Knowledge spillovers from non R&D cooperation and Product Innovation

To what extent does knowledge spillovers from non R&D cooperation influence the product innovation performance of manufacturing companies?

Master thesis

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Table of content

1 Chapter 1 – Introduction

1.1 Motivation

The strategic management theory emphasises that knowledge spillovers can foster the innovation output of companies to achieve sustainable competitive advantage (Phene and Tallman, 2014; Yang et al., 2010; D'Aspremont et al., 1988). Knowledge spillovers can be defined as an unintended flow of information and without any payment and it is to differentiate from intended knowledge transfer (Audrestch & Feldman, 2004). For this reason, knowledge spillovers can be a costless source for companies to get access to new information as internal development (Audretsch & Feldman, 2004).

The economic literature assumes that interaction between organizations is required to generate knowledge spillovers. The endogenous growth theory (Romer, 1994; Grossman & Helpman; 1993) suggests that innovation and technological change lead to economic growth. Knowledge spillovers are one of the key mechanisms to create growth in long term. Knowledge is non-rival and non-excludable and therefore it is determined as a public good (Romer, 1994). These conditions of knowledge will lead to positive technological externalities between organizations by interaction.

Recent research studied that companies use cooperative strategies by sharing complementary capabilities and resources to achieve sustainable competitive advantages (Glaister & Buckley, 1996; Das & Teng, 2000). The globalization changes the business environment that it becomes hardly possible to be profitable as a single company. The main strategic motives by inter-firm relationships for firms are sharing know-how, joint-action, sharing resources, learning (Glaister & Buckley, 1996) First, it is important to differentiate inter-organizational relationships regarding the topic of knowledge spillovers in non R&D cooperation and in R&D partnerships. In R&D partnerships companies cooperate in the technological development, this happens with intended knowledge transfer in a specific issue (D'aspremont & Jacquemin, 1988). In non R&D cooperation such as common purchasing or production (Madhok & Talman, 1998), the knowledge sharing between partners is unintended and therefore defined as a spillovers. Inter-organizational relationships can take different types as strategic alliances, networks, franchising and licensing (Glaister & Buckley, 1996). Non R&D cooperative strategy may be a source for knowledge spillovers. Therefore, this thesis will analyse the impact of knowledge spillovers from non R&D cooperation on product innovation at the firm level. This relationship has two major characteristics: it depends on spatial proximity and it is determined by the absorptive capacity.

First, cooperation may arise in close proximity between two firms to achieve strategic motives (Porter, 1980). Spatial proximity is also an important aspect regarding knowledge spillovers. Empirical studies confirm that knowledge spillovers are geographically bounded (Audretsch & Feldmann, 2004; Jaffe et al., 1992). Jaffe, Tratjenberg and Henderson (1992) have found that knowledge spillovers are localized by analysing patents and the citations of these patents. These findings of empirical research are based on the broader concept of cluster and not focusing on inter-firm cooperation. Technically, a cluster is a spatial model and does not automatically imply cooperation among firms (Porter, 2000).

The attributes of tacit knowledge are the foundation of localized knowledge spillovers (Jaffe et al., 1992; Audretsch & Feldmann, 2004). Tacit knowledge is codified according to a specific context and face-to-face interactions are required for the exchange of it. However, the new development of communication systems offers companies to share information over the web (Gilson et al., 2015). Organizations are replacing traditional spaces with collaborative online workspaces to foster interaction among worker from different locations. Provider of these technologies claim that face-to-face interactions are not more required for effective communication (Gilson et al., 2015). Can real-time communication systems by bringing voice and data together be sufficient for sharing tacit knowledge? Are knowledge spillovers still geographically bounded due the vast development of information and communications technology?

Second, the impact of knowledge spillovers has been associated with the recipient's internal capabilities to absorb and commercialize the new external knowledge; the well-known phenomenon of absorptive capacity (Cohen & Levinthal, 1990). The ability of a firm to commercialize new knowledge has been associated with the recipient's internal capabilities to absorb the new external knowledge. The term absorptive capacity defines the ability of the recipient's to recognize, absorb and apply of the new suitable knowledge (Cohen & Levinthal, 1990). The presence of related knowledge inside the firm is required to recognize and to absorb the new knowledge from external sources (Cohen & Levintahl, 1990; Veugelers & Cassiman, 1999). The absorbing of knowledge spillovers and the utilization of this new information can be considered as two part of the innovation process.

Knowledge is the crucial resource for companies to be innovative (Phene and Tallman, 2014)**.** The knowledge creation rely mainly on internal research and development. However, small businesses can be highly innovative without high R&D expenditures (OECD, 1998). There must be other sources to be innovative than the internal development within the company. In case of the small and medium sized companies, they utilize external sources to create knowledge for the innovation process (OECD, 1998). In this context it is relevant to asked how companies can get access to external knowledge, which strategic tool are relevant? Researchers considered relevant external innovation sources as customers, suppliers and universities. In this paper I will focus on external knowledge from other companies through cooperative strategies, because cooperation with competitors can be source for new relevant knowledge to achieve competitive advantage. Furthermore, global inter-firm relationships become highly relevant in the current business environment so it can be an important source for firms to use it for innovative applications. Yet, an important gap in the literature remains, how knowledge spills over. Also, knowledge spillovers have been researched mainly due to the cluster approach, but less in known about the nature and the type of interfirm cooperation. Therefore the main objective of this thesis is to examine the relationship between knowledge spillovers from non R&D cooperation and the innovation performance of a firm. To answer this question data of Dutch manufacturing companies from the European Manufacturing Survey 2012 will be used. The main question of the thesis is:

“To what extent does knowledge spillovers from non R&D cooperation influence the product innovation performance of manufacturing companies?”

1.2 Purpose

The purpose of this Master thesis is to investigate the relationship between knowledge spillovers from non R&D cooperation and product innovation by taking into consideration of absorptive capacity and spatial proximity. This will contribute to a better understanding of cooperative strategies and will indicate whether the location of the partners is an important driver for spillovers effects. Also, this leads to insights how knowledge spills over. This research will also indicate whether the nature and the type of cooperation have an impact on the occurring of knowledge spillovers.

1.3 Main Question

The main question of this Master thesis is:

To what extent does knowledge spillovers from non R&D cooperation influence the product innovation performance of manufacturing companies?

The sub questions are:

Does knowledge spillovers from non R&D cooperation lead to product innovation?

Does absorptive capacity moderates the relationship between knowledge spillovers from non R&D cooperation and the product innovation?

To what extent influence spatial proximity between cooperating firms the relationship between knowledge spillovers from non R&D cooperation and the product innovation?

1.4 Relevance

In this master thesis, knowledge spillovers through non R&D cooperation will be empirical examined to assess the impact on innovation performance in companies. For this purpose, several variables like geographic distance, absorptive capacity, and type of cooperation will be considered. This research offers a better understanding of cooperative strategies subsequent to knowledge spillovers. The findings will be relevant for companies to assess the conditions of their cooperative strategies and the relevance of the geographic distance by partner selection. Moreover, it will indicate whether new communication systems can be suitable for knowledge sharing process. The insights in knowledge spillovers from non R&D cooperation will enable companies to optimize their innovation performance through cooperative strategies.

Previous literature in strategic management has primarily examined knowledge spillovers due the concept of clustering, where interaction among firms are assumed. There are not many empirical research done yet about the conditions of the cooperative strategies regarding knowledge spillovers. The conceptualisation of local knowledge spillovers is given in previous research, but current development in communication technology lead to the justified approach to examine the spatial proximity of knowledge spillovers from non R&D cooperation. The increasing importance of inter-firm collaboration is relevant to examine whether non R&D cooperation is a valuable external source for new knowledge.

1.5 Thesis outline

Chapter two contains the theoretical part, where the relevant theories are explained and hypothesis developed. In addition, a conceptual framework base on the findings of previous literature is proposed and the empirical part of this master thesis is introduced. The third chapter elaborates the methodology. Subsequently, in the empirical part several variables will be tested with the collected data to provide a well substantiated answer. Finally, the study and findings will be summarized and managerial implications will be provided.

2 Chapter 2 – Theory

2.1 Introduction

This chapter includes the relevant theoretical framework to analyse the impact of knowledge spillovers from non R&D cooperation on the innovation performance of a firm. To capture the importance of non R&D cooperation as a valuable external source for knowledge creation it is important to understand why companies use cooperative strategies. The main theory that is used to answer this question is the Resource Based View. This theory indicates that firms need unique resources to generate competitive advantages. According to the foundation of the RBV companies interfirm cooperation can provide access to strategic resources. The central focus of this study, knowledge spillovers, can therefore be defined as a resource for innovation to achieve sustained competitive advantage for companies. The theoretical link between RBV and cooperation and innovation will be presented in this chapter.

This section starts with the presentation of the RBV. Next, the relevance of interfirm cooperation for companies and its relation to the RBV is explained. Second, the concept of knowledge spillovers will be reviewed to outline the main differences. Third, spatial proximity and absorptive capacity will be analysed as moderating factors of the relationship between knowledge spillovers from non R&D cooperation and product innovation. Finally, the hypotheses are discussed.

2.2 Resource Based-View

In this part, it will be elaborated why inter-firm cooperation in non R&D relations is relevant according to theoretical literature. For this purpose, the resources based view (RBV) is used.

The resource-based view is a theory with the focus on resources and capabilities in the company (Barney, 1991). It examines which characteristics companies can achieve competitive advantage. The resource-based view suggests that resources in a firm determine the business performance (Barney, 1991). This theory defines companies based on their internal bundle of resources and capabilities. The works of Penrose (1959) and Chandler (1977) can be seen as the roots of the theory of resources. But Barney (1991) extends the idea to examine firm's performance based on resources to the firm level and developed a useful framework how companies can achieve competitive advantages.

In the strategic management theory, there are two major theories to explain how companies can generate sustainable competitive advantage. The resource-based view can be seen as an answer or reaction to the "five competitive forces" framework by Porter (1980). The competitive forces approach suggests that the competitive advantage of companies is determined by the characteristics of the industry. The five forces in this approach are entry barriers, substitutes, buyers' and suppliers' bargaining power and intra-industry rivalry (Porter 1980; Mowery, 1998). Therefore a company can here achieve sustainable competitive advantages by focusing on industry attractiveness. This approach based on external factors can be criticized that the limits of companies in terms of the quality of internal factors as managerial capabilities are neglected.

In contrast, the resource-based view suggests that companies can achieve competitive advantage by internal resources and capabilities rather than external factors (Barney 1991; Das & Teng, 2000). In consequence, firms' performance is determined by characteristics within the firms' boundaries.

Resources can be classified into two categories tangible and intangible which are unique for firms (Wernerheldt, 1984). Moreover, such resources can be physical like production techniques, specific knowledge or related to organizational structure. Example for resources in a particular firm are decision-making techniques, management systems product designs experience of user needs (Mowery 1998; Wernerheldt, 1984). However, resources have to be meet some criteria to be strategic relevant for achieving competitive advantage. Sustained competitive advantage can be generated if the resource is valuable, rare, non-substitutable and non-imitable. Valuable means in this context that the resource help a firm to neutralize threats or to exploit opportunities (Barney, 1991). The resource is rare if it is not possessed by competitors. Thirdly, the resource is non-substitutable if it has no strategic equivalents and lastly it has to be costly to imitate by companies' competitors.

It is important to consider the assumptions of the resource based view. First, the resources of firms' are heterogenic. Heterogeneity reflects the presence of superior productive factors in limited supply. The second crucial assumption is that resources are imperfect mobile among firms. This implies that a firm's resources are not commonly, easily, or readily bought and sold in the market place. To sum the theoretical part of RBV, it provides a framework to analyse companies' opportunities to achieve competitive advantage based internal strengths in terms of strategic resources and capabilities. Consequently, competitive advantage resides within the firm and not in a certain industry position.

The theory of relational view extracts the resource-based view theory that critical resources may extend beyond firm boundaries (Dyer & Singh, 1998). Dyer and Singh (1998) argue that inter-firm collaborations are a source for competitive advantages. Relational rents are defined as supernormal profit which jointly generated in inter-firm relationships that cannot be generated by either firm in isolation (Dyer & Singh, 1998). Therefore, the relational rent view recommends companies to cooperate with other companies. These will be taken into account by analysing why companies should cooperate based on the resource-based theory.

2.3 The relevance of inter-firm cooperation

Inter-firm cooperation becomes an important instrument to be profitable by increasing global competition in times of globalization. The main objective for firms to engage in inter-firm cooperation is to maintain their competitiveness. To discover whether there is an effect of cooperation on product innovation it is required to define the term cooperation and to introduce relevant areas of this topic. Phene and Talman (2014) define inter-firm cooperation as "formalized cooperative relationships between firms that involve sharing, exchange, or co-development and can encompass contractual arrangements or equity. In general, we can see cooperation as an exchange between at least two parties with the objective to achieve competitive advantage. There are several strategic motives for companies to collaborate with other companies (Glaister & Buckley, 1996). External factors as globalization have significantly changed the competitive environment for companies. Traditionally, a cooperative strategy was used by firms to get access to new markets and products (Inkpen & Beamish, 1997). The collaboration is now based on many strategic motivations like risk sharing, economies of scale, complementary resources and new capabilities (Glaister & Buckley, 1996). Inter-firm relationships can take several different forms, an overview based contractual and equity arrangements is shown in figure 1 (Kale and Singh, 2009).

Figure 1: Scope of Interfirm Relationships

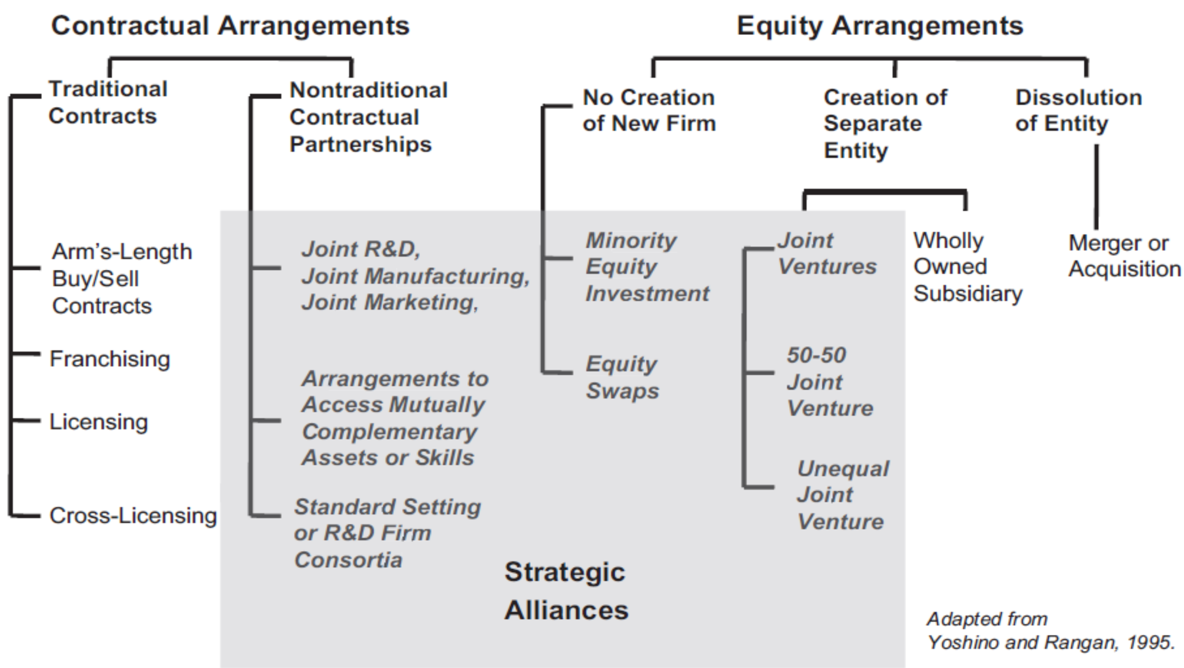


Figure 1 (Kale & Singh, 2009)

In this thesis, the focus will be on non R&D cooperation, including collaboration in purchasing, production, sales/distribution and service. For this research the motives and the type of the partnership are relevant rather than the equity structure of the cooperation.

The strategic cooperation between Daimler and Renault-Nissan is an appropriate example for the relevance of this thesis. The main objective of both companies is the joint production of particular car model to achieve economies of scale. However, Daimler and Renault-Nissan compete for each other in other markets and products beside the partnership. The simultaneous competition and cooperation between companies are called "co-option" (Nalebuff & Brnadenburger, 1996).

2.4 Resource based-view and inter-firm cooperation

The firm is dependent on their own bundle of resources and capabilities and has to improve in order to achieve sustainable competitive advantages. How can companies create or develop resources that are valuable, rare, imperfectly imitable and not substitutable?

Traditionally, companies have tried to upgrade their resources by internal development. However, nowadays firms existing capacities are not sufficient to upgrade their valuable resources (Das & Teng, 2000; Dyer & Singh, 1998). For instance, new technologies are so costly that even the largest companies can bear it alone. So when a company wants to gain access to a certain resource or when it wants to extend a resource, there are usually two options, the internal development or exchange via the market (Das & Teng, 2000). If both are not successful or feasible, then cooperation can offer another opportunity for the company.

Therefore, the academic literature argues that inter-firm cooperation can enable access to important resources (Phene & Talman, 2014; Dyer & Singh, 1998). Therefore, access to complementary resources is one of the main objectives for companies to engage in inter-firm relationships (Glaister & Buckley, 1996). The cooperative strategy enables companies to select relevant resources that is not the case with mergers and acquisitions as exchange opportunity via the market (Das & Teng, 2000). The cooperation between two car manufacture companies Toyota and BMW in developing fuel-cell technology is an example of the relevance of resource-based view how firms can create value through inter-organizational relationship.

The summarizing approach by Madhok & Tallman (1998) shows how companies can get access to strategic resources through cooperative strategy regarding resource-based theory. Companies should consider cooperative relationships to get access to critical resources when internal development or market exchange are not possible.

2.5 Knowledge Spillovers from non R&D cooperation

Non R&D cooperation is an important tool for companies to deal with challenges in the business environment. Inter-firm relationships have also a significant impact on the innovative performance of companies (Audretsch and Feldmann, 2004; Dumont & Meeusen, 2000). Belderbos et al. (2004) analyses the impact of cooperation strategies on firm performance and innovation in Netherlands. Their results are that collaboration with competitors has a positive impact on the innovation performance due to incoming spillovers. The knowledge sharing process is the foundation of this impact on innovation performance. Therefore the scope of this thesis is to analyze the importance of unintended external knowledge (knowledge spillovers) through non R&D cooperative strategies. In this part, knowledge spillovers will be first discussed from economic perspective to apply a firm-level analysis.

Knowledge has been considered as one of the most strategically resource for the innovation process (Kogut & Zander, 1992). According to Nonaka (1994), firms need to develop capabilities how to generate, integrate, transfer and protect their knowledge (Nonaka, 1994). Knowledge can be a source of competitive advantage under the scope of the Resource Based View. The innovation process relies mainly on effective knowledge management (Nonaka, 1994). The accumulation of knowledge can be done by internal development or through external sources (Audretsch & Feldman, 2004). External knowledge is often recognized from firms as less costly and faster source rather than to develop it internally (Phene & Tallmann, 2014; Cohen & Levinthal, 1990).

In the neo-classic growth theory, knowledge and technology have been defined as exogenous (Romer, 1994). However the endogenous growth theory (Romer, 1994; Grossman & Heplman, 1992) assumes that both knowledge and technology are playing significant roles in the long-term economic growth (Romer, 1994; Grossman & Heplman, 1992). Therefore new knowledge is a source of innovation and productivity growth. Furthermore, the research by Romer (1994) shows that perfect competition in the economy is not always a crucial factor to achieve economic growth. Consequently, the cooperative strategy can be a valuable source for companies to be innovative.

Knowledge is a public good in the economy. In Romer (1994), knowledge is thought of as a non-rival and non-excludability. Non-rival in this context is that many economic agents can use it simultaneously without limitation. Regarding the non-excludability, if a firm introduced a new technology, it is difficult to keep other firms from using that knowledge (Jaffe & Trajtenberg, 1992).

There are many different definitions for knowledge spillovers, but the definition by Grosmann and Helpman (1992) is the most appropriate for the context of this thesis.

"By technological spillovers, we mean (1) firms can acquire information created by other without paying for that information in a market transaction, and (2) the creators (or current owners) of the information have no effective resource, under prevailing laws, if other firms utilize information so acquired" (Grossman and Helpman, 1992; p.16). Most research assumes that spillovers of knowledge are externalities that generate positive impact regarding endogenous growth theory (D’aspermont & Jacquemin, 1988; Romer, 1994). A pure externality in this context is for example companies observe and copy techniques from each other.

It is important to distinguish knowledge spillovers from knowledge transfer between companies. Knowledge spillovers are an unintended flow of information and without any payment (Audrestch & Feldman, 2004). Knowledge can be hardly kept within the boundaries of the creator company, even not with patent mechanisms (Jaffe et al., 1992), therefore it leads to knowledge spillovers.

Therefore, based on these characteristics of knowledge, spillovers of knowledge between non R&D cooperation organizations are possible (Audretsch and Feldman, 2004; Jaffe & Trajtenberg, 1999; D’aspremont & Jacquemin, 1988). The empirical research of Ahuja (2000) provides evidence that direct ties among firms have a positive impact on the innovation outcome. The opportunity of knowledge spillovers is an objective for companies to create an alliance (Phene & Talman, 2014).

The externality of knowledge spillovers is recognized as a benefit only for the recipient firm and a loss for the creator company. However, Yang, Phelps, and Steensma (2010) have found that originating company can also benefit if both companies have complementary knowledge base. The spillovers of knowledge between both create a pool of knowledge which can be used than from both. Therefore, companies can generate benefits from non R&D cooperation even as a creator of knowledge spillovers.

A practical example of knowledge spillovers is the OLED technology by the American company Kodak. Kodak developed the new technology of OLED that generate competitive advantage for the company. The management of Kodak have citied a patent for this strategic resource. However, in a short time Sony and Xerox, both competitors of Kodak could use this technology (Yang et al., 2010).

Summarizing, knowledge is the crucial input to be innovative as a company. This study will analyze the relationship between knowledge spillovers from non R&D cooperation and product innovation performance. This process has two major characteristics: knowledge spillovers may be spatially bounded, and absorptive capabilities are required for acquisition and utilizing the new knowledge.

2.5.1 Localized knowledge spillovers

A large number of studies have attempted to show that knowledge spillovers are localized and exist in a particular distance (Jaffe et al., 1992; Audretsch & Feldman, 2004). The geographic distance among the cooperating firms may be a moderating factor for the occurring of knowledge spillovers through non R&D cooperation. This chapter provides a brief review of the localized spillovers literature.

The importance of the spatial concentration of companies was already recognized by Marshall (1920), almost 100 hundred years ago. The fundamental idea here is the cluster approach (Porter, 2000; Jaffe et al., 1992). Porter (2000) defines clusters as “geographic concentrations of interconnected companies, specialized suppliers, service providers, firms in related industries, and associated institutions in a particular field that compete but also cooperate”. Clusters of interconnected companies generate several benefits, especially in firm’s businesses and innovation performance (Porter, 2000). The most important factor of a cluster is the mechanisms of incentives for companies to maintain the business performance through innovation (Porter, 2000). There is a large body of empirical studies which show evidence for localized knowledge spillovers (Dumont & Meeusen, 2000; Jaffe et al., 1992; Audretsch & Feldmann, 2004). Previous cluster literature are assuming that firms in clusters are able to monitor, share, and transfer knowledge due to their geographic distance (Jaffe et al., 1992).

2.5.1.1 Empirical Evidence of localized knowledge spillovers

Knowledge spillovers are hard to measure. Empirical research uses different approaches to measuring the knowledge spillovers. An overview can be fined by Nelson (2009). The most used approach might be the patent citations method introduced by Jaffe et al. (1992).

R&D expenditures and/or registered patents are used as variable to measure unintended knowledge flow (Jaffe et al., 1992). Jaffe et al. (1992) argue that patent citations can be used to track knowledge spillovers. To observe the geography of knowledge flow, they used an approach of examining patent citations by comparing the location of citing patents to the originated patents. The process in which one patent is citing another patent is interpreted as knowledge spillovers. For a better understanding of the knowledge flow ’self-citations’ was excluded from the empirical research. The statistical finding is that new patents are more likely to come from the proximity as the cited patents. This result shows that knowledge flow is indeed geographically concentrated. Jaffe et al. (1992) also found that there is little evidence of the influence of technological area on localization of spillovers.

Audretsch and Feldman (1996) have researched the relationship between innovative activity and geographic concentration of companies. Their empirical test shows that the innovativeness of a geographic area is determined more by the nature of knowledge spillovers rather only on the spatial concentration of the firms. Knowledge spillovers are facilitated mainly among individuals.

Another instance for localized knowledge spillovers can be fined by the research of Almeida and Kogut (1999). They analysis semiconductor clusters in the United States and found that knowledge is highly localized within each cluster. All these studies provide some evidence of clustering effect, but there is still a gap which mechanisms are relevant for localized knowledge spillovers. The nature of knowledge might be the reason that spillovers are geographically bounded.

2.5.1.2 Tacit Knowledge

The foundation of localized knowledge spillovers is the exchange of tacit knowledge. Therefore it is important in this step to analyse first the basic characteristics of knowledge.

Knowledge can be divide into two categories; explicit and tacit (Nonaka & Takeuchi, 1995). Explicitness refers to the codification of the knowledge that it is in written form and can be stored in databases, and therefore it can be easily shared. Tacit knowledge depends on experiences of individuals, and it is rooted in action within a specific context (Nonaka & Takeuchi, 1995). It is important to note here that both types are not exclusive, rather complementary (Nonaka & Takeuchi, 1995). Both forms of knowledge are essential for firm's innovation performance, but tacit knowledge can be considered more relevant because it refers to a specific context. Under these characteristics of knowledge, we can consider that tacit knowledge is difficult to exchange. The transfer of tacit knowledge can be facilitated by personal interaction (Audretsch and Feldman, 2004). Due to the tacit nature of knowledge, researcher argues that knowledge spillovers depends on proximity.

However, Breschi and Lissoni (2001) criticize the theory of localized knowledge spillovers. The main critique is due the definition of tacit knowledge, in some situation knowledge which is considered tacit due the previous definition can also be codified and can be exchanged (Breschi and Lissani, 2001). This transfer depends on codification with an appropriate vocabulary. The management of tacit knowledge is indeed difficult and requires appropriate mechanisms.

Since the development of information and communications technology, it is possible to send knowledge over long distances (Gilson et al., 2015). These new technologies lead to a restructuring of workspaces in organizations that enable collaboration among different locations (Gilson et al., 2015). In fact, it becomes easily to share information through the internet worldwide. Individuals get the opportunity to exchange information transmit with voice and video over the internet. Can this development of communication systems change the requirement of face-to-face interaction for the change of tacit knowledge?

Paunov and Rollo (2014) have analyzed the impact of using the internet on occurring of knowledge spillovers based on 50.013 firms covering 117 countries. The results provide clues that the internet can support the knowledge exchange to foster innovation and firm's productivity, but it depends mainly on the absorptive capacity between companies (Paunov & Rollo, 2014). In another research, Paunov and Rollo (2015) have also found that "internet-driven" knowledge spillovers have a positive impact on firm's productivity. This evidence leads to the hypothesis that knowledge spillovers are not strict geographically bounded due to the impact of information and communication technologies.

The empirical studies of localized knowledge spillovers have been conducted in the context of the cluster approach or the spatial context, but less regarding cooperative relationships among firms. Technically, a cluster is a spatial model and does not automatically imply cooperation among firms (Porter, 2000). The importance of linkages between firms has been mentioned as a component for knowledge spillovers (Audretsch, Knowledge spillovers and the geography of Innovation). The measurement of knowledge spillovers from non R&D cooperation requires a different approach as the patent method.

In 2000, Jaffe et al. adjust their methodology to measure knowledge spillovers to get insights into the mechanisms that permit knowledge spillovers. The findings of the research by Jaffe et al. (2000) is that communication with earlier inventors, in fact, is important. Therefore direct ties among companies are required for spillovers effects. Non R&D cooperation itself brings already communication between companies at different levels; at organizational and at the individual level (Gulati et al., 1995). Personal interaction between individuals of cooperating companies may be a source of knowledge spillovers without the restriction of spatial proximity. It is important here to differentiate between the unintended share of knowledge and the voluntary share of knowledge by joint R&D projects. Not only due to the vast development of communication systems (Gilson et al., 1995) but also due to the nature of inter-firm relationships might be a source for knowledge spillovers that are not geographically bounded (Jaffe et.al., 2000).

Kenta et al. (2015) have examined the role of supplier-buyer linkage on knowledge spillovers. In their analysis of 20.000 Japanese manufacturing companies they provide evidences that knowledge spillovers are occurring between companies and are not affected by distance. The findings show the nonexistence of spatial spillovers, but the occurring of knowledge spillovers by interaction is supported by proximity.

To sum up, based on the development of communication systems and the nature of non R&D it appears that knowledge spillovers are not strict geographically bounded. The objective of this thesis is to measure knowledge spillovers through non R&D cooperation to examine their impact on firm's product innovation performance. For this purpose, the research will be focused on cooperative strategies related to the field of R&D cooperation. In doing so, the patent methods (Jaffe et al. 1992) might be not an appropriate method to measure knowledge spillovers in this thesis, because it analyses the spatial proximity of spillovers effects. Consequently, responses of companies of Dutch manufacturing companies on the European Manufacturing Survey will be used as a variable to measure knowledge spillovers from non R&D cooperation.

2.5.2 Absorbing knowledge spillovers

Academic studies show that knowledge spillovers are associated with the concept of absorptive capacity (Cohen & Levinthal, 1990). Cohen and Levinthal define it as, "the ability to recognize the value of new information, assimilate it, and apply it to commercial ends". The organization's ability to evaluate and use external information is primarily based on prior related knowledge within the firm (Cohen & Levinthal, 1990). In other words, absorptive capacity defines the organization' ability to identify external and new information of value, and apply it to commercial purposes is critical to the innovative capabilities. Due to this definition, it can be noted that absorptive capacity is a multidimensional construct, where it can be analyzed both at the individual level and at the organizational level. Firms with a higher level of absorptive capacity get the capability to exploit better their environment and therefore it can be a source of competitive advantage (Kogut and Zander, 1992).

Absorptive capacity is relevant for the identifying and absorbing of relevant external knowledge, but also for the utilization process inside the company (Zhara & George, 2002). Therefore, having the new knowledge inside the company is not sufficient, the efficient conversion of it is required to be innovative.

This thesis will focus on two dimensions of the concept absorptive capacity that are highly relevant for the analysis of the relationship of knowledge spillovers from non R&D cooperation and innovation performance; first knowledge acquisition and second knowledge utilization (Zhara & George, 2002). Knowledge acquisition describes the capability of firms to identify and acquire knowledge from non R&D cooperation. Knowledge utilization reflects the firm's capabilities to leverage the knowledge that has been absorbed from their non R&D cooperation. Zahra and Goerge (2002) provide a concept, which divides absorptive capacity in potential absorptive capacity and realized absorptive capacity.

The first describe the acquisition process, where firms identify and acquire externally generated knowledge. Cohen and Levinthal argue that previous possession of relevant knowledge increase the firm's ability to identify valuable new information from non R&D cooperation. It is required that a firm has qualified staff that is trained and experienced with the existing knowledge within the organization (Zahra and Goerge, 2002). R&D investments as training activities increase the firm's ability to identify and to acquire new externally generated knowledge. The concept of absorptive capacity is important to identify the value of new knowledge from non R&D cooperation. Empirical support can be found by the research of Chen (2004) with a sample of 137 cases that absorptive capacity has a positive effect on the knowledge transfer in cooperative relationships.

The innovation process has to proceed the acquired knowledge from non R&D cooperation. Knowledge utilization is a crucial process in the development of new products. The effectiveness of this process requires relevant internal capabilities. Prior related knowledge increase the effectiveness of the knowledge exploiting process (Cohen and Levinthal). Zahra and Goerge argue that knowledge management and creativity management are also necessary for the innovation performance. Weerawardena et al. (2004) provide empirical support for this positive impact of absorptive capacity in terms of managerial perception on firm's innovation performance.

Cohen and Leventhal (1990) stresses the importance of the communication structure among companies for knowledge spillovers. Prior related knowledge and experience are the key factors for the concept of absorptive capacity. Absorptive capacity can be increased due the gradual process by absorbing and utilization of new knowledge. In this study absorptive capacity is used as a moderator to study the relationship of knowledge spillovers and innovation performance.

2.6 Innovation performance

Innovation is considered as the most fundamental instrument to contribute growth and profitability of firms (Porter, 2000; Dawson et al. 2010). Schumpeter (1950) notes the importance of innovation “it is based not that kind of competition that counts but the competition from the new commodity, the new technology, the new source of supply, the new type of organization – competition which strikes not at the margins of the profits and the outputs of the existing firms but at their foundations and their very lives”. This definition shows that innovation is a complex multi-faced approach. Therefore innovation can be researched due to different categories. The literature made a distinction between process, product, organizational and social innovation (Dawson et al., 2010), and all types are interconnected and affect each other.

The scope of this research will be to analyze the relationship of knowledge spillovers from non R&D cooperation and innovation performance of a firm. Therefore it will be focused on the outcome of the innovation process rather than the innovation process itself.

The innovation performance of an organization can be measured with numerous variations. For this study, I choose product innovation outcomes as a tangible measure to capture empirically the effect of knowledge spillovers from non R&D cooperation. The measuring of product innovation can express more validity than other types of innovation for manufacturing companies that might be more unambiguously to interpret. Product innovation is defined as ideas generating or the creation of something entirely new (Schilling, 2010).

New products are actually a product of knowledge that determines the eventual transformation into an innovation. Therefore is product development process a creating a useful context that allows exploitation of new knowledge based on prior knowledge that is embedded in the organization (Cohen and Levinthal, 1990; Dawson et al. 2010). New product development can be crucial for manufacturing companies.

2.7 Conceptual Framework and Hypotheses

The main objective of this thesis to analyze empirical the relationship between knowledge spillovers from non R&D cooperation and product innovation. Therefore a conceptual framework with relevant variables is developed to answer the main research question:

“To what extent does knowledge spillovers from non R&D cooperation influence product innovation of manufacturing companies?“

Knowledge spillovers have been associated with different variables that can influence the innovation performance of firms. Following are hypotheses for this research due to the theoretical part:

H1: Knowledge spillovers from non R&D cooperation has a positive effect upon product innovation.

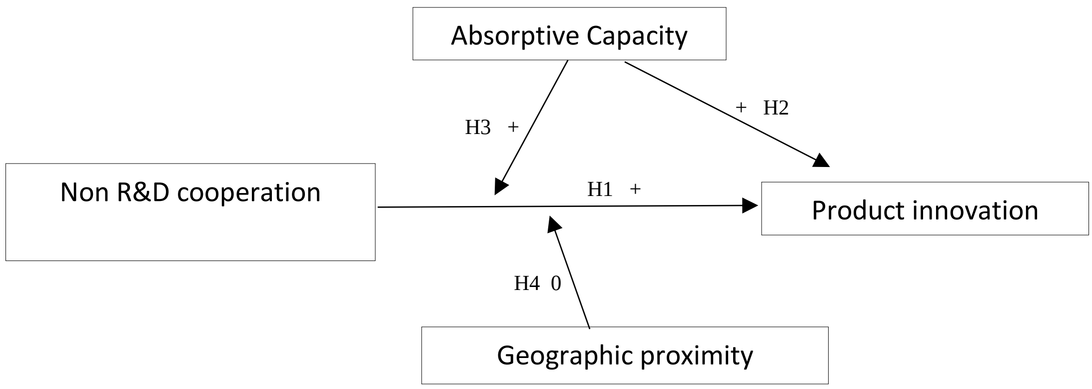
H2: Absorptive capacity has a positive impact upon product innovation.

H3: Absorptive capacity moderates positively the relationship between knowledge spillovers from non R&D cooperation and product innovation.

H4: Non R&D cooperation with closer partners does not contribute more to product innovation than non R&D cooperation with more distant partners.

By the testing these hypotheses I will consider the impact knowledge spillovers from different types of non R&D cooperation strategy; purchasing, production, sales and service cooperation, on product innovation. The hypotheses are summarized in the conceptual model.

Figure 2: Conceptual model



3 Chapter 3 – Empirical Part

3.1 Introduction

In this chapter the empirical part of the research will be discussed. First, the used data is described and the research model with the hypotheses will be presented. Next, research ethics related to the study will be discussed.

3.2 Research Design

The data from the most recent European Manufacturing Survey (EMS) is used in the empirical part of this Master Thesis. The European Manufacturing Survey (EMS) is a questionnaire-based survey with the objective to monitor the manufacturing sector in the respective countries. The survey is conducted currently in 15 countries and addresses companies with at least 10 employees. This survey is providing firm-level data with the focus on innovation activities in manufacturing companies. The European manufacturing survey is performed by a research network of institutions and universities in 15 countries. The survey is nationally organised and conducted simultaneously to provide the relevant database for national and cross-country studies.

For the empirical part of this thesis, the data set of Dutch manufacturing companies will be used. The Radboud University Nijmegen is conducting the survey in the Netherlands. The dataset of Dutch manufacturing companies is collected by Dr. Peter Vaessen and Dr. Paul Lightart. The core questions are focused on firm characteristics, on products and services, on cooperation and on performance indicators. The framework of this survey is reliable by using representative samples and offers valid measures by focusing on facts and figures rather than on subjective estimations. The performing of the survey is done due the general standards of survey research ethics

The advantages of the European manufacturing survey for the empirical research is that it provides indicators to perform research on innovation beyond R&D expenditures by including other types of knowledge generation. The questionnaire includes indicators to research the impact of networks and cooperation on innovation activities of firms. Therefore, the European manufacturing survey is appropriate to analyse the impact of knowledge spillovers from non R&D cooperation on product innovation of companies. The unique framework of EMS makes the collected data a reliable tool to perform for research projects.

3.3 Variables

The main objective of this master thesis is to analyse the relationship between knowledge spillovers from non R&D cooperation and product innovation. Below, the variables and their measurements are discussed. First, the dependent variable and the independent variables of the research model are presented. Next, some control variables will be discussed to get insights of some side effects.

3.3.1 Dependent Variable

Product innovation is the dependent variable in the research model. It is measured whether the companies have introduced new products in the last three years. This indicator has the advantage that it is a reliable measure product innovation, it is also appropriate to analyse the utilization process of the knowledge. In the European Manufacturing Survey 2012, companies are asked whether they have since 2009 introduced new products that are completely new to the factory or incorporated major technical changes. New products that lead to higher sales are for companies crucial to achieve competitive advantage. This variable is appropriate to assess the innovation performance of a firm.

3.3.2 Independent Variables

To include knowledge spillovers from non R&D cooperation correctly in the empirical part I have focused on the nature and type of the cooperative strategies. It is not the objective of this thesis to assess just the impact of incoming knowledge spillovers rather it will analyse the relevance and the value of non R&D cooperation as a source for knowledge spillovers. In the theoretical part, the complexity of measuring of knowledge spillovers is discussed, most of the relevant literature have used the patent citations method (Jaffe et al., 1992). For the aim of this thesis, the response of companies to the question whether they cooperate in non R&D areas is more appropriate to capture it as a variable in the empirical model. Here, four different types of cooperative strategies will be included: (a) purchasing, (b) production, (c) sales/distribution and (d) service cooperation. These relationships are measured with the value of 1 if the firms have engaged in these different types of non R&D cooperation, or 0 if not. These four different types will be used as indicators for the variable non R&D cooperation. This approach is derived by the method of Belderbos et al. (2004).

The importance of the distance between companies in non R&D cooperation is already presented in the theoretical part. The EMS survey provides data regarding the location of partners in terms of regional “< 50km”; national “> 50km” and other response are defined as abroad. The measurement of the variable distance in km is reliable and it is used mainly in the cluster literature (Jaffe et al., 1992).

Another important variable by analysing the relationship of knowledge spillovers from non R&D cooperation and product innovation is the absorptive capacity. In this empirical part, the percentage of R&D workers within the firm's will be used to measure the absorptive capacity (Cohen and Levinthal, 1990). The relevant part of the survey is the request for companies to "indicate their distribution of their personnel over the following areas", the following areas are research and development, configuration and design, manufacturing and assembly, customer service, others. For the variable, the amount of research and development employees of total personnel of firms will be used.

3.3.3 Control Variables

Control variables are included in the model to clarify the effect of knowledge spillovers from non R&D cooperation on product innovation. The considered variables are firm size, sector and the motivation to engage in cooperation.

In many literature, firm size is considered as an important indicator of the innovation performance. Therefore, it will be checked in the analysis as a control variable.

Different type of the industry may differ the impact of the independent variables on the dependent variables. The analysis of the research question can differ due to the different type of the industries.

The most important and interesting control variable will be the motive of firms to use of non R&D cooperative strategy. The companies are asked what the motives are by the R&D cooperation: access to (a) new knowledge, (b) human resources, (c) new markets and (d) reduction of costs. The intention to get access to new knowledge will probably be an important determinant of innovation performance. As already in the theoretical part discussed, the motivation is a crucial determinant of the ability to recognize and utilize the knowledge spillovers from non R&D cooperation. All variables of the empirical model are included in table 1, a more detailed description of the variables with the link to the survey can be found in appendix b.

Table 1: Variables of the analysis

Type of variable	*Variable*	*Indicator*	*Min*	*Max*	*Measurement*
Dependent variable	Product innovation	Introduced new products since 2009	0	1	Nominal
Independent variable	Number of non R&D cooperations	Engagement in non R&D cooperation	0	4	Ratio
	Absorptive Capacity	Percentage of R&D workers	0	100	Ratio
	Distance of cooperation partners	Location of Partners	0	104	Ratio
Control variables	Number of non R&D cooperation fields for accessing external knowledge	Motives for cooperation is to access to new knowledge	0	3	Ratio
	Firm size	Total number of employees in 2011	0	+∞	Ratio
	Industry	Food, Beverages and Tobacco	0	1	Nominal
		Textiles, Leather, Paper and Board	0	1	Nominal
		Construction, Furniture	0	1	Nominal
		Chemistry (energy and non-energy)	0	1	Nominal
		Metals and Metal products (reference group)	0	1	Nominal
		Machinery and Equipment	0	1	Nominal
		Electrical and Optical equipment	0	1	Nominal
		Transport equipment	0	1	Nominal

3.4 Method of Analysis

The regression analysis method is used to test the hypotheses. It is an appropriate method to predict the relationships between on dependent variable and several predictor variables (Field, 2009). SPSS Software will be used for the empirical part of this thesis work. Several Models will be used to test the hypotheses and to assess the independent effects of the predictor variables. Also, moderated and/or interaction effect of the variables will be considered.

Do note that the dependent variable product innovation is dichotomous (Yes or No) and therefore logistic regression (binomial regression) will be used.

3.5 Research Ethics

In this part, ethical aspects relevant to this study are discussed.

First, the relationship by performing of the European Manufacturing Survey several actions are taken to assure the principles of research ethics. To achieve a confidential survey, the respondents will be not identified, this step will also assure trust for the respondents. The participation in the European Manufacturing Survey is voluntary and driven by their interest to get access to offered services. After conducting the survey, respondents receive a benchmark report with key performance indicators of all participated companies. These actions are increasing the validity of using the European Manufacturing Survey in this master thesis.

Second, this master thesis is not sponsored by a company or an institution. A financed thesis would lead that the research face with the expectation of practical results. The approach of this thesis leads to maintain the academic perspective to get theoretical and practical results and more ethical validity.

4 Chapter 4 – Results

4.1 Introduction

In this chapter, the results of the regression analysis will be discussed. First, there is information on the design of data analysis regarding variable construction and variable revision is presented. Next, the results of the univariate and bivariate analysis will be discussed. Then, multivariate analysis is performed to test the hypotheses. Finally, the results of the regression analysis will be discussed.

4.2 Response Rate

In 2012, a list of 7499 Dutch manufacturing with more than 10 employees was provided by the Rabobank. In the first step, 3433 companies are selected as valid respondents for the EMS survey. These 3433 companies were contacted by phone to ask for their willingness to receive the EMS survey questionnaire. This approach led to 901 potential respondents that are willing to participate. In the end, 149 firms have completed the questionnaire and sent it back. This led to the response rate of 16,5%. In total, 4,3% of 3433 valid companies have responded. The low response rate is probably caused by a large number of questions in the questionnaire. The detailed questionnaire is therefore, a valid source for the empirical research of this thesis.

4.3 Variable Construction

A cleaning process of the dataset is required to achieve more meaningful results in the empirical analysis. Some relevant variables of the dataset have missing values. For instance, the variable v07d2 (Location of partners – purchasing) should either 1, 2 or 3, but some companies score -98. This step is performed for all variables and all missing values are marked in the SPSS file.

A crucial assumptions for the logistic regression is that non metric variables are continuous or categorical with two values. The main objective of this empirical part is to determine the effect of knowledge spillovers from non R&D cooperation on product innovation. The EMS survey 2012 allow us to consider different types of non R&D cooperation: purchasing, production, sales/distribution and service cooperation. These four types are used as indicators to compute the variable "number of non R&D cooperations". These four indicators gave a Cronbach's alpha of 0,588, which is slightly reliable by the number of items (see appendix 2a). Next, the variable "industry" is subdivided into seven binominal categories according to their respective line of business. Also, the variable "Location of partners" include three response options with regional, national and abroad. To test the impact of the geographic proximity between cooperating companies, a "distance" variable is computed. The indicators for the computing are of the three options: regional, national and abroad, for the four type of cooperation. The computed metric variable can be interpreted that by higher score a higher number of distant cooperation between companies exists and in contrast a lower core indicates that the cooperation are more present in geographic proximity.

4.4 Univariate Analysis

A preliminary analysis of the empirical model is used to investigate the variables and that the model meets the assumptions. This part consists the descriptive statistic of the most important variables. A log-transformation was used to achieve normality by variables that show a skewness and kurtosis higher than the critical values. An overview is in table 2. The descriptive statistics of non-metric data can be found in table 3.

Table 2: Descriptive statistics of metric variables

Type	*Label*	*Name*	*N*	*Minimum*	*Maximum*	*Mean*	*Std. Deviation*
Indep. Variable	Number of non R&D cooperations	v07d1g2	145	0	4	0,903	1,114
Control Variable	Absorptive Capacity (% of R&D employees)	v14b1_ln	143	0	100	1,614	1,092
	Distance cooperation partners < 25km to all partners abroad	Distance_ln	70	100	104	16,227	21,169
	Number of employees	Ln_Size	147	0	∞	1,666	0,545
	Number of non R&D cooperation fields for accessing knowledge	v07d3g3	148	0	3	0,1486	0,5238

Table 3: Descriptive statistic of non-metric variables

Type	*Name*	*Label*	*Frequency (%)*
Dependent Variable	Product Innovation (products new to factory)	Product Innovation	Yes (1,00) = 65,1 No (0,00) = 34,9
Control Variables	Industry	Industry	100
		Metals and Metal products	23
		Food, Beverages and Tobacco	6,8
		Textiles, Leather, Paper and Board	12,2
		Construction, Furniture	8,1
		Chemicals (energy and non-energy)	19,5
		Machinery and transport equipment	19,5
		Electrical and Optical equipment	10,7
		Non-Industrial Companies	0,7

To check the impact of non R&D cooperation on product innovativeness of a firm, the distribution of the four different cooperation strategies by firm size and industry is presented in table 4, all relevant SPSS Output can be found in appendix 2c. Production cooperation is the most frequent with 41 firms of the sample, followed by Sales/Distribution cooperation (39 firms), purchasing cooperation (36 firms) and service cooperation (21). The comparison across industries indicates the use of cooperative strategies is not similar to the sector differences. It can be noted that companies from “metals and metal product” have a larger propensity to cooperate. To account the effect of the size of firms on the explanatory variables, the number of employees is included in the model as a control variable. Mid-size companies (50 to 99, 100 to 249) reported a higher share of non R&D cooperation. The table shows also the distribution of the four non R&D cooperation types over the three options of geographic distance of the partner. Non R&D cooperation is more frequent between companies that in regional (under 50 km) distance to each other. Therefore, hypothesis 4 will check the moderating effect of geographic proximity on the impact of knowledge spillovers from non R&D cooperation on the product innovation. However, companies that use production cooperation have reported a higher share of abroad partners. This could be reasoned by the motivation of manufacturing companies to get access to new markets by establishing joint production units.

Table 4: Distribution of firms across cooperation types, industries, firm size and location

Variable	Purchasing cooperation	Production cooperation	Sales cooperation	Service cooperation
Firms with cooperation strategies	36	41	39	21
Industry				
Metals and Metal products	9	9	9	3
Food, Beverages and Tobacco	4	3	2	2
Textiles, Leather, Paper and Board	6	6	6	1
Construction, Furniture	4	2	3	3
Chemicals (energy and non-energy)	4	5	5	1
Machinery and transport equipment	7	9	10	7
Electrical and optical equipment	2	7	3	4
Firm size				
Less than 20	6	9	9	6
20 to 49	9	11	12	6
50 to 99	7	10	5	3
100 to 249	11	7	9	4
250 or more	3	4	4	2
Location of partners				
regional (<50Km)	13	13	10	7
National (>50Km)	10	14	7	5
abroad	7	17	5	4

4.5 Bivariate Analysis

A correlation table is used to check interdependencies of the included variables and to indicate possible multicollinearity problems. Multicollinearity, that can destroy the results, is not given by this data. The result shows some significant correlations between variables, but it is important to note that no variable have a significant correlation with the dependent variable product innovation. This will be considered by interpreting of the regression outcome, but it is not harmful at his stage. The correlation table can be found in table 5.

Table 5: Correlation table of the most variables

Variable	***Product Innovation***	***No of non R&D cooperations***	***Absorptive Capacity (%R&D employees***	***Distance of cooperation partners***	***No of non R&D cooperation fields for accessing***	***Absorptive Capacity(%R&D employees)***	***No of Employees***	***vMetal***	***vFood***	***vTextile***	***vConstruction***	***vChemical***	***vMachinery***	***vElectronics***
Products new to the factory	1													
No of non R&D cooperations	-.070	1												
Absorptive Capacity (%R&D employees	.361**	.173*	1											
Distance of cooperation partners	.238*	.377**	.216*	1										
No of non R&D cooperation fields for accessing external knowledge	-.057	.477**	.094	.164	1									
No of Employees	.168*	.161*	.146*	.261*	,118	1								
vMetal	.095	.010	.133	.175	.125	.070	1							
vFood	-.090	-.048	.018	.007	-.129	.006	-.147*	1						
vTextile	-.085	-.011	.091	-.182	-.012	.039	-.203**	-.100	1					
vConstruction	.036	-.026	.088	.146	-.057	.050	-.162*	-.080	-.111	1				
vChemical	-.074	.162*	.055	.083	.072	-.071	-.270**	-.133	-.184	-,147*	1			
vMachinery	.058	-.090	-.175*	-.140	-.086	-.082	-.270**	-.133	-,184*	-,147*	-,244**	1		
vElectronics	-.160*	-.031	-.225**	-.097	.016	.012	-.190**	-,094	-,130	-,103	-,172*	-,172*	1	
	.047	.094	-.126	.160	-.109	-.214*	.771**	-.189*	-.093	-.129	-.103	-.171*	-.171*	1

Green = significant at the 0.01 level (2-tailed)
Orange = significant at the 0.05 level (2-tailed)

4.6 Multivariate Analysis

In this part, the main analysis will be performed to examine the hypotheses. As already discussed in the method of analysis part, by testing the relation of non R&D cooperation and production we assume to capture spillover effects of knowledge between cooperating companies that lead to product innovation. Knowledge spillovers are unintended knowledge transfer between firms, therefore it is hardly possible to measure it directly. The first part of the empirical part consists three models to test the four hypotheses. In the first model, the first both hypotheses will be tested,

H1: Knowledge spillovers from non R&D cooperation have a positive effect upon product innovation.

H2: Absorptive capacity has a positive effect upon product innovation.

The logistic regression method is used to test the hypotheses, because of the dichotomous dependent variable. Non R&D cooperation and absorptive capacity are the relevant independent variables in this model. By testing both hypotheses, two control variables, industry and firm size are included. The control variable industry consist seven sectors, the sector metal is the most frequently in the sample and therefore it is used as the reference category for other sectors. Next, the motivation for accessing external knowledge from non R&D cooperation is an important control variable, since the motivation might increase the ability to recognize knowledge spillovers from non R&D cooperation. The assumptions of logistic regression are checked that are the linearity of the relationship between the explanatory and the dependent variable, the independence of error terms and multicollinearity (Field, 2009). The model appears to fulfill the basic assumptions of logistic regression (appendix 2f, g, h). The impact of the included variables is determined by the significant value of 5% and 10% due to the small number of cases in the models. In this part only main tables and values are presented, the reader is referred to the appendix 2 (Model 1, 2, 3) for a more detailed overview of the logistic regression outcome. The justification of the models is made by the goodness-of-fit statistics and by R-squared.

The outcomes of the logistic regression is presented in table 6. The first model shows a goodness of fit to the data (Chi-square = 35,313, p = 0,00). Next, it can be seen that the model explains 31,6 % of the dependent variable.

The results show that the hypothesis 1 is not supported. The number of non R&D cooperations is not significantly related to product innovation. This outcome suggests that non R&D

cooperation does not lead to receive incoming spillovers or the received spillovers does not lead to new products.

The result of this model suggests that H2 is supported. The absorptive capacity variable (ln_v14b1) has a significant effect on the dependent variable, product innovation. Consequently, hypotheses 2 is confirmed while hypotheses 1 seems not to be supported. However, regarding this latter outcome not all is said and done. There appears to be more concerning non R&D cooperation and product innovation. We will return to this in section 4.7.

The second model is used to test the moderating effect of absorptive capacity on the effect of non R&D cooperation on product innovation. In this model are only the cooperating companies included to assess reliably whether or not absorptive capacity positively moderates the relation between non R&D cooperation and product innovation. First, the second model shows a goodness of fit with significant chi-square (Chi^2 =20,433, p=0,025). This model can explain 34,6 % of the dependent variable. The result of the logistic regression does not reveal a significant positive impact of absorptive capacity upon the relation between non R&D cooperation and product innovation. The coefficient of the interaction variable even shows a negative sign albeit not significantly so. We can note that no evidence is found for the moderating effect of absorptive capacity on the effect of the four type non R&D cooperation on product innovation. Taken together, absorptive capacity has only autonomously a positive effect on product innovation and not as a moderating effect with non R&D cooperation.

Model 3 is used to test the last hypotheses: location of partners has not a moderating effect on the effect of non R&D cooperation on product innovation. As in model 2, only cooperating companies are included in this logistic regression to get reliable result for the moderating effect of distance between companies. Regarding the theory, we expect that knowledge spillovers from partners that are close by do not contribute more to product innovation than knowledge spillovers from distant partners. The main reason therefore is that the transfer of tacit knowledge can occur over long distance due to modern communication systems and does not requires face-to-face contacts of individuals. First, the third model shows a goodness of fit with significant chi-square (Chi^2 =29,413, p = 0,001). The third model increases the value for Nagelkerke R^2 to 50,7%. Hypotheses 4 is supported in that non R&D cooperation nearby does not appear to support product innovation to a greater extent than distant cooperation. What is more the latter, distant cooperation partners significantly contribute more to product innovation than cooperation partners nearby. This suggests that distant knowledge spillovers are more appropriate for product innovation than incoming knowledge spillovers from a close cooperation partner.

Table 6: Outcome of the logistic regression

	Model 1 (H 1+2)		Model 2 (H 3)		Model 3 (H 4)	
	B-Coefficient	**S.E**	**B-Coefficient**	**S.E**	**B-Coefficient**	**S.E**
Independent Variables						
Constant	1,293	4,700	-5,517	4,120	-7,385	5,050
Number of non R&D cooperations	-,230	,224	,035	,359	-,464	,441
Absorptive Capacity (%R&D employees)	,889	,228	1,142	,776	,851	,428
Distance of cooperation partners					1,005	,379
Interactions						
*Number Non R&D coop. * Abs. capacity*			-,108	,397		
Control Variables						
Number of Employees	,553	,233	,860	,366	,931	,442
No of non R&D cooperation fields for accessing external knowledge	-,615	,472	-,647	,502	-1,378	,762
Industry - Food	-2,196	1,342	-,610	1,567	-1,778	2,732
Industry - Textile	,197	,680	1,067	1,017	2,751	1,384
Industry - Construction	-,580	,852	-,300	1,156	-,013	1,388
Industry - Chemical	-,445	,623	-,277	,965	-,152	1,042
Industry - Machinery	,390	,599	1,249	,840	2,008	1,082
Industry - Electronic	-1,373	,921	-	-	-	-
	Orange = significant at 5% level; Green = significant at 10 % level					
Model Statistics						
Chi²	35,313		20,433		29,413	
Nagelkerke Pseudo R²	,316		,346		,507	
Number of Cases in the models	135		70		63	

Industry – Electronic is excluded from model 2 and 3 due to highly non-significance and standard error.

Overall the results reveal that non R&D cooperation has not a significant effect on product innovation. As expected due to the theoretical part, absorptive capacity has a positive impact on product innovation. However, there is not a positive moderating effect of absorptive capacity on the relationship between non R&D cooperation and product innovation. It was expected that partner companies located in close proximity do not have greater contribution to product innovation than distant partners that is supported by the regression outcome. An overview of the hypotheses and their respective outcomes can be found in the following table.

Table 7: Overview of the results of the hypotheses testing

Overview of the Hypotheses Testing	
1. Knowledge spillovers from non R&D cooperation has a positive effect upon product innovation.	Not supported
2. Absorptive capacity has a positive impact upon product innovation.	Supported
3. Absorptive capacity moderates positively the relationship between knowledge spillovers from non R&D cooperation and the product innovation.	Not Supported
4. Non R&D cooperation with closer partners does not contribute more to product innovation than non R&D cooperation with more distant partners	Supported

4.7 Follow-up Analyses

The results of testing the first and third hypothesis raise questions. In this part, follow-up analyses will be performed to get potential reasons for the non-significance impact of non R&D cooperation on product innovation and for the non-existent of the moderating effect of absorptive capacity. First, the relevance of non R&D cooperation as a source of external knowledge acquisition will be discussed. In doing so, an additional empirical research will be conducted to test whether the impact of non R&D cooperation on product innovation differs by one of the four types of cooperative strategies: purchasing, production, sales/distribution and service cooperation. Next, the appropriateness of non R&D cooperation for external knowledge creation will be compared to R&D cooperation by asking the question: to what extent does the impact of knowledge spillovers from non R&D cooperation on product innovation rely on the engagement of the companies in R&D cooperation? Last, the absorptive capabilities of cooperating companies will researched in the next paragraph to get possible explanations for the non-significant result of the moderating effect in the logistic regression.

4.7.1 Do the four fields of non R&D cooperation contribute to product innovation, by individual consideration?

The objective in this part is to check to what extent differ the impacts of the four fields of non R&D cooperation on product innovation from the effect of the number of non R&D cooperation. Therefore, an additional logistic regression with four dummy variables will be conducted (Model 1 in table 9). For this purpose, only companies that engaged in any field of non R&D cooperation will be included in the following empirical model to get more reliable and meaningful results. However, first the distribution of companies across the field of cooperative strategy and new product innovation performance, is presented in table 8. There are 94 companies of 149 that have introduced a new product in the last three years in the sample. By non R&D cooperation, the most frequent type is purchasing and production (23 companies respectively) where companies with sales/distribution and service cooperation have introduced 13 new product in the last three years.

Table 8: Crosstab product innovation and different type of R&D and non R&D cooperation

	Products new to factory		
Purchasing cooperation	**No**	**Yes**	**Total**
No	34	74	113
Yes	18	23	36
Production cooperation			
No	34	74	108
Yes	18	23	41
Sales/Distribution cooperation			
No	44	84	128
Yes	8	13	21
Service cooperation			
No	44	84	128
Yes	8	13	21
R&D cooperation with customer or supplier			
No	33	34	67
Yes	19	63	82
R&D cooperation with other companies			
No	37	77	114
Yes	15	20	35

In the model A of the additional logistic regression, product innovation is the dependent variable as before. The independent variables are purchasing, production, sales/distribution, service cooperation and absorptive capacity (% R&D workers). The control variables are the motivation to get access to external knowledge and the number of employees. The results are presented in table 9, detailed overview of the regression outcome is in the appendix 2k available.

The first additional model shows a goodness of fit to the data (Chi-square = 25,708 p = 0,001). Next, it can be seen that the model explains 41,5 % of the dependent variable. In the additional exploratory first model, we can conclude that knowledge spillovers from purchasing, production and service cooperation do not lead to product innovation as the previous main result. However, looking at sales and distribution cooperation, there is a significant positive overall effect. Therefore, we can conclude that knowledge spillovers from sales and distribution cooperation leads to product innovation.

Table 9: Outcome of the additional logistic regression (R&D cooperation)

	Model A		*Model B*	
Product Innovation **=** ***Yes***	**B-Coefficient**	**S.E**	**B-Coefficient**	**S.E**
Independent Variables				
Constant	-3,523	1,697	-4,064	1,765
Purchasing cooperation	-1,085	,105	-,975	,719
Production cooperation	-,793	,654	-,172	,743
Sales/Dis. cooperation	1,408	,686	1,681	,856
Service cooperation	-,158	,845	,274	,946
R&D coop. with customers and suppliers			1,053	,741
R&D coop. with other companies			-1,987	,887
Absorptive Capacity (%R&D employees)	,658	,348	,901	,408
No of cooperation fields for accessing external knowledge (total)	-,653	,502	-1,171	,596
Control Variables				
Number of Employees	,857	,366	,797	,374
Orange = significant significant at 5% level; Green = significant at 10 % level				
Model Statistics				
Chi²		25,708		32,181
Nagelkerke Pseudo R²		,415		,519
Number of cases		71		68

4.7.2 Do knowledge spillovers from R&D cooperation contribute greater to product innovation than knowledge spillovers from non R&D cooperation by firms that are engaged in non R&D cooperation?

The results from model A confirm mainly the results of the main empirical research from table 6, that non R&D cooperation, besides sales and distribution cooperation, appears not to be an appropriate source for knowledge spillovers that contribute to product innovation. It can be seen in table 8 that 63 of 82 companies that have engaged in R&D cooperation with customers or supplier, have reported product innovativeness in the last three years, this propensity is initially higher than by non R&D cooperation. However, it is possible that companies that are engaged in non R&D cooperation can also be engaged in R&D cooperation. The descriptive statistics shows that more firms are engaged in R&D cooperation (62%) than in non R&D cooperation (in appendix 2k). Therefore, it is important to check the relation between R&D cooperation (52%) on product innovation by companies that are engaged in non R&D cooperation. An additional logistic regression (Model B in table 8) will be conducted to assess the actual contribution of non R&D cooperation on product innovation. It is important here, to note that knowledge spillovers through R&D cooperation might be possible but it addresses primarily, in contrast to non R&D cooperation, the voluntary exchange of knowledge (Dumont & Meeusen, 2000). Since R&D cooperation promote the exchange of know-how and resources to facilitate innovation and technical progress (Dumont & Meeusen, 2000).

In model B, the two fields of R&D cooperation, the four fields of R&D cooperation, absorptive capacity (percentage of R&D employees of total personnel), the motivation to get new knowledge through cooperation and the number of employees are included. To get meaningful results only companies that have engaged in non R&D cooperation are inserted in the model B. Regarding the fields of R&D cooperation, the companies respond in the EMS Survey whether they have R&D cooperation with customers, suppliers or with other non-supplying companies. The model B of the additional logistic regression shows a goodness of fit with (Chi^2 = 32,181, p = 0,000; see appendix 2l). Also, the model can explain 51,9 % of the dependent variable. None of the two fields of R&D cooperation, cooperation with customers or suppliers and with other companies, has a significant positive effect on product innovation. However, it is to differentiate that R&D cooperation with other companies, suppliers excluded, have a non-significant negative impact upon product innovation. This can be interpret that especially customers might be a valuable source for external knowledge that lead to new products.

Taken together, we can answer that the impact of non R&D cooperation on product innovation is derived from the fields of non R&D cooperation. R&D cooperation, by companies that are engaged in non R&D cooperation, do not have significant effect on product innovation. Therefore, we can conclude that the positive impact of knowledge spillovers from sales/distribution cooperation upon product innovation is stemming from sales/distribution cooperation.

4.7.3 To what extent are R&D workers sufficient to absorb knowledge spillovers from non R&D cooperation that is related to product innovation?

The result of the main empirical model reveals that the absorptive capacity has only an autonomous positive effect on product innovation, but not a positive moderating effect upon the relation between non R&D cooperation and product innovation. Absorptive capacity is measured in the model with the share of R&D employees, it indicates the amount of resources that are required to be innovative. The previous part of the follow-up analyses has shown that the impact of non R&D cooperation on product innovation differ by the fields of non R&D cooperation. Therefore, the moderating effect of absorptive capacity on the relation between the four fields of non R&D cooperation and product innovation will be checked. In the regression model, each field of non R&D cooperation will be conducted individually against the other fields to achieve reliable results for the moderating effect of absorptive capacity. The results are presented in table 10 (appendix 2m).

Table 10: Outcome of logistic regression (Moderating effect of absorptive capacity)

	Model C	
Product Innovation = Yes	**B-Coefficient**	**S.E**
Independent Variables		
Constant	-3,621	1,905
Sales/Distribution cooperation	1,443	,685
Non Sales/Distribution cooperation	-,532	,493
Absorptive Capacity (%R&D employees)	,484	,686
Interactions		
*Sales/Dis. coop. * Abs. capacity*	,922	,861
*Non Sales/Dis. coop. * Abs. capacity*	-,188	,543
Control Variables		
No of cooperation fields for accessing external knowledge (total)	-,640	,496
Number of Employees	,858	,352
Orange = significant significant at 5% level; Green = significant at 10 %		
Model Statistics		
Chi²		26,048
Nagelkerke Pseudo R²		,420
Number of cases		71

In the Model C, only the result for the moderating effect upon the relation between sales/distribution cooperation and product innovation is provided because this field has as the only one a positive impact on product innovation, for the outcomes of other fields see appendix 2m. The Model C shows a goodness of fit with (Chi2 = 26,048, p = 0,000). Also, the model can explain 42 % of the dependent variable. The outcome of Model C does not reveals a significant impact of absorptive capacity upon the relation between sales/distribution cooperation and product innovation. Furthermore, absorptive capacity does also not moderate the relation between the other fields of non R&D cooperation and product innovation. Consequently, we can conclude that the positive impact of sales/distribution cooperation upon product innovation is not moderated by R&D employees.

What can be the reason for the non-significant moderation effect of absorptive capacity on the relation between sales/distribution cooperation and product innovation?

To answer this question, it can be important to analyse the effect of motivation of companies to acquire new knowledge from their non R&D cooperative strategies. This variable is a factor of the knowledge acquisition process from external sources (Zhara & George, 2002). Moreover, it describes the ability of firms to recognize valuable new product ideas from external sources. The recognition of valuable external ideas is linked with the capabilities of the staff. It is important to note here, that motivation to get access to new knowledge describes the recognition of the emerged external knowledge due to the fact that knowledge spillovers are defined as unintended knowledge transfer between companies. Knowledge spillovers from non R&D cooperation can emerge because knowledge is a public good that can be hardly kept within the boundaries. However, motivation or awareness is required that a firm can absorb the incoming spillovers from his partner. In the EMS survey companies were asked what the main motivation is to engage in non R&D cooperation. One answer possibility is the purpose to get access to new knowledge. To analyse this relationship, a crosstab between the four type of non R&D cooperation and the motivation for the cooperation will be made (appendix 2n).

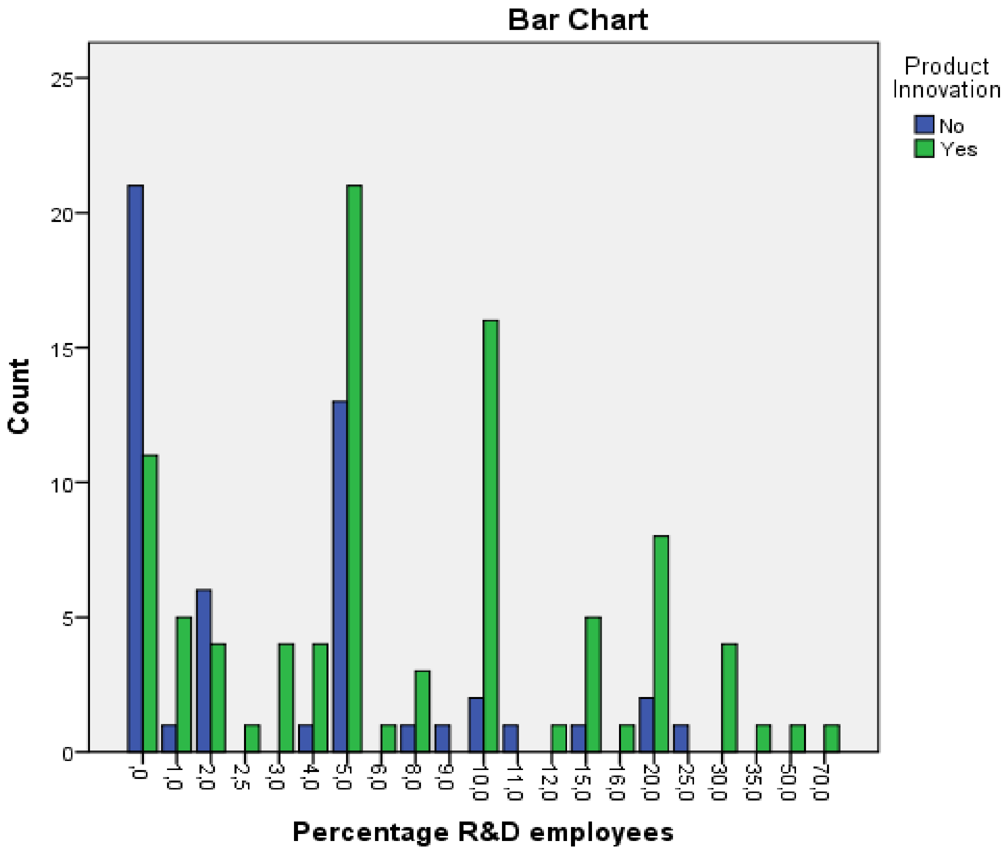
Table 11: Crosstab non R&D cooperation and access to new knowledge

Variable		**Access to new knowledge**		
		No	***Yes***	∑
Purchasing cooperation	**No**	113	0	113
	Yes	34	2	36
Production cooperation	**No**	108	0	108
	Yes	30	11	41
Sales/Distribution cooperation	**No**	110	0	120
	Yes	33	6	39
Service cooperation	**No**	128	0	128
	Yes	18	3	21

From the table, it can be derived that only a small number of companies that use non R&D cooperation followed the goal to achieve new knowledge from their partner. Production cooperation is the most frequent with 11 of 41 companies that possess the motivation to get access to new knowledge, followed by sales/distribution cooperation (6 of 39 companies), service cooperation (3 of 21 companies) and purchasing cooperation (2 of 36 cooperating companies). The table shows that firms do not assess non R&D cooperation as a relevant source for external knowledge acquisition. The result of the empirical part in table 6 shows that the control variable, motivation to capture knowledge spillovers from non R&D cooperation does not have a positive correlation with product innovation. Therefore, the non-significant moderating effect of absorptive capacity cannot be explained due to the motivation of companies to acquire new knowledge from non R&D cooperation.

To find explanations for the non-significance for the moderating effect of absorptive capacity, the capabilities of R&D workers regarding the absorbing knowledge spillovers from non R&D cooperation will be checked. The absorbing of external knowledge has to do with the capability of employees and with organizational capabilities to utilize new product ideas. A crosstab between R&D workers and product innovation is done to analyse it further. The table can be found in the appendix 2l.

Figure 3: Distribution of product innovation frequencies over absorptive capacity (Percentage of R&D employees)



From this figure, it becomes clear that the propensity to introduce new products increase with a higher percentage of R&D employees. However, it is important to note that some companies with a high share of R&D employees were also not able to introduce new products. Furthermore, it is important to note that 11 firms without any R&D workers was able to introduce a new product in the last three years. Therefore, it can be suggest that these companies might utilizing external sources for their product development process. To check this, a T-test is done to see if companies without R&D workers but with product innovation have more non R&D cooperation activities than companies without R&D and without product innovation. The results are presented in appendix 2o.

Table 12: Outcomes of T-test of firms without R&D workers; testing the difference between firms with and without product innovation

	Products innovation	Number of non R&D cooperation	N
	No new products	,65	20
	New Products	,11	9

Table 13: Outcomes of T-test of firms with R&D workers; testing the difference between firms with and without product innovation

	Products innovation	Number of non R&D cooperation	N
	No new products	1,3	30
	New Products	,93	79

The average amount of non R&D cooperation used by companies without R&D and without product innovation 0,65, which is a difference of 0,11 to firms without R&D but with product innovation. The t-test is significant, which means that firms without R&D workers and without product innovation have significantly more non R&D cooperation activities than firms without R&D workers but with product innovation. In contrast, companies with R&D and without product innovation are more engaged in non R&D cooperation than companies with R&D and with product innovation, 1,3 and 0.93 respectively (appendix 2p). However, the t-test is non-significant, which means that firms with R&D and without product innovation do not have significantly more non R&D cooperation activities than firms with R&D workers and product innovation.

Consequently, it looks that engagement in non R&D cooperation do not lead to new product innovation by companies without R&D workers. Therefore, it is suggested that companies without R&D but with product innovation do not utilize non R&D cooperation as an external source for new product ideas. This could be explained by the fact that product innovation without R&D workers might lean on their non R&D workers.

Summing up, we can answer that the non-significance result for the moderating effect of absorptive capacity upon the relation between non R&D cooperation and product innovation might not be caused by the capabilities of R&D workers or by the lack of motivation to acquire new knowledge from non R&D cooperation. The knowledge spillovers from sales/distribution cooperation might be not knowledge intensive that it can be understood by R&D workers, which are likely technical trained. Therefore, companies do not need to possess advanced knowledge-based R&D employees to produce any substantial utilization of knowledge spillovers from non R&D cooperation. However, further research about the impact of non R&D employees on the relation between non R&D cooperation and product innovation is required to get sufficient explanations.

4.8 Discussion of the Results

From the logistic regression can be concluded that H1 is not supported. The individual consideration of the fields of non R&D cooperation in the follow-up analyses leads to the result that only sales/distribution cooperation has a positive effect on product innovation. The obtained result conflicts with that of Ahuja (2000), he found evidence that direct ties among firms have a positive impact on the innovation outcome. However, this can be explained by the fact that he does not differentiate between the fields of cooperative strategy. The mainly non-significant positive result for the relationship between non R&D cooperation and product innovation could also be due to the fact that complementary knowledge base between cooperating companies is required to utilize knowledge spillovers (Yang et al., 2010). The external knowledge development depends on different factors, that non R&D cooperation can be a valuable source for knowledge spillovers that leads to product innovation if companies possess the required capacity. This needs further research, therefore we analyse in the follow-up analyses part the relevance of non R&D cooperation for knowledge spillovers. By checking the impact of R&D cooperation on product innovation, by companies that are engaged in non R&D cooperation, we see that the effect of sales/distribution cooperation upon product innovation is stemming from the fields of non R&D cooperation. However, R&D cooperation with customers and suppliers has a non-significant positive relation to product innovation as compared to R&D cooperation with other companies. The result for R&D cooperation is in line with that of Belderbos et al. (2004), however this is accepted only for R&D cooperation with customers and suppliers. Further, Belderbos et al. (2004) have found that knowledge sharing process is essential for the positive impact of knowledge spillovers, therefore the mode of communication between cooperating firms requires further research.

The second hypothesis is accepted, absorptive capacity has a significant positive single effect on product innovation. This is in line with many previous pieces of research (Cohen & Levinthal, 1990; Kogut & Zander, 1992), as stated in the theoretical part. Hypothesis three is not supported, there is no significant interaction of non R&D cooperation and absorptive capacity on product innovation. There is also no significant moderation effect of absorptive capacity on the relation between the four fields of non R&D cooperation and product innovation. This result for the moderating effect conflicts with that of Chen (2002). A possible explanation can be that knowledge spillovers from sales/distribution cooperation might be not knowledge intensive that it can be understand by R&D workers, which are probably technical trained. Therefore, companies do not need to possess advanced knowledge-based R&D workers to produce any substantial utilization of knowledge spillovers from non R&D cooperation.

The fourth hypothesis is accepted, which means that partner companies located in close proximity do not have a greater contribution to product innovation than distant partners. This means that knowledge spillovers are not geographically bounded. Furthermore, the result can be interpreted that knowledge spillovers from a distant cooperating partner are more useful for product innovation than from companies that are close to each other. This result is in line with the findings of Kenta et al. (2015) and with Panuov & Rollo (2014). A possible explanation can be that modern communication systems support the share of tacit knowledge over long distance (Paunov & Rollo, 2004).

5 Chapter 5 – Discussion and Conclusion

5.1 Introduction

In this chapter the results of the empirical part will be discussed to answer the research questions of this thesis. Next, practical and theoretical implications will be stated. Subsequently, some limitations will be outlined and finally, research recommendations will be addressed.

5.2 Conclusions and Discussion

In this study, a theoretical and empirical framework has been developed to assess the impact of knowledge spillovers from non R&D cooperation on product innovation. The importance of interfirm cooperation for companies has increased in the last years. In the light of these developments, the main objective of this thesis was to assess the value of non R&D cooperation as a source for knowledge spillovers. Knowledge spillovers are defined as an unintended flow of knowledge without any payment. Therefore the conceptual model is constructed to test the relationship of non R&D cooperation and product innovation, by doing this we assume knowledge spillovers between cooperating companies. The analysis includes the number of non R&D cooperations from different fields of non R&D cooperative strategy: purchasing, production, sales/distribution and service cooperation. Furthermore, absorptive capacity and spatial proximity are analysed to evaluate how these two factors can affect the relationship between knowledge spillovers from non R&D cooperation and product innovation.

In the theoretical part, the Resource Based View was used to deduce hypotheses with respect to non R&D cooperation. This theory describes the importance of resources and capabilities of companies to achieve competitive advantages. Nowadays, the upgrade of resources by internal development is hardly possible that external sources become more important for companies. Therefore companies engage interfirm cooperation to get access to complementary resources. The exchange of knowledge between firms can affect the innovation performance due to incoming spillovers that can lead to product innovation. In this master thesis, the impact of knowledge spillovers from non R&D cooperation on product innovation was tested in order to evaluate the relevance of non R&D cooperation as a source for acquiring new knowledge for the product development process. The developed framework was used to answer the main research question:

"To what extent does knowledge spillovers from non R&D cooperation influence product innovation performance of manufacturing companies?"

To answer this main question it is important to consider two external factors that might affect the impact of knowledge spillovers from non R&D cooperation on product innovation: absorptive capacity and spatial proximity. These two factors are tested in the following sub-questions:

> *Does knowledge spillovers from non R&D cooperation lead to product innovation?*
>
> *Does absorptive capacity moderates positively the relationship between knowledge spillovers from non R&D cooperation and the product innovation?*
>
> *To what extent influence spatial proximity between cooperating firms the relationship between knowledge spillovers from non R&D cooperation and the product innovation?*

For the research of these questions, the data of 149 Dutch manufacturing companies that completed the EMS survey. The companies respond whether they engage in the four different types of non R&D cooperation: purchasing, production, sales/distribution and service cooperation.

Empirical evidence obtained that knowledge spillovers from non R&D cooperation do have no significant effect on product innovation. There is no positive independent effect between knowledge spillovers from purchasing, production and service cooperation on product cooperation. New products correlate only positively with the incoming knowledge spillovers from sales/distribution cooperation. The second sub-questions can be answered with no, that no moderating effect of absorptive capacity upon the relation between non R&D cooperation and product innovation is found. It is crucial to note, that the independent impact of absorptive capacity is supported by the empirical part. The results for the last sub-question appears that knowledge spillovers from distant partners of non R&D cooperation do support product innovation to a greater extent than knowledge spillovers from partner nearby.

The outcome of the logistic regression for non R&D cooperation and absorptive capacity deserved further investigations. To assess the relevance of the impact of sales/distribution cooperation upon product innovation, we checked whether companies that are engaged in non R&D cooperation are also engaged in R&D cooperation. The positive effect of sales/distribution cooperation on product innovation is autonomously and do not rely on the R&D cooperation of companies that are engaged in non R&D cooperation. Absorptive capacity does not moderate the relation between sales/distribution cooperation and product innovation also not the relationships of the other fields of non R&D cooperation. A possible explanation can be that knowledge spillovers from sales/distribution cooperation might be not knowledge intensive that it cannot be understood by R&D workers, which are mainly technical trained. Therefore, companies do not need to possess advanced knowledge-based R&D workers to produce any substantial utilization of the knowledge spillovers from non R&D cooperation. However, more factors than R&D workers are required to capture the dimension of absorptive capacity completely.

Based on the results of the empirical and the follow-up analyses parts, it is possible to answer the main research question.

The general conclusion is that knowledge spillovers from non R&D cooperation do partly influence positively product innovation of Dutch manufacturing companies. In addition, this relationship is not moderated by absorptive capacity. Therefore it seems that external knowledge from non R&D cooperation possess a specific characteristic that R&D employees cannot absorb that. However, the distance between partners moderates the effectiveness of knowledge spillovers from non R&D cooperation. Knowledge spillovers from distant partners are more useful for product innovation than knowledge spillovers from partners that are close to each other.

5.3 Theoretical Implications

The framework of this master thesis can be classified in the fields of research in spillovers, interfirm cooperation and innovation. Knowledge spillovers were researched on economic context (Romer, 1990). Furthermore, the localized knowledge spillover theory, mainly introduced by Jaffe (1992) examined the geographic spread of knowledge flows. This thesis extends these literature by presenting a model that focus on the source of knowledge spillover and their impact on innovation performance. The framework of this thesis is derived mainly from the work of Belderbos et al. (2004), they analysed the performance effect of incoming knowledge spillovers from R&D cooperation at the firm level and differentiate between the types of R&D partner. The approach of this thesis focuses on non R&D cooperation by including different fields of non R&D cooperation. This research is important to the innovation literature because it provides the relevance of the type of cooperative strategies for external knowledge acquisition.

In the strategic management theory, the opportunity of learning trough inter-firm cooperation have focused on the competence of firm (Glaister & Buckley, 2009). Therefore, partner selection is an important part of mutual learning in cooperative strategy. The framework of this thesis provides insights into the relevance of partner selection for knowledge acquisition through cooperation. This thesis suggests the better contribution of distant knowledge spillovers on product innovation. Additional Cohen and Leventhal (1990) have already stressed the importance of the communication structure among companies for knowledge spillovers.

Taken together, this research contributes that the research of knowledge spillovers with the focus on the type of cooperation and on the type of partner offers an alternative approach to the cluster literature.

5.4 Practical Implications

The results of this empirical research indicate also practical implications for the manufacturing industry. Companies should consider cooperative strategies only slightly as a source for external knowledge acquisition to enhance their knowledge development process. The result of this thesis confirmed that engagement in sales/distribution cooperation leads to knowledge spillovers that increase the innovativeness of the firms.

Next, the obtained results of this thesis show that management of firms should note that acquisition and utilization of incoming knowledge spillovers depend strongly on absorptive capacity, therefore companies should put greater emphasis on absorptive capacity in their innovation management strategy. Knowledge spillovers from non R&D cooperation, particularly from sales/distribution cooperation seems to be not knowledge intensive that R&D workers are sufficient to absorb these knowledge spillovers. Therefore, companies should involve non R&D workers in the external knowledge acquisition process. The management has to invest in training their non R&D workers to absorb effectively knowledge spillovers from non R&D cooperation.

Finally, the results of this work lead to another important managerial implication for the managers in the Dutch manufacturing industry. They should take the distance of partners into account. External knowledge from distant partners is more appropriate for product innovation than from partners that are close to each other.

5.5 Limitations

There are some serious limitations for the theoretical and practical results even by careful performing of the methodology.

The sample with 149 companies can be relatively small for reliable results. The dependent variable in this thesis was measured whether companies have introduced new products in the last three years. Not included in this variable construction are the percentage of turnover that can attribute to the new products and also not the total number of invented products. It is possible that introduced products do not meet the requirements of the market and therefore do not contribute to the sales performance.

Next, the share of R&D employees of total employees of firms is used for absorptive capacity. However, due to the complexity of the absorptive capacity, this measure seems too narrow. The determining of absorptive capacity depends not only on to have R&D employees but also to have qualified and trained personnel. The use of only one indicator for absorptive capacity makes not possible to include the total strength of absorptive capacity in the analysis.

Another limitation of the research is the identifying of knowledge spillovers with focusing on non R&D cooperation. However, this approach can’t capture the real flow of knowledge spilllovers to assess the impact upon product innovation. The response of companies where the major ideas for innovation come are not included in the empirical part, this might give different research outcomes.

5.6 Future Research

Some future research recommendations can be originated from this research. It is recommendable to differentiate the cooperative strategies in the model. This will lead to more insights of the required characteristics of non R&D cooperative agreements relate to knowledge acquisition. Another interesting possibility to research further is the geographic spread of knowledge spillovers between cooperating firms with including information share systems. This will contribute which factors are relevant for emerging knowledge spillovers trough interfirm cooperation. It will also offer a complete understanding of the role of tacit knowledge on knowledge spillovers. Another interesting issue to research further is the relevance of non R&D workers for absorbing knowledge spillovers from non R&D cooperation. Also, a future research on the communication mode between companies that are engaged in non R&D cooperation will lead to a better understanding of which factors affect the unintended share of knowledge. A more general research recommendation is to investigate the type of partner and the type of cooperation in one research. This will lead to a better understanding of how these two factors relate to product innovation.

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Appendix 1: Relevant part of the EMS Survey

Independent variable

- *Non R&D cooperation*
- *Location of partners*

Control Variables

- *Motivation for cooperation*

7 **Does your factory co-operate in any of the following areas?**
▸ co-operation is a voluntary cooperation between different companies beyond pure business relations.

R&D co-operation with companies or research institutions h07h1 — h07h2 Location of partners — h07h3 h07h3 h07h3 h07h3 Motives for co-operation

h07a1 — h07a2

no			yes	regional (< 50 km)	national (> 50 km)	abroad	access to ... new know-ledge	human resources	new markets	reduction of costs
0	R&D co-operation with research organizations or research entities (e.g. universities/institutes)		1 ➔	1	2	3	h07a3 0/1	h07a4	h07a5	h07a6
0	R&D co-operation with customers or supplie	h07b1	1 ➔	1	h07b2	3	h07b3 0/1	h07b4	h07b5	h07b6
0	R&D co-operation with other companies (customers or suppliers excluded)	h07c1	1 ➔	1	h07c2	3	h07c3 0/1	h07c4	h07c5	h07c6
0	Purchasing co-operation	h07d1	1 ➔	1	h07d2	3	h07d3 0/1	h07d4	h07d5	h07d6
0	Production co-operation (for total system offe or for capacity compensation)	h07e1	1 ➔	1	h07e2	3	h07e3 0/1	h07e4	h07e5	h07e6
0	Sales/distribution co-operation	h07f1	1 ➔	1	h07f2	3	h07f3 0/1	h07f4	h07f5	h07f6
0	Service co-operation	h07g1	1 ➔	1	h07g2	3	h07g3 0/1	h07g4	h07g5	h07g6

- *Absorptive capacity*

14.1 **Please indicate the formal qualification level of your employees.**

Level 1
Level 2
Level 3

Graduate degree, PhD	approx.	h14a1	%	=100%
Technicians	approx.	h14a2	%	
Employees with commercial or technical/industrial training	approx.	h14a3	%	
Semiskilled and unskilled workers	approx.	h14a4	%	
Technical/industrial or commercial apprentices	approx.	h14a5	%	

14.2 **Please indicate the distribution of your personnel over the following areas.**

Research and development	approx.	h14b1	%	=100%
Configuration, design	approx.	h14b2	%	
Manufacturing and assembly	approx.	h14b3	%	
Customer service	approx.	h14b4	%	
Other (administration, purchase, sales, maintenance, production planning, etc.)	approx.	h14b5	%	

Dependent variable

- *Product Innovation*

11.1 **Has your factory introduced <u>products</u> since 2009, that were completely <u>new to the factory</u> or incorporated <u>major technical changes</u>?**
(e.g. application of new materials, modifications in product function, altered mode of operation, etc.)

0 no 1 yes ➔ What share of turnover did these products have in 2011? approx. h11b %
h11a

➔ How long did it take, on average, to develop such a new product? (from product idea to product launch) approx. h11c months

➔ Did these product innovations cause also an improvement of the environmental impact of using or disposing these new products? 0 no 1 yes
h11d

Control variables

- *Number of employees*

20	Please characterize your factory:						
	Annual turnover	2011	h20a1	million €	2009	h20a2	million €
	Number of employees (excl. temporary agency workers)	2011	h20b1	number	2009	h20b2	number
	Did your factory employ agency workers in 2011?	0 no / 1 yes → (h20c1)		How many agency workers have been employed in your factory on average in 2008?	approx.	h20c2	number

- *Industry*

1.2	Please indicate your industry and the main product or line of products produced at your factory.		
	Industry (e.g. textile industry, chemical industry, machinery etc.):	Main line of products	Share of turnover of main line of products
	h01bx	h01cx	appr. h01d %

Appendix 2: Relevant SPSS output

Appendix 2a: Testing the reliability of “number of non R&D cooperations” and “number of non R&D cooperation fields for accessing external knowledge”

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
,588	,598	4

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
,651	,719	4

Appendix 2b: Testing Normality - Descriptive table of metric data

Statistics

		number of non R&D cooperations	% R&D employees (1+natural log)	Distance cooperation partners ranging from: all partners < 25km to all partners abroad (natural log)	number of non R&D cooperation fields for accessing external knowledge	number of employees (natural log)
N	Valid	145	143	70	148	147
	Missing	4	6	79	1	2
Mean		,9034	1,6143	2,0006	,1486	3,8171
Median		1,0000	1,7918	1,6094	,0000	3,6376
Std. Deviation		1,11383	1,09225	1,33505	,52638	1,25271
Skewness		1,171	-,119	,052	4,130	1,209
Std. Error of Skewness		,201	,203	,287	,199	,200
Kurtosis		,525	-,843	-1,060	17,853	2,929
Std. Error of Kurtosis		,400	,403	,566	,396	,397

Appendix 2c: Testing the Normality - Frequency of the non-metric data

Product Innovation

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	52	34,9	34,9	34,9
	Yes	97	65,1	65,1	100,0
	Total	149	100,0	100,0	

Industry sector

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Metals and Metal products	34	22,8	23,0	23,0
	Food, Beverages and Tobacco	10	6,7	6,8	29,7
	Textiles, Leather, Paper and Board	18	12,1	12,2	41,9
	Construction, Furniture	12	8,1	8,1	50,0
	Chemicals (energy and non-energy)	29	19,5	19,6	69,6
	Machinery, Equipment Transport	29	19,5	19,6	89,2
	Electrical and Optical equipment	16	10,7	10,8	100,0
	Total	148	99,3	100,0	
Missing	niet industriele bedrijven: verhuur diensten	1	,7		
Total		149	100,0		

Purchasing Cooperation

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	no	113	75,8	75,8	75,8
	yes	36	24,2	24,2	100,0
	Total	149	100,0	100,0	

Production Cooperation

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	no	108	72,5	72,5	72,5
	yes	41	27,5	27,5	100,0
	Total	149	100,0	100,0	

Sales Distribution

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	no	110	73,8	73,8	73,8
	yes	39	26,2	26,2	100,0
	Total	149	100,0	100,0	

Service Cooperation

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	no	128	85,9	85,9	85,9
	yes	21	14,1	14,1	100,0
	Total	149	100,0	100,0	

Appendix 2d: Cross tabulation of non R&D cooperation and industry, location of partners, size

Purchasing Cooperation * Location Purchasing Crosstabulation

Count

		Location Purchasing			Total
		<50KM	>50KM	Abroad	
Purchasing Cooperation	no	113	0	0	113
	yes	19	10	7	36
Total		132	10	7	149

Production Cooperation * Production Location Crosstabulation

Count

		Production Location			Total
		<50KM	>50KM	Abroad	
Production Cooperation	no	0	108	0	108
	yes	13	21	7	41
Total		13	129	7	149

Sales Distribution * Sales Location Crosstabulation

Count

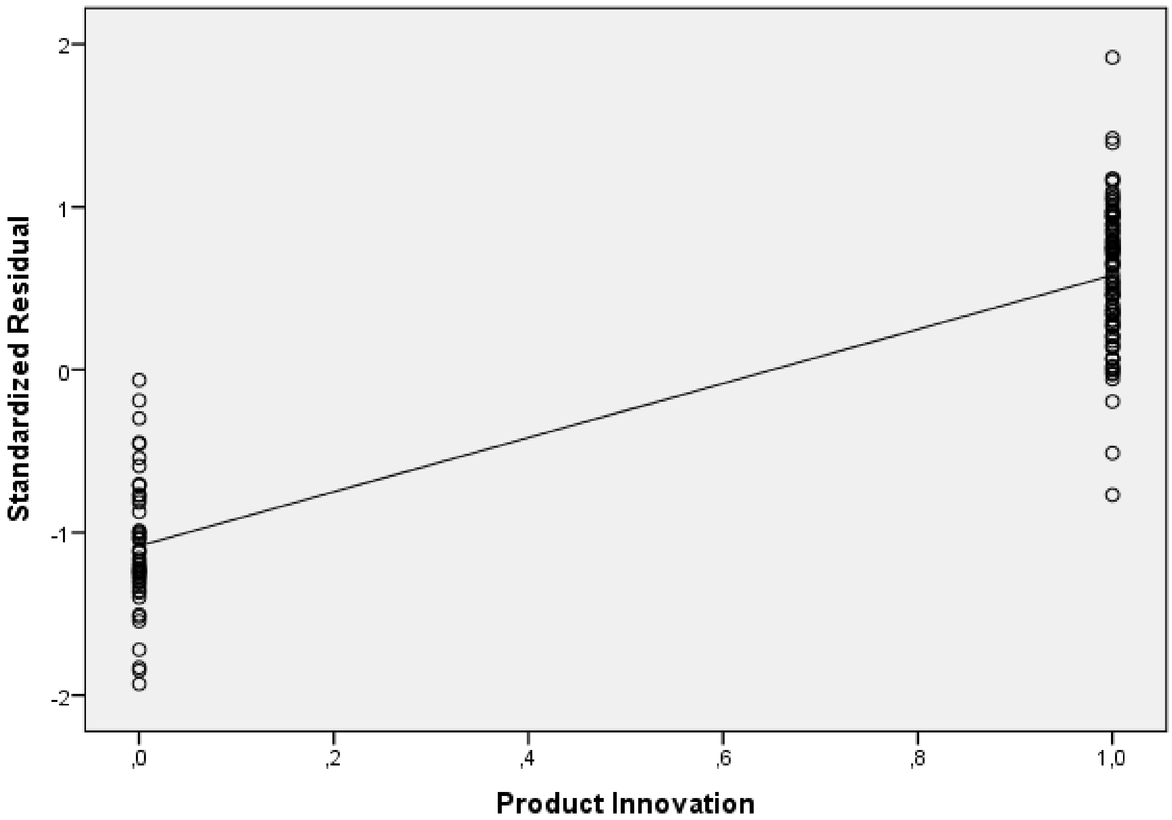
		Sales Location			Total
		<50KM	>50KM	Abroad	
Sales Distribution	no	0	0	110	110
	yes	10	7	22	39
Total		10	7	132	149

Service Cooperation * Service Location Crosstabulation

Count

		Service Location			Total
		<50KM	>50KM	Abroad	
Service Cooperation	no	128	0	0	128
	yes	12	5	4	21
Total		140	5	4	149

Appendix 2e: Testing Homoscedasticity



Appendix 2f: Testing for Linearity

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	v07d1g1	-,338	,385	,770	1	,380	,713
	v14b1_ln	,914	,387	5,597	1	,018	2,495
	distance_ln	,487	,266	3,354	1	,067	1,627
	v07d3g3	-,785	,596	1,738	1	,187	,456
	v20b1_ln	,675	,371	3,311	1	,069	1,964
	Constant	-3,866	1,780	4,715	1	,030	,021

a. Variable(s) entered on step 1: v07d1g1, v14b1_ln, distance_ln, v07d3g3, v20b1_ln.

Appendix 2g: Testing Multicollinearity

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients			Collinearity Statistics	
		B	Std. Error	Beta	t	Sig.	Tolerance	VIF
1	(Constant)	-,161	,792		-,203	,840		
	number of non R&D cooperations	-,071	,072	-,142	-,997	,323	,608	1,645
	% R&D employees (1+natural log)	,123	,076	,231	1,622	,111	,613	1,632
	Distance cooperation partners ranging from: all partners < 25km to all partners abroad (natural log)	,134	,049	,368	2,731	,009	,682	1,466
	number of employees (natural log)	,112	,058	,229	1,935	,059	,887	1,128
	number of non R&D cooperation fields for accessing external knowledge	-,194	,108	-,253	-1,789	,079	,617	1,621
	vFood	-,247	,258	-,124	-,959	,342	,737	1,356
	vTextile	,304	,203	,208	1,495	,141	,638	1,569
	vConstruction	-,033	,238	-,018	-,137	,891	,706	1,417
	vChemical	-,047	,175	-,035	-,268	,790	,714	1,400
	vMachinery	,221	,162	,184	1,361	,180	,676	1,480
	vElectronic	-,143	,249	-,079	-,572	,570	,644	1,552

a. Dependent Variable: products new to the factory

Appendix 2h: Testing of Independent errors

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R Square Change	F Change	df1	df2	Sig. F Change	
1	,607[a]	,369	,233	,4288	,369	2,708	11	51	,008	2,293

a. Predictors: (Constant), vElectronic, number of employees (natural log), number of non R&D cooperation fields for accessing external knowledge, vChemical, vConstruction, vTextile, vFood, Distance cooperation partners ranging from: all partners < 25km to all partners abroad (natural log), vMachinery, % R&D employees (1+natural log), number of non R&D cooperations

b. Dependent Variable: products new to the factory

Model 1: Hypotheses 1 and 2

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	35,313	10	,000
	Block	35,313	10	,000
	Model	35,313	10	,000

Dependent Variable Encoding

Original Value	Internal Value
no	0
yes	1

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	140,408[a]	,230	,316

a. Estimation terminated at iteration number 5 because parameter estimates changed by less than ,001.

Iteration History[a,b,c]

Iteration		-2 Log likelihood	Coefficients
			Constant
Step 0	1	175,730	,578
	2	175,721	,595
	3	175,721	,595

a. Constant is included in the model.
b. Initial -2 Log Likelihood: 175,721
c. Estimation terminated at iteration number 3 because parameter estimates changed by less than ,001.

Classification Table[a,b]

	Observed		Predicted		
			products new to the factory		Percentage Correct
			no	yes	
Step 0	products new to the factory	no	0	48	,0
		yes	0	87	100,0
	Overall Percentage				64,4

a. Constant is included in the model.
b. The cut value is ,500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B) Lower	Upper
Step 1[a]	v07d1g1	-,230	,224	1,059	1	,303	,794	,512	1,231
	v14b1_ln	,889	,228	15,182	1	,000	2,433	1,556	3,805
	v07d3g3	-,615	,472	1,698	1	,193	,541	,214	1,363
	v20b1_ln	,553	,233	5,621	1	,018	1,738	1,101	2,745
	vFood	-2,196	1,342	2,679	1	,102	,111	,008	1,543
	vTextile	,197	,680	,084	1	,772	1,217	,321	4,613
	vConstruction	-,580	,852	,463	1	,496	,560	,105	2,977
	vChemical	-,445	,623	,511	1	,475	,641	,189	2,171
	vMachinery	,390	,599	,424	1	,515	1,477	,457	4,776
	vElectronic	-1,373	,921	2,223	1	,136	,253	,042	1,540
	Constant	1,293	2,851	,206	1	,650	3,645		

a. Variable(s) entered on step 1: v07d1g1, v14b1_ln, v07d3g3, v20b1_ln, vFood, vTextile, vConstruction, vChemical, vMachinery, vElectronic.

Model 2: Hypotheses 3

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	20,433	10	,025
	Block	20,433	10	,025
	Model	20,433	10	,025

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	71,927[a]	,253	,346

a. Estimation terminated at iteration number 5 because parameter estimates changed by less than ,001.

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B) Lower	Upper
Step 1[a]	v14b1_v07d1g1	-,108	,397	,075	1	,785	,897	,412	1,953
	v07d1g1	,035	,359	,009	1	,923	1,035	,512	2,091
	v14b1_ln	1,142	,776	2,169	1	,141	3,134	,685	14,336
	v07d3g3	-,647	,502	1,662	1	,197	,523	,196	1,401
	v20b1_ln	,860	,366	5,517	1	,019	2,363	1,153	4,842
	vFood	-,610	1,567	,152	1	,697	,543	,025	11,720
	vTextile	1,067	1,017	1,101	1	,294	2,908	,396	21,346
	vConstruction	-,300	1,156	,067	1	,795	,741	,077	7,139
	vChemical	-,277	,965	,082	1	,774	,758	,114	5,029
	vMachinery	1,249	,840	2,214	1	,137	3,487	,673	18,080
	Constant	-5,517	4,120	1,793	1	,181	,004		

a. Variable(s) entered on step 1: v14b1_v07d1g1, v07d1g1, v14b1_ln, v07d3g3, v20b1_ln, vFood, vTextile, vConstruction, vChemical, vMachinery.

Model 3: Hypotheses 4

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	29,413	10	,001
	Block	29,413	10	,001
	Model	29,413	10	,001

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	54,317[a]	,373	,507

a. Estimation terminated at iteration number 6 because parameter estimates changed by less than ,001.

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B) Lower	Upper
Step 1[a]	distance_ln	1,005	,379	7,015	1	,008	2,731	1,298	5,743
	v07d1g1	-,464	,441	1,111	1	,292	,628	,265	1,490
	v14b1_ln	,851	,428	3,953	1	,047	2,341	1,012	5,415
	v07d3g3	-1,378	,762	3,271	1	,070	,252	,057	1,122
	v20b1_ln	,931	,442	4,445	1	,035	2,537	1,068	6,030
	vFood	-1,778	2,732	,424	1	,515	,169	,001	35,740
	vTextile	2,751	1,384	3,949	1	,047	15,653	1,039	235,932
	vConstruction	-,013	1,388	,000	1	,993	,988	,065	14,988
	vChemical	-,152	1,042	,021	1	,884	,859	,111	6,626
	vMachinery	2,008	1,082	3,445	1	,063	7,448	,894	62,083
	Constant	-7,385	5,050	2,139	1	,144	,001		

a. Variable(s) entered on step 1: distance_ln, v07d1g1, v14b1_ln, v07d3g3, v20b1_ln, vFood, vTextile, vConstruction, vChemical, vMachinery.

Appendix 2i: Crosstabs product innovation and non R&D cooperation, R&D cooperation

R&D Cooperation customer supplier * Product Innovation Crosstabulation

Count

		Product Innovation No	Yes	Total
R&D Cooperation customer supplier	no	33	34	67
	yes	19	63	82
Total		52	97	149

R&D Cooperation with other comp * Product Innovation Crosstabulation

Count

		Product Innovation		
		No	Yes	Total
R&D Cooperation with other comp	no	37	77	114
	yes	15	20	35
Total		52	97	149

Purchasing Cooperation * Product Innovation Crosstabulation

Count

		Product Innovation		
		No	Yes	Total
Purchasing Cooperation	no	34	79	113
	yes	18	18	36
Total		52	97	149

Production Cooperation * Product Innovation Crosstabulation

Count

		Product Innovation		
		No	Yes	Total
Production Cooperation	no	34	74	108
	yes	18	23	41
Total		52	97	149

Sales Distribution * Product Innovation Crosstabulation

Count

		Product Innovation		
		No	Yes	Total
Sales Distribution	no	42	68	110
	yes	10	29	39
Total		52	97	149

Service Cooperation * Product Innovation Crosstabulation

Count

		Product Innovation		
		No	Yes	Total
Service Cooperation	no	44	84	128

	yes	8	13	21
Total		52	97	149

Appendix 2j: Binary logistic regression (individual fields of non R&D cooperation)

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	25,708	7	,001
	Block	25,708	7	,001
	Model	25,708	7	,001

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	67,572[a]	,304	,415

a. Estimation terminated at iteration number 5 because parameter estimates changed by less than ,001.

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B) Lower	Upper
Step 1[a]	v07d1	-1,085	,669	2,633	1	,105	,338	,091	1,253
	v07e1	-,793	,654	1,469	1	,226	,453	,126	1,631
	v07f1	1,408	,686	4,209	1	,040	4,086	1,065	15,678
	v07g1	-,158	,810	,038	1	,845	,854	,175	4,172
	v14b1_ln	,658	,348	3,573	1	,059	1,930	,976	3,817
	v20b1_ln	,857	,366	5,472	1	,019	2,356	1,149	4,830
	v07d3g3	-,653	,502	1,692	1	,193	,521	,195	1,392
	Constant	-3,523	1,697	4,310	1	,038	,030		

a. Variable(s) entered on step 1: v07d1, v07e1, v07f1, v07g1, v14b1_ln, v20b1_ln, v07d3g3.

Appendix 2k: Frequencies of R&D and non R&D cooperation

R&D cooperation with suppliers or customers

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	no	67	45,0	45,3	45,3
	yes	81	54,4	54,7	100,0
	Total	148	99,3	100,0	
Missing	-98,0	1	,7		
Total		149	100,0		

R&D cooperation with other firms

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	no	108	72,5	75,5	75,5
	yes	35	23,5	24,5	100,0
	Total	143	96,0	100,0	
Missing	-98,0	6	4,0		
Total		149	100,0		

number of non R&D cooperations

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	,00	70	47,0	48,3	48,3
	1,00	41	27,5	28,3	76,6
	2,00	17	11,4	11,7	88,3
	3,00	12	8,1	8,3	96,6
	4,00	5	3,4	3,4	100,0
	Total	145	97,3	100,0	
Missing	-999,00	1	,7		
	System	3	2,0		
	Total	4	2,7		
Total		149	100,0		

Appendix 2l: Binary logistic regression (individual fields of R&D cooperation)

Case Processing Summary

Unweighted Cases[a]		N	Percent
Selected Cases	Included in Analysis	68	90,7
	Missing Cases	7	9,3
	Total	75	100,0
Unselected Cases		0	,0
Total		75	100,0

a. If weight is in effect, see classification table for the total number of cases.

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	32,181	9	,000
	Block	32,181	9	,000
	Model	32,181	9	,000

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	56,116[a]	,377	,519

a. Estimation terminated at iteration number 6 because parameter estimates changed by less than ,001.

Variables in the Equation

								95% C.I.for EXP(B)	
		B	S.E.	Wald	df	Sig.	Exp(B)	Lower	Upper
Step 1[a]	v07d1	-,975	,719	1,841	1	,175	,377	,092	1,543
	v07e1	-,172	,743	,053	1	,817	,842	,196	3,614
	v07f1	1,681	,856	3,859	1	,049	5,370	1,004	28,722
	v07g1	,274	,946	,084	1	,773	1,315	,206	8,399
	v14b1_ln	,901	,408	4,878	1	,027	2,461	1,107	5,474
	v20b1_ln	,797	,374	4,539	1	,033	2,218	1,066	4,616
	v07d3g3	-1,171	,596	3,851	1	,050	,310	,096	,999
	v07b1	1,053	,741	2,017	1	,156	2,866	,670	12,251

	v07c1	-1,987	,887	5,012	1	,025	,137	,024	,781
	Constant	-4,064	1,765	5,300	1	,021	,017		

a. Variable(s) entered on step 1: v07d1, v07e1, v07f1, v07g1, v14b1_ln, v20b1_ln, v07d3g3, v07b1, v07c1.

Appendix 2m: Binary logistic regression (moderating effect of absorptive capacity –on the relation of each fields of non R&D cooperation and product innovation)

(a) Outcome for purchasing cooperation

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	18,673	7	,009
	Block	18,673	7	,009
	Model	18,673	7	,009

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	74,607[a]	,231	,316

a. Estimation terminated at iteration number 5 because parameter estimates changed by less than ,001.

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B) Lower	Upper
Step 1[a]	v07d1	-,880	,636	1,918	1	,166	,415	,119	1,441
	v14b1_v07d1	,136	,810	,028	1	,867	1,146	,234	5,610
	v07e1g1	,171	,363	,223	1	,637	1,187	,583	2,417
	v14b1_v07e1g1	-,061	,344	,032	1	,858	,941	,479	1,846
	v14b1_ln	,787	,591	1,774	1	,183	2,197	,690	6,997
	v20b1_ln	,765	,351	4,741	1	,029	2,148	1,079	4,275
	v07d3g3	-,617	,471	1,718	1	,190	,540	,215	1,357
	Constant	-3,506	2,030	2,982	1	,084	,030		

a. Variable(s) entered on step 1: v07d1, v14b1_v07d1, v07e1g1, v14b1_v07e1g1, v14b1_ln, v20b1_ln, v07d3g3.

(b) Outcome for production cooperation

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	26,896	7	,000
	Block	26,896	7	,000
	Model	26,896	7	,000

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	66,384[a]	,315	,431

a. Estimation terminated at iteration number 6 because parameter estimates changed by less than ,001.

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B) Lower	Upper
Step 1[a]	v07e1	-,491	,650	,571	1	,450	,612	,171	2,187
	v14b1_v07e1	-2,443	1,104	4,898	1	,027	,087	,010	,756
	v07d1f1g1	,182	,392	,215	1	,643	1,199	,556	2,584
	v14b1_v07d1f1g1	,634	,434	2,139	1	,144	1,886	,806	4,412
	v14b1_ln	2,046	,911	5,040	1	,025	7,733	1,296	46,129
	v20b1_ln	,821	,349	5,548	1	,019	2,273	1,148	4,500
	v07d3g3	-,609	,494	1,520	1	,218	,544	,207	1,432
	Constant	-6,015	2,405	6,255	1	,012	,002		

a. Variable(s) entered on step 1: v07e1, v14b1_v07e1, v07d1f1g1, v14b1_v07d1f1g1, v14b1_ln, v20b1_ln, v07d3g3.

(c) Outcome for sales/distribution cooperation

Case Processing Summary

Unweighted Cases[a]		N	Percent
Selected Cases	Included in Analysis	71	94,7
	Missing Cases	4	5,3
	Total	75	100,0
Unselected Cases		0	,0
Total		75	100,0

a. If weight is in effect, see classification table for the total number of cases.

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	26,048	7	,000
	Block	26,048	7	,000
	Model	26,048	7	,000

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	67,232[a]	,307	,420

a. Estimation terminated at iteration number 6 because parameter estimates changed by less than ,001.

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B) Lower	Upper
Step 1[a]	v07f1	1,443	,685	4,440	1	,035	4,234	1,106	16,212
	v14b1_v07f1	,922	,861	1,148	1	,284	2,514	,465	13,578
	v07d1e1g1	-,532	,493	1,167	1	,280	,587	,223	1,543
	v14b1_v07d1e1g1	-,188	,543	,119	1	,730	,829	,286	2,403
	v14b1_ln	,484	,565	,735	1	,391	1,623	,536	4,909
	v20b1_ln	,858	,352	5,960	1	,015	2,359	1,184	4,699
	v07d3g3	-,640	,496	1,666	1	,197	,527	,199	1,394
	Constant	-3,621	1,905	3,612	1	,057	,027		

a. Variable(s) entered on step 1: v07f1, v14b1_v07f1, v07d1e1g1, v14b1_v07d1e1g1, v14b1_ln, v20b1_ln, v07d3g3.

(d) Outcome for service cooperation

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	17,554	7	,014
	Block	17,554	7	,014
	Model	17,554	7	,014

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	75,726[a]	,219	,300

a. Estimation terminated at iteration number 5 because parameter estimates changed by less than ,001.

Contingency Table for Hosmer and Lemeshow Test

		products new to the factory = no		products new to the factory = yes		
		Observed	Expected	Observed	Expected	Total
Step 1	1	6	5,843	1	1,157	7
	2	6	4,547	1	2,453	7
	3	3	3,397	4	3,603	7
	4	1	2,896	6	4,104	7
	5	2	2,438	5	4,562	7
	6	4	2,067	3	4,933	7
	7	0	1,897	7	5,103	7
	8	2	1,644	5	5,356	7
	9	2	,876	5	6,124	7
	10	0	,395	8	7,605	8

Appendix 2n: Cross tab non R&D cooperation and motivation to get access for knowledge

Purchasing Cooperation * Purchasing New Tech Access Crosstabulation

Count

		Purchasing New Tech Acess		
		no	yes	Total
Purchasing Cooperation	no	113	0	113
	yes	34	2	36
Total		147	2	149

Production Cooperation * Prod New Tech Crosstabulation

Count

		Prod New Tech		
		no	yes	Total
Production Cooperation	no	108	0	108
	yes	30	11	41
Total		138	11	149

Sales Distribution * Sales New Tech Crosstabulation

Count

		Sales New Tech		
		no	yes	Total
Sales Distribution	no	110	0	110
	yes	33	6	39
Total		143	6	149

Service Coperation * Service New Tech Crosstabulation

Count

		Service New Tech		
		no	yes	Total
Service Coperation	no	128	0	128
	yes	18	3	21
Total		146	3	149

Appendix 2l: Cross tab product innovation and absorptive capacity

Percentage R&D employees * Product Innovation Crosstabulation

Count

		Product Innovation		
		No	Yes	Total
Percentage R&D employees	,0	21	11	32
	1,0	1	5	6
	2,0	6	4	10
	2,5	0	1	1
	3,0	0	4	4
	4,0	1	4	5
	5,0	13	21	34
	6,0	0	1	1
	8,0	1	3	4
	9,0	1	0	1
	10,0	2	16	18
	11,0	1	0	1
	12,0	0	1	1
	15,0	1	5	6
	16,0	0	1	1
	20,0	2	8	10
	25,0	1	0	1
	30,0	0	4	4
	35,0	0	1	1
	50,0	0	1	1
	70,0	0	1	1
Total		51	92	143

Appendix 2o: T-test

Group Statistics

	products new to the factory	N	Mean	Std. Deviation	Std. Error Mean
number of non R&D cooperations	no	20	,6500	1,03999	,23255
	yes	9	,1111	,33333	,11111

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
number of non R&D cooperations	Equal variances assumed	10,321	,003	1,507	27	,144	,53889	,35767	-,19499	1,27277
	Equal variances not assumed			2,091	25,508	,047	,53889	,25773	,00862	1,06916

Appendix 2p: T-test

Group Statistics

	products new to the factory	N	Mean	Std. Deviation	Std. Error Mean
number of non R&D cooperations	no	30	1,3000	1,26355	,23069
	yes	79	,9367	1,07824	,12131

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
number of non R&D cooperations	Equal variances assumed	1,279	,261	1,497	107	,137	,36329	,24265	-,11774	,84432
	Equal variances not assumed			1,394	45,950	,170	,36329	,26064	-,16137	,88795