select partners based on their innovation goals and they assume that they have made the appropriate choice. However, no one is able to consistently make the right choices and therefore it is important to make agreements before starting the alliance.

Agreements on division of outcome

At the very beginning of the alliance several innovation goals have been established. Subsequently, alliance partners have to agree on the division of the alliance outcome. One can imagine that it will be dangerous to expose core competences and unique resources to the partner because the partner can be a competitor or a customer. The more exposed information, the greater the risk companies run. However, companies must expose their intellectual property if they hope to innovate together. The unique capabilities and competences of both companies are used to create the product or process innovation. The results or revenues from the alliance must be distributed over the alliance partners. Therefore, it seems to be highly important to make agreements about the outcomes of the alliance in order to avoid conflicts.

Investment agreements

Investments in the alliance comprise investments in human resources and financial resources. Besides, agreements about division of tasks can also be seen as investments. In most cases companies have different strategic goals when it comes to their core business. The remainder question in innovation alliances is whether the product or process innovation will end up in profit. Before reaching their innovation goals, companies have to put resources into the alliance otherwise it will not be possible to develop the innovation. To measure the input it is suggested to draw up agreements about the input of several investments.

Governance agreements

When the contracts are incomplete regarding deliverables, the input of resources and finances, possible conflicts that arise, or possible termination, the alliance partner could benefit from "blind areas". When this occurs the alliance performance will be threatened leading to less favorable alliance outcome (Sheng-yue and Xu, 2005). Therefore, procedures for resolving conflicts will be worthwhile because differences of opinion may quickly lead to conflicts. Certain conflicts which arise during the collaboration period will be submitted to a higher level because on a lower level it is not possible to resolve it. When and how to submit certain conflicts, can be described in conflict procedures. However, it will not always be the case that conflicts will be resolved which subsequently leads to the termination of the alliance. In stages such as those it is possible to resolve the conflict at the highest management level within an alliance. However, this does not apply to small companies because all functions/departments are concentrated to the director. Agreements also need to be made regarding termination because of conflicts. Companies have to break up in a proper way otherwise their reputation will be damaged.

Monitoring agreements
Monitoring agreements can be used to control the collaboration process in alliances and is one of the tangible possibilities to manage the collaboration process. According to Nakos and Brouthers (2008) monitoring the outputs in alliances may increase opportunism and reduce cooperation performance. Monitoring therefore should be seen as the control of the process in alliances which may have positive impact resulting in reduced opportunism and enhancement of the alliance performance. During the collaboration process, deliverables can be seen as the output where 'go/no-go moments' are implemented.

Confidentiality agreements
Companies should not collaborate when the risk of leaking essential information is too large otherwise they have to think about confidentiality agreements. Confidentiality agreements can be used to reduce the risk of leaking essential information. However, it can be possible that companies have already experience with certain alliance partners which indicate that not only confidentiality agreements play a role in the search for appropriate alliance partners.

Together this leads us to the following hypothesis:

Hypothesis 5: The level of drafted alliance agreements is positively associated with alliance performance.

§ 3.5 Alliance execution

The alliance execution is influenced by the following aspects: communication intensity, level of knowledge transfer, and level of compliance. The exchange of equipment and technical know-how between alliance partners is determined as highly important in alliances because it leads to the transformation of resources into something new. This resource exchange is possible through different forms of communication. Furthermore, the level of knowledge transfer is influenced through the information and human resources exchanged. Finally, in the execution phase compliance is very important. For example, opportunistic behavior of the alliance partner may have negative influence on the alliance performance.

§ *3.5.1 Communication intensity*

When it comes to execute the tasks that were formulated at the very beginning of the alliance, partners have to inform each other about the progress of the project. Communication can occur via face-to-face contact, e-mail, and telephone. According to Mohr and Spekman (1994) the quality of communication contributes to the success of a partnership because it will help realize the expectations about the innovation. The role of communication and IP protection in relation to innovation performance of alliances is extensively investigated by Ruitenburg (2011). At first sight, the influence of communication and IP protection on trust was investigated to measure the extent to which communication builds trust. It was established that the influence of communication on trust is much larger than of high level of IP arrangements. Subsequently, the model of trust and innovation performance was tested. It turned out that trust positively influences the innovation performance to large extent. However, the concept trust building is discussed in next section. The following hypothesis is developed for the influence of communication intensity on alliance performance:

Hypothesis 6: The level of communication intensity is positively associated with alliance performance.

§ *3.5.2 Level of knowledge transfer*

In order to share or exchange **information** the focal company as well as the alliance partner should be willing to provide the information where is asked for. Although companies communicate or exchange employees, when the information asked for, will not be shared, the alliance performance may be negatively influenced. However, the more information exchange may enhance the alliance performance.

Sharing knowledge is very important in innovation alliances because it influences the progression of the alliance. Mostly, the purpose of the alliance is to share new knowledge and to implement this knowledge into the proposed product or process innovation. The knowledge transfer could be enhanced by **exchange of employees** between partners. Garbade (2009) investigated the relation of human resources exchange to R&D alliance performance. It was determined that human resource exchange has significant positive influence on R&D performance. It is expected that exchange of human resource increases the knowledge transfer between alliance partners because it creates the flow of information that leads to the transformation of resources from both alliance partners in something new. Moreover, human resource exchange is also expected to build trust between the alliance partners. This increases the face-to-face contact that has positive influence on the amount of trust. Also the exchange of alliance partners' employees can be used to coach and train the employees of the focal company.

Furthermore, two types of knowledge can be distinguished: tacit and explicit knowledge. The difference between the types is reflected in *"Whether knowledge can or cannot be codified and transmitted in a formal, systematic language or representation"* (Chen, 2004). Explicit knowledge can be shared in scientific literature, formulas, and data while tacit knowledge cannot be codified because it is personal and hard to formalize. This implies that it is difficult to communicate tacit knowledge to the partner firm, for instance. Based on a literature review of the role of tacit knowledge in innovation management, Alwis *et al.* (2004) conclude that when tacit knowledge is more relevant to the innovation process, innovation success is higher. When taken into account that tacit knowledge is harder to formalize and communicate it can be expected that exchange of human resources can enhance the communication of tacit knowledge and simultaneously enhancing the level of knowledge transfer. This leads us to the following hypothesis:

Hypothesis 7: The level of knowledge transfer is positively associated with alliance performance.

§ *3.5.3 Level of compliance*

Alliance alignment has to be created through the contribution they make to the innovation. Otherwise there will be some struggles and the pace of the innovation development will be inhibited. Problems that can play a role which eventually lead to non-compliance are opportunistic behavior and failure to fulfill promises. Therefore it is important to avoid opportunistic behavior and to meet the promises that are made. Opportunistic behavior can be defined as *"The lack of candor or honesty in transactions, to include self-interest seeking with guile"* (Das and Rahman, 2010). For alliances this implies that the partner shows opportunistic behavior by breaking promises, not complying with the agreements made, bluffing, lying, misleading, mispresenting, distorting, cheating, misappropriating, and stealing (Das and Rahman, 2010). Together this leads us to the following hypothesis:

Hypothesis 8: the level of compliance is positively associated with alliance performance.

§ 3.6 Alliance performance

It is conceivable that when the alliance performs better, the innovation performance of the alliance will likewise be superior. However, due to the different aspects within the alliance development trajectory it can be possible that certain aspects have an especially significant impact on the innovation performance and others on the cooperation performance. For instance, the cooperation performance is strongly influenced by the communication that takes place between the partners whereas innovation performance is more influenced by the knowledge transfer between the partners. This implies that it is both of importance to make the innovation alliance development trajectory more efficient, thereby resulting in a higher innovation performance, and also focus on the aspects that most influence innovation performance.

§ *3.6.1 Cooperation performance*

When the focal firm or partner firm is willing to invest in the alliance again and re-collaborate, this implies that the company is satisfied with the alliance. Of course, the alliance can be terminated when the innovation is done and the cooperation will be closed. However, this is normal and does not imply that the collaboration has failed. Although it is expected that cooperation performance influences the innovation performance it can be possible that the innovation performance is superior while the alliance performance is not perceived as was expected in the beginning. This can also be the other way around because the cooperation performance can be superior but the innovation performance was not the outcome as expected in the start-up of the alliance.

§ *3.6.2 Innovation performance*

Innovation performance within innovation alliances is defined as the extent to which new products, processes, and knowledge are developed. This is because it direcly measures the outcome of the alliance and it indicates the extent to which the innovation is developed. However, low innovation performance could have more reasons. First, it was not possible to develop the innovation because of wrong partner assessment. The partners did not meet the expectations of the focal company at the beginning of the alliance. Secondly, it was not possible to develop the innovation due to complicated problems. It therefore is important to measure the interaction effect between cooperation and innovation performance. These findings constitute together the following hypothesis:

Hypothesis 9: Positive interaction effect is present between innovation performance and cooperation performance.

§ 3.7 Concluding remarks

Innovation is widely accepted and implemented in low-, medium-, and high-tech sectors. Nowadays, the emphasis on product and process innovation developed in the internal R&D department has been shifted towards open innovation which includes collaboration with external partners. One of the open innovation strategies available to companies is the “coupled” process. This strategy implies the development of a particular innovation in cooperation with an external partner. Both the focal company and the alliance partner could deliver complementary resources to develop the innovation. The development of this cooperation could be distinguished to five different phases. First, companies should be aware of the alliance antecendents. Secondly, appropriate partners have to be found which require careful alliance partner assessment. Thirdly, agreements have to be drawn up such as monitoring agreements and agreements on division of outcome. Phase three is followed by the fourth phase, namely the execution of the alliance. In this phase the level of knowledge transfer is important because it develops innovation and at the same time it builds trust. Finally, the alliance outcome determines the success of the alliance in terms of innovation performance and cooperation performance. Questions to be answered here are: *Was the innovation developed as was intended? Was the cooperation as successful as expected?*

Chapter 4 Research Methods

In this chapter the methodology used for this study is presented. First, the research methodology, operationalization of the conceptual model and the sample selection will be discussed in Section 4.1. In Section 4.2 the methods for quantitative and qualitative methods will be presented. Finally, a discussion is given about the methodology used for this study in Section 4.3.

§ 4.1 Data collection

The collection of data is based on the methodology explained in Section 4.1.1. In Section 4.1.2 the desk research that was carried out is explained in more detail. Furthermore, several research variables are derived from literature. The structure of these variables is shown in Section 4.1.3, whereas the sample selection will be discussed in Section 4.1.4. Finally, the process of data collection in presented in Section 4.1.5.

§ *4.1.1 Research Methodology*

The conceptual model as presented in Section 3.1 is based on several theories revealed by scientific researchers. To test this model, a theory-testing research is carried out since this is an empirical study. Bryman and Bell (2003) refer to the deductive and inductive theory. This means that theory is developed within a certain domain. Based on this theory several hypotheses are emerged and subjected to empirical research. Subsequently, after data collection, the hypotheses have been confirmed or rejected based on the findings. This type of research is mainly based on the collection of quantitative data. According to Creswell and Clark (2007), mixing qualitative and quantitative data will gain deeper understanding of the research.

Whereas Creswell and Clark (2007) refer to mixed methodology when it comes to combining qualitative and quantitative, Bryman and Bell (2003) call it multi-strategy research. When using a mixed method or multi-strategy research the research results in a complete picture that includes trends and generalizations, as well as in-depth knowledge of participants' perspectives. The research design proposed for this study is the triangulation design because different but complementary data is obtained on the same topic (Creswell and Clark, 2007). This is to validate and embellish the quantitative findings. Important statements that arise during open interviews can be used to support the quantitative findings.

The first part of the results in Chapter 6 is focused on testing the conceptual model to identify key performance indicators for collaboration in innovation alliances. In the second part we have compared the high-tech, high-tech agrifood, non high-tech, and non high-tech agrifood sectors. For Part 1 as well as Part 2 quantitative findings will be supported with qualitative statements from open interviews.

§ *4.1.2 Desk research*

Desk research was used to gain deeper understanding about the topic related to this study. Especially literature regarding the innovation alliance development trajectory is gathered to develop the conceptual model. Moreover, after desk research decisions were made with respect to include or leave out certain aspects in our study, because literature showed extensive research to these topics. Furthermore, deeper understanding was necessary about differences in open innovation among industries. We address two different parts in our study regarding innovation alliances: the innovation alliance development trajectory and differences between industries. Therefore, we consider literature about open innovation, innovation alliances, and differences between industries as the theoretical background and literature about the alliance development trajectory as the theoretical framework. The literature review given in Chapter 3 was used to develop the conceptual model and to get deeper understanding about the results presented in Chapter 6. In addition, the literature review was used to develop the research questionnaire.

§ *4.1.3 Operationalization of the conceptual model*

The research questionnaire used for this study is presented in Appendix 1 and Appendix 2. The research questionnaire consisted of 67 questions. The questions were divided into three different parts. The first part is used to obtain detailed information about the respondent. The second part elaborates on the questions with respect to innovation processes carried out internally. The last part includes questions about the collaboration process in innovation alliances. Open interviews have been carried out after completion of the online questionnaire. This was done in order to discuss the results of the online questionnaire which has increased the reliability of the quantitative findings as well as to get reasons behind the answers. The concepts developed in Chapter 3 have been divided into research variables which are presented in Table 4.1. For all questions (with exception of qualitative questions), a seven-point Likert scale was used, ranging from 'totally not' (1) to 'to a very great extent' (7), with the exception of questions regarding the concepts communication intensity and two questions of innovation competences (multidisciplinary teams and 'stage-gate' innovation process). However, the measurement of these concepts is not ordinal, but a seven-point scale[4] is used to have similar measurements scales. As can be seen from Table 4.1, the questions related to each research variable were in most cases cross-structured in the questionnaire to avoid a repeating answer pattern.

[4] Measurement options were: *1=less than annually, 2=annually, 3=once every six months, 4=once per quarter, 5=monthly, 6=once every two weeks, 7=once a week*

Table 4.1 Operationalization of the conceptual model.

Research Concepts & Variables	Definition of the concepts	Measures
1. ALLIANCE ANTECEDENTS		
1.1 Complexity		
RV 1 Innovation complexity	The extent to which the project is new to the company	PART 3 – Q12
RV 2 Alliance complexity	Number of employees involved in the alliance from the focal company	PART 3 – Q11
	Number of departments involved in the alliance from the focal company	PART 3 – Q10
	Number of companies involved in the alliance	PART 3 – Q6
1.2 Focal company competences		
RV 3 Innovation competences	Companies' competences that are used in innovation processes carried out internally. Aspects measured are:	
	• multidisciplinary teams;	PART 2 – Q2a
	• organized 'stage gate' innovation process with 'go/no go' moments or change moments;	PART 2 – Q2b
	• remuneration policy for innovation;	PART 2 – Q2c
	• key performance indicators (KPI);	PART 2 – Q2d
	• capturing innovation experiences.	PART 2 – Q2e
RV 4 Alliance experience	Experience with alliances	PART 2 – Q4
RV 5 Size	Size classes; less than 50 employees, 50-249 employees, more than 250 employees	Annual reports, etc
2. ALLIANCE PARTNER ASSESSMENT		
2.1 Risk mitigation		
RV 6 Risk assessment	Information that is essential to one's company that can leak out	PART 3 – Q18 (reversed scale)

RV 7 Previous experience	Companies' experience with the concerning partner. Reputation and earlier collaboration gives companies an idea about the input of the alliance partner.	PART 3 – Q8
RV 8 IP/Innovation protection	IP/Innovations can be protected by several methods. It represents the extent to which companies have protected IP/innovations. The methods measured are: • speed of gaining market share; • patents/breeders rights; • confidentiality. Extent to which IP/Innovation is protected compared to competitors	 PART 2 – Q1a PART 2 – Q1b PART 2 – Q1c PART 2 – Q2
2.2 Level of complementarity		
RV 9 Equipment	Companies sourced out the activities needed for the alliance because of limitations in technical equipment.	PART 3 – Q9a
RV 10 Know-how	Companies sourced out the activities needed for the alliance because of limitations in technical know-how.	PART 3 – Q9b
RV 11 Cognitive distance	The extent to which the alliance partner differ in: • technology ; • research area; • expertise. Difficulties in understanding each other with respect to technical and/or scientific details	 PART 3 – Q17a PART 3 – Q17b PART 3 – Q17c PART 3 – Q17d
3. ALLIANCE AGREEMENTS		
RV 12 Investment agreements	Agreements about the investment in the alliance with respect to • input of staff; • finance; • division of tasks.	 PART 3 – Q19b PART 3 – Q19c PART 3 – Q19d

RV 13 Agreements on division of outcome	Agreements about property rights about output and/or results	PART 3 – Q19g
RV 14 Monitoring agreements	Agreements about deliverables per go/no go moment	PART 3 – Q19a
RV 15 Governance agreements	Agreements about various scenarios, for example: • conflicts that arise; • in case of early termination.	 PART 3 – Q19e PART 3 – Q19f
RV 16 Confidentiality agreements	Agreements made to protect essential information or findings from stealing.	PART 3 – Q19h
4. ALLIANCE EXECUTION		
RV 17 Communication Intensity	The intensity in which is communicated by: • face-to-face contact; • telephone contact; • e-mail contact.	 PART 3 – Q14a PART 3 – Q14b PART 3 – Q14c
RV 18 Level of knowledge transfer by employee exchange - information - employees	The level of knowledge transfer is dependent on the information exchanged. The following aspects influence information exchange: • willingness to provide information by the partner • willingness to provide information that the alliance partner asked for • partner support in management, coaching and training of companies' employees. The level of knowledge transfer is also dependent on the exchange of employees: • importance of human exchange • extent to which employee exchange took place	 PART 3 – Q21 PART 3 – Q20 PART 3 – Q16 PART 3 – Q13 PART 3 – Q15
RV 19 Compliance	The following aspects are related to compliance: • Opportunism showed by the partner • Alignment of the various contributions to the alliance. • Promises fulfilled by partner	 PART 3 – Q24 (reversed scale) PART 3 – Q26 (reversed scale) PART 3 – Q22

5. ALLIANCE OUTCOMES		
RV 20 Cooperation performance	The willingness of the focal company to re-invest (1) or re-collaborate (2) with the concerning partner when this was necessary.	1) PART 3 – Q23 2) PART 3 – Q25
RV 21 Innovation performance	The following aspects are related to innovation performance: • New knowledge developed • New products developed • New processes developed • Created synergy between alliance partners • Innovation leaded to profit • Established goals achieved	 PART 3 – Q27a PART 3 – Q27b PART 3 – Q27c PART 3 – Q28a PART 3 – Q28b PART 3 – Q28c

Independent variables

The following research concepts can be seen as the most important elements for this study: alliance antecendents (complexity and focal company antecedents), alliance partner assessment (risk mitigation and level of complementarity), alliance agreements, and alliance execution (communication intensity, level of knowledge transfer, and level of compliance). IP/Innovation protection and innovation competences are measured on company level whereas the other elements are measured on alliance level.

Dependent variables

As dependent variables, innovation performance and cooperation performance are used to measure alliance performance. We have already elaborated on the differences between innovation and cooperation performance. It will be interesting to see which research variables influence the dependent variables positively or negatively.

§ ***4.1.5 Sample selection & survey setup***

For this thesis part of the data are used (5 out of 41 cases) collected by dr. F. Fortuin, MSc P. Garbade and Richard Ruitenburg. Richard has conducted his minor thesis at Food Valley organization about: C*ommunication, IP, and trust and their relation to innovation performance: how to build trust to improve innovation performance in the setting of open innovation clusters.* The interview guide has been partly used for this study to develop our research questionnaire. For this interview guide we would like to refer to Ruitenburg (2011).

Within the sectors we aimed at 50 completed research questionnaires. Due to the time period for the development of the online research questionnaire this number was not achieved. However, we have 41 completed questionnaires which can be seen as valid and reliable. Of course, we contacted much more people (over 100) than the desired number of participants. Respondents were not always willing to fill in the questionnaire. This was due to the fact that they had to give information about their alliance partner. Moreover, some companies made confidentiality agreements at the beginning of the alliance; hence, information could not be shared. Furthermore, it was more difficult to contact high-tech companies compared to non high-tech companies because they showed less willingness to complete the questionnaire. This may indicate that these companies are dealing with radical innovations which must be kept secret. In Chapter 5 an overview is given of the companies that participated in this research. The industries are ranked according to high-tech and non high-tech sectors. Definition about the non high-tech and high-tech sector is also given in Chapter 5.

§ ***4.1.4 Data collection process***

We selected respondents based on personal relations. It was expected that, due to personal relations, respondents were more willing to complete the questionnaire compared to respondents approached based on snowball sampling. Of course, we used snowball sampling to increase our study sample. However, we tried as much as possible to reach respondents based on personal relations. Secondly, we started to contact respondents to increase the dataset with more cases. We selected companies based on experiences with open innovation using the internet. This has provided much information about open innovation practices of companies. Only employees that were strongly involved in the innovation alliance were approached which has increased the reliability of the results. We sent the online questionnaire directly to the respondent after the telephone call. In addition, five open interviews about the results were carried out in order to discuss the results of the research questionnaire. For these open interviews, we did not develop specific questions. The research questionnaires were checked on validity and we gain deeper insight in the alliance to ask the respondent more general questions about the innovation alliance. Moreover, the answers given in the research questionnaire were discussed.

From literature it turned out that online questionnaires have advantages over open interviews when it comes to quantitative questions. First, they reduce the number of missing values. These missing values can alter the reliability of the data and therefore we want to have as few missing values as possible. Secondly, according to Bryman and Bell (2003) the response time is found to be faster compared to postal questionnaires. Moreover, the management of data collection will be easier because it is possible to monitor respondents that have opened their e-mail or filled in the questionnaire. Based on these findings we decided to send online questionnaires instead of postal questionnaires or open interviews. However, we made appointments with the respondents after they completed the questionnaire in order to discuss the results. Questionnaires were not taken anonymously because we wanted to keep overview of the approached respondents and completed questionnaires.

§ 4.2 Methods of data analysis

The obtained interview data will be analyzed by quantitative and qualitative analyses. Both analyses are used to answer the research questions that were proposed at the beginning of this study.

§ *4.2.1 Quantitative analysis*

The quantitative data consists of questions that are measured on a seven-point Likert scale or similar scale. After gathering all data, an overview is given about the general descriptions of the participating companies presented in Chapter 5. Quantitative data analysis is divided into two different parts. The first part focuses on the collaboration process in innovation alliance in general, and the second part provides a deeper understanding of differences among industries. Data analysis in the first part consisted of comparing group means between successful and failed alliances. To be clear in the presentation of results, we used non-parametric methods, average, standard deviation, and t-tests. Subsequently, we performed Spearman correlations among the various research variables as well as the stepwise regression method to test the hypotheses presented in the conceptual model. For the non-parametrical statistical analyses we used the Mann-Whitney Test for comparing group means. In cases with more than two group means we used the Kruskal-Wallis H Test to check for significant differences.

In the second part we address the differences between the high-tech and non high-tech sector where special attention is given to the food industry. We show results about IP/Innovation protection and innovation management. In order to indicate whether non high-tech companies differ over high-tech companies we have chosen to present the individual items of these research variables. Furthermore, we used non parametric methods, average, standard deviation, and t-tests for the presentation of the individual items as well as for the constructs relating to the innovation alliance process. In order to identify significant differences at statement level and additionally we performed Spearman correlations. We expect several significant relationships among the various constructs and individual items.

§ *4.2.2 Qualitative analysis*

Qualitative data analysis is executed on results of open interview provided by respondents who completed the online questionnaire. The main reason for qualitative interviews was to discuss the quantitative results in order to be clearer in the interpretation and presentation of the results. All open interviews were recorded and took 1 to 1.5 hours. Questions for this open interview were prepared specifically for each completed questionnaire. These questions were related to the alliance itself and to the answers given in the completed questionnaire. It can be argued that the qualitative data is not valuable without the quantitative data. The quantitative data can be used to check the qualitative data and vice versa. This indicates that quantitative data without qualitative data is not useful because the story that backs up the quantitative findings is not present.

§ 4.3 Discussion and limitations

To increase response on our questionnaire we decided to develop an online questionnaire. Because most questions are quantitative we found it more important that the time for the completion of the questionnaire was not bound to a certain moment. Also to avoid uncomfortable situations during an open interview we considered it valuable for the respondent when he can decide to complete our questionnaire. Of course, during open interviews more information is given on the respective innovation alliances and the company itself. However, respondents were informed about the open interview after completion of the questionnaire. Therefore, they had to answer questions very carefully because during the open interview we asked in great detail how answers were established.

It can be argued that the total sample size will be too small and therefore have low reliability and validity to execute statistical analysis. Although, we can state that the total data is subjected to different statistical analysis that indicate significant differences to very great detail which are supported with qualitative data. We did not include the type of industry as control variable because we want to investigate those differences in more detail in the second part of Chapter 6. Moreover, the data analysis is carried out in as transparent a manner as possible through the use of several statistical analysis and providing group means and standard deviations on research variable and individual statement level.

Chapter 5 Baseline description

This chapter describes the baseline description of the participating companies. A distinction can be made between company and alliance data which means that the data was gathered on two levels. In Section 5.1 insight is given in the different companies that participated in this study and are classified as belonging to the high-tech sector and non high-tech sector. In Section 5.2 description is given about the innovation alliances in which companies participated and Section 5.3 shows the reliability and validity of the study sample.

§ 5.1 The Companies

Companies that participated in our research are primarily classified to the industries they belong. The classification used is according to the organization OECD *(as far as possible)*. Subsequently, the industries are categorized to the high-tech sector or non high-tech sector. Companies from the electronic and chemical industry are automatically seen as high-tech companies while seed companies are not directly related to the high-tech sector. Although, according to Omta et al. (2011) seed companies can be seen as high-tech companies because comparisons were found in the area of product or process innovation development. It takes about 6 to 12 years in the seed industry to launch a new product on the market which is comparable with those of high-tech industries. In addition, the R&D investments are comparable with respect to percentage of sales. Moreover, the failure rate of innovations for both sectors seems high; one out of twenty breeds reaches the market.

Table 5.1 Classification of the industries participating in this research, ranked according to sector (N=41).

Sectors	Quantitative data		Open interviews
	Company	Innovation Alliance	
High-tech			
Electronics	1	1	
Chemicals	1	1	
High-tech: Agrifood			
Seed	3	4	1 (2 alliances, success and failed)
Non High-tech			
Knowledge/research institute	1*	1	
Software development	4	5	
Gas distribution	1	1	1 (1 alliance, success)
Truck development	1	2	1 (2 alliances, success and failed)
Machinery	4	4	
Road Construction	1	1	
Non High-tech: Agrifood			
Producers of ingredients	8	8	2 (4 alliances, 2 success and 2 failed)
Producers of consumer products	9	11	
Knowledge research institutes	2	2	
Overall total	**36**	**41**	**5****

**results are valid to include in the study sample because the output of the dependent variables are similar to those of companies*
***several statements are included in the description of the empirical results.*

Table 5.1 shows that, in total, five high-tech companies and 31 non high-tech companies participated in this study sample. In the latter, 19 companies have been classified as non high-tech whereas 12 companies were classified as non high-tech agrifood. The high-tech sector consists of companies coming from three different industries, namely seed, electronics, and chemicals. The non high-tech sector is represented by companies coming from the software development industry, gas distribution, truck development, machinery, and road construction. Furthermore, the non high-tech food industry includes producers of food ingredients, food consumer products and knowledge institutes. Three knowledge/research institutes are included in the study sample because we considered it important to include as much as possible appropriate innovation alliances to increase the reliability and validity. The dependent variables innovation performance and cooperation performance are similar for knowledge institutes as for companies. Therefore in the coming sections we will speak only about companies. The knowledge/research institutes were not considered to be high-tech companies and are classified to the non-high tech sector because of low/medium technological alliance projects.

Table 5.2 Classification of participating companies according to size classes (N=41).

Sectors	Companies		Alliances		Range Turnover
High-tech					
>250 employees	2		2		400 – 4,400 €M
50-249 employees	0		0		-
<50 employees	0		0		-
High-tech: Food					
>250 employees	0		0		-
50-249 employees	1		1		15 €M
<50 employees	2		3		-
Non high-tech					
>250 employees	3		4		1,700 – 6,400 € M*
50-249 employees	4		4		30 – 50 €M**
<50 employees	5		6		≈0.3 €M***
Non high-tech: Food					
>250 employees	7		7		85 – 10,000 €M
50-249 employees	5		5		20 – 250 €M****
<50 employees	7		9		1 – 3 €M*****
Overall total	**36**	**100%**	**41**	**100%**	

**Based on 2 out of 3 companies; **Based on 2 out of 4 companies; ***Based on 1 out of 5 companies; ****Based on 3 out of 5 companies; Based on 2 out of 7 companies*

We distinguish the sectors to firm size classes, ranging from small sized (less than 50 employees), to medium sized (50-249 employees), up to large companies (250 or more employees). Table 5.2 presents the number of companies to the different sectors and the above mentioned firm size classes. In addition, the turnover range is given which indicates that companies participated in our research show a turnover range of 0.3 million euro up to 10 billion euro. Very small as well as large companies are involved in this study. The variety of size class could impact the results because large companies are expected to be more professional. The differences between small, medium, and large sized companies will be discussed in Section 6.5.1.

It can be stated that no balance was found between high-tech and non high-tech sectors in terms of number of companies and innovation alliances. It may be possible that respondents of high-tech companies have filled confidentiality agreements that are part of their contract, as noted earlier. Therefore, they were not willing to fill in the questionnaire which could hamper our statistical analysis to certain extent. However, a deeper insight in the high-tech and non high-tech sector is achieved to give special emphasis for the agrifood industry operating in the high-tech as well as the non high-tech sector. It is expected that comparing the 'non high-tech', 'non high-tech food', 'high-tech', and 'high-tech food companies' will give a better understanding of differences between sectors.

§ 5.2 The innovation alliances

As indicated in Table 5.1 the total data set consists of 41 alliances carried out by 36 companies from the high-tech, high-tech food, non high-tech, and non high-tech food sector. Again, we would like to mention that the food industry is given special attention to gain deeper understanding of this industry. Although, the food industry also belongs to the non high-tech sector, it is shown separately. Only five companies filled in the questionnaire two times as requested. Besides, companies that filled in two times the questionnaire did this for a successful and failed alliance. Of course, we can argue that we lost a certain amount of data. On the other hand, companies that filled in the questionnaire two times may be influenced by one of the alliances which has a negative impact on the output of the data analysis. Furthermore, Table 5.1 shows that five open interviews are performed. In the seed industry two completed questionnaires could be discussed as well as two completed questionnaires from the truck development industry. Moreover, four alliances in the non high-tech agrifood sector and one in the gas distribution industry are discussed with the respondents.

As is mentioned in Section 2.2, open innovation strategies occur in several forms. To be sure that the innovation alliances in our study sample can be defined as innovation partnerships, participants were asked to fill in the general purpose of the alliance. It was clearly shown that all alliances were focused on jointly developing a product or process innovation. Furthermore, another important aspect of the questionnaire was the result of the alliance. *"Was the alliance successful or a failure?"* Table 5.3 shows that we end up with 17% failed alliances of the total sample and 83% successful alliances. In total, the data consists of 29 successful alliances, five in-between, and seven failed alliances. What can be seen here is the imbalance between the different types of alliances. The reason for this could be that respondents do not like to assess failed alliances because no one likes to give a negative assessment. In contrast, one of the respondents that filled in the questionnaire two times, mentioned that the questionnaire served as a checklist; it assessed what went right and what went wrong. Table 5.3 illustrates also the alliance type 'in-between'. For more explanation about this type of alliance we refer to Section 6.1.

Table 5.3 Data-set divided into successful, in-between, and failed innovation alliances.

Sector	Successful		In-Between		Failed	
High-tech	1		0		1	
High-tech: Food	3		0		1	
Non high-tech	10		1		3	
Non high-tech: Food	15		4		2	
Total	29	(71%)	5	(12%)	7	(17%)

§ 5.3 Study sample; reliability and validity

The total study sample of innovation alliances includes 36 companies from the high-tech, high-tech food, non high-tech, and non high-tech agrifood sector. For this study respondents are directors, product and process managers, R&D managers, and sales managers. Almost all innovation alliances have been completed in the past. The time period in which the alliances have been running is 1998 to the present. This could mean that the data about alliances of five to six years ago is less reliable than the data of alliances that have occurred recently. Some of the questions have been formulated negatively to counter response error in the answers.

To indicate the type of alliance, respondents were asked to indicate whether the innovation alliance was successful or failed. Not surprisingly, this was also reflected in the results because successful alliances did score higher for alliance performance compared to failed alliances. To increase the reliability of the study sample, we looked for abnormalities in the response pattern. Differences between successful alliances could be discovered when it comes to alliances performance. This indicates that some successful projects have been classified as in-between as described in Section 6.1. For this reason distinction is made between successful, in-between, and failed alliances. In addition, the differences between the high-tech, high-tech agrifood, non high-tech, and non high-tech agrifood sector will also be described in more detail. To see whether the relationships in the conceptual model, presented in Section 3.1, can be established, the total study sample is used. To do so we performed Spearman correlations and a regression analysis.

A principal component analysis (PCA) with Varimax rotation was conducted which showed five factors with reflective latent variables presented in Appendix 3. All factors have an 'eigen value' greater than 0.9 and all factor loadings are >0.5. The variation in the score for each variable is measured with the communality test. This test showed that all research variables are appropriate for the factor analysis. Also the KMO (*Kaiser-Meyer-Olkin*) was performed to determine the suitability of the sample to be tested. The value 0.57 can be seen as moderate. Given the size of the sample, it is understandable that it is too small for factor analysis according to Field (2005) who recommended sample sizes of more than 250. However, for this study five factors could be obtained in combination with Cronbach α higher than 0.65. Bartlett's test of sphericity is used to test whether factor analysis is allowed with the research variables. It turned out that the test was significantly <.0001 which indicates that factor analysis is allowed.

For ever research variable, the number corresponding with the questionnaire is given. The questionnaire is presented in Appendix 2. For all underlying questions for the factors presented in Appendix 3, a seven-point Likert scale was used, ranging from 'totally not' (1) to 'to a very great extent' (7). Important to mention is that research variables formed with factors are called as factors, research variables formed with only reliability tests as constructs, and research variables consisting of one underlying questions as individual item.

As can be seen from Table 5.4, for innovation competences, investment agreements, governance agreements, and communication intensity only a Cronbach's α was constituted. For the research variable compliance a Cronbach's α was found below 0.7 what can be seen as unreliable. However, because this study is exploratory, a Cronbach's α above 0.6 is acceptable (Hair, 1998). Although a Cronbach's α below 0.7 was found for level of knowledge transfer, this research variable was performed with a principal component analysis. These research variables, formed with only reliability tests, are seen as formative latent variables. It was not possible to form these research variables with reflective items because the respondent had answered the formative items in another context. We tried to constitute the construct IP/innovation protection as a reflective latent variable with the group mean for IP/Innovation protection methods and importance of IP protection compared to competitors. It was determined that this research variable should be measured with two research variables; namely, IP/Innovation protection and Importance of IP protection because the research variables behave like formative variables. For this reason we take the SUM for IP protection methods which are 'speed of gaining market share', patents/breeders rights, and confidentiality. The constructs innovation competences, communication intensity, investment agreements, and governance agreements have a Cronbach's α >0.69, which is acceptable, as mentioned. We need to give reason for the use of communication intensity as a formative construct. The items used for communication intensity turned out to be answered in the same direction like formative questions. Therefore we have chosen to perceive communication intensity as a formative construct. Indicated that the research variables show appropriate interdependence the research variables formed with reliability tests and a principal component analysis could be seen as representative for the statistical analysis.

The research variables presented in Table 5.4 correspond partly with the operationalization table in Section 4.1.3. It was not possible to constitute all research variables as was intended. Therefore we also included the individual items that show important results which can be used to outline the main findings. These individual items are also included in Table 5.4 and still belong to the research variable that was structured in Chapter 3.

Table 5.4 Structure research variables, ranked to the alliance development trajectories.

Research Concepts & Variables	Definition of the concepts	Measures	Research variables: Factor, construct, or individual item
1. ALLIANCE ANTECEDENTS **1.1 Complexity**			
RV 1 Innovation complexity (1=totally not, 7=to very great extent)	• Newness of project to the company	PART 3 – Q12	**Individual item**
RV 2 Alliance complexity (number:…..)	• Number of employees from the focal company involved in the alliance • Number of departments from the focal company involved in the alliance • Number of companies involved in the alliance	PART 3 – Q11 PART 3 – Q10 PART 3 – Q6	**Individual item** **Individual item** **Individual item**
1.2 Focal company antecedents			
RV 3 Innovation competences <u>Q2a and 2b:</u> (1=less than annually, 2=annually, 3=once every six months, 4=once per quarter, 5=monthly, 6=once every two weeks, 7=once a week) <u>Q2c up to 2e:</u> (1=totally not, 7=to very great extent)	• Multidisciplinary teams discuss new product/process possibilities • Organized 'stage gate' innovation process with 'go/no-go' moments. • Active compensation policy to stimulate and motivate our R&D employees to foster innovation • Key Performance Indicators used for innovation projects. • Captured innovation experiences for future innovation projects	PART 2 – Q2a PART 2 – Q2b PART 2 – Q2c PART 2 – Q2d PART 2 – Q2e	**Construct: group mean** Questions 2a up to 2e *(Cronbach α 0.71)*
RV 4 Alliance experience (1=totally not, 7=to very great extent)	• Experience with alliances in general	PART 2 – Q4	**Individual item**
RV 5 Size	Size classes; (1) less than 50 employees, (2) 50-249 employees, (3) more than 250 employees	Annual reports, etc	-

2. ALLIANCE PARTNER ASSESSMENT **2.1 Risk mitigation**			
RV 6 Risk assessment (1=very small, 7=very large)	• Risk of leaking essential information	PART 3 – Q18 *(reversed scale)*	**Individual item**
RV 7 Previous experience (1=totally not, 7=to very great extent)	• Previous experience with alliance partner	PART 3 – Q8	**Individual item**
RV 8 IP/Innovation protection (1=very unimportant, 7=very important)	• speed of gaining market share; • patents/breeders rights; • confidentiality.	PART 2 – Q1a PART 2 – Q1b PART 2 – Q1c	**Construct: Sum** Questions 1a up to 1c
(1=very unimportant, 7=very important)	• Importance of IP/Innovation protection compared to competitors	PART 2 – Q2	**Individual item**
2.2 Level of complementarity			
RV 9 Equipment (1=totally not, 7=to very great extent)	• Outsourcing due to limitations of the technical equipment in the company.	PART 3 – Q9a	**Individual item**
RV 10 Know-how (1=totally not, 7=to very great extent)	• Outsourcing due to limitations of the technical know-how in the company.	PART 3 – Q9b	**Individual item**
RV 11 Cognitive distance (1=the same technology, research area, and expertise, 7=totally different technology, research area, and expertise.	• The alliance partner possesses different technology • The alliance partner works on a different research area • The alliance partner possesses a different expertise	PART 3 – Q17a PART 3 – Q17b PART 3 – Q17c	**Factor 1: group mean** Questions 17a up to 17c (eigen value 2.45, explained variance 18.85%, Cronbach α 0,76)
(1=totally not, 7=to very great extent)	Difficulties in understanding each other	PART 3 – Q17d	**Individual item**

3. ALLIANCE AGREEMENTS For all agreements: (1=totally not, 2=very little, 3=little, 4=on average, 5=more than average, 6=to great extent, 7=to very great extent)			
RV 12 Investment agreements	• Extent to which agreements are made about distribution of staff input, at the beginning of the alliance • Extent to which agreements are made about distribution of financial input, at the beginning of the alliance • Extent to which agreements are made about division of tasks, at the beginning of the alliance	PART 3 – Q19b PART 3 – Q19c PART 3 – Q19d	**Construct: Group mean** Questions 19b up to 19d (Cronbach α 0.70)
RV 13 Agreements on division of outcome	Agreements made about property rights of revenues/result	PART 3 – Q19g	**Individual item**
RV 14 Monitoring agreements	Agreements made about deliverables per 'go / no go' moments	PART 3 – Q19a	**Individual item**
RV 15 Governance agreements	• Extent to which agreements are made about procedures for resolution of conflicts, at the beginning of the alliance • Extent to which agreements are made about possible early termination of the cooperation at the beginning of the alliance	PART 3 – Q19e PART 3 – Q19f	**Construct: Group mean** Questions 19e up to 19f *(Cronbach α 0.83)*
RV 16 Confidentiality agreements	Confidentiality agreements made	PART 3 – Q19h	**Individual item**
4. ALLIANCE EXECUTION			
RV 17 Communication Intensity (1=less than annually, 2=annually, 3=once every six months, 4=once per quarter, 5=monthly, 6=once every two weeks, 7=once a week)	• Frequency of face-to-face contact • Frequency of telephone contact • Frequency of e-mail contact?	PART 3 – Q14a PART 3 – Q14b PART 3 – Q14c	**Construct: Group mean** Questions 14a up to14c *(Cronbach α 0.69)*
RV 18 Level of knowledge transfer (1=totally not, 7=to very great extent)	• Partner support in management, coaching and training • Importance of human exchange • Exchange of human resources	PART 3 – Q16 PART 3 – Q13 PART 3 – Q15	**Factor 2: Group mean** Questions 21,20, and 16 (eigen value 2.11, explained variance 16.25%, Cronbach α 0.65)

(1=totally not, 7=to very great extent)	• willingness to provide information by the partner	PART 3 – Q21	**Individual item**
(1=totally not, 7=to very great extent)	• willingness to provide information that the partner asked for	PART 3 – Q20	**Individual item**
RV 19 Compliance (1=totally not, 7=to very great extent)	The following aspects are related to compliance: • Opportunism showed by the partner • Problems with alignment of the various contributions to the alliance.	PART 3 – Q24 *(reversed scale)* PART 3 – Q26 *(reversed scale)*	**Factor 3: Group mean** Questions 24 and 26 (eigen value 1.04, explained variance 8.02%, Cronbach α 0.67)
(1=totally not, 7=to very great extent)	• Fulfilling promises by the partner	PART 3 – Q22	Individual item
5. ALLIANCE OUTCOMES			
RV 20 Cooperation performance (1=totally not, 7=to very great extent)	• Willingness to do extra investments in the alliance • Preference to cooperate again with alliance partner	PART 3 – Q23 PART 3 – Q25	**Factor 4: Group mean** Questions 23 and 25 (eigen value 0.90, explained variance 6.95%, Cronbach α 0.73)
RV 21 Innovation performance (1=totally not, 7=to very great extent)	• The alliance has generated new processes • The alliance has generated new knowledge • The alliance has generated new products	PART 3 – Q27a PART 3 – Q27b PART 3 – Q27c	**Factor 5: Group mean** Questions 27a up to 27c (eigen value 3.30, explained variance 25.36%, Cronbach α 0.84)
	• Created synergy between alliance partners • Innovation has leaded to profit • Established goals achieved	PART 3 – Q28a PART 3 – Q28b PART 3 – Q28c	Individual item Individual item Individual item

Chapter 6 Empirical results

This chapter presents the results of the statistical analyses carried out with the data gathered. The chapter is divided into two parts. First of all, **in Part 1** the successful, in-between, and failed alliances will be addressed in more detail. Section 6.1 describes the key performance indicators of innovation alliances whereas in Section 6.2 the most important items in which the alliances will differ are discussed. In Section 6.3 the relationships are established with the most important constructs and items. Section 6.4 elaborates on the factors that influence the dependent variables innovation performance and cooperation performance. Finally, in Section 6.5 the hypotheses formulated in Chapter 3 are tested. In **Part 2** we will look in more detail to differences between the high-tech, high-tech agrifood, non high-tech and non high-tech agrifood sector. Section 6.7 presents the differences in innovation competences and IP/Innovation protection. Then, in Section 6.8, a deeper understanding is given regarding the collaboration process in high-tech, high-tech agrifood, non high-tech, and non high-tech agrifood sectors. Section 6.9 reports the findings about important items and finally in Section 6.10 relationships are established with the most important constructs and items.

Part 1 Key performance indicators

This part describes the aspects that play an important role in innovation alliances in general. Key performance indicators will be identified and the conceptual model will be tested using Spearman rank correlations and linear regression analysis.

§ 6.1 Key performance indicators

The data on alliance level include successful and failed innovation alliances as indicated by the respondents. In the questionnaire as well as during the open interviews, respondents were asked to assess the alliance as successful or failed. During the open interviews it often was mentioned, *"The cooperation was terminated at an earlier stage due to bankruptcy of the partner or just the product or process innovation was unsuccessful."* Interestingly, from Table 6.1 it turned out that the failed alliances proceeded differently compared to the successful alliances. However, it can be argued that several successful alliances did perform different compared to the remainder successful alliances. We call them in-between alliances. There turned out to be a significant difference in the research variables 'innovation performance' and 'cooperation performance' with respectively p-values < .05 and <.01. This shows that indeed the three types of alliances[5] differ in the innovation alliance development trajectory. Furthermore, the research variables 'cognitive distance' and 'confidentiality agreements' were significant with p-values < 0.1, and 'level of compliance' has a p-value < .05.

[5] Three types of alliances: successful, in-between, and failed innovative alliances.

The determination of the key performance indicators for innovation alliances group means for all research variables were used which are summarized in Table 6.1, ranked as successful, in-between, and failed alliances. One exception is the research variable IP/Innovation protection because the sum of all underlying questions is taken for this research variable as is mentioned in Section 5.3. This is to increase the difference in IP/Innovation protection among the various alliance types and because the non-formative character of this research variable.

A higher group mean could be distinguished for the research variable **previous experience** for successful alliances compared to in-between and failed alliances. This indicates that companies with failed alliances considerably have less experience with the alliance partners concerned compared to the other alliance types. It may be possible that companies feel more comfortable with a familiar partner which positively influences the innovation and cooperation performance. It was expected that companies which have protected IP/Innovation to a large extent will perform better in innovation alliances because it protects a company's IP from being stolen by the alliance partner. However, companies with failed alliances have protected their IP/Innovation to greater extent. Companies have chosen for the safe side; however, this might mean that IP/Innovation has been excessively protected, hampering the alliance progress as a result. A higher group mean on the research variable **cognitive distance** indicates that partners have a more diversified resource profile. According to Das and Teng (2002) this may enhance the innovation performance. But, as expected, it seems that too much complementarity of resources will deteriorate the alliance performance. In addition, according to one of the respondents involved in a failed alliance: *"our company and alliance partner, had too much of the same core business."*

Interestingly, it turned out that the **innovation complexity** of the alliance project to the company was also high among failed alliances. It may be possible that due to too complementary resources, the innovation was too complex. Alliance partners were involved in the innovation because of their unique resources. However, the company was not able to take full advantage of it. The interpretation for this could be that complex innovation alliances with alliance partners who deliver too complementary resources result in lower innovation and cooperation performance. We interpret this finding as a signal that automatically the cognitive distance as well as innovation complexity increases. It could be that complex innovations require too complementary resources which are not for every company suitable. This was also stated during one of the interviews. *"The alliance partner went bankrupt while the innovation was already developed to certain extent. However, the focal company was not able to continue the innovation development because a lack of knowledge."*

The group mean for **communication intensity** shows that for all types of alliance projects the communication through email, telephone, and face-to-face contact was on equal basis. The group means are all around 5 which indicate a monthly contact frequency.

With exception of **confidentiality agreements**, none of the other agreement constructs came out as significant. In successful alliances, confidentiality agreements seem to have positive impact on the innovation and cooperation performance because of higher mean score compared to in-between alliances. Looking to the high score for governance agreements at failed alliances it seems that making governance agreements does not impact innovation or cooperation performance. One of the respondents mentioned: *"formal/legal contracts at the beginning of the alliance are an indicator of non-confidentiality."* In fact, drawing up contracts to large extent will not guarantee excellent cooperation. But on the other hand, it seems rare that governance agreements are made to a greater extent in failed alliances. One can imagine that governance agreements can be helpful when troubles arise during the execution of the alliance. Despite the use of governance agreements to a large extent in failed alliances it has not contributed to the overall alliance success. Reason for this could be that governance agreements were made at a late stage. This also applies in all probability for agreements on division of outcome.

Very interesting was one of the statements of a non high-tech company from the truck development industry: *“no chemistry was present between the company and partners which indicates a wrong partner choice.”* From Table 6.1 it can be seen that the group mean for risk assessment is high for failed alliances. This indicates that companies with failed alliances are more at risk compared to companies with successful alliances. Therefore, companies with failed alliance should perform better alliance partner assessment when looking for appropriate partners. For instance, a question to be answered here is: “*How valuable is the information that for the potential alliance partner?”* The question remains whether the company has to reduce the risk of leaking information or do careful partner assessment. Although, this question could be answered using the results on the extent to which companies protect IP/innovation. It turned out that predominantly failed alliances were not able to reduce the risk of leaking essential information through IP/Innovation protection. Therefore, it is plausible to argue that optimal cognitive distance and previous experience with partners will be more important than protecting or reducing the risk on leaking essential information.

Also, a significant difference was found for alliance complexity with respect to the number of departments involved in the alliance, which is in line with our expectations. Interestingly, it turned out that in failed alliances the number of people involved was higher. Therefore, we could expect here significant difference as well. However, this was not the case but still it might mean that this was also perceived as a problem in failed alliances. The group mean for ‘number of partners involved in the alliance’ turned out to be higher for successful alliances only. We can argue that the number of partners can decrease the alliance complexity. It is better to have more partners than to have more employees or departments involved in the alliance.

In conclusion, Figure 6.1 clearly shows the results of failed and successful alliances. We decided to leave out the results of in-between alliances in order to clearly constitute the points of differences. First, a higher group mean for cognitive distance can be seen which could indicate that this is one of the factors which has had negative impact on the failed alliances. Furthermore, a great point of difference is the extent to which compliance was showed in the failed alliances. Moreover, it had negative impact on the alliance, that partners did not show compliance. Important to mention is that not only partners that failed to show compliance causes the alliance ended in failure. In the following sections we will discuss the correlations and relationships between the independent and dependent research variables.

Table 6.1 Mean scores of the research variables, ranked by level of success of innovation alliances: successful (N=29), in-between (N=5), and failed (N=7).

Research variables	Successful Mean	(SD)	In-Between Mean	(SD)	Failed Mean	(SD)	Significance *p-value*
1. ALLIANCE ANTECEDENTS							
1.1 Complexity							
RV 1 Innovation complexity	4.11	(2.22)	4.80	(2.49)	5.33	(2.42)	0.409
RV 2 Alliance complexity							
- Number of employees	5.36	(5.20)	4.40	(3.36)	7.14	(8.63)	0.793
- Number of departments	2.71	(1.30)	2.20	(0.45)	4.17	(1.47)	0.054**
- Number of partners	4.34	(9.47)	2.60	(0.89)	2.71	(1.11)	0.837
1.2 Focal company antecedents							
RV 3 Innovation competences	4.09	(1.26)	4.24	(1.24)	3.71	(0.79)	0.624
RV 4 Alliance experience	4.12	(2.21)	4.00	(2.45)	4.20	(2.59)	0.993
RV 5 Size	-		-		-		-
2. ALLIANCE PARTNER ASSESSMENT							
2.1 Risk mitigation							
RV 6 Risk assessment	2.69	(1.64)	3.00	(2.16)	3.80	(2.78)	0.733
RV 7 Previous experience	4.37	(2.06)	4.50	(1.73)	3.20	(1.79)	0.439
RV 8 IP/Innovation protection	14.74	(3.59)	14.25	(3.50)	15.8	(4.09)	0.767
2.2 Level of complementarity							
RV 9 Equipment	4.07	(2.49)	3.25	(2.87)	3.00	(2.45)	0.675
RV 10 Know-how	3.89	(2.08)	4.25	(0.96)	4.67	(2.16)	0.591
RV 11 Cognitive distance	4.37	(1.63)	4.73	(1.44)	5.62	(1.41)	0.065*[1]
3. ALLIANCE AGREEMENTS							
RV 12 Investment agreements	4.44	(1.49)	4.73	(0.80)	4.71	(1.75)	0.771
RV 13 Agreements on division of outcome	5.00	(1.77)	3.80	(1.92)	5.00	(2.77)	0.307
RV 14 Monitoring agreements	4.14	(2.20)	4.80	(1.30)	4.43	(2.23)	0.867
RV 15 Governance agreements	2.95	(1.67)	2.70	(1.52)	4.14	(2.43)	0.428
RV 16 Confidentiality agreements	5.38	(1.52)	3.80	(1.79)	5.14	(2.27)	0.071*[2]
4. ALLIANCE EXECUTION							
RV 17 Communication Intensity	5.09	(1.32)	5.00	(0.85)	5.44	(0.62)	0.795
RV 18 Level of knowledge transfer	2.94	(1.53)	3.20	(2.22)	2.83	(1.79)	0.981
RV 19 Level of compliance	5.50	(1.26)	4.70	(1.10)	3.36	(1.82)	0.013*
5. ALLIANCE PERFORMANCE							
RV 20 Cooperation performance	5.66	(0.86)	3.90	(1.19)	3.43	(1.59)	0.000***
RV 21 Innovation performance	5.44	(1.47)	5.13	(1.39)	3.52	(1.79)	0.044**

* p < 0.1, **p < .05, *** p <.01

[1]significant difference between successful and failed alliances

[2]significant difference between successful and in-between alliances

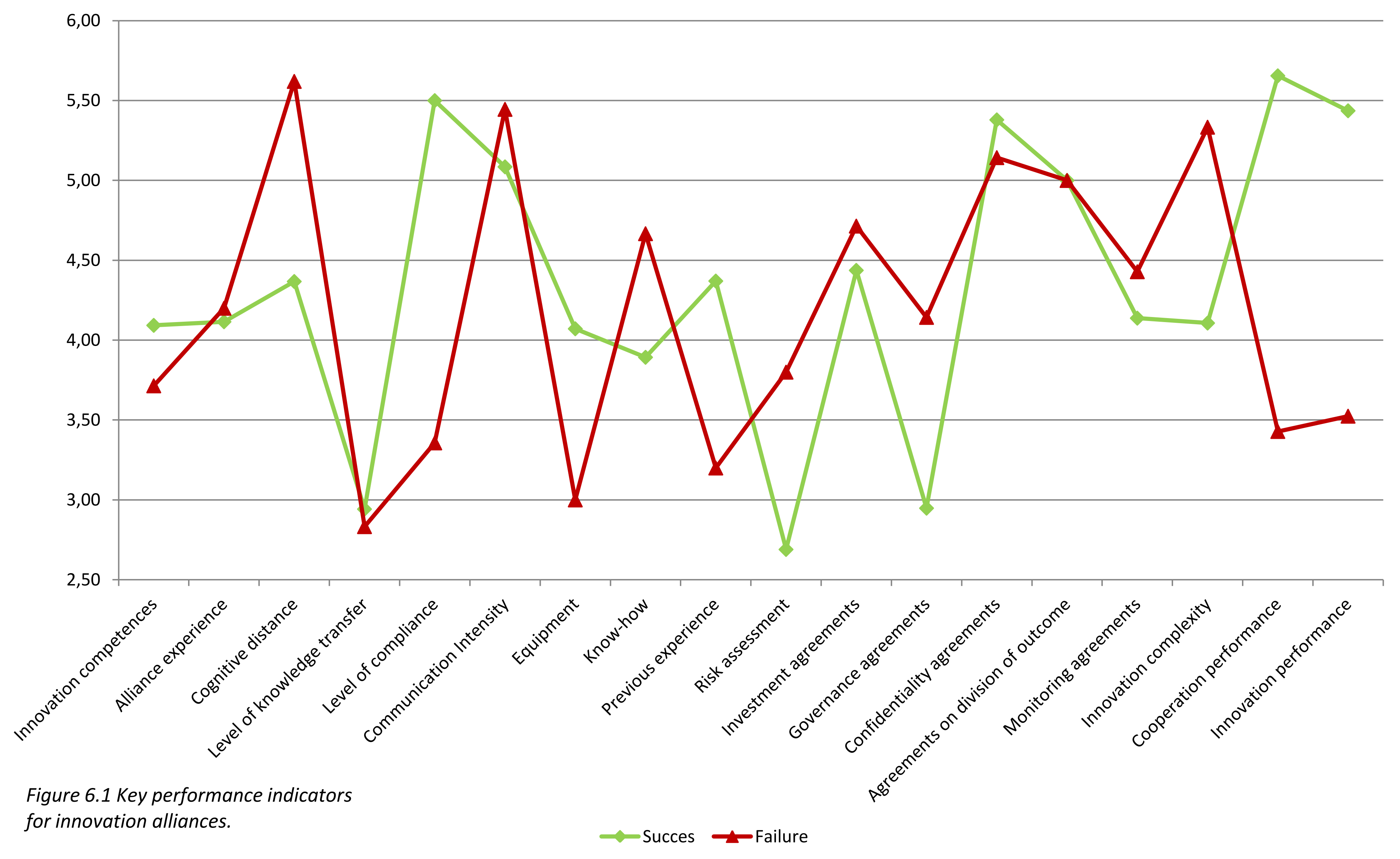

Figure 6.1 Key performance indicators for innovation alliances.

§ 6.2 Key performance indicators at statement level

As we want to be clear in presenting and explaining results, the group means and standard deviations for individual items are presented in Table 6.2. Some items belong to research variables presented in previous section whereas other items are only measured in this analysis. From Chapter 5 it can be seen that not all the proposed questions belong to the research variables. Only the individual items which show significant difference are included in Table 6.2. With the help of these results it is possible to get more insight in the three types of alliances.

Table 6.2 Mean scores for individual research variables, ranked by level of success of innovation alliances: successful (N=29), in-between (N=5), and failed (N=7).

Research Variable	Successful Mean		In-Between Mean		Failed Mean		Sign. *p-value*
Level of knowledge transfer							
Willingness to provide information by the partner	6.14	(0.92)	5.40	(1.34)	4.00	(2.16)	0.019***
Willingness to provide information that the partner asked for	6.24	(0.83)	6.00	(0.00)	5.14	(1.77)	0.094*[1]
Cognitive distance							
The partner possess a different expertise	5.17	(1.58)	4.80	(1.64)	6.00	(1.00)	0.098*[2]
Difficulties in understanding each other	2.93	(1.83)	2.40	(0.89)	4.00	(1.92)	0.091*[2]
Level of compliance							
No Opportunism	5.46	(1.35)	5.20	(1.64)	3.00	(2.08)	0.017**
Alignment of various contributions to the alliance	5.43	(1.48)	4.20	(1.64)	3.71	(2.29)	0.072*
Fulfilling promises	5.62	(0.90)	4.20	(1.64)	4.00	(1.41)	0.008***
Cooperation performance							
Extra investments	5.38	(1.08)	2.80	(1.79)	3.14	(2.12)	0.001***
Re-collaboration	5.93	(0.92)	5.00	(1.41)	3.67	(1.63)	0.004***
Innovation performance							
New products developed	5.59	(1.82)	4.00	(2.35)	3.57	(2.07)	0.041**
New knowledge developed	5.69	(1.58)	5.80	(0.84)	3.86	(2.12)	0.076*
New processes developed	5.03	(1.74)	5.60	(1.14)	3.14	(1.19)	0.079*
Synergy created	5.59	(0.95)	5.10	(1.30)	4.20	(1.80)	0.009***
Cost reduction	5.21	(1.26)	3.40	(1.52)	2.29	(1.60)	0.001***
Objectives achieved	5.74	(1.16)	4.50	(1.29)	2.80	(1.30)	0.001***

*p < .1 ; **p < .05 ;***p < .01

[1]Significant difference: between successful and failed alliances ; [2]between failed and in-between alliances; [3]between successful and in-between alliances

From the results on item level it became clear that at successful alliances both the company and the partner were willing to share information. This influences the level of knowledge transfer positively, which improves the alliance performance. Moreover, as previously shown, the research variable cognitive distance was significant with a p-value < .1 for the items 'the partner possess a different expertise' and 'difficulties in understanding each other'. It turned out that the partner in failed alliances was predominantly too complementary resources when it came to expertise. Automatically, the company itself was not able to absorb information from the partner because there were difficulties in understanding scientific details. Furthermore, the item ‘no opportunism’ was also significant, which means that this behavior hampers the innovation development in alliance. One of the respondents mentioned: *“The alliance failed primarily due to opportunistic behavior.”* Furthermore, we heard: *“An alliance partner sometimes showed certain arrogance by claiming that they could develop the innovation based on their own capabilities. Moreover, this partner wanted to involve more companies to sell the innovation developed in collaboration with the company concerned. We did not agree with this but no agreements were made, resulting in a failed alliance.”*

Interestingly, companies with in-between alliances were not willing to do re-investments in the alliance but they agree to some extent to re-collaboration with the partner concerned. Reason for this may be that the objectives were reached but improving the innovation through extra investments was not possible or did not make sense. It has to be said that it is difficult to establish the output of the innovation alliance before the collaboration has been started. The innovativeness of the projects can be radical, which entails uncertainties. However, results from Table 6.1 and Table 6.2 show patterns from high group means to low group means. Such descending patterns of group means run from successful to failed alliances, which indicate that several aspects went wrong.

From the group mean on the research variable re-collaboration, it became visible that most companies were not willing to cooperate again with the concerning partner. This may indicate that the collaboration process did not proceed smoothly. The failure of an alliance can have the following two reasons: the collaboration process was not optimal or it was not possible to develop the innovation. When cooperating again was not an option for the companies with failed alliances it is probably due to less cooperation performance than that it was not possible to carry out the innovation. In Section 6.3 and Section 6.4 we will elaborate more on the aspects that influence innovation and cooperation performance.

It turned out that the group mean on the item fulfilling promises is in line with our expectations. Successful alliances were carried out with partners that fulfilled promises to large extent while for in-between and failed alliances the score was lower. This pattern was also seen at the research variable ‘level of compliance’. Partners did not fulfill promises while at the same time compliance to agreements was not shown. We can argue that these constructs clearly show what went wrong.

§ 6.3 Spearman rank correlations; relationships among research variables

Spearman rank correlations were performed for the research variables mentioned in Section 5.3. We began by making Spearman rank correlations with the data from successful, in-between, and failed alliances. However, the detailed findings for such limited sample sizes were very low and therefore we performed Spearman rank correlations which included the total study sample.

According to Table 6.3, a significant correlation was found between innovation performance and cooperation performance with a p-value < .01, as expected. This indicates that cooperation performance has positive influence on the innovation performance, and vice versa. Therefore, it can be argued that the collaboration process in alliances is very important to the success of the alliance and not only the resources shared.

The independent variables that correlate significantly on **innovation performance** with p-values < .1 are communication intensity, risk, investment agreements, and agreements on division of outcome. Furthermore, significant correlations were found for the variables knowledge transfer and confidentiality agreements with p-value < .05, and equipment with p-value < .01. Also risk assessment was significantly positively correlated with innovation performance which indicates that thorough risk assessment has positively influence on alliance performance. As expected, the level of agreements is positively correlated to innovation performance. Additionally, the level of knowledge transfer through employee exchange and communication intensity, positively contribute to innovation performance. The more frequent alliance partners have telephone, e-mail, and face-to-face contact, the better the innovation performance. Also, it seems that employee exchange positively influences the level of knowledge transfer, which could indicate that trust was built between the focal company and alliance partner. It also turned out that exchange of equipment particularly enhance innovation performance because a significant correlation was found with a p-value < .01. This can be interpreted as a signal that know-how is difficult for partners to implement during innovation development. Equipment can be seen as the tangible resource that is changed, whereas know-how can be seen as the intangible resource that is exchanged between alliance partners.

Significant correlations with **cooperation performance** were found with IP/Innovation protection with a p-value < .1, and exchange of equipment with a p-value < .01. Interestingly, the negative correlation of IP/Innovation protection with cooperation performance can be interpreted as greater IP/Innovation protection lowering cooperation performance. We have seen in the Section 6.1 that in failed alliances the IP/Innovation protection was developed to a greater extent than in in-between and successful alliances. This may indicate that making alliance agreements performs a greater role in the alliance performance compared to increasing the protection of a company's IP/Innovation.

Furthermore, the research variable compliance correlates significantly and negatively with both the number of employees and number of departments. We interpret this finding as the more people or departments involved in the alliance, the less compliance is present. Strongly and positively related to the number of departments is communication intensity. It could be expected that number of departments influences communication intensity because with more departments comes more communication.

Interestingly, **cognitive distance**, **compliance**, **previous experience**, and **innovation competences** were not shown to be significantly correlated to the dependent variables. However, from Section 6.1

we have seen that these elements may contribute to higher innovation performance. For example, previous experience was found to be important in successful alliances. An explanation for the non-significant correlation between risk and alliance performance could be the positive significant correlation between previous experience and risk assessment. When companies have more experience with the concerned partner, the risk of leaking essential information declines. No significant correlation was found between risk assessment and alliance performance, but the interrelationship between previous experience and risk assessment positively influence each other. In fact, we see from Table 6.3 that high risk assessment positively influences innovation performance. Therefore, this interrelationship is perceived as highly important for the overall alliance success.

In conclusion, we can argue that making alliance agreements, protection of IP/Innovations to a small extent, and exchange of equipment contribute directly to a significant, positive alliance performance. In next section we performed a stepwise regression analysis to determine which relationships could be established between the independent variables and alliance performance.

Table 6.3 Spearman rank correlation matrix with the research variables.

	M	*SD*	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
1. Number of partners	3.85	7.98	NA																						
2. Number of departments	2.87	1.36	,11	NA																					
3. Number of employees	5.55	5.66	-,26*	,31**	NA																				
4. Innovation competences	4.05	1.17	,02	-,08	-,02	α=0,71																			
5. IP/Innovation protection	4.94	1.19	-,01	,05	,05	,49***	NA																		
6. Alliance experience	4.11	2.22	,28*	-,14	-,12	,31**	,08	NA																	
7. Cognitive distance	4.63	1.61	,21*	,08	-,18	,05	,02	,06	α=0,76																
8. Level of knowledge transfer	2.96	1.62	,04	,34**	,24*	,33**	,21	-,22	-,05	α=0,65															
9. Level of compliance	5.04	1.55	-,11	-,28**	-,37***	,26*	-,15	,36**	-,20	-,33**	α=0,67														
10. Communication Intensity	5.13	1.17	,19	,66***	,16	-,20	-,33**	,04	,17	,25*	-,12	α=0,69													
11. Fulfilling promises	5.17	1.28	,15	-,23*	-,30**	,00	,04	,02	-,02	,01	,23*	-,04	NA												
12. Equipment	3.82	2.49	-,21	,05	-,06	,00	,21	-,22	,20	,26*	-,06	,04	,24*	NA											
13. Know-how	4.05	1.99	,11	-,16	-,10	,17	-,03	,21	,33**	,19	-,08	-,17	,00	,23*	NA										
14. Previous experience	4.22	1.99	,10	-,20	-,25*	,36**	,23*	,08	,00	,01	,26*	-,25	,12	-,10	-,06	NA									
15. Risk assessment	5.11	1.86	-,32**	,49***	,29**	-,07	,06	-,48***	,19	,23*	-,41***	,33**	,24*	,52***	-,24*	-,38**	NA								
16. Investment agreements	4.52	1.45	,22*	-,10	-,25*	,05	,12	-,01	,27*	,06	-,04	,01	-,03	-,06	,02	,24*	,03	α=0,70							
17. Governance agreements	3.12	1.81	,31**	,05	-,09	-,03	,18	,15	,22*	-,08	-,14	-,10	,07	-,30**	-,02	-,03	-,15	,60***	α=0,83						
18. Confidentiality agreements	5.15	1.73	-,03	-0,06	-0,09	,25*	,23*	,02	,03	,18	-,06	-,16	,18	,02	,06	,14	-,04	,60***	,42***	NA					
19. Agreements on division of outcome	4.85	1.97	-,04	-,14	-,25*	,22	,23	,13	,17	,00	,10	-,21	,11	-,03	,19	,34**	-,14	,66***	,52***	,78***	NA				
20. Monitoring agreements	4.27	2.09	,13	-,10	-,13	,39***	,18	,25*	,25*	-,01	,13	-,23*	-,16	-,29**	,21	,37**	-,20	,63***	,41***	,46***	,68***	NA			
21. Innovation complexity	4.38	2.27	,15	,01	-,11	,27	,38**	,01	,06	,43***	-,22*	,02	-,01	,13	,23*	-,04	,07	,20	,12	,19	,29**	,22*	NA		
22. Cooperation performance	5.06	1.39	-,01	-,07	,13	-,11	-,24*	,01	-,11	,12	,19	,20	,49***	,38***	,12	,05	-,07	-,18	-,13	,10	,08	-,18	-,16	α=0,73	
23. Innovation performance	5.07	1.65	,17	-,06	,03	,07	,06	-,02	,17	,28**	-,06	,22*	,38***	,38***	,13	-,08	,25*	,21*	,07	,33**	,25*	,15	-,01	,48***	α=0,84

*p < .1 (1-tailed), **p < .05 (1-tailed), ***p < .01 (1-tailed)

§ 6.4 Factors related to alliance performance

A stepwise linear regression was conducted with innovation performance and cooperation performance as the dependent variables. In the regression with the dependent variable innovation performance, cooperation performance was included as an independent variable because positive interaction effect between the dependent variables was expected. This was also the case for cooperation performance. According to the conceptual model presented in Section 3.1 we included all research variables in the regression analysis using the enter-method which is presented in Appendix 3. Only one individual item that is not perceived as one research variable is included in the regression analysis: fulfilling promises. However, we also performed the stepwise regression method presented in Table 6.4 and Table 6.5 to get more insight into the research variables that are significantly related to innovation or cooperation performance.

The independent variables cooperation performance, risk assessment, know-how, and cognitive distance significantly predicted innovation performance. Table 6.4 shows that 68.7% of the total variance of innovation performance can be explained by the independent variables. As predicted, cooperation performance is an important variable that is positively related to innovation performance. The expectation that cognitive distance is positively related to innovation performance and/or cooperation performance was not supported. Rather, cognitive distance was found to be negatively related to innovation performance and non-significant in the cooperation model. This may be related to the findings presented in Section 6.3 which indicate that cognitive distance does not show correlations with alliance performance. This is because a high level of complementary resources comes from the alliance partner. When combining the results of the group means for cognitive distance related to the types of alliances and the regression analysis, we can conclude that an inverted U-shape is present between cognitive and alliance performance. From literature, we found that the alliance performance is not always high when the cognitive distance between alliance partners is large. We have seen that this is influenced by the absorptive capacity of the partners.

Table 6.4 Stepwise linear regression with innovation performance as the dependent variable (N=41).

Research variables	**Beta[2]**	**t value**
Alliance performance		
Cooperation performance	0.793	7.567***
Risk mitigation		
Risk assessment	0.695	5.524***
Level of complementarity		
Know-how	0.378	3.352**
Cognitive distance	- 0.293	- 2.594*
Alliance complexity		
Number of departments	- 0.243	- 2.083*
Constant		- 0.518
Adjusted R^2	0.687	15.07***[1]

**p < 0.05, **p < 0.01, ***p < 0.000.*
[1]*F value*
[2]*Standardized beta;*

Furthermore, a positive relationship was found between exchange of know-how and innovation performance. In contrast, we found a significant negative relationship between technical know-how and cooperation performance. This negative relationship could be related to the construct cognitive distance. Cognitive distance was found to be high in failed alliances as can be seen from Section 6.1. Companies with failed alliances had difficulties understanding scientific information. Therefore, it can be argued that exchange of technical know-how may cause more problems than exchange of technical equipment.

The expectation that a higher risk assessment positively influences cooperation performance is not supported as it is significantly negatively related to cooperation performance. However, it turned out that risk assessment is positively related to innovation performance because a significant positive relation was found. This means that for the innovation performance that it will not hamper the performance of the innovation to be developed when risk on leaking information is high. The positive influence of high risk assessment is that the information that runs the risk on leaking is essential for the product or process innovation. Although, risk assessment is negatively related to cooperation performance, it indicates that companies try to keep this information away for the alliance partner. Therefore, risk assessment is negatively related to cooperation performance because it can be perceived as a barrier for collaboration. Furthermore, it may be possible that other factors are of influence on innovation performance, for instance confidentiality agreements. In fact, in the previous section it was found that confidentiality agreements were significant, positively correlated to innovation performance. This explains that in innovation alliances high risk on leaking essential information resulted in higher innovation performance but this is due to the fact that confidentiality agreements were made.

Table 6.5 Stepwise linear regression with cooperation performance as the dependent variable (N=41).

Research variables	**Beta**[2]	**t value**
Level of compliance		
Fulfilling promises	0.373	3.005**
Alliance performance		
Innovation performance	0.584	4.845***
Risk mitigation		
Risk assessment	- 0.313	- 2.604*
Level of complementarity		
Know-how	- 0.217	- 2.081*
Constant		2.447**
Adjusted R^2	0.682	18.181***[1]

**p* < 0.05, ***p* < 0.01, ****p* < 0.000.
[1]*F value*
[2]*Standardized beta;*

The number of departments involved in the alliance, which belong to the research variable alliance complexity, was also significant; this finding explains why innovation performance is negatively influenced as more departments become involved in the innovation alliance. This is in line with one of the remarks of the respondents from the gas distribution company: *"The more departments* *involved in the innovation, the more it will inhibit the collaboration process."* This statement corresponds to expectations regarding the alliance complexity.

In Table 6.5 it is shown that 59.9% of the total variance of cooperation performance can be explained by the research variables. From the stepwise linear regression with cooperation performance as the dependent variable it was demonstrated that fulfilling promises is positively related to cooperation performance. This is in line with our expectations. Also a positive interaction is found between innovation and cooperation performance, as can be seen from the Spearman rank correlations and regression analysis.

§ 6.5 Hypotheses testing

To test the stated hypotheses in Section 3.1 we performed a Spearman rank correlation analysis with the research variables presented in Section 5.3, followed by a stepwise regression analysis. Table 6.6 summarizes the results of the hypotheses tested, providing the Spearman rank correlations found and the results of the regression analysis. In addition, we will also use the results from the statistical analysis on group means. We have to mention here that alliance performance is used as the overall performance of the alliance which includes cooperation performance and innovation performance.

§ *6.5.1 Alliance antecedents*

Hypothesis 1: The level of complexity is negatively associated with alliance performance.

Hypothesis 2: The level of focal company competences is positively associated with alliance performance.

<u>Complexity:</u>
For **hypothesis 1** it was found that complexity is partly significant, negatively related to innovation performance. For <u>innovation complexity</u>, no positive or negative relation could be found with alliance performance. This indicates that the complexity of the innovation has no impact on the alliance performance. <u>Alliance complexity</u> was measured by the number of departments, number of employees from the focal company involved in the alliance and the number of alliance partners that participated in the innovation alliance. As expected, the more departments and the more employees involved in the alliance will negatively influence the alliance performance. It turned out that the number of departments from the focal company involved in the alliance, the innovation performance is negatively influenced. So this is one of the negative 'side-effects' when working on a certain innovation together with different departments. In addition, from comparing group means it turned out that in successful alliances more alliance partners were involved compared to in-between and failed alliances. This indicates that although the alliance complexity increases through the involvement of more alliance partners, the alliance performance increases. Although the number of alliance partners is positively associated with alliance performance, we did not found significant results with Spearman rank correlations and regression analysis. Therefore, hypothesis 1 is only confirmed for the number of departments whereas for the other complexity variables the hypothesis is not confirmed.

<u>Focal company antecedents:</u>
Hypothesis 2 suggests that focal company antecedents are positively associated with alliance performance. For <u>Innovation competences,</u> no significant correlation could be found. This suggests

that other research variables have more impact on alliance performance. In Part 2 we will elaborate more on the innovation competences comparing high-tech and non high-tech sectors.

To see whether the research variable firm size has impact on the data, non-parametric analyses are carried out using the Kruskal-Wallis H Test for all research variables from Section 5.3. We expected that significant differences could be found between small, medium, and large companies regarding innovation competences, IP/Innovation protection and the collaboration process in innovation alliances. Interestingly, it turned out that the research variables 'number of alliance partners,' 'fulfilling promises,' and 'level of newness' are significant with p-values < .05. Next, the research variable 'number of employees' is significant with a p-value < .01 as well as communication intensity with a p-value < .1. The mean score of 5.94 for 'number of companies' indicates that many more companies were involved in the alliance compared to large sized companies with a mean score of 2.94. In addition, for number of employees this relationship is reversed because in medium and large sized companies many more employees are involved in the innovation alliance with respectively a mean score of 7.70 and 7.07 and for small companies 3.19. This may indicate that small companies participate in innovation alliances that are subsidized by the Dutch government. For small companies it is attractive to participate in such projects because the costs are very low. As was expected, the newness of the innovation was higher for large companies compared to small companies. Because of large investments in R&D, large companies are more able to develop advanced products and processes. Furthermore, we also performed the non-parametric Mann-Whitney Test to investigate whether differences could be found between two groups. However, it turned out that comparing two groups did not alter the conclusions in relation to the comparison of three groups. Since we found no significant result between firm size and innovation or cooperation performance, we can conclude that the hypothesis is not confirmed.

We also tested the impact of alliance experience on the dependent variables innovation performance and cooperation performance. Table 6.6 showed that no correlation was found between alliance experience and the dependent variables. However, it turned out that positive significant correlations could be found for alliance experience with compliance. Looking to these correlations we found that having an alliance experience decreased the opportunism of the partner because more compliance is showed by the partner. Considering this an important success factor, the alliance experience that companies have may indicate that more experience with alliances result in better alliance partner assessment. However, we did not find direct relationships between alliance experience and alliance performance. Therefore, the hypothesis is not confirmed.

§ *6.5.2 Alliance partner assessment*

Hypothesis 3: The level of risk mitigation is positively associated with alliance performance.

Hypothesis 4: The level of complementarity shows an inverted U-shape with alliance performance.

Risk mitigation

With **hypothesis 3** we argued there is a significant positive correlation between risk assessment and alliance performance. We found a significant positive relationship between risk assessment and innovation performance. It seems that thorough risk assessment has positive influence on alliance performance. However, in contrast, a significant negative relationship was found for risk assessment and cooperation performance. The more risk assessment gives the impression to be unimportant for cooperation performance since it is negatively related. However, it could indicate that companies have more difficulties with the cooperation when the risk of leaking essential information is high. Risk assessment is negatively related to cooperation performance because it may indicate that high risk assessment is a barrier for collaboration.

For the research variable previous experience, no significant relationship was found with alliance performance. However, from comparing group means on the research variable previous experience, it turned out that successful alliances already had experience with the alliance partner concerned whereas failed alliances did not.

For IP/Innovation protection support is found in Table 6.6, stating that there is a significant, negative correlation present between IP/Innovation and cooperation performance. We have seen that for failed alliances the extent to which IP/Innovations were protected was high compared to in-between and successful alliances. This suggests that an optimal balance could be found between IP/Innovation protection and alliance performance. Protection of IP/Innovation indicates that it will be more difficult to cooperate. Based on these findings we reject hypothesis 3 for IP/Innovation protection. For previous experience and risk assessment we did not found clear results that can confirm or reject hypothesis 3.

Level of complementarity

The test of **hypothesis 4** has a very notable result consisting of significant positive correlations between equipment and know-how with alliance performance. However, from the regression analysis it turned out that a negative relationship was found between know-how and cooperation performance. This could mean that exchange of tangible resources will be easier to cooperate compared to exchange of intangible resources like technical know-how. Furthermore, we found a significant negative relationship between cognitive distance and innovation performance. This confirms our hypothesis because we found that too many differences in resources provided by the alliance partners. Therefore this suggests that an optimal balance is present between complementarity and alliance performance. Thus, hypothesis 4 is completely confirmed based on the findings for group means on the research variables for complementarity and the findings with Spearman rank correlations and the regression analysis.

§ 6.5.3 Alliance agreements

Hypothesis 5: The level of drafted alliance agreements is positively associated with alliance performance.

Hypothesis 5 states that controlling alliances with alliance agreements may contribute positively to alliance performance. The results in Table 6.6 show that all alliance agreements contribute to innovation performance with the exception of governance and monitoring agreements. From Section 6.1 it turned out that failed alliances made governance agreements to a great extent, even though the agreements did not positively affect alliance performance. We interpret this as a signal of agreements made at a late stage. However, based on the findings with Spearman rank correlations and regression analysis, with exception of governance agreements and monitoring agreements, **hypothesis 5** is completely confirmed.

§ 6.5.4 Alliance execution

Hypothesis 6: The level of communication intensity is positively associated with alliance performance

Hypothesis 7: The level of knowledge transfer is positively associated with alliance performance.

Hypothesis 8: The level of compliance is positively associated with alliance performance.

Communication intensity

Communication intensity is positively correlated with innovation performance. In addition, we expected that communication stimulates knowledge transfer. From Spearman rank correlations, a significant positive effect was established for communication intensity and level of knowledge transfer. Based on the positive relationship between communication intensity and innovation performance, **hypothesis 6** is confirmed.

Level of knowledge transfer

With **hypothesis 7** we expected significant positive correlations between level of knowledge transfer and alliance performance. It was expected that the level of knowledge transfer positively influences alliance performance because it builds trust between alliance partners. Exchange of human resources could stimulate information exchange which increases the amount of trust. Therefore, hypothesis 7 is completely confirmed.

Level of compliance

Compliance does not show any positive or negative correlation with alliance performance as was expected at first sight. However, we found at comparing group means a reduction of compliance from successful to failed alliances. This indicates that opportunism has a negative impact on alliance performance although this is not seen from the spearman rank correlations and regression analysis. Because we found any positive effect between compliance and alliance performance, **hypothesis 8** is not confirmed.

However, for fulfilling promises we found significant positive correlations for both, innovation performance and cooperation performance as well as a significant positive relationship with cooperation performance. Because it was not possible to constitute a research variable with fulfilling promises, this individual item is not included in the hypotheses testing analysis. But these findings indicate that some amount of compliance is desired in collaborations.

§ *6.5.5 Alliance performance*

Hypothesis 9: Positive interaction effect is present between innovation performance and cooperation performance.

Finally, we could confirm **hypothesis 9** because significant positive interaction was found between innovation and cooperation performance. Looking to Table 6.6 we see that especially exchange of equipment contributes positively to cooperation performance. This finding may indicate that when special attention is given to this aspect, the alliance will perform better in the innovation development. On the other hand, innovation performance is positively influenced by risk assessment, equipment, know-how, investment agreements, and agreements on division of outcome, confidentiality agreements, communication intensity, and level of knowledge transfer. This indicates that not only the resources delivered by the alliance partner are important, but also managerial capacities are important. However, it has to be argued that cooperation performance as well as innovation performance contributes to the alliance performance.

Table 6.6 Hypotheses tested through Spearman rank correlations and regression analysis

Hypothesis	**Concept**	**Research variable**	**Spearman correlation**		**Regression analysis**		**Rejected/Confirmed/not confirmed**
ALLIANCE ANTECEDENTS			**IP**	**CP**	**IP**	**CP**	
Hypothesis 1	1.1 Complexity	*Innovation complexity*					Not confirmed
		Alliance complexity:					
		Number of alliance partners					Not confirmed
		Number of departments			-		Confirmed
		Number of employees					Not confirmed
Hypothesis 2	1.2 Focal company competences	Innovation competences					Not confirmed
		Alliance experience					Not confirmed
		Size	NA	NA	NA	NA	NA
ALLIANCE PARTNER ASSESSMENT							
Hypotheses 3	2.1 Risk mitigation	Risk assessment	+		+	-	Partly Confirmed
		Previous experience					Not confirmed
		IP/Innovation protection		-			Rejected
Hypothesis 4	2.2 Level of complementarity	Equipment	+	+			Confirmed
		Know-how			+	-	Confirmed
		Conitive distance			-		Confirmed
ALLIANCE AGREEMENTS							
Hypothesis 5	Alliance agreements	Investment agreements	+				Confirmed
		Agreements on division of outcome	+				Confirmed
		Governance agreements					Not confirmed
		Monitoring agreements					Non confirmed
		Confidentiality agreements	+				Confirmed
ALLIANCE EXECUTION							
Hypothesis 6	Communication intensity		+				Confirmed
Hypothesis 7	Level of knowledge transfer		+				Confirmed
Hypothesis 8	Level of compliance						Not confirmed
ALLIANCE PERFORMANCE							
Hypothesis 9	Alliance performance	Interaction effect between cooperation and innovation performance	+	+	+	+	Confirmed

§ 6.6 Concluding remarks

We performed several analyses to get deeper insight in the key performance indicators for collaboration in innovation alliances. From the statistical analysis on group means, it was shown that complexity and cognitive distance play an important role in the performance of the alliances. Moreover, several expectations were confirmed regarding risk assessment, compliance and previous experience. For collaboration in alliances it can be concluded that thorough risk assessment is necessary. Furthermore, compliance has to be shown to the agreements made; otherwise the alliance will not proceed smoothly. Moreover, it seems to be important to have previous experience with the concerned alliance partner. However, companies do not have the possibility to collaborate with well-known alliance partners.

Hypotheses are tested through Spearman rank correlations and regression analysis to determine significant effects between the independent variables and alliance performance. However, it turned out that also a positive interaction effect was found for the dependent variables. This may indicate that several research variables positively influence cooperation performance, whereas other research variables influence innovation performance positively. The results show that innovation performance is influenced by more research variables compared to cooperation performance. Therefore, it can be recommended to pay more attention to cooperation performance, because a positive interaction effect was found for the dependent variables. However, it has to be mentioned that a combination of good cooperation and innovation development is necessary for the overall alliance performance.

Part 2 An empirical assessment of high-tech and non high-tech sectors

The second part of Chapter 6 gives a deeper insight in the collaboration process of innovation alliances in high-tech and non high-tech sectors. In Section 6.6 the results of IP/Innovation protection and innovation competences are summarized and give insight to the extent IP/Innovation protection and innovation competences are applied in the sectors mentioned. Section 6.7 provides the results of the collaboration process in innovation alliances in which the most important differences are addressed. Section 6.8 elaborates on the individual items which came out as significant when comparing the sectors. In last section (6.9), correlations among the different research variables are presented and differences will be addressed comparing high-tech with non high-tech sectors.

§ 6.7 In-house capabilities

The level of in-house capabilities refers to the extent to which product and process innovations are managed internally and the extent to which a company's IP/Innovation is protected. According to our expectations these aspects will be applied to a lesser or greater extent in high-tech and non high-tech sectors. From Section 5.2 it can be seen that the distribution of failed alliances over the different industries is proportional. The distribution of in-between alliances over the industries is unbalanced, but due to the fact that respondents assessed the in-between alliances as successful alliances, the in-between alliances are included for the statistical analyses. In addition, leaving out several cases in such a limited sample size will decrease the reliability of empirical results. Moreover, we found that the group means for high-tech companies and high-tech agrifood companies were similar. Therefore we decided to transform both industries to one group mean to be clearer in the presentation of the results. To summarize, we distinguish three different sectors; the high-tech sector, the non high-tech sector, and the non high-tech agrifood sector.

§ *6.7.1 IP protection*

Table 6.7 presents the results about IP/Innovation protection methods. Significant differences were found in two research variables, 'gaining speed of market share' and 'patents/breeders rights,' both with p-values <.01 level. Speed of gaining market share is more important for the high-tech sector which consists of companies from the seed, electronics, or chemicals industry. These companies are active in markets where gaining speed of market share is very important because of long-term innovation development. When the product or process is ready for the market the penetration of the product or process should be as quick as possible. One of the respondents from the high-tech (food) industry mentioned: *"With completely new seeds the market penetration has to be as quick as possible because it needs its return on investments."* For the non high-tech agrifood companies this IP protection method is less important because protection of recipes has significant more impact on the business performance of the company. Unique food products depend on the recipe which is used to produce the product. One can imagine that stealing such recipes have large disadvantages for those companies. Furthermore, the recipe ensures that food ingredients and food consumer products can be developed. In particular, protection of recipes is very important for these companies. However, it is not possible to protect recipes to a great extent which implies that competitors have the opportunity to imitate the product. The brand of food products is even more important for companies because it is recognizable by consumers. The product imitated by competitors is mostly always from lower quality because they do not know the exact recipe and they do not have the possibility to use the same brand. For example, the recipe and brand of Coca-Cola are strongly related to each other because it makes the product unique and therefore recipes are highly important. Non high-tech agrifood companies and high-tech companies have comparable group means for the IP/Innovation protection method; namely, confidentiality. It was expected that predominantly non high-tech agrifood companies protect IP/Innovation by confidentiality to keep their recipes secret. However, one of the respondents from the high-tech industry mentioned: *"It is worthwhile to keep innovation in development secret before the patent is published. This is because it is possible that other companies benefit from this development because it is still not patented."* Furthermore, one of the respondents from the food industry mentioned: *"Food recipes will not be shared with the alliance partner under any circumstances."* Therefore, confidentiality is very important to the non high-tech agrifood industry. On the other hand, the recipe and the processes are matched to one another which mean that it will be difficult for competitors to imitate the product.

Table 6.7 Mean scores for the individual research variables regarding innovation IP/Innovation protection, ranked to the high-tech (N=6) non high-tech (N=14), and non high-tech agrifood (N=21) sector.

Research Variable	High-tech		Non high-tech		Non high-tech: agrifood		Sign. *p-value*
	Mean	(SD)	Mean	(SD)	Mean	(SD)	
Importance of IP protection	4.17	(0.41)	3.93	(0.48)	3.86	(1.32)	0.814
1. Confidentiality	6.17	(1.30)	5.00	(1.84)	5.94	(1.34)	0.147
2. Gaining speed of market share	6.50	(0.84)	4.50	(1.29)	4.69	(1.08)	0.006***
3. Patents/breeders rights	6.50	(0.55)	3.57	(2.07)	4.13	(1.75)	0.006***
SUM of method 1,2, and 3	19.17	(2.14)	13.07	(3.45)	14.76	(2.72)	0.004***

*p < 0.1, ** p < 0.05, *** p < 0.01
[1]*Significant difference between high-tech and non high-tech agrifood companies*

The use of patents in the non high-tech agrifood industry is lower compared to the high-tech sector. In case of non high-tech agrifood companies it often is not possible to protect IP/Innovation by patents because recipes and food products cannot be protected through this IP/Innovation protection method. Also, it is questionable whether patents foster innovation in the non high-tech agrifood industry. According to Section 2.5.1 the non high-tech agrifood industry constitutes more incremental innovations which may indicate that the importance of protecting such innovations by patents is less attractive. In addition, high costs are involved to apply for patents which food companies cannot afford. Small margins impede food companies from investing much money in research and development. From Table 6.7 it can be seen that confidentiality is perceived as highly important in the non high-tech agrifood industry which is in line with our expectations. It also turned out that the high-tech industry invests more in patents and/or breeders rights. Interestingly, the group mean of patents/breeders rights for non high-tech agrifood companies is higher compared with non high-tech companies. We performed a Kruskal-Wallis H Test to check whether significant differences could be found between small, medium, and large sized companies. However, it turned out that no significant differences were present in size classes with respect to patents/breeders rights. We found that some large non high-tech agrifood companies as well as small companies in this study sample have patented certain technologies. This could indicate that non high-tech agrifood companies find it increasingly important to patent their technologies.

Looking to Table 6.7, it seems that high-tech companies pay more attention to protection of IP/Innovation because the SUM of all three IP protection methods is strongly significant with a p-value <.01. For non high-tech and non high-tech agrifood companies the group mean was equal, whereas for high-tech companies the sum for IP protection methods is considerably higher.

§ *6.7.2 Innovation competences*

No significant differences could be found in innovation competences with exception of the implementation of a remuneration policy, as is shown in Table 6.8. This variable has a p-value < .1. It turned out that high-tech companies implement remuneration policies to stimulate and motivate employees to foster innovation to a greater extent than non high-tech sectors. It seems that this is accepted practice in the high-tech industry to stimulate employees to think about new possibilities. The reward that is related to the discovering of new products or processes motivates people to innovate.

According to (CIAA, 2008) it seems that the bargaining power of non high-tech agrifood companies is much lower compared to supermarkets. Supermarkets have built up the power to negotiate product prices throughout the years. Fortuin and Omta (2009) identified this imbalance in bargaining power as an innovation driver for non high-tech agrifood companies. The importance of innovation is increasingly seen in these companies. Therefore, the high mean score on multidisciplinary teams can be explained by the fact that non high-tech agrifood companies already have implemented such meetings to discuss new possibilities.

Furthermore, it came out that a ‘stage-gate’ innovation process is already applied on equal scale in all sectors. This research variable and ‘multi-disciplinary teams’ are measured on a seven-point scale from 1 ‘less than annually’ to 7 ‘once a week’. It seems that all three sectors have monthly disciplinary meetings and an organized ‘stage-gate’ innovation process. Key Performance Indicators and innovation experiences are applied less in non high-tech fagriood companies compared to high-tech companies. This can be interpreted as a signal that these principles are more complicated because it is about the management of an innovation process. High-tech companies are more used to work with the parameters whereas non high-tech agrifood companies currently not yet see its importance.

Looking to Table 6.7, it seems that high-tech companies implement to greater extent innovation competences. However, no significant results could be found for the innovation competences group means. The finding that non high-tech agrifood companies rely on the principles of innovation management (Fortuin and Omta, 2009) is supported by the findings in Table 6.8. It shows that non high-tech agrifood companies benefit from the implementation of innovation competences developed earlier in high-tech companies despite the lower group mean for remuneration policies, key performance indicators, and innovation experiences. This signals that non high-tech agrifood companies are ready to implement open innovation competences as well, which will be discussed in more detail in Section 6.9.

Table 6.8 Mean scores for the individual research variables regarding innovation competences, ranked to the high-tech (N=6), non high-tech (N=41), and non high-tech agrifood (N=21) sector.

Research Variable	High-tech		Non high-tech: others than food		Non high-tech: Agrifood		Sign. *p-value*
	Mean	(SD)	Mean	(SD)	Mean	(SD)	
Multi-disciplinary teams	5.33	(1.86)	5.08	(1.66)	5.76	(1.41)	0.423
'Stage-gate' innovation process with 'go/no-go' decisions	4.33	(1.97)	4.15	(1.82)	4.00	(1.67)	0.903
Remuneration policy	4.83	(1.47)	3.69	(2.25)	3.19	(1.83)	0.085*[1]
Key Performance indicators	4.17	(1.94)	2.54	(1.76)	3.38	(1.69)	0.154
Innovation experiences	4.50	(1.38)	4.00	(1.63)	3.52	(1.86)	0.424
Group mean	4.63	(1.57)	3.89	(1.08)	3.97	(1.12)	0.348

*p < 0.1, ** p < 0.05, *** p < 0.01
[1]*Significant difference between high-tech and non high-tech agrifood companies*

§ 6.8 Collaboration in innovation alliances

In the previous section we have discussed to what extent innovation competences are implemented and to what extent IP/Innovation protection methods are applied in the high-tech and non high-tech sectors. In this section we discuss the collaboration process in more detail and the differences that may arise between the high-tech and non high-tech sectors. According to Section 6.5 the research variable firm size was used to determine whether the size of the company is decisive for the outcome of the results, which was found not to be the case for mostly all research variables.

Table 6.9 presents the results regarding the research varaibles that characterize the collaboration process in innovation alliances. As in the previous section, the high-tech sector includes high-tech as well as high-tech agrifood companies whereas the non high-tech sector is divided into non high-tech agrifood and other non high-tech companies.

From Table 6.9 it turned out that high-tech companies and non high-tech companies have more alliance experience compared to non high-tech agrifood companies. For this research variable we found a significant difference between high-tech and non high-tech agrifood companies with a p-value < .1. With the results of Part 1 it can be argued that this will help high-tech and non high-tech companies to perform better in future alliances. An interesting finding was found for the research variable investment agreements. Non high-tech agrifood companies are more accustomed to make agreements about investments compared to non high-tech companies. This could be related to the innovation complexity because this group mean for the non high-tech agrifood industry is higher compared to the non high-tech industry. When the innovation complexity is perceived as high it advocates for more agreements. The finding for investment agreements applies also for monitoring agreements, governance agreements, and agreements on division of outcome.

Table 6.9 Mean scores of the research variables, ranked to high-tech (N=6), non high-tech (N=14), and non high-tech food (N=21).

Research variables	**High-tech**		**Non high-tech**		**Non high-tech Agrifood**		**Sign.** *p-value*
	Mean	**(SD)**	**Mean**	**(SD)**	**Mean**	**(SD)**	
1. ALLIANCE ANTECEDENTS							
1.1 Complexity							
RV 1 Innovation complexity	6.17	(1.17)	3.71	(2.30)	4.32	(2.29)	0.086*
RV 2 Alliance complexity							
- Number of employees	7.17	(8.91)	6.93	(7.17)	4.10	(2.27)	*0.458*
- Number of departments	2.67	(1.37)	2.86	(1.35)	2.95	(1.43)	*0.919*
- Number of companies	2.33	(1.03)	5.86	(13.59)	2.95	(1.66)	*0.651*
1.2 Focal company competences							
RV 3 Innovation competences	4.63	(1.57)	3.89	(1.08)	3.97	(1.12)	0.348
RV 4 Alliance experience	5.17	(2.14)	4.38	(2.44)	3.50	(2.00)	*0.070*[3]*
RV 5 Size	-		-		-		-
2. ALLIANCE PARTNER ASSESSMENT							
2.1 Risk mitigation							
RV 6 Risk assessment	3.00	(2.1)	2.43	(1.87)	3.27	(1.79)	0.338
RV 7 Previous experience	4.83	(1.33)	3.50	(2.44)	4.63	(1.63)	*0.323*
RV 8 IP/Innovation protection	19.17	(2.14)	13.07	(3.45)	14.76	(2.72)	0.004***
2.2 Level of complementarity							
RV 9 Equipment	4.67	(2.58)	3.14	(2.51)	4.06	(2.46)	*0.443*
RV 10 Know-how	4.00	(2.10)	4.14	(2.51)	4.00	(1.57)	*0.918*
RV 11 Cognitive distance	4.61	(1.60)	4.79	(1.61)	4.52	(1.68)	*0.971*
3. ALLIANCE AGREEMENTS							
RV 12 Investment agreements	5.00	(0.73)	3.86	(1.50)	4.83	(1.45)	*0.076*[1] 0.096*[2]*
RV 13 Agreements on division of outcome	6.67	(0.52)	3.64	(2.13)	5.14	(1.62)	*0.004****
RV 14 Monitoring agreements	4.83	(1.17)	3.43	(2.10)	4.67	(2.18)	*0.196*
RV 15 Governance agreements	3.83	(1.51)	2.43	(1.47)	3.38	(2.01)	*0.076*[1]*
RV 16 Confidentiality agreements	6.50	(0.55)	4.36	(1.86)	5.29	(1.62)	*0.028***
4. ALLIANCE EXECUTION							
RV 17 Communication Intensity	4.72	(1.08)	5.55	(0.88)	4.94	(1.35)	*0.305*
RV 18 Level of knowledge transfer	3.28	(1.25)	3.24	(1.92)	2.67	(1.50)	*0.497*
RV 19 Level of compliance	4.33	(1.72)	5.18	(1.85)	5.14	(1.29)	*0.458*
5. ALLIANCE PERFORMANCE							
RV 20 Cooperation performance	5.17	(1.78)	5.04	(1.62)	5.05	(1.16)	*0.830*
RV 21 Innovation performance	5.17	(2.16)	4.79	(1.86)	5.24	(1.39)	*0.756*

*p < 0.1, ** p < 0.05, *** p < 0.01
[1]significant difference between: high-tech and non high-tech (others than food); [2]non high-tech (others than food) and food; [3]high-tech and food

Figure 6.2 highlight the scores of high-tech and non high-tech companies. We chose to include non high-tech agrifood companies at the non high-tech sector for the graphical overview of the differences between both sectors. Because of the small differences between the three sectors it will be more interesting to reduce the data to two groups to get reliable overview about the results regarding the collaboration process in innovation alliances. Although similar mean scores could be distinguished for non high-tech agrifood companies and other non high-tech companies, for the research variables number of alliance partners involved and alliance experience dissimilar group means are shown. These research variables probably explain the differences between non high-tech and non high-tech agrifood companies.

From Figure 6.2 it turned out that at some points both sectors have equal scores while at others differences are quite large. First of all, it seems that high-tech companies have more experience which can be an advantage for new collaborations. The research variables compliance and communication intensity show that partners from high-tech alliances did fulfill promises to a larger extent and also did communicate to a larger extent. It turned out that exchange of equipment was the most important reason to collaborate with external partners for the non high-tech industry. Interestingly, alliance agreements are made to greater extent in high-tech alliances compared with non high-tech alliances. This is probably due to the alliance experience high-tech companies.

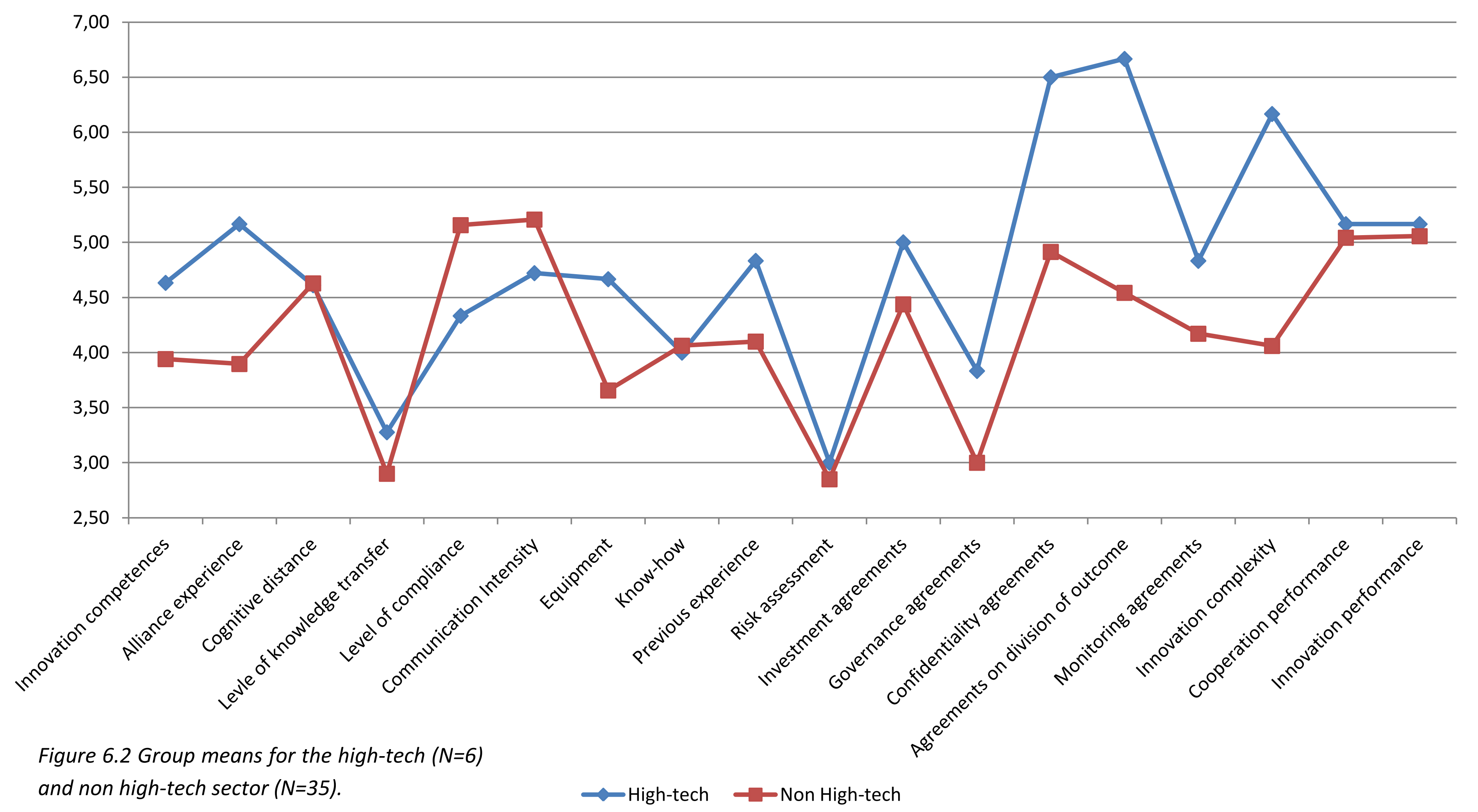

Figure 6.2 Group means for the high-tech (N=6) and non high-tech sector (N=35).

§ 6.9 Comparison at statement level

From Table 6.10 it seems that agreements about the financial input and in the case of early termination have played an important role in the high-tech industry. The extent to which agreements were made about financial input was lower for non high-tech innovation alliances compared to the alliances of non high-tech agrifood and high-tech companies. From the open interviews it turned out that agreements about financial input were generally not made, especially in one of the non high-tech alliances. The respondent mentioned: "*It was intended that the innovation at the end was implemented in our core business. We had defined the innovation goals for the innovation to be developed but shared resources with the alliance partner. In the final phase of development, the alliance failed because the partner was going to involve other potential customers that could buy the innovation developed in the innovation alliance.*" One can imagine that damaged the position of the focal company because the innovation was no longer unique for the company.

Table 6.10 Mean scores of the individual items, ranked to high-tech (N=6), non high-tech (N=14), and food (N=21).

	High-tech		Non high-tech:		Non high-tech: Agrifood		Sign. *p-value*
Alliance agreements							
Financial input	5.50	(1.23)	3.64	(2.24)	5.14	(2.01)	0.086*
Early termination	4.33	(1.63)	2.29	(1.64)	3.67	(2.15)	0.058*

*p < 0.1, ** p < .05, *** p < .01

§ 6.10 Spearman rank correlations; relationships among research variables

With Spearman rank correlations, relationships are established between all research variables. Special attention is given to the dependent variables innovation performance and cooperation performance. We made correlation matrices for three groups, namely high-tech, non high-tech and non high-tech agrifood sector. We include a separate non high-tech agrifood correlation matrix because some correlations for the non high-tech agrifood industry were interesting. The Spearman rank correlation matrix is presented in Appendix 5. Some correlations are included to support the findings. Correlations without a star are found with a p-value <.1 (1-tailed), with one star at the .05 level (1-tailed), and with two stars at the .01 level.

First, we have a look at the correlations between cooperation performance and innovation performance. The correlation between cooperation performance and innovation performance is highly significant for the non high-tech and high-tech companies only (respectively .86** and .81*). Interestingly, no correlation was found for the non high-tech agrifood industry which indicates that the this industry could increase innovation performance through improvement of cooperation performance. From Section 6.5 we have seen that exchange of equipment in particular contribute positively to cooperation performance. From Appendix 5 it can be seen that significant correlations between equipment and cooperation performance could be found for the high-tech and non high-tech sector only. This may indicate that the non high-tech agrifood industry should share more tangible resources like high-tech and non high-tech companies do. Furthermore, the results of the non high-tech agrifood sector on the research variable 'fulfilling promises' shows a lower significant positive correlation (0.35) compared to the correlations for the high-tech and non high-tech sector (respectively 0.84* and 0.53*). One of the respondents from the food industry mentioned: "W*e did not provide any recipes to the alliance partner, even if the partner was asking for it."* The significant negative correlation (-.64) found between IP/Innovation protection and cooperation performance supports this statement because confidentiality was perceived as highly important to this company. In addition, in Section 6.7 a lower group mean for confidentiality agreements was found for the non high-tech agrifood industry (5.29) compared to the mean score for the high-tech industry (6.50). This may indicate that the non high-tech agrifood industry should increase the extent to which confidentiality agreements could be made.

One of the most striking findings is the significant negative correlation (-.41*) between cooperation performance and innovation competences for the non high-tech agrifood sector. It is difficult to explain why innovation competences have negative influence on cooperation performance. On this research variable a positive correlation (.53*) could be found for the non high-tech sector with cooperation performance. The negative correlation between innovation competences and cooperation performance can be interpreted as a signal of insufficiently developed innovation competences. It was expected that, due to the findings in Section 2.5, non high-tech agrifood companies could rely on their innovation competences for the management of innovation alliances. However, these results suggest that non high-tech agrifood companies should put their house in order before they can manage external innovation processes.

When looking at the number of departments involved, high-tech alliances show negative correlations with cooperation performance (-.66) and innovation performance (-.64). This indicates that alliance complexity negatively influences alliance performance because the more departments involved, the worse the alliance performance. From Section 6.7 it seems that on average three departments are involved in the alliance. Perhaps it is due to the high level of innovation complexity. We have seen from Section 6.7 that the innovation complexity of the innovation development was much higher for high-tech alliances compared to non high-tech agrifood and non high-tech alliances. This may indicate complex innovations together with a high level of departments both negatively influence the innovation and cooperation performance. In addition, From **Part 1** it was established that the number of departments is negatively related to alliance performance.

The alliance experience is significantly and negatively correlated with risk assessment for non high-tech agrifood and non high-tech companies only, (-.47* and -.68** respectively). It may be possible that the risk of leaking essential information was rather low because companies already had experience with alliances. As we have seen from Section 6.5, alliance experience may have an impact on the success of an alliance because with this correlation it shows that risk assessment is reduced when companies have earlier experience with alliances. In addition, previous experience is also found significantly negatively correlated with risk assessment for the non high-tech agrifood and non high-tech sector only which suggests that experience with alliances and with alliance partners could reduce the extent to which risk assessment is needed. This is because the risk of leaking essential information is rather low.

§ 6.11 Concluding remarks

Several statistical analyses are carried out for comparing high-tech and non high-tech agrifood companies, with other high-tech and non high-tech agrifood companies. After the first analysis on IP/Innovation protection and innovation competences, it was seen that high-tech and high-tech agrifood companies belong together. From literature, it was expected that these industries have similar innovation management principles which is confirmed. We also found similarities between non high-tech companies and non high-tech agrifood companies. However, due to interesting differences we decided to keep the non high-tech divided into non high-tech agrifood companies and other non high-tech companies.

From the analysis on in-house capabilities, it turned out that the use of patents/breeders rights is lower for non high-tech agrifood companies compared with high-tech and non high-tech companies. Moreover, speed of gaining market share seems to be important in these industries. For the non high-tech agrifood industry, confidentiality is very important because the recipe determines the uniqueness of food product. From this analysis, it can be concluded that companies are aware of protecting their IP/Innovation. However, the high-tech industry seems to be more consistent in protecting IP/Innovation because the total sum of the IP/Innovation protection methods was the highest compared to non high-tech and non high-tech agrifood companies.

Innovation competences are implemented on equal basis when comparing all three sectors. However, a remuneration policy is one of the competences that can be applied to larger extent since non high-tech companies have a significant, lower group mean for this aspect. This could stimulate employees to foster innovation to increase the competitive position of the company. Also key performance indicators and innovation experiences should receive more attention by non high-tech agrifood companies. It can be argued that professional innovation processes and a cross-functional approach to innovation are applied on large scale in non high-tech agrifood companies. However, implementing key performance indicators and capturing innovation experience, the managerial aspects of the innovation process, should receive more attention by non high-tech agrifood companies.

The comparison analysis for the collaboration process in innovation alliances turned out to be very interesting. Not only the high-tech and non high-tech agrifood companies differ in group mean for several research variables, but also non high-tech agrifood companies and other non high-tech companies. However, when comparing both high-tech and non high-tech sectors, it seems that making alliance agreements will be worthwhile in order to increase the alliance performance. Significant differences could be distinguished for all types of alliance agreements. Another interesting result is one of the Spearman rank correlations. Cooperation performance and innovation performance were found to be significant, positively correlated for high-tech and non high-tech companies. That turns out not to be the case for non high-tech agrifood companies. Therefore, it can be concluded that non high-tech agrifood companies should increase cooperation performance because that is inherent with increase in innovation performance.

Chapter 7 Discussion, Conclusions and Recommendations

In the previous section the results are shown in relation to the statistical analysis. Several interesting findings have been made in order to answer the main research questions to achieve our research objective. However, this study has its limitations which will be discussed in Section 7.1. Furthermore in Section 7.2, we draw conclusions based on the results regarding the identification of key performance indicators for collaboration in innovation alliances. In Section 7.3 we will address the differences among high-tech and non high-tech sectors. Finally, in Section 7.4 recommendations for further research are given.

§ 7.1 Discussion and limitations

The results from Part 1 are used to indicate the most prominent performance indicators that influence the alliance performance in innovation alliances. Therefore, we could identify the most important factors in the different phases of the innovation alliance development trajectory that eventually contribute in a highly positive way to the alliance performance. Nonetheless, several limitations did arise such as the sample size and firm size which are expected to be influencing the interpretation of the results. However, for these research variables we found that the most important aspects influencing alliance performance did not differ over the various size classes.

For the results of Part 2, it is important to notice that measuring open innovation practices at high-tech, high-tech agrifood, non high-tech, and non high-tech agrifood sectors was difficult because of several limitations. We experienced difficulties dividing the completed questionnaires over the various industries and sectors. We decided to divide the total dataset into the high-tech, high-tech food, non high-tech companies and the non high-tech food sector. In order to measure differences comparing high-tech and non high-tech agrifood companies, with other high-tech and non high-tech companies, when it comes to open innovation practices, special attention was given for the non high-tech agrifood industry. Only six completed questionnaires were received from high-tech companies against 35 questionnaires from the non high-tech industry. This imbalance negatively influences the interpretations of the empirical results. However, we have investigated the data in various ways to be clear in the presentation of the results and we found that firm size did not influence the results to great extent. Therefore, we could argue that the results can be perceived as reliable and valid.

Before we draw conclusions about the empirical results, it is highly important to indicate in which way we have divided the completed questionnaires into the high-tech and non high-tech sector. This is mainly done based on the technological level where the high-tech industry and non high-tech industry is dealing with. However, we did not include a question to measure the technological level of the company. We used the 'OECD industry classification' in order to divide our questionnaires over the high-tech and non high-tech sectors. In addition, to check whether high-tech agrifood companies can be seen as high-tech companies we performed a statistical analysis to test whether the innovation competences were similar. It came out that indeed the group means of both the high-tech and high-tech agrifood companies were similar and therefore we could transform the results into one group mean.

Furthermore, for every online questionnaire only one respondent was involved to complete the questionnaire. Because more persons were involved in the alliance it could be relevant to fill in the questionnaire with more than one respondent to increase the reliability of the results. However, such an approach requires other research methods including focus groups.

§ 7.2 Conclusions

From the literature we found several aspects explaining how innovation alliances should ideally be managed. From these aspects we constitute a model for the alliance development trajectory which includes the following elements: *alliance antecedents, alliance partner assessment, alliance agreements, alliance execution, and the output of the innovation alliance measured as alliance performance.* Subsequently, we developed the conceptual model including all important aspects that are measured in this study. Our research question is developed as follows:

"Can agrifood companies learn from other high-tech and non high-tech companies regarding innovation and the management of open innovation projects, carried out in innovation alliances?"

To be clear in presenting the conclusions, they are drawn separately for the first part and the second part of Chapter 6. The conclusions based on the results in part 1 are given in Section 7.2.1, whereas the conclusions based on the results in part 2 are given in Section 7.1.2.

§ *7.2.1 Key performance indicators for collaboration in innovation alliances*

Our research objective was formulated in order to identify key performance indicators for collaboration in innovation alliances. In this part of the study we have considered the relation between various elements with respect to the innovation alliance development trajectory and the innovation and cooperation performance of firms cooperating in innovation alliances.

Our total study sample includes 41 completed questionnaires. All data are used to identify the key indicators for collaboration in innovation alliances. Distinction is made in the performance of different types of alliances. In particular, innovation performance and cooperation performance were significant from the statistical analyzes which increases the reliability of the results. Based on the output measured as innovation and cooperation performance we could identify three types of alliances: successful, in-between, and failed alliances. The research questions that were formulated at the very beginning of this study will be answered below, explaining the key performance indicators which influence the innovative output of alliances, measured as alliance performance.

<u>A1: What are the most important alliance antecedents that contribute to alliance performance?</u>
The alliance antecedents were divided among complexity and focal company competences. It turned out that especially alliance complexity negatively influences alliance performance. The more departments involved in the alliance, the less the alliance performance will be influenced positively. However, to overcome this problem, more alliance partners involved in the innovation development may have positive impact on alliance performance. Innovation complexity could be identified as one of the key performance indicators for collaboration in innovation alliances in terms of number of departments involved in the alliance. However, innovation complexity may be related to cognitive distance which is discussed below.

Furthermore, innovation competences could not be distinguished as a key performance indicator. However, comparing high-tech and non high-tech sectors will give more insight in the effect of innovation competences. Alliance experience in itself was not found to be positively associated with alliance performance. However, alliance experience may have influence on other research variables which influence, on their part, alliance performance. The effect of firm size, measured on categorical level, turns out to be not influencing the alliance development trajectory and alliance performance to great extent.

<u>A2: What are the key performance indicators for selecting alliance partners that contribute to alliance performance?</u>

For the key performance indicators for selecting alliance partners, we investigated the elements that belong to alliance partner assessment. For risk mitigation, the following elements have been selected as the most prominent reducing risk factors that contribute positively to alliance performance: risk assessment and previous experience. Concerning previous experience, the reputation of the alliance partner that was known by the company, is seen as highly important because it contributes positively to the success of the alliance. It is demonstrated that alliance experience positively contributes to the alliance performance because risk assessment can be reduced. However, risk assessment can be related to previous experience. We can conclude that when companies have no experience with the concerned partner they have to do thorough risk assessment. Companies should not shy away from collaboration because the risk of leaking essential information is high. However, this will be discussed at alliance agreements. Interestingly, IP/Innovation protection seems to have less impact compared to risk assessment and previous experience. It probably inhibits the cooperation process due to extensive protection of IP/Innovation.

To meet the established innovation goals, companies have to select the most appropriate partner in order to do successful innovation development. Cognitive distance may be seen as important to the success of the innovation alliance. However, it was determined that there is an optimal balance between cognitive distance and alliance performance, as indicated in the literature overview. It was shown that companies in failed alliances selected partners who were too different and for them it was also difficult to understand scientific details. Furthermore, exchange of equipment was found to be important for the success of the innovative output of alliances. The empirical results clearly confirm that exchange of equipment goes beyond exchange of technical know-how. However, a combination of equipment and know-how is necessary, because know-how is needed to implement equipment.

<u>A3: What are the key performance indicators in the start-up phase which contribute to alliance performance?</u>

For the start-up phase, success is about drawing up agreements concerning ‘confidentiality,’ ‘investment,’ ‘governance,’ and ‘division of outcome’ agreements. We can conclude that confidentiality agreements play an important role in reducing the risk of leaking essential information. Companies should not shy away from collaboration because the risk of leaking essential information is high. This is because the risk of leaking essential information may be reduced when confidentiality agreements are made at the beginning of the alliance. Furthermore, it may be explicitly mentioned that governance agreements have to be made at the very beginning of the alliance. The results show that governance agreements were more often made in failed alliances than in successful ones. This phenomenon refers to drawing up governance agreements at a late stage. Overall, it can be concluded that drawing up agreements can be seen as highly important to the alliance performance.

A4: What are the key performance indicators in the execution phase that contribute to alliance performance?

In the execution phase several aspects contribute to the implementation of the alliance, either positively or negatively. Important elements in this phase are fulfilling promises, level of compliance, and knowledge transfer. It can be concluded that fulfilling promises and compliance were important to the alliance execution. That is, when promises are not fulfilled and compliance is not shown the alliance will not be successful. Therefore, we could see these variables also act as control variables to demonstrate the reliability of the empirical results. It was demonstrated that in in-between and failed alliances the group means for fulfilling promises and compliance were lower compared to successful alliances. Furthermore, the level of knowledge transfer contributes positively to the overall alliance success. This is because knowledge transfer through exchange of employees builds trust which positively contributes to alliance performance. However, no differences could be found in relation to the different alliance types.

§ *7.2.2 High-tech versus non high-tech alliances*

The following research questions were used to measure differences in IP/Innovation protection, innovation competences, and collaboration in innovation alliances between high-tech and non high-tech sectors. It turned out that high-tech and high-tech agrifood companies are comparable in applying IP/Innovation protection and innovation competences. Therefore, one group mean was performed for both sectors.

B1: Which differences can be found with respect to IP/Innovation protection and innovation competences?

IP/Innovation protection methods were seen as important in the high-tech sector as well as the non high-tech and non high-tech agrifood sector. For the high-tech industry speed of gaining market share is perceived as important whereas in the non high-tech agrifood industry the protection of recipes by confidentiality is highly important. It can be concluded that both high-tech and non high-tech sectors pay strong attention to protection of their IP/Innovation.

We also investigated the implementation of innovation competences. It can be concluded that the main difference can be seen in the implementation of a remuneration policy because the high-tech industry shows a significantly higher group mean compared to the non high-tech sectors. Overall, we can conclude that non high-tech agrifood companies rely on the principles of innovation management developed earlier by high-tech industries. Hence, we felt that non high-tech agrifood companies can also rely on the principles of open innovation management developed by high-tech industries. However, it turned out that several differences in group means and correlations could be identified which are discussed at the following research question.

B2: Which differences can be found with respect to the innovation alliance development trajectory?

Great differences could be distinguished between high-tech companies including high-tech agrifood companies and the non high-tech sectors. Innovation complexity and alliance agreements came out as the most significant differences. From the Spearman rank correlations, it turned out that for non high-tech agrifood companies no positive interaction effect could be found between innovation performance and cooperation performance. Also a significant negative correlation could be found for innovation competences with cooperation performance. Also a lower significant positive correlation was found for fulfilling promises with cooperation performance for the non high-tech agrifood industry compared to high-tech and non high-tech companies.

B3: How will these differences influence the alliance performance in the high-tech, high-tech agrifood, non high-tech, and non high-tech agrifood sectors?

First of all, we can conclude that the non high-tech food sector should focus more on sharing tangible resources instead of intangible ones. Exchange of equipment might contribute to higher innovation performance as it does in high-tech and non high-tech alliances. Moreover, the results suggest that indeed food companies should put their house in order, to perform better in alliances. Therefore, we can conclude that the innovation competences should be developed to greater extent in order to use them in innovation alliances. Furthermore, the positive interaction effect between innovation and cooperation performance should be achieved for non high-tech agrifood innovation alliances. Therefore, we could recommend the key performance indicators found in Part 1 of the results. For non high-tech agrifood companies it was found that they have less alliance experience. However, this is difficult to pursue because experience comes with age.

§ *7.2.3 Overall conclusion*

Based on the conclusions above it can be argued that non high-tech agrifood companies can learn from high-tech companies regarding the management of innovation alliances. We have seen that several key performance indicators could be derived from the empirical results. We would recommend these performance factors to every company practicing open innovation. However, we also investigated the differences in IP/Innovation protection, innovation competences, and collaboration in innovation alliances between the high-tech and non high-tech sectors in more detail. The companies that fall in the high-tech and non high-tech sector originate from different industries. Therefore, we gave special attention to the agrifood industry, separating it from the rest of the high-tech and non high-tech sector. As mentioned earlier, high-tech and high-tech agrifood companies have been transformed into one group mean. We can conclude that, especially for the non high-tech agrifood companies, the following aspects deserve more attention: innovation competences, exchange of equipment, previous experience, and alliance agreements in general. For these aspects we found positive correlations for the high-tech industry or negative correlations for the non high-tech agrifood industry. Based on the abovementioned arguments, the following research question is answered:

B4: When differences are found, are these instructive for the agrifood industry, and if so, in what way?

§ 7.3 Recommendations

It seems that this is the first research that empirically investigates the open innovation practices both in the high-tech and food sector. Sarkar and Costa (2008) advocate for more empirical results regarding the management of open innovation in the agrifood industry. Batterink (2009) thoroughly investigated to what extent different types (size and technology classes) of innovating firms pursue an open innovation strategy. It turned out that low-tech firms like the non high-tech agrifood industry pursue open innovation strategies to operate in a competitive environment. Therefore, we can argue that we have delivered evidence that the food industry already implement open innovation to great extent but also knows how to deal with open innovation practices. However, we have seen also that non high-tech agrifood companies could benefit from the open innovation practices in high-tech companies.

On the other hand, it can be argued that this research shows weaknesses as well. It is difficult to state that the alliance performance will be increased if non high-tech agrifood companies will give special attention to these aspects. We have to state that we did not find a significant difference between high-tech alliances and non high-tech alliances when it comes to alliance performance, as can be seen in Section 6.7. Although high-tech companies already draw up alliance agreements to a larger extent, they do not show better alliance performance. Therefore, longitudinal studies are proposed to provide a more detailed view about the progress of food companies when implementing the suggestions for the non high-tech industry made in Section 7.2.

Potential alliance partners can be defined as competitors, customers, research institutes, and suppliers. In this study we did not address the different type of alliance partner. Therefore, it is recommended for further research that the type of alliance partner should be investigated. One can imagine that collaboration with suppliers differs over a partnership with research institutes.

References

Alwis, R. S.-d., E. Hartmann and H. G. Gemünden (2004). The role of tacit knowledge in innovation management. Institute of Information Science. Cologne, University of Applied Sciences.

America, N. (2011). Food moet inhaalslag maken. Food&Nutrition, Newness. **3**.

Arranz, N. and J. C. F. d. Arroyabe (2008). "The choice of partners in R&D cooperation: An empirical analysis of Spanish firms." Technovation **28**(1–2): 88-100.

Bailey, W. J., R. Masson and R. Raeside (1998). "Choosing successful technology development partners: a best-practice model." International Journal of Technology Management **15**(1-2): 124-138.

Baker, K. A. (2002). Innovation. Managing Science as a Public Good: Overseeing Publicly Funded Science.

Batterink, M. (2009). Profiting from external knowledge: how firms use different knowledge acquisition strategies to improve their innovation performance, Wageningen Academic Publishers.

Bergsma, E. (2010). Innovation in Food SME's - the current state of innovation management and innovation measurement in Food SME's. Management Studies Group. Wageningen, Wageningen Universitie. **Msc:** 85.

Bryman, A. and E. Bell (2003). Business research methods, Oxford University Press.

Cáceres, R., J. Guzmán and M. Rekowski (2011). "Firms as source of variety in innovation: Influence of size and sector." International Entrepreneurship and Management Journal **7**(3): 357-372.

Cervantes, M. and K. D. Backer (2008). Open Innovation in Global Networks, OECD (Organisation for Economic Co-operation and Development).

Chen, C. J. (2004). "The effects of knowledge attribute, alliance characteristics, and absorptive capacity on knowledge transfer performance." R & D Management **34**(3): 311-321.

Chesbrough, H. (2005). "Open Innovation Experts." from http://www.openinnovation.net/About/Chesbrough.html.

Chesbrough, H. and A. K. Crowther (2006). "Beyond high tech: early adopters of open innovation in other industries." R & D Management **36**(3): 229-236.

Chesbrough, H. W. (2003). "The era of open innovation." Mit Sloan Management Review **44**(3): 35-41.

Chesbrough, H. W. (2003). Open innovation : the new imperative for creating and profiting from technology. Boston, MA, Harvard Business School Press.

Christensen, C. M. (2003). The innovator's dilemma: the revolutionary book that will changed the way you do business, HarperCollins.

CIAA (2008). Data & trends of the European Food and Drink Industry. Brussels, CIAA.

Cohen, W. M. and D. A. Levinthal (1990). "Absorptive capacity - A new perspective on learning and innovation." Administrative Science Quarterly **35**(1): 128-152.

Cooper, R., S. Edgett and E. Kleinschmidt (2001). "Portfolio management for new product development: results of an industry practices study." R & D Management **31**(4): 361-380.

Creswell, J. W. and V. L. P. Clark (2007). Designing & Conducting Mixed Methods Research + The Mixed Methods Reader (bundle), SAGE Publications.

Dahlander, L. and D. M. Gann (2010). "How open is innovation?" Research Policy **39**(6): 699-709.

Das, T. K. and N. Rahman (2010). "Determinants of Partner Opportunism in Strategic Alliances: A Conceptual Framework." Journal of Business and Psychology **25**(1): 55-74.

Das, T. K. and B. S. Teng (2000). "Instabilities of strategic alliances. An internal tensions perspective." Organization Science **11**(1): 77-101.

Das, T. K. and B. S. Teng (2002). "The dynamics of alliance conditions in the alliance development process." Journal of Management Studies **39**(5): 725-746.

De Man, A.-P. (2006). Alliantiebesturing: Samenwerking als precisie-instrument. Stichting Management Studies (SMS), Den Haag, Van Gorkum.

De Rochemont, M. H. (2010). Opening up for innovation: The antecedents of multi partner alliance performance. Eindhoven, Technical University Eindhoven.

Earle, M. D. (1997). "Innovation in the food industry." Trends in Food Science & Technology **8**(5): 166-175.

Elmuti, D. and Y. Kathawala (2001). "An overview of strategic alliances." Management Decision **39**(3): 205-218.

Field, A. P. (2005). Discovering statistics using SPSS: (and sex, drugs and rock'n'roll), Sage Publications.

Fortuin, F. (2007). Strategic alignment of innovation to business. Wageningen, Wageningen Academic Publishers.

Fortuin, F. and S. W. F. Omta (2008). The Dark Side of Open Innovation: a survey of Failed Inter-company cooperation. the 8th International Conference on Management in AgriFood Chains and Networks, Ede, Wageningen Academic Publishers.

Fortuin, F. and S. W. F. Omta (2009). "Innovation drivers and barriers in food processing." British Food Journal **111**(8): 839-851.

Fryer, P. J. and C. Versteeg (2008). "Processing technology innovation in the food industry." Innovation: Management, Policy and Practice **10**(1): 74-90.

Garbade, P. (2009). Exploration Alliances in the Biotechnology-Sector. Management Studies Group Unternehmensführung, Organisation und Informationsmanagement. Wageningen, the Netherlands Bonn, Germany, Wageningen University and Research Centre University of Bonn. **MSc:** 113.

Gassmann, O. and E. Enkel (2004). Towards a theory of open innovation: three core process archetypes, Institute of Technology Management.

Gerritsma, F. and S. W. F. Omta (1998). The Content Methodology. Facilitating performance measurement by assessing the complexity of R&D projects. Management of Technology, Sustainable Development and Ecoefficiency. Amsterdam etc, Pergamon, Elsevier Science Ltd**:** 101-110.

Hair, J. F. (1998). Multivariate data analysis, Prentice Hall.

Hanel, P. (2006). "Intellectual property rights business management practices: A survey of the literature." Technovation **26**(8): 895-931.

Hippel, E. (1994). The sources of innovation, Oxford University Press.

Huston, L. and N. Sakkab (2006). "Connect and develop: Inside Procter & Gamble's new model for innovation." Harvard Business Review **84**(3): 58-+.

Jamrog, J. J. (2006). The quest for innovation: a global study for innovation management, American Management Association.

Johnson, G., R. Whittington and K. Scholes (2009). Fundamentals of Strategy with MyStrategyLab, Pearson Education, Limited.

Johnson, J. L., J. B. Cullen, T. Sakano and H. Takenouchi (1996). "Setting the stage for trust and strategic integration in Japanese-US cooperative alliances." Journal of International Business Studies **27**(5): 981-1004.

Jolink, M. (2009). Open Innovation in the Food Industry: People Management to Stimulate External Networking

External Networking. Institute for Science, Innovation and Society. Nijmegen, Radboud University Nijmegen.

Larsson, R., L. Bengtsson, K. Henriksson and J. Sparks (1998). "The interorganizational learning dilemma: Collective knowledge development in strategic alliances." Organization Science **9**(3): 285-305.

Lin, Z., H. B. Yang and B. Arya (2009). "Alliance partners and firm performance: resource complemenntarity and status association." Strategic Management Journal **30**(9): 921-940.

Linnemann, A. R. and M. A. J. S. Van Boekel (2007). Food product design: an integrated approach, Wageningen Academic Publishers.

Mohammad, M. and M. Romeri (2009). The roadmap for innovation succes. Waltham, PRTM Management Consulting.

Mohr, J. and R. Spekman (1994). "Characteristics of partnership succes: partnership attributes, communication behavior, and conflict-resolution techniques " Strategic Management Journal **15**(2): 135-152.

Nakos, G. and K. D. Brouthers (2008). "International alliance commitment and performance of small and medium-size enterprises: The mediating role of process control." Journal of International Management **14**(2): 124-137.

Nooteboom, B., W. P. M. Vanhaverbeke, G. M. Duysters, V. A. Gilsing and A. J. van den Oord (2005). Optimal cognitive distance and absorptive capacity. Working Paper. Eindhoven, Eindhoven Centre for Innovation Studies: 47.

Norman, P. M. (2002). "Protecting knowledge in strategic alliances: Resource and relational characteristics." The Journal of High Technology Management Research **13**(2): 177-202.

Omta, O., F. Fortuin and N. Dijkman (2011). Samenwerken voor open innovatie: kunst of kunde?, ABN Amro.

Päällysaho, S. and J. Kuusisto (2008). Intellectual property protection in service sector.

Pavitt, K. (1984). "Sectoral patterns of technical change - Towards a taxonomy and a theory." Research Policy **13**(6): 343-373.

Ruitenburg, R. (2011). Communication, IP and trust and their relation to innovation performance : how to build trust to improve innovation performance in the setting of open innovation in clusters. [S.l., s.n.].

Sarkar, S. and A. I. A. Costa (2008). "Dynamics of open innovation in the food industry." Trends in Food Science & Technology **19**(11): 574-580.

Schreurs, W. (2011). Goede samenwerking is heel belangrijk. Eigen Bedrijf. Eindhoven, Kamer van Koophandel. **2:** 51.

Sheng-yue, H. and R. Xu (2005). Analyses of Strategic Alliance Failure: A Dynamic Model. Proceedings of 2005 International Conference on Management Science and Engineering. Beijing, Beijing Jiaotong University.

Shenhar, A. J., A. Tishler, D. Dvir, S. Lipovetsky and T. Lechler (2002). "Refining the search for project success factors: a multivariate, typological approach." R & D Management **32**(2): 111-126.

Sluyts, K., P. Matthyssens, R. Martens and S. Streukens (2011). "Building capabilities to manage strategic alliances." Industrial Marketing Management **40**(6): 875-886.

Todeva, E. and D. Knoke (2005). "Strategic Alliances and Models of Collaboration." Management Decision **43**(1): 123-148.

Trott, P. (2005). Innovation management and new product development, Financial Times Prentice Hall.

Vanhaverbeke, W. P. M., M. H. d. Rochemont, E. Meijer and A. H. W. M. Roijakkers (2007). Open innovation in the Agri-Food sector. Eindhoven, Eindhoven University of Technology.

Veliyath, R. and R. B. Sambharya (2011). "R&D Investments of Multinational Corporations." Management International Review **51**(3): 407-428.

Vrande van de, V., J. P. J. de Jong, W. Vanhaverbeke and M. de Rochemont (2009). "Open innovation in SMEs: Trends, motives and management challenges." Technovation **29**(6-7): 423-437.

Zakić, N., A. Jovanović and M. Stamatović (2008). External and internal factors affecting the product and business process innovation. Faculty of Entrepreneurial Business. Belgrade, Union University.

Appendices

Appendix 1 Interview Guide: Introduction

Dear Sir/Madam,

Please find enclosed, as agreed during our telephone consersation, a brief explanation of our research and the link to the online questionnaire. Completing the online questionnaire takes about 10-15 minutes.

After this research is completed you will receive an individualized feedback paper. This paper can be used to compare your scores with the average of all respondents, ranked according to various industries.

The aim of this research is to identify critical success factors for innovation alliances: partnerships in which two or more parties cooperation with the aim to jointly develop an innovation. When your company has collaborated or is collaborating with knowledge/research institutes, customers, competitors, suppliers or any other external partner, please fill in this online questionnaire. The innovation can be either the development of new products or new processes, and do not necessarily focus on something completely new, but can also focus on improving existing products and/or processes.

This study is conducted by Food Valley under the responsibility of mrs. F. Fortuin and is supervised by Prof. Dr. S.W.F. Omta from the Wageningen University.

Any information you enter in the questionnaire will be treated confidentially. Any forthcoming publication that draws on information obtained from this questionnaire will in no way traceable to your personally or your company.

If you have questions, please contact the researchers Bas-Jan Bax (M: 06-30392934, E: or MSc Philipp Garbade (M: 06-30065164, E:

Thank you for your participation,

Bas-Jan Bax & Philipp Garbade

CLICK ON THE LINK BELOW FOR THE ONLINE QUESTIONNAIRE OR COPY THIS IN YOUR BROWSER BAR

Appendix 2 Interview Guide: Questionnaire

The questionnaire structure is composed of three parts:

Part 1: Contact details

Part 2: Questions regarding companies' internal R&D processes and IP protection methods

Part 3: Questions regarding the innovation alliance (s)

In this questionnaire several questions have to be answered on a 7-points scale. In the case when you are not familiar with such questions, the following question can be used as an example.

Question example with 7-points scale
Question: *'How important is innovation to maintain the competitiveness of your company?'*
When you click on the answer box, you choose the following options:
1=very unimportant
2
3
4
5
6
7=very important

For questions like this two extreme outcomes are given; 1: very unimportant and 7: very important. You can choose which digit (from 1 to 7) best reflects your opinion. You select this value in the answer box. In this case, you choose how important innovation is to maintain competitiveness of your company, on a scale of 1 to 7. The score '4' indicates a neutral value.

When you have questions, you can always contact us by phone or e-mail:

1. Bas-Jan Bax 06-30392934, basjanbax@foodvalley.nl
2. Philipp Garbade 06-30065164,

PART 1 CONTACT DETAILS

1) What is your name?...
2) Name of your company……………………………………………………………………………………………………
3) Your e-mail address[6]…………………………………………………………………………………………………..
4) What is your position in the organization?..
5) In which sector do you operate?...

PART 2 THE COMPANY

1) How important are the following methods to protect your IP or innovations?
   (1=very unimportant, 7=very important)
   a. Confidentiality (for example recipes)
   b. Speed of gaining market share
   c. Patents/breeders rights

2) The protection of our products and processes is, for example through patents, breeders rights, and keeping recipes confidential, compared to our competitors:
   (1=very much weaker, 2=much weaker, 3=slightly weaker, 4=the same, 5=slightly stronger, 6=much stronger, 7=very much stronger)

3) The following statements are related to the R&D management of your company
   a. Within our company we have multidisciplinary teams to discuss new product/technology possibilities.
   (1=less than annually, 2=annually, 3=once every six months, 4=once per quarter, 5=monthly, 6=once every two weeks, 7=once a week)
   b. Our company has a organized 'stage gate' innovation process with 'go - no go' or change moments
   (1=less than annually, 2=annually, 3=once every six months, 4=once per quarter, 5=monthly, 6=once every two weeks, 7=once a week)
   c. Our company conducts an active policy to stimulate employees (for example through remuneration) to promote innovation.
   (1=totally not, 7=to very great extent)
   d. Our company formulates Key Performance Indicators for our innovation projects.
   (1=totally not, 7=to very great extent)
   e. At the end of each innovation project we fix the experiences that we can use for future innovation projects.
   (1=totally not, 7=to very great extent)

4) *Do you have experience with alliances?*
   (1=totally not, 7=to very great extent)

[*]When this research is completed you will receive an individualized feedback paper. This paper can be used to compare your scores with the average of all respondents, ranked according to various industries.

PART 3 THE ALLIANCE(S)

The following questions have been written in paste tense. This doesn't mean that the alliance have to be finalized. The questionnaire is also suitable for running alliances or almost finished alliances.

1) For how many alliances do you want to fill in the alliance?
(1 or 2)

2) How can you assess the alliance?
(as successful, or as failed)

3) Startdate of the alliance, and possibly completion date)
(start:………, completion:……………) (year)

4) Name alliance…….

5) What was the purpose of the alliance?..
(Please, describe the alliance purpose in one sentence)

6) How many organizations were involved in the alliance?
(number:…………)

7) Who was the most important partner within the alliance?[7]…………………………………………………....

8) Did you have previously experience with this partner?
(1=totally not, 7=to very great extent)

9) Activities were outsources to the alliance partner because:
(1=totally not, 7=to very great extent)
    a. limitations of the technical equipment of our company.
    b. limitations of the technical competences or our company.

10) How many departments of your company were involved in the alliance (number)?
SUM (1=research&development, 2=marketing, 3=sales, 4=procurement, 5=finance, 6=topmanagement)

11) How many employees of your company were involved in the alliance?
(number:…………)

12) This project was completely new to our company.
(1=totally not, 7=to very great extent)

13) Exchange of human resources was important in this alliance.
(1=totally not, 7=very important)

14) How often did you have:
SUM (1=less than annually, 2=annually, 3=once every six months, 4=once per quarter, 5=monthly, 6=once every two weeks, 7=once a week)
    a. face-to-face with the most important partner?
    b. telephone contact with the most important partner?

[7] This is also the 'main partner' for which the following answers have to be answered. If you don't want to give the alliance partner name, please briefly describe the business activities of the concerning company.

c. e-mail contact with the most important partner?

15) Was there exchange of employees for each other's company work?
(1=totally not, 7=to very great extent)

16) The most important partner supported us by management, coaching, and training
(1=totally not, 7=to very great extent)

17) To what extent:
   a. used the most important partner in this alliance a different technology than your company.
   b. worked the most imporant partner in this alliance on a different research area than your company.
   c. possessed the most important partner in this alliance a different expertise than your company?
   d. were there difficulties in understanding each other with respect to technical and/or scientific details?

18) The risk on leaking out confidential information was...
(1=very small, 7=very large)

19) To what extent, at the beginning of the alliance, are agreements made about:
(1=totally not, 2=very little, 3=little, 4=on average, 5=more than average, 6=to great extent, 7=to very great extent)
   a. deliverables per 'go - no go' moments
   b. distribution of input from staff
   c. distribution of financial input
   d. division of tasks
   e. procedures for resolution of conflicts
   f. early termination of the cooperation
   g. property rights of revenues/
   h. confidentiality agreements

20) We gave our most important partner the information he asked for
(1=totally not, 7=to very great extent)

21) The most important partner gave us the information where we asked for
(1=totally not, 7=to very great extent)

22) The partner did always what he promised.
(1=totally not, 7=to very great extent)

23) We are willing to do extra investments in this alliance, when this was necessary.
(1=totally not, 7=to very great extent)

24) In the alliance opportunism appeared to be a problem
(1=totally not, 7=to very great extent)

25) In a new project I prefer to work again with the most important partner
(1=totally not, 7=to very great extent)

26) In this alliance the alignment of the various contributions was a problem
(1=totally not, 7=to very great extent)

27) This alliance has developed
(1=totally not, 7=to very great extent)
   a. new knowledge
   b. new products
   c. new processes

28) Alliance performance:
(1=totally not, 7=to very great extent)
   a. This alliance resulted in synergy
   b. This alliance has brought us more that it has cost
   c. The goal we had in mind with this alliance is in our opinion reached

Are you interested for a discussion about the results?
(1=yes, 2=no)

You have reached the end of this questionnaire. As promised you will receive the feedback document at the end of this study.

Appendix 3 Principal component analysis

Factor	Factor loadings	Measures
Factor 1 Partner Complementarity (eigen value 2.45, explained variance 18.85%, Cronbach α 0,76)		
The alliance partner possesses different technology	0.75	PART 3 – Q21a
The alliance partner works on a different research area	0,87	PART 3 – Q21b
The alliance partner possesses a different expertise	0,75	PART 3 – Q21c
Factor 2 Knowledge transfer (eigen value 2.11, explained variance 16.25%, Cronbach α 0.65)		
Partner support in management, coaching and training	0,67	PART 3 – Q20c
Importance of human exchange	0,81	PART 3 – Q15
Exchange of human resources	0,78	PART 3 – Q18
Factor 3 Compliance (eigen value 1.04, explained variance 8.02%, Cronbach α 0.67)		
Alignment of the various contributions to the alliance	0,84	PART 3 – Q30
Opportunism *(reversed scale)*	0,90	PART 3 – Q28
Factor 4 Cooperation performance (eigen value 0.90, explained variance 6.95%, Cronbach α 0.73)		
Willingness to do extra investments in the alliance	0,78	PART 3 – Q27
Preference to cooperate again with alliance partner	0,57	PART 3 – Q29
Factor 5 Innovation performance (eigen value 3.30, explained variance 25.36%, Cronbach α 0.84)		
The alliance has generated new processes	0,86	PART 3 – Q32c
The alliance has generated new knowledge	0,86	PART 3 – Q32a
The alliance has generated new products	0,80	PART 3 – Q32b

Appendix 4 Regression analysis (Enter-method)

DEPENDENT VARIABLE: COOPERATION PERFORMANCE		
Research variables	**Beta[2]**	**t value**
1. ALLIANCE ANTECEDENTS		
1.1 Complexity		
RV 1 Innovation complexity		
RV 2 Alliance complexity		
- Number of employees	0.120	0.446
- Number of departments	0.429	1.089
- Number of partners	-0.134	-0.706
1.2 Focal company antecedents		
RV 3 Innovation competences	0.444	1.333
RV 4 Alliance experience	-0.182	-0.900
RV 5 Size	-	-
2. ALLIANCE PARTNER ASSESSMENT		
2.1 Risk mitigation		
RV 6 Risk assessment	-0.894	-2.469**
RV 7 Previous experience	-0.052	-0.217
RV 8 IP/Innovation protection	-0.411	-1.714
2.2 Level of complementarity		
RV 9 Equipment	0.168	0.533
RV 10 Know-how	-0.516	-1.782
RV 11 Cognitive distance	0.145	0.700
3. ALLIANCE AGREEMENTS		
RV 12 Investment agreements	0.292	0.607
RV 13 Agreements on division of outcome	0.513	1.213
RV 14 Monitoring agreements	-0.395	-1.055
RV 15 Governance agreements	-0.207	-0.623
RV 16 Confidentiality agreements	-0.326	-0.872
4. ALLIANCE EXECUTION		
RV 17 Communication Intensity	-0.269	-0.647
RV 18 Level of knowledge transfer	-0.103	-0.380
RV 19 Level of compliance	-0.176	-0.596
5. ALLIANCE PERFORMANCE		
RV 20 Cooperation performance	0.664	2.252**
RV 21 Innovation performance	-	-
Constant	-	1.674
Adjusted R^2	0.590	3.090[1]**

**p < .1, **p < 0.05, ***p < 0.01*
[1]*F value*
[2]*Standardized beta;*

DEPENDENT VARIABLE: INNOVATION PERFORMANCE		
Research variables	**Beta[2]**	**t value**
ALLIANCE ANTECEDENTS		
1.1 Complexity		
RV 1 Innovation complexity	-0.108	-0.647
RV 2 Alliance complexity		
- Number of employees	-0.010	-0.040
- Number of departments	-0.784	-2.940**
- Number of partners	0.306	2.191*
1.2 Focal company antecedents		
RV 3 Innovation competences	-0.450	-1.594
RV 4 Alliance experience	0.108	0.596
RV 5 Size	-	-
2. ALLIANCE PARTNER ASSESSMENT		
2.1 Risk mitigation		
RV 6 Risk assessment	0.755	2.343**
RV 7 Previous experience	-0.002	-0.010
RV 8 IP/Innovation protection	0.265	1.189
2.2 Level of complementarity		
RV 9 Equipment	0.286	1.085
RV 10 Know-how	0.424	1.649
RV 11 Cognitive distance	-0.270	-1.645
3. ALLIANCE AGREEMENTS		
RV 12 Investment agreements	-0.720	-1.989*
RV 13 Agreements on division of outcome	-0.301	-0.784
RV 14 Monitoring agreements	0.705	2.675**
RV 15 Governance agreements	0.404	1.520
RV 16 Confidentiality agreements	0.470	1.541
4. ALLIANCE EXECUTION		
RV 17 Communication Intensity	0.697	2.336**
RV 18 Level of knowledge transfer	0.366	1.757
RV 19 Level of compliance	0.118	0.455
5. ALLIANCE PERFORMANCE		
RV 20 Cooperation performance	0.507	2.252**
RV 21 Innovation performance	-	-
Constant		-1.578
Adjusted R^2	0.687	4.190**

**p < .1, **p < 0.05, ***p < 0.01*
[1]*F value*
[2]*Standardized beta;*

Appendix 5 Spearman rank correlation matrix

Research variable	Sector	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
1. Number of alliance partners	H																							
	N-H*																							
	Food																							
2. Number of departments	H		X																					
	N-H*		X																					
	Food		X																					
3. Number of employees	H			X																				
	N-H*	-,385	,615**	X																				
	Food			X																				
4. Alliance experience	H				X																			
	N-H*	,536*	-,383	-,570*	X																			
	Food			,441*	X																			
5. Fulfilling promises	H		-,758*			X																		
	N-H*			-,456		X																		
	Food					X																		
6. Cognitive distance	H						X																	
	N-H*						X																	
	Food	,381*		-,534**			X																	
7. Level of knowledge transfer	H						-,657	X																
	N-H*		,367	,385	-,583*			X																
	Food		,463*					X																
8. Compliance	H			-,812*			-,657		X															
	N-H*		-,604*	-,642**	,720**			-,391	X															
	Food	-,384*						-,360	X															

Research variable	**Sector**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**
9. Innovation competences	H				1,000**					X														
	N-H*	,472			,395			,433		X														
	Food							,374*	,331	X														
10. IP/Innovation protection (SUM)	H										X													
	N-H*		,564*								X													
	Food		-,349							,751**	X													
11. Equipment	H											X												
	N-H*						,374					X												
	Food			-,320								X												
12. Know-how	H												X											
	N-H*						,589*					,647**	X											
	Food				,575**								X											
13.Previous experience	H		,625					,638					-,616	X										
	N-H*				,418				,621**	,462				X										
	Food		-,458*	-,408			,429*							X										
14. Risk assessment	H	-,678		,750*			,638								X									
	N-H*	-,443	,596*	,739**	-,680**	-,493*			-,732**			,425		-,650**	X									
	Food		,400	-,410	-,465*			,388				,699**	-,421	-,419	X									
15. Confidentiality agreements	H		,905**										-,693	,726		X								
	N-H*					,440										X								
	Food															X								
16. Agreements on division of outcome	H				-,660					-,660			-,840*			,707	X							
	N-H*		-,428		,538*				,437		-,415				-,432	,580*	X							
	Food			-,392*			,325						,473*			,782**	X							
17. Monitoring agreements	H		,712	-,687					,618					,844*		,804*		X						
	N-H*				,403				,393		-,399						,794**	X						
	Food						,360			,368		-,469*	,554**		-,569*	,495*	,732**	X						
18. Governance agreemens	H			,812*			,657		-1,000**									-,618	X					
	N-H*											-,551*				,427	,697**	,547*	X					
	Food	,514**										-,401*			-,398	,466*	,346	,430*	X					

Research variable	Sector	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
19. Investment agreements	H		,761*										-,868*	,893**		,891**	,735*	,731*		X				
	N-H*										-,477*					,429	,795**	,810**	,763**	X				
	Food	,309		-,530**			,513**							,340		,602**	,534**	,534**	,595**	X				
20. Level of Newness	H			-,939**			-,679		,926**						,783*			,636	-,926**		X			
	N-H*															-,431					X			
	Food							,654**		,329			,369			,376	,363	,422*			X			
21. Communication Intensity	H	-,647	,672												-,618							X		
	N-H*		,564*				,480*	,402	-,434										,467*	,478*	,611*	X		
	Food	,455*	,746**							-,504*	-,457*		-,390	-,382	-,428			-,542*				X		
22. Innovation performance	H		-,636									,851*						-,727					X	
	N-H*					,555*										,824**	,582*	,427		,398			X	
	Food	,408*												-,568*							,477*		X	
23. Cooperation performance	H		-,657			,836*						,882**											,806*	X
	N-H*					,525*		,407		,533*		,367				,633**	,379						,864**	X
	Food					,351				-,410*	-,640**							-,470*		-,523**		,369		X

All correlations are one-tailed

Blank is no correlation at least at the .1

No start: correlations is significant at the .1 lvel

*significant correlation at the ,05 level

**significant correlation at the .01 level