Outsourcing and Innovation:

To what extent does outsourcing manufacturing or Research and Development influence the product innovation performance of organisations in the Dutch production industry?

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by

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ABSTRACT

The central topic in the present research is the relationship between outsourcing and innovation from the perspective of the firm. More specifically, the central question is to what extent outsourcing of manufacturing or Research and Development -RnD- influences the product innovation performance of organisations in the Dutch production industry. To answer this question, a theoretical framework is developed that is used to deduce hypotheses. These hypotheses are tested in ordinal regression models, with data obtained from managers who work in the Dutch production industry. The empirical evidence gathered from 112 firms indicates that offshoring manufacturing or RnD -as a way of outsourcing- has a positive effect on the innovativeness of Dutch production firms. In addition, for offshoring manufacturing this relationship was moderated by the 'distance' between the Netherlands and the country to which the activity was offshored. The positive effect of offshoring production can be explained by presuming that the offshored activities are simple of nature and only lead to a marginal loss in knowledge and that the gained slack resources are allocated to strengthen activities directed to innovation; the trade-off favours innovation. For RnD activities, the gained access to a larger RnD capacity at lower cost can have inspired the positive relationship with product innovation performance. No significant effect was found for outsourcing in general. The data did not offer evidence for the assumption that the absence of a significant relationship between outsourcing and innovation was caused by a lack of absorptive capacity or dictated by the reason why the activity was sourced to an external party. A plausible explanation is that the relationship between outsourcing and innovation is highly contingent to the specific situation, distorting an unambiguous relationship. Another interesting result -but which is beyond the scope of the research question- is that the strategic intent to innovation is positively related to product innovation performance. The latter effect is quite strong and even makes the effect of absorptive capacity on product innovation performance obsolete. This finding suggests that absorptive capacity is influenced by the emphasis a firm puts on its innovation activities; it is dependent on the strategic intent to innovation. Given that some of the results are inconclusive, further research is recommended to create a more comprehensive understanding of the relationship between outsourcing and innovation.

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1. INTRODUCTION

> ***"The White House is now outsourcing the manufacturing of our passports overseas. See, this is how a global economy works. See, when an illegal immigrant from Mexico living in LA and working in a Japanese-owned company wants to go home to visit his relatives, he uses a passport made in Thailand that he gets by calling a customer service number in India. You see how it works?" –*** **Jay Leno, March 2008.**

Quoting Jay Leno might seem a strange way to start a master's thesis in the field of economics. However, this quote nicely demonstrates the shared scepticism to outsourcing that is held by many people (especially the working-class). Associations between outsourcing and the loss of jobs contribute to the creation of this negative image. Besides, it is also argued that outsourcing hollows an organisation's capability (Bettis et al., 1992), e.g. in the field of innovation. Are the effects of outsourcing really as bad as some people tend to think?

To answer this question -well, at least one facet of it-, this thesis focuses on the effect of outsourcing on innovation. Why innovation, you might think? There are two main reasons. First, in economics innovation is considered to be one of the most important driving forces behind economic growth.[1] Therefore, the effect of outsourcing on innovation could lead to important policy implications for governments that stimulate economic prosperity. Secondly, innovation offers commercial organisations one of the few possibilities to create a sustainable competitive advantage, one that is hard to imitate. Consequently, management should be well aware of how the two elements relate to one another. Clearly the present topic is both socially and commercially a relevant issue.

In the light of these developments, the present study investigates the relationship between outsourcing and innovation in the Dutch production industry at the firm level; a relationship that -as far as the author knows- has not been empirically tested before. To limit the scope of the research, it is chosen to look at product innovation performance and its relationship with outsourcing of manufacturing or Research and Development -RnD-, in the production industry. Product innovation performance is chosen because it is the most 'visible' outcome of the innovation process at production firms. Besides, products are -in the end- often what it is all about in *production* firms. The focus on manufacturing and RnD activities is inspired by the decision to investigate the relationship between outsourcing and product innovation. After all, both activities are intuitively closely related to the product innovation process. Taken together, the central research question of this study is the following:

[1] For instance, one can think of the Solow-growth model or of the endogenous growth model.

> *"To what extent does outsourcing manufacturing or Research and Development influence the product innovation performance of organisations in the Dutch production industry?"*

To come up with a well substantiated answer, different hypotheses are developed and are tested empirically with data obtained by means of a questionnaire, filled-out by managers that work in a firm in the Dutch production industry.

The thesis consists of three main parts. First, the theoretical part deals with the literature on outsourcing and innovation. Subsequently a theoretical -knowledge-based- framework is developed to embed the hypotheses. The second part of this thesis covers the empirical analyses and interpretation and discussion of the obtained results. Finally, a concluding chapter is included that poses some of the limitations, some future research recommendations and which answers the main research question.

2. THEORETICAL PART

In this chapter a theoretical framework will be developed that is used to deduce the hypotheses with respect to the relationship between outsourcing and innovation. First the two main elements of this study, outsourcing and innovation, will be elaborated on. Secondly prerequisites to innovation are developed from a knowledge perspective and put in a theoretical framework. Finally, the hypotheses are discussed.

2.1 Defining Outsourcing

2.1.1 Definition

As with many other buzzwords there is no clear, unambiguous definition of outsourcing (Deavers, 1997; Gilley & Rasheed, 2000; Accenture, 2004). Although most definitions are very closely linked, some small but essential differences remain. In the table below some definitions will be reproduced and discussed to create an overview of what literature defines as outsourcing. Based on this impression a definition will be formulated that will be used for the remainder of the paper.

1996	**Ulset**	TCE perspective: transaction done via the market or hybrid form
1996	**Aubert et al**	outsourcing is a make-or-buy decision
1998	**Bryce and Useem**	an outside company's provision of the product or services associated with a major function or activity of a user organisation
1999	**Lankford and Parsa**	the procurement of products or services from sources that are external to the organisation
2000	**Gilley and Rasheed**	either substitution or abstention of internal activities, hence there must be a clear choice, rejection of internalization
2000	**Arnold**	grammatical approach: outside resource using, hence taking advantage of outside resources
2004	**Bhagwati et al**	definition of WTO: offshore trade at arm's length services, it is a trade phenomenon
2004	**Accenture**	purchasing ongoing services from an outside company that a company currently provides, or most organisations normally provide, for themselves
2005	**Kumar and Eickhoff**	a practise followed by management of contracting out in-house functions that companies do not do particularly well to outside firms that do

Table 1: Definitions of Outsourcing.

First, when taking the transaction cost economical (TCE) perspective of Williamson (1985), outsourcing can be defined as transactions performed either via the market or via some hybrid, intermediate form (Ulset, 1996). In this sense outsourcing is described as a governance choice in which is chosen for markets instead of hierarchies and as such it is very broad applicable. A similar definition is given by Aubert, Rivard and Patry (1996), who characterize outsourcing as a make-or-buy decision. Both definitions come down to the same meaning, but the first is from an economical perspective whereas the latter is from a business administrational view. Other researchers define outsourcing as the procurement -and taking advantage- of outside resources

(Lei & Hitt, 1995; Bryce & Useem, 1998; Lankford & Parsa, 1999; Gilley & Rasheed, 2000; Arnold, 2000). However, in recent years the definition has been refined: It is indicated that outsourcing is not just about procurement, but rather about the conscious choice of procurement (Gilley & Rasheed, 2000; Bhagwati, Panagariya, & Srinivasan, 2004; Accenture, 2004; Kumar & Eickhoff, 2005). Thus it ought to be a deliberate choice of the outsourcing firm. Gilley & Rasheed (2000) make an interesting specification on this point by discerning substitution of an activity and abstention of an activity. The former indicates external sourcing of an activity once performed in-house, whereas abstention is about transferring the activity to an external party, without having done the activity in-house, yet having the capabilities to perform the task itself. Hence abstention is about the "decision to reject internalization" (Gilley & Rasheed, 2000, p. 765). Not being able to do it yourself because of, for instance, prohibitively high cost or lack of knowledge logically leads to outside procurement and hence is not seen as outsourcing (Gilley & Rasheed, 2000). Firms should have either done it themselves in the past, or they should be able to do it before outside procurement can be characterized as outsourcing (Gilley & Rasheed, 2000; Accenture, 2004). Although this leads to a more narrow definition than the earlier specified definitions, it is -at least to some extent- in concordance with the first mentioned transaction cost approach and make-or-buy decision. After all, these approaches take the cost of doing it yourself into account. An aspect on which there seems to be consensus, is the fact that the activity that is outsourced should be an ongoing activity (e.g. Bryce & Useem, 1998; Accenture, 2004). Hence a one-time order does not cover the meaning of outsourcing. Moreover, it is also stressed that it concerns an external, independent supplier (Lei & Hitt, 1995; Lankford & Parsa, 1999; Gilley & Rasheed, 2000; Accenture, 2004).

When taking the literature into account, it becomes apparent that outsourcing is about ongoing outside procurement with respect to services or products which the firm is capable of doing as well, or has done in the past. The latter is crucial when defining outsourcing, as the phenomenon is seen as a strategic management tool and part of the corporate strategy (Bettis et al., 1992; Lankford & Parsa, 1999; Accenture, 2004). If it would not be in the competencies of the company to produce the goods itself, there is not much use for management to consider the 'tool' of outsourcing since the firm will have to procure it from outside anyway. From the short review above it can be deduced that, in its essence, outsourcing is basically a resource allocation decision and as such closely related to the boundaries of the firm. Based on the review, the following definition is inferred:

> *"Outsourcing is about ongoing procurement of products or services from an external supplier which the firm itself is able to do as well, or has done in the past."*

Based on this definition joint-ventures and strategic alliances are not seen as outsourcing because outsourcing consists of more or less one-way resource flows (Bryce & Useem, 1998). The outside firm is paid to deliver a service or product and although there might be some sort of information exchange, there is no real mutual development. After all, the outsourcing firm usually procures the product outside the firm because the provider is more knowledgeable and because the provider has a competitive advantage in producing the product (Quélin & Duhamel, 2003). Furthermore, management and implementation are transferred to the provider, unlike with joint-ventures. For an even more detailed discussion and overview regarding the concept

of outsourcing it is recommended to turn to the comprehensive book written by Michael J. Mol (2007).

2.1.2 Outsourcing in its Context

In this section outsourcing is placed within the context of a firm to contribute to a better understanding of the phenomenon in question. As deduced above, outsourcing is about the make-or-buy decision and entails the procurement of products and/or services from third parties: it essentially deals with resource allocation.

Resource allocation -from the perspective of the firm- is a strategic matter as it is part of a strategy (Walker, 2006). However, there are several strategic levels within a corporation. At the highest level there exists a corporate strategy which is directed to formulating how success of the firm as a whole ought to be reached (Mitreanu, 2006). This strategy is overarching in that it "deals with the way in which a corporation manages a set of businesses together" (Bowman & Helfat, 2001, p. 1). The corporate strategy is the foundation of the business strategy, which is the formulated strategy on business unit level and tells something about how the firm is going to compete in the chosen market (Walker, 2006). The business strategy, on its turn, informs the operational strategy which is concerned with the day-to-day operational business (Jonhs & Lee-Ross, 1996).[2] This level consists of two components: strategic priorities and implementation. The first deals with the focus of the operational activity, e.g. cost, innovation and/or quality. Implementation is about the realization and translation of the strategic priorities into the day-to-day business. Hence it actually determines the allocation of your resources in a very precise way on the micro level. This is where outsourcing comes in.

Outsourcing is a resource allocation decision that can be used for the realization of strategic priorities. For instance if the strategic priority is cost, outsourcing to a specialized supplier can be a management tool -or way of implementation- of this priority that changes the allocation of resources in the organisation. Outsourcing is thus an implementation-component of the operational strategy and in that sense it can also be characterized as a management tool: it is a mean that can be called upon by management to 'translate' the strategic priorities. Outsourcing, as explained earlier, is a deliberate choice and an integral part of the firm. This is schematically shown in Figure 1. It is important to keep in mind that outsourcing decisions arise at different levels. For instance, it can be decided to do a certain process in-house -i.e. because it is part of their core competence- yet small operational parts of that process are also subjected to the make-or-buy decision.

Figure 1: Outsourcing placed in its context.

[2] Also known as the functional strategy (Walker, 2006).

2.1.3 Modes of Outsourcing

Literature does not discern much different modes of outsourcing. One commonly used pair is peripheral and core outsourcing (Gilley & Rasheed, 2000). The first entails the outsourcing of activities that are not of highly strategic importance, whereas the latter concerns activities that are critical to long term success of the firm. What constitutes these core activities is highly contingent on the situation of the firm and can differ even between firms within the same industry.

Two different modes are given in a research report by Accenture (2004), in which the author distinguishes between 'conventional' outsourcing and transformational outsourcing. Transformational outsourcing is used to bring about rapid and sustainable improvements of the firm's performance. It often concerns activities that are critical to the success of the business. Conventional outsourcing mainly applies to less relevant activities and small improvements with a focus on cost reduction (Accenture, 2004). In essence both typologies make the distinction between core and non-core outsourcing, yet their approach differs. The research report typology can actually work as a moderating effect on the distinction made by Gilley & Rasheed by characterizing how outsourcing can be done. Quélin and Duhamel (2003) created a similar 'moderator' and make a distinction between strategic outsourcing and non-strategic outsourcing. Strategic outsourcing deals with outsourcing beyond peripheral tasks. It also focuses on functions that add significant value to the firm and uses outsourcing as a strategic choice to generate a strategic advantage over competitors (Quélin & Duhamel, 2003). Cost reduction is not considered to be the main driver of strategic outsourcing but other, more qualitative, factors are of importance (Quélin & Duhamel, 2003). The strategic vs. non-strategic pair captures the earlier mentioned different levels on which the make-or-buy decision might occur.

Another often mentioned mode of outsourcing is offshoring (Bhagwati, Panagariya, & Srinivasan, 2004; Aron & Singh, 2005). Offshoring, as mode of outsourcing, is nothing more than procurement of the product or service from an external supplier from abroad (as compared to domestic, local outsourcing). It is, however, important to keep in mind that offshoring is not always a mode of outsourcing. For example, if a firm moves a production facility abroad while retaining control it is also called (captive)offshoring but it is not a mode of outsourcing (Lewin & Peeters, 2006). Hence offshoring can be interpreted differently in different situation (see Figure 2). As this research focuses on outsourcing, offshoring -when used in the paper- should be interpreted as outsourcing activities to independent firms abroad. The interplay between the different types of modes is schematically shown in Figure 3

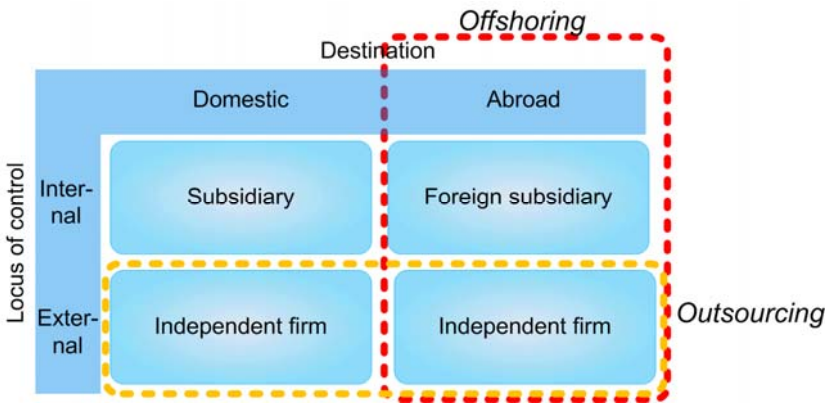

Figure 2: Difference between offshoring and outsourcing.

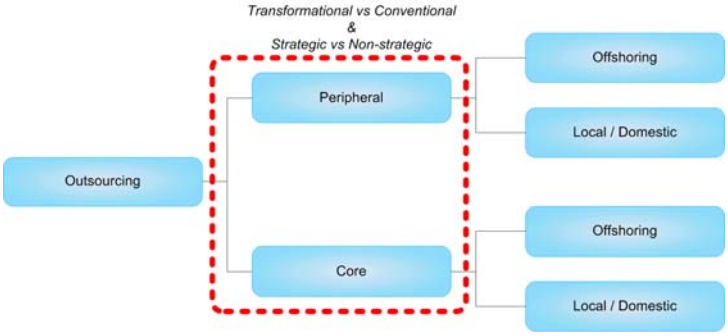

Figure 3: Modes of outsourcing.

This research will look at some of the different modes of outsourcing and their effect on innovation. For instance, the moderating effect of strategic outsourcing on innovation performance will be investigated. In addition, the effect of offshoring is also discussed and tested in an innovation context. This will be discussed more thoroughly when dealing with the hypotheses.

2.2 Pros and Cons of Outsourcing

Before being able to discuss the merits and drawbacks of outsourcing, the *why*-question has to be answered. Why do firms outsource activities? What determines the activities they outsource? In their research Quélin and Duhamel (2003) give a clear overview of the main motives to engage in outsourcing activities:

Identified main motives for outsourcing
Reduce operational cost
Reduce capital investments
Transform fixed cost into variable cost
Improve measurability of cost
Improve quality
Focus on core competencies
Regain control over internal departments
Gain access to external competencies

Table 2: Motives for outsourcing. Adapted from Quélin & Duhamel 2003.

Other motives are risk sharing and freeing up resources for other purposes (Deavers, 1997; Gilley & Rasheed, 2000). In particular, generating a decrease in -labour- cost is often mentioned by Dutch manufacturers as a motive to engage in outsourcing of production and to some less extent RnD (Ligthart et al., 2008). In the same research, these firms indicated that access to external competencies -knowledge- was of great importance on deciding on outsourcing of RnD. Finally, capacity problems also appear to trigger outsourcing of both RnD and production with Dutch manufacturers.

From an economical perspective transaction cost theory, the resource based view and the competency based view can contribute to an understanding why firms engage in outsourcing.

Transaction cost economics explains outsourcing by looking at asset specificity and at cost -in a very broad meaning of the word- involved in doing it yourself as compared to outside procurement (Ulset, 1996; Deavers, 1997; Arnold, 2000). If the market can do it better and cheaper despite the negotiation and control cost, outsourcing could be a valuable implementation tool to realize strategic priorities. Another explanation is given by the resource based view of Penrose (Penrose, 1959) which states that a firm is a structure of unique resources and capabilities. Only these unique resources and abilities can constitute a sustainable competitive advantage (Arnold, 2000). Hence the firm should focus on these resources and capabilities and procure the resource or ability from outside if it will not contribute to a sustainable advantage. In-house investment is not justifiable if it does not lead to a unique valuable resource. The competency approach takes a similar perspective. According to Prahalad and Hamel (1990) a firm should only engage in activities that are part of the core competency of the firm. Other activities are probably done better by others -to whom the activity is part of their core competency- and should thus be outsourced. The core competencies determine the direction and growth of the firm and should therefore be the point of interest to the firm. The aforementioned theories also indicate which activities are most suitable to be outsourced. Especially the core competency approach is a useful indicator which is often used to come to a preliminary judgement to determine if an activity should be outsourced or not and since core competencies are of crucial importance, firms should be very careful in outsourcing these activities (Bettis et al., 1992; Lankford & Parsa, 1999; Arnold, 2000; Gilley & Rasheed, 2000; Kumar & Eickhoff, 2005; De Vaan & Krebbekx, 2006).

With the motives from Table 2, most of the advantages are illustrated. For example, a specialized supplier is more likely to generate scale economies and is probably able to sustain a higher quality given that the outsourced activity is part of the core competency of the provider. This has positive effects on the operational costs since there is a clear specialization -or some kind of division of labour- that can lead to a higher overall productivity (Alchian & Demsetz, 1972; Lankford & Parsa, 1999). Slack resources could be one of the side products of these cost reductions and given the found inverted U-shaped relationship between slack resources and innovation with business units by Nohria & Gulati (1996), outsourcing can have either a positive or a negative effect on innovative performance. Besides the fact that costs decline, costs become more visible. Outsourcing also transforms cost from a fixed component to a more variable component, creating increased production flexibility (Razzaque & Sheng, 1998; Kumar & Eickhoff, 2005). Flexibility is also enhanced with respect to technological possibilities: a firm is no longer 'stuck' / biased to its own technology as it can choose to switch from supplier (Insinga & Werle, 2000; Mol, 2007).[3] Moreover it saves the outsourcing firm large capital investments at the start up as well as at a later stage when the firm tries to keep up with technological progress to remain competitive (Razzaque & Sheng, 1998). Probably one of the more important benefits lies in the freeing up of resources -managerial, monetary- and the possibility to direct these 'slack' resources towards the core competencies of the firm (Dess et al., 1995; Deavers, 1997). Through this increased focus, operational and strategic processes can be improved eventually leading to an improved performance (Gilley & Rasheed, 2000; Accenture, 2004). Similarly,

[3] This will, of course, not always be the case as firms can also become entrenched in an outsourcing relationship, but especially with respect to more straightforward tasks switching cost will not be exorbitantly high.

Acemoglu et al. (2003) state that outsourcing can prevent managerial overload and increase innovative activities because it frees up managerial time. Another -very important- positive aspect of outsourcing lies in the access to specialized knowledge of third parties (Quinn, 1999). Not only does this improve product quality of the outsourced activity, it could also lead to knowledge spill-over from the supplier to the outsourcer (Kumar & Eickhoff, 2005). Finally, a major advantage is the spread of risk to other parties for instance with respect to irreversible asset specific investments (Quélin & Duhamel, 2003).

Unfortunately, outsourcing also comes with certain disadvantages. These disadvantages can be external or internal of nature. An external disadvantage is, for instance, the knowledge spillover flows from supplier to outsourcer can also be reversed, leading to a decrease in competitive advantage over competitors (Hoecht & Trott, 2006). In some cases this can even augment to a certain point where the supplier has gained that much knowledge, that it can produce the entire product itself, leapfrogging the original outsourcer (i.e. through vertical integration) (Gilley & Rasheed, 2000; Kumar & Eickhoff, 2005). Another disadvantage related to the behaviour of the provider, is the hold-up problem (Milgrom & Roberts, 1992). This is especially relevant when high asset specificity functions -in terms of TCE- are outsourced because then the outsourcer is highly dependent upon the supplier, also due contract incompleteness (Dyer, 1997). The supplier can take advantage of his position by suddenly demanding a higher price or demanding more beneficial conditions (Aron & Singh, 2005). Yet probably of higher concern are the internal disadvantages. One of these downsides is that some firms might use outsourcing as a substitute for innovation (Gilley & Rasheed, 2000), or have a below optimal level of innovation because of outsourcing, as is mathematically shown by Plambeck & Taylor (2005). Another possible pitfall lies in the outsourcing spiral in which a firm can end up, eventually losing all competitive capabilities as a result of the hollowing of the organisation (Bettis et al., 1992; Ross & Westerman, 2004). Similar argument is given by Razzaque and Sheng (1998) who state that outsourcing leads to high losses of information and control. The loss of control is also mentioned by other authors (Quélin & Duhamel, 2003; Kumar & Eickhoff, 2005; Plambeck & Taylor, 2005). The loss of control is especially difficult with offshoring, when the supplier / producer is far away. Moreover this distance creates extra logistical risks, time lags and perhaps even monetary fluctuation risks (Gilley & Rasheed, 2000). Finally, outsourcing encompasses the danger that firms lose their ability to provide the activity themselves. A problematic situation since it can contribute to a loss in control and, as a result, in increased danger of being held-up. Moreover, peripheral activities can become core capabilities in the future, besides that it is already hard to determine core capabilities on the long run (Lankford & Parsa, 1999; Quélin & Duhamel, 2003). Not to mention the forgone future opportunities -'options'- through activities which were once devaluated -and therefore outsourced- but that suddenly opened up new growth markets. The firm will then lack the necessary expertise because of their earlier made outsourcing decision (Prahalad & Hamel, 1990; Kotabe, 1998). Firms also miss out on possible valuable networks by outsourcing certain activities, or can become isolated from this kind of networks (Hoecht & Trott, 2006). What comes to mind when reviewing the disadvantages of outsourcing, is that the impact of the disadvantage is contingent on the situation: asset specificity, importance of the activity, imperfectness of contract etc..

2.3 Defining Innovation

2.3.1 Definition

This section will deal with the concept of innovation. First a definition is posed, after which the concept is placed in its context. Secondly, different types of innovation will be discussed and a typology will be chosen on which the paper will be build. Finally some imperative circumstances to engage in innovation will be mentioned.

When considering the existing literature on the concept of innovation -see Table 3-, it can be said that the concept has been quite consistent over the years. Moreover, since implementation/introduction is mentioned as part of the definition of innovation (Mohr, 1969; Damanpour, 1987; Gurteen, 1998; Schilling, 2005), it can be deduced that 'inventing' is not enough to be talking about innovation; something has to be done with the invention. Despite the relative consistency during the years, there is also a certain development of the concept: from a phenomenon that 'happens to you' to something what a firm can 'make happen'. Especially the more recent literature emphasizes the purposive acts of the firm as part of their innovation definition (Gurteen, 1998; Love & Roper, 1999; Schilling, 2005; Beije, 2006). Taken these definitions together, one can define innovation as the deliberate search for and implementation/commercialisation of new technologies, services, markets and structures.

1927	**Schumpeter**	"… such changes of the combinations of the factors of production as cannot be effected by infinitesimal steps or variations on the margin. They consist primarily in changes in methods of production and transportation, or in changes in industrial organisation, or in the production of a new article, or in the opening up of new markets or of new sources of material."
1939	**Schumpeter**	Innovation as a useful and creative change which leads to creative destruction.
1969	**Mohr**	"…the successful introduction into an applied situation of means or ends that are new to that situation."
1998	**Gurteen**	The sifting, refining and most critically the implementation of generated ideas. It's about putting the ideas into action.
1999	**Love & Roper**	"...a commercial rather than a technological activity, which is related to and affects firms' competitive position."
2005	**Schilling**	The act of introducing something new to commercial or practical objectives. The innovation projects should align with the resources and objectives, leveraging the core competencies and helping achieving the strategic intents.
2006	**Beije**	"…new products or services, new ways to manufacture products, new ways to distribute/sell products, etcetera. Which are the result of a deliberate and non-trivial effort and are aimed at realizing a competitive advantage."

Table 3: Definitions of Innovation.

2.3.2 Types of Innovation

Literature discerns many different types of innovation, often formulated in pairs such as product/process innovation, competence destroying/enhancing innovation, radical/incremental innovation, administrative/technical innovation etc. (Schilling, 2005). However, with these

typologies two different aspects are easily confused. A clear distinction should be made between classification of innovation with respect to impact and classification with respect to attributes. The former deals with the effect of the innovation on the firm -or society- whereas the latter more or less says something about the nature of the innovation itself. Examples of the first are radical/incremental, competence destroying/enhancing and architectural/component innovations (Abernathy & Clark, 1985; Henderson & Clark, 1990; Schilling, 2005). These classifications exhibit consequences for the firm and say something about the impact of the innovation. Product/process and administrative/technical innovations are examples of the second as they clearly lead to information about the nature of the innovation (Damanpour et al., 1989; Schilling, 2005).

A comprehensive typology framework regarding the nature of the innovation is given by Krebbekx et al. (2006) and will be used -in adapted form- in the remainder of this paper.[4] The advantage of his typology lies in fact that it is rather eclectic and precise in nature, yet limited to only five types of innovation. Moreover, it is very intuitive. The five types of innovation are listed in Table 4:

1. Physical Product Innovation	Innovations concerning physical end-products
2. Service Innovation	Innovations concerning non-physical end-products
3. Production Process Innovation	Innovations concerning the primary production process
4. Secondary Process Innovation	Innovations concerning secondary processes and the organisational structure within the company
5. Social Innovation	Innovations concerning the social network, corporate culture and HRM

Table 4: Different types of innovation based on Krebbekx et al. (2006), adapted.

Practically every innovation within a corporation can be assigned to one of the categories, depending on the nature of the innovation. Although the first three are quite obvious, the last two are fairly vague and will therefore be briefly discussed. Secondary process innovation is about innovations with respect to the organisational structure and secondary processes such as the research and development process and sales department (i.e. marketing). Hence it has an internal focus directed towards procedures and the organisation as an entity. Social innovation, on the other hand, is directed towards the people constituting the organisation. These innovations often involve a change in thinking.[5] Moreover, this type of innovation also entails remuneration schemes and other motivational innovations (De Jong & Braaksma, 2005). This definition deviates on this point from that originally given by Krebbekx et al. (2006).

It is important to note that the different types of innovations are highly interdependent: i.e. one type of innovation can initiate another type and any barriers resulting from one type of innovation can have its impact on any other type of innovation. This is schematically shown with

[4] Do note that his classification is practise based, and not that much based on a scientific method. However, the typology is very appealing to common understanding and scientific literature deals with equivalent typologies.

[5] An example is the introduction of e-mail in corporations: people are expected to answer their e-mail within 24 hours (unwritten rule). The e-mail in itself is not the social innovation, yet its consequence - change in corporate culture- is.

the pentagram of Figure 4 and is also confirmed by Damanpour et al. (1989) in the context of administrative and technical innovation in public libraries.

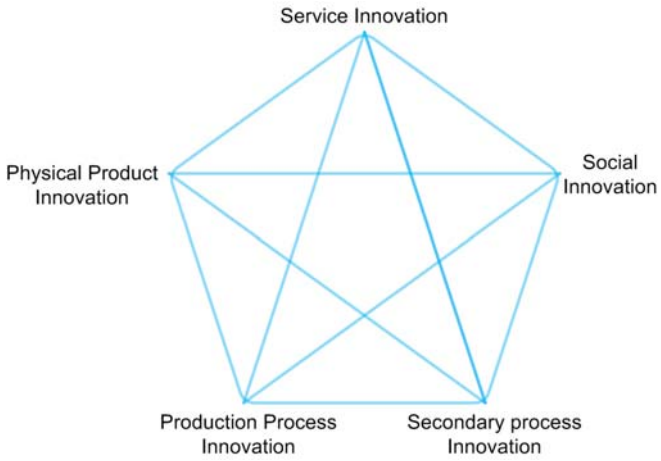

Figure 4: Schematic overview of the interrelationships of the different types of innovation.

The scope of this research will confine itself to physical product innovation as these are very likely to occur within the production industry and often used in other research (e.g. (Becheikh et al., 2006)). The author has not come across a research that relates this type of innovation with outsourcing for any Dutch industry. Another argument in favour of the choice for product innovation performance is that the validity in measuring this element is higher than for, e.g., social innovations since its definition is probably more unambiguously interpreted.

In Figure 5 the typologies are schematically shown to illustrate the position of the different types -note that it is not meant hierarchal!- and to clearly show how they relate to the other type of classification. With this model it is also easier to demonstrate the comprehensiveness of the model as most of the pairs mentioned in literature can be placed somewhere in the overview. Take for instance the product/process innovation distinction. Clearly the adapted typology of Krebbekx et al. (2006) covers this pair and even deepens the dimension with one level. Another pair is that of administrative and technical innovation. The definition given by Damanpour et al. (1987; 1989) characterizes technical innovation as innovations that lead to a change in the technological system of the organisation. This system refers to the production and secondary processes and hence corresponds to the process innovation in the figure. Again the adapted typology of Krebbekx et al. deepens the dimension with one level. Administrative innovations are defined as innovations that relate to management and personnel -i.e. recruitment, incentive schemes and staff development plans- and are said to influence the social system of an organisation (Damanpour, 1987; Damanpour et al., 1989). This seems to coincide with social innovation. These examples illustrate the comprehensiveness of the typology.

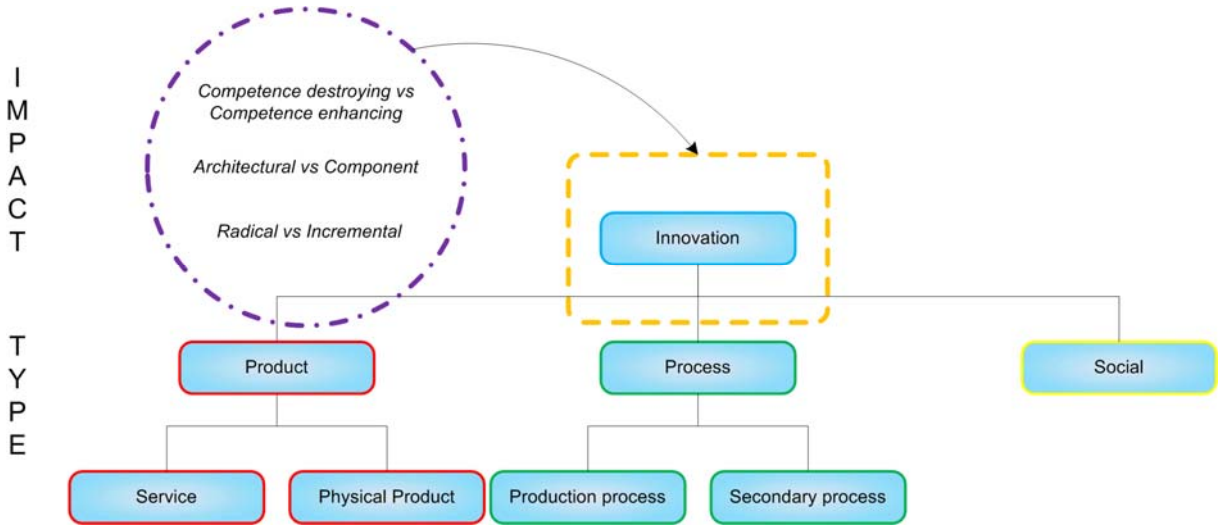

Figure 5: Different classifications of innovation.

Relating to the classification according to impact are pairs such as radical/incremental, competency enhancing/destroying and architectural/component. Although each of these pairs encompasses a different perspective, they also have some things in common and are -in essence- very much alike. For instance, each pair consists of two extremes between which there exists a continuum to classify the innovation. Incremental innovations refer to small improvements to the existing situation. Radical innovations are usually new to the market and/or firm and often make other i.e. products obsolete (Schilling, 2005). They drastically change the status quo and as such are closely related to the competence destroying typology. Competence destroying innovations are those innovations that devaluate the firm's current resources and knowledge. The innovation calls upon new requirements which are poorly met by the established resources (Abernathy & Clark, 1985; Tushman & Anderson, 1986). At the other end of the continuum are competence enhancing innovations. These types of innovation strengthen the current resources of the firm and are capable of improving the competitive position, i.e. a process innovation which allows for more effective labour allocation (Abernathy & Clark, 1985; Tushman & Anderson, 1986). Finally, there is the architectural/component innovation pair. Again there exists a close relationship with the other pairs. Henderson and Clark (1990) define architectural innovations as innovations that "change the way in which the components of a product are linked together, while leaving the core design concepts (and thus the basic knowledge underlying the components) untouched" (p. 10). Hence the firm's architectural knowledge is made obsolete, but their component knowledge remains unimpaired. Component innovations are exactly the opposite. The difference with for example radical and incremental innovation lies in the perspective of the impact and they can actually be seen as complementary. Whereas radical and incremental takes a more or less external perspective (how is the innovation perceived by the outside world?), component and architectural innovation takes an internal perspective (how does the innovation influence the firm itself?).

The elements of impact are of importance for a good understanding of the literature about innovation, but will be of less concern in this research. In this paper a distinction will be made to the nature of the innovation, not the impact. This has to do with the fact that it is intended to measure the innovative performance of a firm not on a technological basis, but on more

financial grounds. The financial measure is also a less biased measure as technological performance is less tangible than monetary earnings. With the concept of innovation somewhat clarified, it is possible to take a look at relevant prerequisites for corporations to engage in innovation. This topic will be elaborated upon in the next section.

2.4 What do you need for Innovation?

This section will deal with the innovation process and the elements that are crucial in this process. Some prerequisites to innovation will be mentioned and will be further elaborated on in the forthcoming paragraphs. The prerequisites are not meant exhaustive but are used to demarcate the scope of this research. Moreover, the schematic figure in this paragraph certainly does not pretend to give the whole picture, but it does represent a possible perspective to look at innovation.

2.4.1 Prerequisites to Innovation

Both the definition of innovation stated earlier and literature recognise two essential elements of innovation: invention and commercialisation (Schulz, 1992; Feldman, 1994; Krebbekx et al., 2006). The invention does not have to be done within the company -it can also be purchased or imitated- but what is crucial to innovation is that it is expropriated.[6] The commercialisation component consists of further development of the invention and introduction to the market (Feldman, 1994; Adams et al., 2006). An invention alone is not an innovation, it has to be brought 'on the market' (Fagerberg, 2005; Becheikh et al., 2006). Here it is assumed that innovation -by definition- is the commercialisation of an invention. This perspective will be used as framework to investigate the effect of outsourcing on innovation.

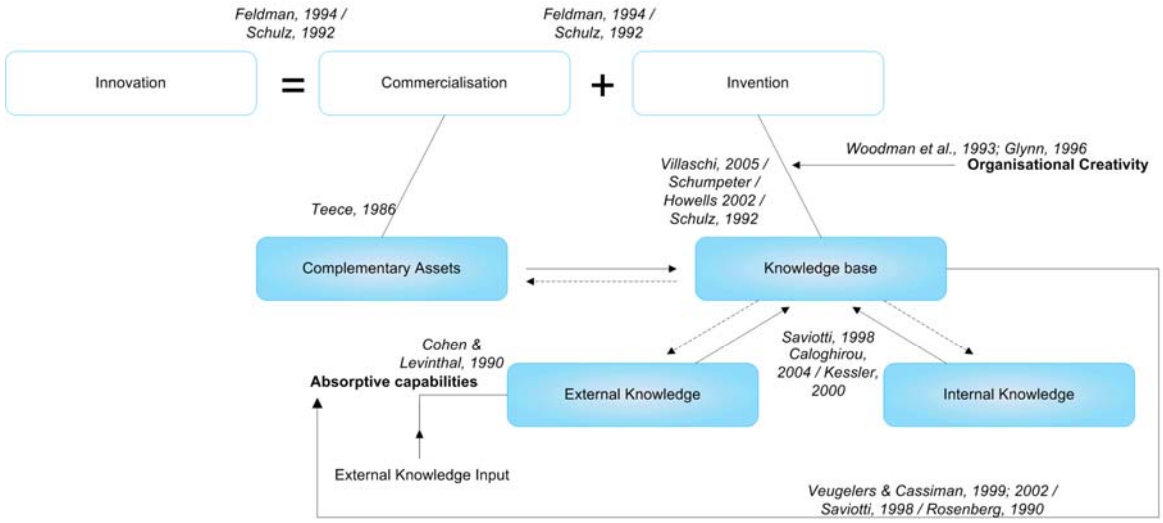

Figure 6: Schematic overview of prerequisites of innovation.

[6] Compare Grassmann & Enkel (2004) who state that the locus of knowledge does not have to be the same as the locus of innovation.

2.4.2 Knowledge

Inventions -i.e. new products and processes but also new organisational structures- are actually a product of knowledge; new combinations of earlier knowledge, Schumpeterian new combinations (Villaschi, 2005). Schulz (1992) indicates that new products and processes are built upon generic knowledge and that entrepreneurial choice -in the figure indicated by the commercialisation element- determines the eventual transformation into an innovation. Yet the knowledge aspect in the initial stage is of high importance. Accumulation of knowledge can be done either via internal knowledge channels -such as RnD- or external knowledge where both sources are often seen as complementary (Rothwell, 1991; Saviotti, 1998; Kessler et al., 2000; Caloghirou et al., 2004; Hoecht & Trott, 2006). The knowledge base is defined here as the knowledge embedded in the organisation and its personnel (Nonaka et al., 2000). The knowledge base is essential to the absorption of external knowledge, as firms have to be able to recognise and assimilate external knowledge; the well known phenomenon of absorptive ability (Cohen & Levinthal, 1990). After all, there is little to win from a central network position that provides access to knowledge if the firm in question cannot absorb that knowledge (Tsai, 2001). Hence the presence of a minimum threshold of knowledge inside the corporation is called upon, which illustrates the need for internal knowledge development (Rosenberg, 1990; Saviotti, 1998). Veugelers and Cassiman (1999; 2002) found empirical evidence for this relationship at Belgian manufacturing firms. The absorptive capacity has, on its turn, a positive effect on the internal knowledge development, via the knowledge base, as well (Veugelers, 1997). The need for both sources of knowledge is also stressed by Malerba (2005), who found this relationship in the chemical sector.

Cohen and Levinthal (1990) introduced the concept of 'absorptive capacity'.[7] This refers to the capabilities of a firm to exploit, assimilate and recognise useful external knowledge and is in that sense critical to a firm's innovative capabilities (Cohen & Levinthal, 1990; Chen, 2004; Lazonick, 2005; Volberda et al., 2007). From the definition it is clear that the construct entails three elements: recognition of new knowledge, assimilation of knowledge into the firm and application of that knowledge to commercial ends (Lane & Lubatkin, 1998; Lane et al., 2001; Van den Bosch et al., 2003). Innovative ability is improved because with a large absorptive power the scope of resources is also enlarged. And given that innovation is a new combination of existing resources, the innovative capacity increases (Volberda et al., 2007). Empirical research by Weerawardena et al. (2006) supports the positive effect of absorptive capacity on the innovative performance of a firm. The ability to absorb knowledge from outside builds upon the knowledge base of the firm (Cohen & Levinthal, 1990) and elucidates why firms should develop at least a minimum threshold of knowledge themselves at some point in time. Cohen and Levinthal (1990) also indicate other methods of creating absorptive capacity, such as the training of personnel and as the by-product of manufacturing (generating the necessary background knowledge). The development of the knowledge base -and with this the absorptive capacity- is an accumulative process and can therefore be seen as path dependent (Adams et al., 2006; Zhang et al., 2007). This is also one of the dangers as path dependency can lead to inertia: firms should not become entrenched in a too narrow scope of knowledge. Thinking out-of-the-box and access to a broad

[7] For a deeper understanding and more thorough analysis of this concept, it is recommended to read Zahra & George (2001) and Van den Bosch et al. (2003).

scope of knowledge -as indicated above- remain important. The knowledge base is of high importance since it is a prerequisite to the absorptive capacity of the corporation.

Having knowledge inside the organisation is not enough. After all, knowledge does not equal invention; the available knowledge has to be converted into an invention. According to literature, it is creativity that facilitates this process and that generates new inventions/ideas (Woodman et al., 1993; Amabile et al., 1996; Glynn, 1996). Woodman et al. (1993) argue that creativity is a multi-level phenomenon: it starts with the individual and results in organisational creativity through group creativity and social and contextual influences. Similar line of reasoning is also proclaimed by other authors (Glynn, 1996; Drazin et al., 1999). Although creativity at the individual level is determined to a great extent by personality characteristics, contextual, social influences are considered important as well (Woodman et al., 1993; Glynn, 1996; Andriopoulos, 2001). For instance, research has shown that a certain work environment can positively influence creativity with individuals (Oldham & Cummings, 1996). Moreover, Amabile (1998) showed that intrinsic motivation is an important determinant of creativity. As just mentioned organisational creativity is the outcome of the interaction between and aggregation of -among others- individual and group creativity, group processes, social influences and other contextual influences within the firm. It eventually determines the capability of the organisation to convert knowledge in inventions -on firm level analysis- and is as such essential to the innovative performance of the firm. From this perspective, beside the individuals of the firm that determine the organisational creativity, a corporation should also address those issues that could inhibit creativity (Amabile et al., 1996). For example, corporate culture, leadership, formal approaches and organisational resources should stimulate creativity in order to enhance organisational creativity (Glynn, 1996; Andriopoulos, 2001). The positive effect of organisational characteristics that foster creativity on the firm level is empirically supported by the research of Bharadwaj and Menon (2000) and the earlier cited work of Oldham and Cummings (1996).

2.4.3 Complementary Assets

Whereas knowledge is about the know-how of the invention, complementary assets come at play when it comes to production and further commercialisation as is argued by Teece in his widely cited seminal article (Teece, 1986). From the discussion of the meaning of innovation, it becomes evident that commercialisation is a crucial aspect of innovation. The ability of the firm to bring products to the market, efficient production capability and its marketing skills are all examples of complementary assets (Teece, 1986; Fagerberg, 2005). Hence complementary assets are -with innovation- those resources and capabilities that complement the know-how of invention to and in the market, i.e. marketing and after-sales support. Empirical research has found support for the importance of complementary assets such as understanding customer's necessities and marketing capabilities as they can significantly influence innovative performance (Galende & De la Fuente, 2003). Although Teece talks about technological knowledge and innovation, the reasoning can easily be extended to other types of innovation. Teece (1986) further distinguishes between different complementary assets -generic vs. specialized- to identify the interaction with the innovation. More specifically, it determines the interrelated dependency and helps assessing the make-or-buy decision. According to Teece (1986), the complementary assets determine to what extend the firm captures the value of the eventual

innovation. From the perspective of complementary assets it is not necessarily the first mover with a new technology that wins, but the firm with the better complementary assets (Teece, 2007).

2.5 Hypotheses

In this section the proposed relationships that are tested in the next chapter are stated and elucidated on. The hypotheses ought to lead to a general impression and conclusion with respect to the effect of outsourcing on innovative performance of the firm. The effect on innovative performance will be measured by looking at the effect of the independent variables on product innovation performance. This type of innovation is chosen, as explained earlier, because it is very important and common in the production industry. On top of that, it is well measurable with a high validity. With respect to outsourcing the focus will be on the outsourcing of two activities: 1. Manufacturing, and 2. RnD. By not including all the different activities in one model, possible opposing, flattening effects are prevented. These two groups are chosen because product innovation is most likely to occur in these two activities and the scope of the research had to be limited. Moreover, in his research Leiponen (2005) argues that outsourcing complementary, closely related activities can be detrimental to innovation. In the production industry, it is very plausible that manufacturing and RnD are highly complementary for engaging in innovation, thus making it more likely that outsourcing one of the two activities will have its effect on product innovation performance. The reader will notice that determining the effects asks for weighing trade-offs, hinting to a contingency approach.

As mentioned earlier, outsourcing activities leads to a loss of control, capabilities and even knowledge as the firm loses touch with -among others- emerging technologies (Bettis et al., 1992; Kotabe, 1998). Given that knowledge is an essential element of innovation and is built upon external and internal sources, outsourcing would mean a decrease in the internal knowledge and as such result in a loss of innovation capabilities. On top of that, separating activities will make it more difficult to innovate, because of the lack of linkages between the different activities within the firm (Kotabe, 1998; Mol, 2007). On the other hand, access to external specialized knowledge was named as one of the advantages/reasons to engage in an outsourcing relationship (Quinn, 1999; Quélin & Duhamel, 2003). Hence the external knowledge component increases, possibly offsetting the initial loss in internal knowledge. Apparently there is some kind of trade-off. This seems very likely, however one should not forget an imperative prerequisite to external knowledge absorption: the absorptive capacity of the firm (Cohen & Levinthal, 1990). The absorptive ability of the firm is determined -to a large extent- by the knowledge base of the firm, as is argued above. Especially the internal knowledge is of great importance to assimilate and recognise external information. Taken together it is convincing to reason that initially, outsourcing will have a positive effect on innovative performance, for external knowledge from the supplier is incorporated and replaces the original internal knowledge. However, it is plausible that a firm that continues to outsource activities loses absorptive capabilities -as the firm hollows- through which it will fail to assimilate external knowledge to an extent, sufficient for offsetting the loss in internal knowledge. This net loss in knowledge has negative ramification on the innovative capabilities of a firm, given the role of

knowledge in the innovation process, as elaborated upon above. Consequently it is expected that outsourcing is related to innovative performance through an inverted U-shaped curve. This reasoning applies as well to outsourcing of manufacturing activities as to outsourcing of RnD. It brings about the conclusion that too much outsourcing leads to a hollowing of the organisation's innovative capabilities.

The following hypotheses are used to test this statement:

1. *The percentage of manufacturing/RnD activities that is outsourced has a negative effect on product innovation performance.*
2. *The relationship between product innovation performance and outsourcing manufacturing/RnD is characterized by an inverted U-shape.*

Closely related to the previous statement is the expected moderating effect of the absorptive ability of the firm. Firms with a better absorptive capacity ought to be more capable to leverage the knowledge that a firm might tap in to via an outsourcing relationship. This, as explained earlier, has to do with the technological aspiration level and ability to recognise important information with which the firm can improve its inventions as well as its complementary assets. Empirical support is found for the positive effect of the absorptive capacity of the firm on the -technological- knowledge transfer between two firms (Chen, 2004) as well as within a firm (Szulanski, 1996; Wong et al., 1999). Moreover, in his research covering the petrochemical and food-manufacturing industry, Tsai (2001) found that the absorptive capacity had a positive interaction effect with the network position on the innovative performance of business units. This supports the idea that absorptive capacity improves the leverage of knowledge when gaining access to outside knowledge. Following the same reasoning as with the first statement, an increase in absorptive capacity will lead to more knowledge within the organisation when engaging in outsourcing, which will translate itself in higher innovative performance. The same reasoning applies to both manufacturing as RnD outsourcing. Taken together, it can be argued that absorptive capacity is important to leverage the knowledge a firm taps in to via outsourcing.

The following hypothesis is used to test this asumption:

3. *Absorptive capacity positively moderates the relationship between outsourcing manufacturing/RnD and product innovation performance.*

An important determinant of knowledge transfer, knowledge accumulation and knowledge creation is interaction (Sternberg, 1999; Nonaka et al., 2000; Caloghirou et al., 2004; Malerba, 2005; Hoecht & Trott, 2006). The use of interaction in explaining clusters and the value of regional and national innovation systems in the economy is a good illustration of how important interaction is for the transfer of -especially tacit-knowledge (Hoecht & Trott, 2006). With this in mind, it is plausible that offshoring -as a mode of outsourcing- negatively influences knowledge transfer from the supplier to the firm as the firms will find it harder to communicate. Halpern & Muraközy (2007) have found empirical support for this reasoning as they found a negative effect of distance on spillovers between firms in Hungary. Since it is likely that firms that offshore activities have less direct/effective interaction with their supplier due to physical and cultural distance, a negative moderating effect on innovative performance is expected (Becheikh et al., 2006). The knowledge base will find it more difficult to accumulate due to the depressed

knowledge transfer and communication, leading to a decrease in inventions and a decrease in enhancement of complementary assets, resulting in fewer innovations. Especially at the start of an offshoring relationship the so called 'liability of foreignness' (Eden & Miller, 2004), known from the internationalisation literature, might also negatively influence the outsourcing / innovation relationship. Moreover, it is said that separating the two activities will make it harder to innovate, i.e. because synchronisation of the commercialisation and creation -invention- becomes more difficult (Kotabe, 1998; Poldahl, 2006). The possible positive effect of keeping both activities in-house is empirically supported by Parthasarthy and Hammond (2002) in the surgical and medical device production industry, who found a positive interaction effect between functional integration and RnD intensity on the number of product innovations (whereas the effect was absent with external integration). Naghavi and Ottaviano have set up a mathematical model in which they illustrate that offshoring of production, due to its negative effects on knowledge spill-overs generates less feedback to the RnD department which on its turn negatively influences product innovation and growth (Naghavi & Ottaviano, 2007). This reasoning brings forth that offshoring ought to have a negative effect on the relationship between outsourcing and innovation.

The following hypotheses are used to test this statement:

4. *Offshoring manufacturing/RnD negatively influences product innovation performance.*
5. *The 'distance' between the reference country (the Netherlands) and the offshoring country negatively moderates the relationship between offshoring manufacturing/Rnd and the product innovation performance of the firm.*

In the section 2.1.3 it was stated that outsourcing can be done either in a strategic or non-strategic fashion. The latter is often seen as purely directed to cost reduction whereas the first also entails more strategic matters such as access to specialized knowledge (Mol, 2007). When a firm outsources with the intention to access external knowledge, it will probably try to take advantage of this by more actively absorbing knowledge from the supplier, after all that was its motive to engage in the relationship. Hence the knowledge base of the firm is more prone to increase when a corporation sources for access to external knowledge than when it just sources for cost reduction. Following the reasoning above this should lead to increased innovative performance for manufacturing as well as RnD. For outsourcing RnD, this idea is supported and argued in the working paper of Adams & Marcu (2004). They don't find a significant effect of sourcing RnD on the number of product innovations, whereas they do find positive effects for other kinds of RnD activities, such as research joint-ventures. Adams & Marcu explain this difference by pointing to the underlying reason to source RnD or to start a research joint-venture.

Another often mentioned reason to engage in outsourcing is creating a focus on core competencies within the firm. As a firm outsources it is likely to lessen the managerial pressure since there are few activities to worry about. The spare managerial attention can be redirected to more important activities in the organisation (Mol, 2007). This focus might translate itself in more attention for current processes in-house or even new product development and is possibly dependent on the strategic intent / core competencies of the firm. Moreover, outsourcing can

also lead to slack resources which can be allocated to these core competencies. Up to a certain point these slack resources will be beneficial for innovative performance (Nohria & Gulati, 1996; Adams et al., 2006).

These examples illustrate that if a firm outsources for strategic reasons, it will try harder to expropriate the relationship with respect to knowledge leverage than when a firm outsources non-strategically for mere cost reduction. Moreover, the benefit of access to knowledge is not likely to be at full strength when outsourcing is done merely to decrease costs. Again, the argument holds for both outsourcing of manufacturing and RnD. The reasoning suggests that firms that outsource with strategic motives beyond cost driven reasons have increased innovative performance.

The following hypotheses are used to test this statement:

6. *Outsourcing manufacturing/RnD activities with the intention to access external knowledge, positively moderates the relationship between outsourcing manufacturing/RnD and product innovation performance.*
7. *Outsourcing manufacturing/RnD activities with the intention to reduce cost, does not moderate the relationship between outsourcing manufacturing/RnD and product innovation performance.*

3. EMPIRICAL PART

In this chapter the empirical part of the research will be discussed. First, the data collection process is described and the models that are used to test the hypotheses will be presented. Secondly, the method with which these models will be investigated is discussed after which the relevant variables are examined. Finally, the statistical results are elaborated on and will be interpreted.

3.1 Sample Information

The list of potential respondents was constructed for a PhD-research on outsourcing in 2007. A list of two thousand production firms was provided by the Rotterdam School of Management. In 2007, the firms on this list were contacted by phone to ask if they could be sent a questionnaire. This led to one thousand potential respondents, who are all employed in a management position at a firm in the Dutch production industry. In the end, 200 respondents cooperated with the PhD-research. For the present study the same -one thousand- firms were contacted.[8] Given the research in 2007, two groups can be discerned: a group of 200 respondents who already participated in the 2007 research and a group of 800 respondents who did not. Both groups had their own questionnaire. The difference between the two questionnaires was that the group of 800 respondents also had to answer questions that the other group already answered the year before.[9] Almost all questions relevant to the hypotheses testing were included in both questionnaires. The group that did not participate with last year's research had an average time to complete the questionnaire of about 25 minutes as compared to 17 minutes for the other group. The exact completion time depended on the answers given by the respondents.[10]

The data is collected through an internet based questionnaire (Global Park software). This offered the opportunity to build a questionnaire with several different 'paths', depending on the answers that were given by the respondents (compare footnote 10). The two groups were sent an e-mail -and several reminders- with a personal link that directed them to the questionnaire. The first invitation was sent at the start of June, 2008. Several days earlier, the 200 respondents of the PhD-research were sent their personal feedback-report on the results of the PhD-research and with the announcement that they would be invited to cooperate with a follow-up questionnaire. First after two weeks and then after four weeks, two additional reminders were sent to both groups (again with the personal link). After the summer holidays, in September two

[8] Clearly, this offered many advantages. For instance, it saved a lot of time, the database included many personal names and e-mail addresses of managers / CEO's, there was already some data on outsourcing available from these firms and they already signaled that they could be willing to participate.
[9] Many of these questions were irrelevant to this study.
[10] For instance, if a respondent indicates that he outsources production, a next question asks him to assess the percentage of the activity that he outsources to independent firms in the Netherlands, abroad etc.. The latter question is omitted if the answer to the first question is "no".

more reminders were sent to those who did not fill out the entire questionnaire. Finally, in October about fifty potential respondents from the group of 200 respondents were called to ask if they would like to reconsider their decision not to fill out the questionnaire.[11] All this effort has resulted in the following numbers: 146 respondents started filling out the questionnaire. In the end 107 filled out all the questions (73 respondents from the group of 200 respondents versus 34 from the other group).[12] The many drop-outs are probably caused by the large number of questions in the questionnaire. This has led to a total response rate of 11.5 % which is not very high. Luckily most relevant questions were asked in the first part of the questionnaire, therefore in the final analyses the number of respondents is slightly higher than 107.

The questionnaire was specifically designed to test the hypotheses from chapter two.[13] Variables were deduced from the hypotheses and their measurements were decided upon after a thorough literature search (see section 3.3). Obviously, the questionnaire for the PhD-research offered a good starting point for some of the variables in the present study (i.e. strategy and outsourcing reasons).

Both small and larger firms are included in the sample; about 50% of the respondents represent a firm with less than 100 employees (measured as number of FTEs). There is also a wide distribution in age and sector. The latter is already discussed in section 3.3.3.

The Figure 7 to 11 show that most of the firms in the sample are active in innovation. For instance, 84 % percent of the respondents have either introduced a radical or incremental product innovation in the last three years.[14] It is interesting to see that there is no real difference in frequency of radical innovations as compared to incremental innovations. Apparently firms in the Dutch production industry do not have a strong preference for either one of the two innovation types. When looking at outsourcing of manufacturing and RnD to *external* parties -this does not include foreign subsidiaries!-, it becomes apparent that outsourcing RnD is less commonplace than the first in the Dutch production industry. The diagrams illustrate that quite some firms in the sample outsource and innovate, which is reassuring for the forthcoming analyses.

[11] It was chosen to focus on this group, since the average completion time for the questions was far lower than that of the other group. Moreover, they have already showed willingness to cooperate during last year's research.

[12] A brief analysis -Mann-Whitney test- does not indicate a difference in mean of the variables between the two groups of the sample. Therefore there does not appear to be a self-selection mechanism at play with the respondents that fill out the questions.

[13] This is only partly true for the questionnaire for the group of 800 respondents. After all, this questionnaire also contained questions relevant to the earlier mentioned PhD research.

[14] Similar binary measurements are often used in literature (e.g. (Tether, 2002; De Jong & Marsili, 2004; Huergo & Jaumandreu, 2004; Bhattacharya & Bloch, 2004).

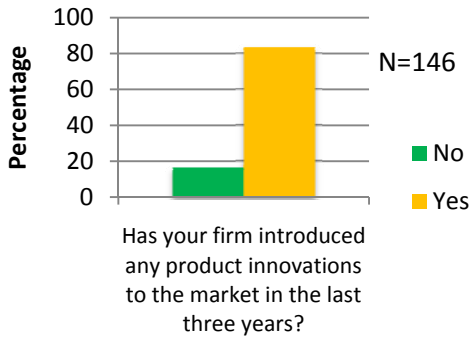

Figure 7: Product innovation, Yes/No?

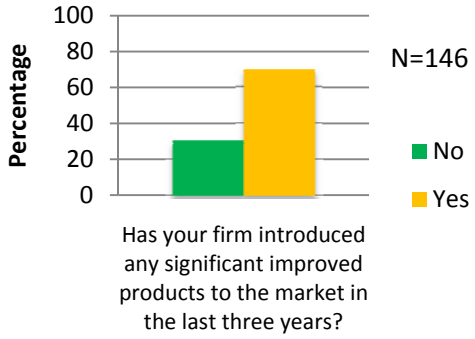

Figure 8: Incremental product innovation.

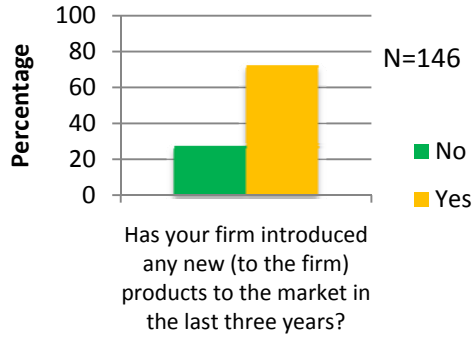

Figure 9: Radical product innovation, Yes/No?

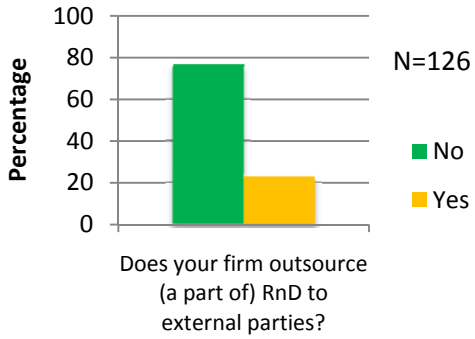

Figure 10: Outsourcing RnD, Yes/No?

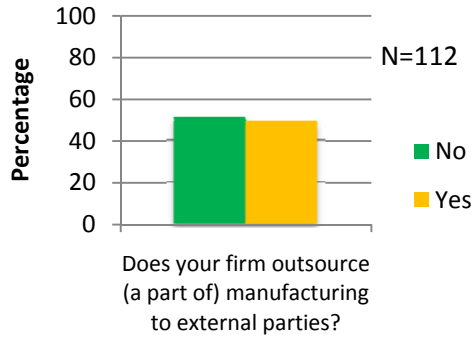

Figure 11: Outsourcing manufacturing, Yes/No?

3.2 Models

The hypotheses developed in the previous chapter will serve as the starting point for the different models that are to be tested. First the effect of outsourcing manufacturing and RnD on innovative performance -product innovation- is tested. Second, the role of absorptive capacity is investigated. Thirdly offshore outsourcing is taken into consideration to determine the effect of

outsourcing on innovative performance. Finally, the reasons to outsource a certain activity will be investigated in relationship to product innovation performance.

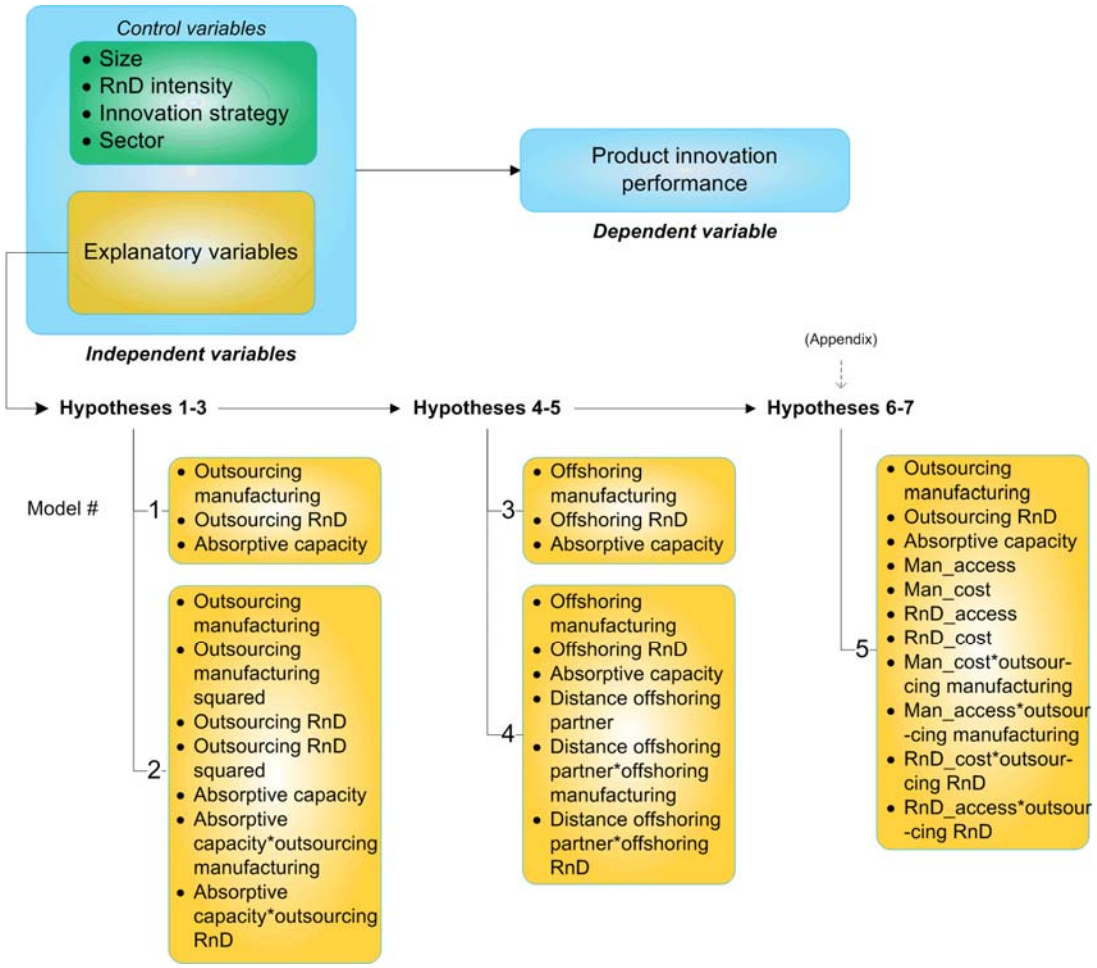

Figure 12: Schematic overview of the models that are tested.

In the interest of clarity, Figure 12 gives an overview of the models needed to test the designated hypothesis. The orange part of the figure indicates which are the explanatory variables for that specific model. The forthcoming section regarding the variables, will further elaborate on the choice of the specific variables and the way they are measured.

Five models have been specified. The independent effects of outsourcing and offshoring are estimated in separate regressions for two reasons. First of all, by isolating the estimates of the independent effects from the interaction terms, possible multi collinearity problems are prevented which increases validity of the estimates of outsourcing / offshoring. In addition, if offshoring and outsourcing would not have been separated, it would not be possible to test the independent effect of outsourcing, since offshoring is a further specification of the former (see section 2.1.3). The outsourcing reasons are less relevant and are put in a model placed in the appendix -number 6.6- to improve readability of the more important results. Moreover, if the reason variables had also been included in model two, there would be so many interaction terms in one model that inevitably multi collinearity would have seriously distorted the estimates. On top of that, there are no theoretical objections to separating outsourcing reasons from the other

variables in model two that are not included in model five (i.e. the squared terms and the interaction terms of absorptive capacity).

3.3 Variables

Below, the variables and their measurements are discussed. First the dependent variable is discussed. Next the explanatory variables that can be deduced from the hypotheses are talked over and finally some control variables are considered.

3.3.1 Dependent Variables

Product innovation performance is measured as the percentage of sales that can be attributed to products that were significantly improved or new to the firm in the last three years. This is quite a commonly used measure (e.g. Rogers, 1998; Veugelers & Cassiman, 2002; Caloghirou et al., 2004) and is also mentioned in the Oslo Manual (OECD, 1997). The indicator has the advantage that it really measures innovative performance and not just the technical quality of the invention. It is a good measure, for it also takes the commercialisation aspect into account by assessing the contribution of the invention to the sales of the firm. Literature, as shown above, emphasizes the importance of commercialisation in the determination of innovation performance. This is also one of the reasons why patent-data exhibit considerable shortcomings to measure innovation as this data only measures inventions (Becheikh et al., 2006). In the author's opinion a highly sophisticated new product that nobody wants to buy, embodies less innovative performance than an incremental product improvement that boosts sales. Respondents were asked to assess this percentage on a 0-100% scale. The continuous answers of the respondents are assigned to one of the following six categories: [≤2%] [2-10%] [10-20%] [20-40%] [40-60%] [≥60%]. Classifying the answers in categories is motivated by the regression method, explained in section 3.4.2. Moreover, it also restrains the effect on the variance of the dependent variable caused by the fact that most of the respondents had to estimate their product innovation performance.[15]

3.3.2 Independent Variables

Obviously, the most relevant variables, are those covering the outsourcing of manufacturing and RnD. Corresponding to Gilley and Rasheed (2000) outsourcing of manufacturing and RnD is measured as the percentage of the total value of the outsourced activity that is carried out by outside organisations. Outside organisations are defined as independent organisations either in the Netherlands or abroad. To make sure that outsourcing was interpreted correctly -in concordance with the definition developed in chapter 2- it was explicitly stated that outsourcing an activity means that either the firm once did the activity itself or that the firm was capable of doing the activity in-house but rejected internalisation. The two outsourcing variables are the

[15] The classes are chosen arbitrary, yet with the aim to suit the variable for the ordinal regression method and of course with a certain degree of intuition.

extent -percentage- to which a firm outsources manufacturing to external, independent parties and the extent to which a firm outsources RnD to external, independent parties: respectively OUT_ManExt and OUT_RnDExt. By looking at the percentage of the activity that is outsourced, it is possible to assess the 'hollowing' of the organisation, which is necessary to test hypothesis one. Moreover, to test the expected inverted U-shape, the outsourcing variables are squared and added to the regression, as is commonplace to measure such curve linear relationships.

Closely related to the outsourcing variables are the variables regarding offshoring as mode of outsourcing. These variables are actually a further specification of the earlier mentioned variables OUT_ManExt and OUT_RnDExt. The respondents were asked to indicate the percentage of the activity they outsource to a 100% independent organisation abroad. The resulting variables are OUT_ManExt_off and OUT_RnDExt_off. Moreover offshoring is given an extra dimension by creating a variable that assesses the offshoring *distance*; the distance between the Netherlands and the country to which the firm outsources some part of its activity. For simplicity it is assumed that the first declared country in the questionnaire is the only country to which the firm outsources part of its activity. Do note that 'distance' is not measured in kilometres, but more in a 'cultural distance' fashion by taking the institutional environment into account. To create such a sophisticated measure of distance, the Global Competitiveness Report (Porter et al., 2007) is used as reference work. To assess the offshoring distance with outsourcing manufacturing, the absolute difference between the value of the Business Sophistication Index of the Netherlands and the first mentioned offshoring country is taken. The obtained value illustrates to what extent both countries are alike on a certain field. If there is just a small difference in score, it is plausible to argue that communication and interaction -and thus knowledge spillovers- will flourish as compared to when there is a huge cultural gap. Similar reasoning holds for offshoring RnD. Here the distance is estimated by taking the absolute difference between the value on the Innovation Index of the Netherlands and the offshoring country, as stated in the Global Competitiveness Report. For both activities a different index is chosen in an attempt to improve validity. For example, different elements are at play regarding interaction when outsourcing production as compared to outsourcing RnD. This way of measuring distance should be more valid since contemporary information technology has suppressed the effect of physical distance in day-to-day life. The above mentioned measures take a more abstract -holistic?- approach. [16]

The importance of a good absorptive capacity for innovation is already illustrated in the previous chapter. One commonly used measurement for absorptive capacity is the RnD intensity of the firm (Cohen & Levinthal, 1990; Stock et al., 2001). RnD intensity is certainly of great importance to determine the absorptive capacity of the firm. After all, it indicates the amount of resources allocated to knowledge development, which serves as a base for the absorptive capacity. However, when examining literature it becomes apparent that this measure is too narrow and in that sense somewhat superficial (Lane et al., 2006). Other factors also play a role in determining the absorptive strength (Zahra & George, 2001; Nieto & Quevedo, 2005; Soo et al., 2005; Weerawardena et al., 2006). Elements such as staff skill and investment in training appear to be

[16] For the sake of overview -and given its comprehensiveness- the Business Sophistication Index and Innovation Index, will not be further explained. If you are interested in a more detailed discussion of the two distance measures, you are referred to the Global Competitiveness Report (Porter et al., 2007).

important. In order to capture the different aspects that determine the absorptive capacity of the firm, it is chosen to construct a variable existing of six items -scored on a 5-point Likert-scale- that are reoccurring in literature when it comes to measuring this phenomenon. The items are displayed in Table 5.

Item	Derived from	Variable
Knowledge is shared and distributed internally	*Soo et al., 2005; Weerawardena et al. 2006*	***ABSORP = .78***
We invest a great deal in training	*Lane et al., 2001; Nieto & Quevedo, 2005; Soo et al., 2005*	
Most of our staff is highly skilled and qualified	*Nieto & Quevedo, 2005; Weerawardena et al. 2006*	
We have considerable capacity for technological development	*Nieto & Quevedo, 2005*	
We are capable of effectively using external acquired knowledge	*Own addition.*	
We spend relatively much on RnD	*Cohen and Levinthal, 1990; Stock et al., 2001; Tsai, 2001; Poldahl, 2006*	

Table 5: Construct items for absorptive capacity.

From the table it can be derived that training and skill of personnel are important elements in assessing the absorptive ability of a firm. This has to do with the aspiration level of the organisation which is co-determined by the aspiration level of its employees. The importance of qualified personnel is also stressed by Rothwell in his research of the innovative capabilities of SMEs (Rothwell, 1991). Closely related to this argument is the item about knowledge sharing. Knowledge sharing increases the overall knowledge within the firm and enhances the aspiration level of staff. Somewhat more direct measures of absorptive capacity are the items regarding the capacity to use external knowledge and the capacity for technological development, as they explicitly ask for a 'performance' assessment of the absorptive capacity. RnD intensity remains important and is therefore also captured in one of the items. To illustrate the importance of RnD intensity as part of the absorptive capacity measure, one could for instance look at the research of Poldahl (2006). He finds a positive interaction effect of RnD with knowledge spillover on total factor productivity. The construct has a respectable alpha co-efficient of .78.

In order to test hypothesis number four, respondents were asked to score items containing reasons to outsource on their importance in the decision to outsource. Some of the scores on outsourcing of production were already known, since the items were asked in the research last year. To be able to get as much information as possible, it was decided to copy these items and therefore no new items were developed. In this way it was prevented that the already lengthy questionnaire got even lengthier because new items had to be asked concerning reasons of outsourcing production. With respect to the reasons to outsource RnD activities, it was chosen to use the same items. The items are quite generally formulated and well applicable to both outsourcing activities. By means of a principal component analysis -combined with an internal consistency test- two different reasons are deduced: cost reduction and access to external knowledge. This is not a trivial outcome, since these two aspects were kept in mind when the questionnaire was developed. Obviously, because of the length of the questionnaire, not all possible reasons could be included in the analysis. It is stressed once more that these reasons were chosen because most of the possible respondents had already answered the question for outsourcing manufacturing, leading to a smaller questionnaire. The latter has hopefully led to a

higher response rate. Detailed information about the constructs can be found in the appendix 63.

3.3.3 Control Variables

From the model overview, it becomes apparent that four control variables are included in the analyses: size, sector, strategic intent towards innovation and RnD intensity. These variables are inferred from literature and will be shortly discussed separately.

A firm's size is measured as the natural logarithm of the number of employees -FTEs- in the organisation. This is a commonly used measure, for instance found in the research of Damanpour (1992) and of Majocchi & Zucchella (2003). Although empirical results are somewhat mixed, size does appear to play a role in determining the innovative performance of a firm (Damanpour, 1992; Bhattacharya & Bloch, 2004; Becheikh et al., 2006).

To account for sector differences and to further purify the effect of the explanatory variables, sector dummies are added to the model. It is plausible that innovation is more accessible, commonplace or expensive in one sector as compared to another sector. Controlling for sector should somewhat 'downplay' the effect these differences on the explanatory variables. The different firms are clustered in five groups according to similarity of their true sector.[17] Figure 13 shows the distribution of the sample over these five clustered sectors. For a detailed overview of which ISIC code was assigned to which cluster: see appendix number 6.4. The respondents self-reported the sector that is most suitable for the firm they work for.

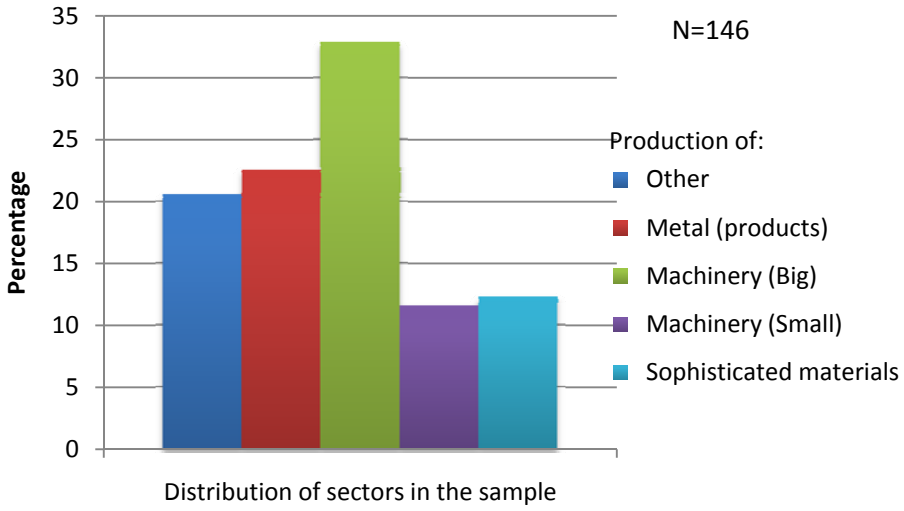

Figure 13: Distribution of the sectors in the sample.

Strategic intent to innovation of a firm will probably be an important determinant of innovative performance. Clearly a firm that follows an innovation strategy ought to be more innovative -product innovation performance- than a firm that follows a cost strategy. Moreover, the firm's structure is probably more suitable for innovative behaviour if it is recognized as one of the important pillars, or strategic intentions, of the organisation. This could be somewhat different

[17] For a valid classification of the sectors in one of the clustered groups, the classification of the Dutch Bureau of Statistics -CBS- was taken as the starting point. However, classification remains arbitrary.

for process innovations when cost-aspects are of great importance, process innovation could contribute to a better cost position. However, given that this study deals with product innovation, this will not cause any problems. To measure the strategic intention of a firm, respondents were asked to assign a score on a scale of one to five to indicate the degree of emphasis that the firm plans to place on the given items in order to maintain or improve its competitive position. The items are based on the research of Ward et al (1995) and Swamidas and Newell (1987) who –together- form five general strategies: cost, quality, delivery, flexibility and innovation. The reason to use these specific items is threefold. First the derived strategies are quite comprehensive and contain most of the basic components of a production firm's strategy (Ward et al., 1995). Secondly, from the cited research the constructs proved to have a good internal consistency. And thirdly -a more practical reasons- the newly collected data would be better compatible with the earlier collected data.

After the data collection a principal component analysis and further analyses with Cronbach's Alpha led to four different strategies, of which only the designated control variable "innovation strategy" appeared to be of influence on the dependent variable.[18] The control variable is measured as the mean score of the items as shown in Table 6: Items for the variable STR_Innov..

Item: emphasis on...	**Variable**
...New product introduction	***STR_Innov***
...Introduce more product varieties	***= .74***
...Invest more in R&D	
...Reduce new product development cycle	
...Introduce new production processes	
...Introduce more product features	

Table 6: Items for the variable STR_Innov.

Finally, RnD intensity is included as control variable. The effect of this variable as an input for innovative performance is widely recognized and therefore it is crucial to include this variable in the models (Parthasarthy & Hammond, 2002; Adams et al., 2006). In this research the intensity is measured as the expenditures on RnD as percentage of the firm's sales, which is also well accepted in literature (e.g. (Parthasarthy & Hammond, 2002; Bhattacharya & Bloch, 2004)). It is chosen to assign the answers to one of five categories of intensities: [<2%] [2-5%] [5-10%] [10-15%] [>15%].[19] Since many of the respondents probably estimated their percentage of RnD expenditures of sales, assigning the percentages to categories will take care of some of the variance caused by assessing the answer. Appendix number 6.5 summarises all the variables and their definitions.

Now all the models, variables and measurements are known, the next paragraph will deal with the method and the obtained results. In the appendix you will find a summary of the variable names and what they represent.

[18] The four different strategies are: delivery, cost, quality and innovation.
[19] The boundaries of the five different groups are chosen arbitrary. However, the frequency table indicates a declining line of the percentage per group, which is intuitively.

3.4 Results

Several different statistical tests are used to investigate the interrelationship between the variables and to test the models that are shown in paragraph 3.2. A correlation table is constructed to create understanding with respect to interdependence of variables and to check for signs of multi collinearity problems. Next, as a starting point, the Kruskal Wallis test is used -after testing for normality- to explore the relationship of some of the variables with the different categories of the dependent variable. In addition, to create some insights in the differences between firms that outsource and those that do not, a Mann-Whitney test is run. Finally, numerous regressions are run to investigate the interdependencies of the variables and to test the hypotheses. Only those relevant for the answering of the hypotheses will be discussed. However, first the descriptive statistics -excluding the correlation matrix- of the most important variables are shown in Table 7. Do note that the means for outsourcing and offshoring are distorted by the fact that a large part of the sample does not outsource / offshore at all (e.g. only 22 % of the respondents outsources RnD activities).

Variable	N	Minimum	Maximum	Mean	Std. Deviation
Prod_cat	142	1.00	6.00	2.9930	1.48513
Size	146	1.61	11.78	4.6220	1.59710
RnD_cat	146	1.00	5.00	2.0411	1.13184
ABSORP	132	1.17	4.83	3.5139	.65868
STR_Innov	146	1.67	5.00	3.5845	.62919
OUT_ManExt	112	.00	100.00	17.4955	28.58963
OUT_RnDExt	126	.00	100.00	4.5556	13.02893
OUT_ManExt_off	112	.00	100.00	7.5000	18.39359
OUT_RnDExt_off	126	.00	85.00	1.5238	8.25272
Valid N (listwise)	112				

Table 7: Descriptive statistics.

3.4.1 Preliminary Analyses

A correlation table can be helpful to shed light on the interdependencies of the variables and to indicate possible multi collinearity problems. Table 8 includes the most important variables in a correlation table.

The correlation table does not hint in the direction of any unexpected multi collinearity problems; extremely high correlations are only found between similar outsourcing measures. Other interesting outcomes are the moderate strong correlations between RnD intensity, absorptive capacity and innovation strategy. The variable ABSORP exhibits a high correlation with both RnD intensity and STR_Innov and the latter two also correlate significantly. Another interesting variable, is the dependent variable product innovation performance (categories). It correlates rather strong with the three earlier mentioned variables ABSORP, RnD intensity and strategic intent towards innovation. Likewise, the dependent variable exhibits a respectable correlation of .33 with offshoring production activities. Outsourcing manufacturing -either

abroad or domestic- also correlates with product innovation performance. Taken together, the many significant correlations with the dependent variable are promising for the forthcoming regression analyses in the next section.

	Prod_ cat	Size	RnD_ cat	ABSO RP	STR_ Innov	OUT_ Man Ext	OUT_ RnD Ext	sq_O UT_M anExt	sq_O UT_R nDExt	OUT_ RnDE xt_off	OUT_ ManE xt_off
Prod_cat	1										
Size	**.249**	1									
RnD_cat	**.416**	.095	1								
ABSORP	**.376**	.087	**.426**	1							
STR_Innov	**.342**	.028	**.269**	**.401**	1						
OUT_ManExt	**.247**	.039	.118	.035	.087	1					
OUT_RnDExt	-.011	.024	.039	-.052	-.055	.063	1				
sq_OUT_ManExt	**.209**	.006	.098	.058	.077	**.957**	.033	1			
sq_OUT_RnDExt	-.073	-.055	-.066	-.065	-.141	-.015	**.897**	-.020	1		
OUT_RnDExt_off	.040	.036	.025	.024	**-.150**	.049	**.756**	.054	**.882**	1	
OUT_ManExt_off	**.328**	.013	.141	.031	**.182**	**.759**	.074	**.778**	.000	.063	1

Green = significant at the 5 % level (2-tailed).
Orange = significant at the 10 % level (2-tailed).

Table 8: Correlation table of the most important variables.

After having investigated potential outliers, the Kruskal Wallis test offers a good opportunity to investigate differences of variables between the categories of product innovation performance. The results are depicted in Table 9. The outcomes indicate that almost all the variables -except those of outsourcing / offshoring RnD- are not the same across groups. In particular, the ranks suggest that there exists a difference between the first category(-ies) and the higher categories. The results imply that highly innovative firms are bigger, spend more on RnD, have a better absorptive capacity and have a stronger intent to innovation as compared to non-innovative firms, i.e. with a value of <3 %. On top of that, firms in the highest product innovation performance category appear to outsource and offshore a greater part of their production activities.

Test Statistics(a.b)

a Kruskal Wallis Test
b Grouping Variable: Prod_cat

	Size	RnD_cat	ABSORP	STR_Innov	OUT_ManExt	OUT_RnDExt	OUT_ManExt_off	OUT_RnDExt_off
Chi-Square	11.485	26.401	17.805	22.095	11.389	2.313	20.738	5.090
df	5	5	5	5	5	5	5	5
Asymp. Sig.	**.043**	**.000**	**.003**	**.001**	**.044**	.804	**.001**	.405
Ranks								
Prod_cat								
<3 %	61.31	47.21	45.29	42.26	48.68	57.48	42.30	58.56
3-10 %	63.45	59.88	58.91	74.07	52.10	65.54	47.25	61.06
11-20 %	71.52	73.69	62.87	70.96	55.54	60.54	61.57	63.83
21-40 %	70.55	87.26	79.66	88.74	66.22	66.26	65.84	63.77
41-60 %	99.30	87.67	84.50	78.40	46.96	66.33	53.46	69.27
>60 %	90.38	100.44	86.71	85.63	85.58	68.00	89.58	74.86

Green = 5 % sign. level.

Table 9: Kruskal Wallis Test on the product innovation performance categories.

The Mann-Whitney test is used to see if there are discrepancies with respect to certain variables when it comes to firms that outsource manufacturing or RnD juxtaposed with firms that do not.[20] The two different tables are combined in Table 10. Each of these tables divides the respondents in two groups, more specifically: outsourcing -a part of- manufacturing versus not outsourcing any percentage of production and outsourcing -a part of- RnD versus no RnD outsourcing at all. When comparing the group of outsourcers of manufacturing with the group of non-outsourcers of manufacturing, a totally different result is obtained than with the dependent variable. None of the variables emerges as favourable for either one of the two groups. This is in contrast to the other grouping variable, outsourcing RnD activities. Firms that outsource RnD expose a higher RnD expenditure intensity as well as a higher strategic intent to innovation.

[20] The non-parametric test is used since the Kolmogorov-Smirnov test indicated that the two variables are not normally distributed.

	Outsourcing manufacturing			Outsourcing RnD		
Variable	*Group*	*Mean Rank*	*Significant?*	*Group*	*Mean Rank*	*Significant?*
Prod_cat	0	53	No	0	61	No
	1	60		1	70	
Size	0	57	No	0	62	No
	1	56		1	68	
RnD_cat	0	56	No	0	59	**Yes**
	1	57		1	78	
ABSORP	0	59	No	0	61	No
	1	54		1	72	
STR_Innov	0	56	No	0	60	**Yes**
	1	57		1	77	
OUT_ManExt				0	55	No
				1	62	
OUT_RnDExt	0	54	No			
	1	59				
OUT_ManExt_off				0	54	**Yes**
				1	64	
OUT_RnDExt_off	0	55	No			
	1	58				

Group 0 = No; Group 1 = Yes

Green = 5 % sign. level; Orange = 10 % sign. level.

Table 10: Results from the Mann-Withney test.

3.4.2 Method

The ordinal regression method is used to test the hypotheses. OLS regression is not an option, since the dependent variable is not normally distributed.[21] To overcome this problem of non-normality, the dependent variable "product innovation performance" is divided in six ordered categories with category one being of 'lower value' than category two and so forth. Ordinal regression can be used to test possible relationships with ordered groups as dependent variable. This method does not assume normality. The method is further specified by choosing the appropriate link function to estimate the model. Based on the distribution of the dependent

[21] See appendix number 6.1 for the normality test. Moreover, the 0 – 100 scale violates the OLS assumption that the relationship follows a line and not just a line segment. However, this is of far less concern than the non-normality. Do note, though, that in this study similar results are obtained via OLS as via ordinal regression. Yet only the latter is statistically relevant.

variable and the overview given in the SPSS-help file -see appendix number 6.2-, the negative log-log is designated as the correct link function: lower categories are more likely to occur than higher categories and therefore the negative log-log link function should be used. Additional justification follows from the goodness-of-fit statistics and R-squared which are better with the negative log-log link function as compared to any other link function. For instance, with other link functions the Pearson Chi-Square indicates that the models do not fit the data. Obviously, a link function is preferred that does lead to a model that appears to fit the data well. Not all the obtained results are robust to alternative specification, i.e. changes in the link function.[22] This is not that surprising given that the different functions have different basic assumptions. Nevertheless, given that the other link functions are not / less appropriate, it can be said that the presented results are more valid.

3.4.3 Hypotheses Testing

This paragraph gives an overview of which hypotheses were supported, rejected or left in the middle. Table 11 summarizes the coefficients of the models as presented earlier in this chapter. Green numbers indicate a p-value of <.05 and orange numbers represent coefficients with p-values <.1. Sector dummies are omitted from the table to improve readability. The reader is referred to appendix number 6.5 for a more detailed overview of the regression outcomes.

First thing that stands out, are the significant threshold coefficients. This indicates a proper categorisation and suggests that none of the categories should be combined. Size, RnD intensity and STR_Innov show a positive effect on the dependent variable at the 5 % level in practically all models, as was expected. Investing more in RnD, or having a larger emphasis on innovation in your strategy will make it more likely that you are in one of the higher categories of the product innovation performance variable. Strangely enough, the absorptive capacity of a firm does not seem to affect the innovative performance. Although model two exhibits a 10 % significant effect of absorptive capacity, it is very plausible to argue that this effect is caused by multi collinearity problems due to the presence of the interaction terms since significant results in other model specifications -that include STR_Innov- fail to occur. More thorough research demonstrates that the addition of the variable STR_Innov to the model is likely to be responsible for the loss of significance of the ABSORP variable. If STR_Innov is not included, ABSORP exhibits a positive effect, significant at the 10 % level. This issue will be further addressed in the discussion section.

Model number one and two are used to test hypothesis number one and two, concerning the hollowing of the organisational innovative capabilities due to excessive outsourcing. However, nor the regular outsourcing variables nor the squared terms exhibit a significant effect on the dependent variable, product innovation performance. Consequently, hypotheses one and two are not supported. No evidence is found for the statement that outsourcing leads to a hollowing of the organisation's innovative capabilities.

[22] For instance RnD expenditures are often not significant with other link functions. On the other hand, the effect of strategic intention towards innovation is robust to a change in the link function.

Model		#1		#2		#3		#4	
	Variable	Estimate	Std. Error	Estimate	Std. Error	Estimate	Std. Error	Estimate	Std. Error
Threshold	[Prod_cat = 1,00]	**4.107**	1.032	**5.041**	1.213	**3.903**	1.037	**3.57**	1.034
	[Prod_cat = 2,00]	**5.016**	1.067	**5.967**	1.252	**4.855**	1.072	**4.554**	1.067
	[Prod_cat = 3,00]	**5.858**	1.096	**6.817**	1.279	**5.758**	1.104	**5.5**	1.101
	[Prod_cat = 4,00]	**7.051**	1.136	**8.021**	1.314	**7.012**	1.147	**6.81**	1.147
	[Prod_cat = 5,00]	**8.399**	1.2	**9.382**	1.369	**8.381**	1.212	**8.203**	1.212
Location	Size	**.167**	.071	**.189**	.073	**.153**	.071	**.143**	.074
	RnD_cat	**.353**	.118	**.344**	.121	**.355**	.119	**.384**	.126
	ABSORP	.241	.203	**.508**	.262	.264	.204	.21	.206
	STR_Innov	**.653**	.214	**.608**	.219	**.595**	.22	**.567**	.221
	OUT_ManExt	.004	.004	.036	.025			.501	.309
	OUT_RnDExt	.011	.009	-.012	.086			.016	.609
	sq_OUT_ManExt			5.56E-006	.000				
	sq_OUT_RnDExt			5.97E-005	.000				
	OUT_ManExt_off					**.02**	.006	**.044**	.015
	OUT_RnDExt_off					**.021**	.013	.113	.089
	ABSORP * OUT_ManExt			-.009	.006				
	ABSORP * OUT_RnDExt			.005	.024				
	RnDDistance * OUT_RnDExt_off							-.158	.161
	ManDistance * OUT_ManExt_off							**-.027**	.015
		Green = significant at 5% level; **Orange** = significant at 10 % level.							
	R-squared (McFadden)		*.152*		*.159*		*.176*		*.19*
	Test of Parallel Lines		*Fail*		*Fail*		*Pass*		*Pass*

Table 11: Regression outcomes.

The coefficients of model number two test hypothesis three: absorptive capacity has a moderating effect on the effect of outsourcing on innovative performance. As depicted in Figure 12 interaction terms are included in the regression to test the hypothesis. The results from the table do not show a significant coefficient for either the interaction term with outsourcing RnD or the interaction term with outsourcing production and hence hypothesis three is not supported. No evidence is found for the moderating effect of absorptive capacity on the effect of outsourcing on innovative performance.

Hypothesis four has led to an interesting outcome. In order to test the assumption that offshoring -as a mode of outsourcing- negatively influences innovative performance, the offshoring intensities replace the outsourcing intensities and interaction terms with the 'distance' variables are included in a separate model. Model three examines the independent effect of offshoring. Surprisingly, a *positive* significant effect is found for both offshoring production and RnD. The first has a p-value <.05 and the latter of <.1. Clearly this rejects hypothesis four. On the other hand, when looking at the interaction term between offshoring manufacturing and the 'distance' in model four, there appears to be a negative, significant effect on the dependent variable. The latter outcome is supportive to hypothesis five as far as it

concerns offshoring of manufacturing. Taken together, the idea that offshoring has a negative effect on innovative performance is partly supported, but also rejected up to a certain point.[23]

Hypothesis six is not supported (see appendix, section 6.5). There is no significant interaction effect of access-reason on outsourcing with respect to product innovation performance. Neither is there a significant moderating effect of the cost-reason on the relationship between outsourcing and the dependent variable (hypothesis 7). The latter is in concordance with expectations, though note that not being able to reject H_0 is statistically less strong than the other way around. Therefore this obtained result can only be used as an indication of partly supporting the statement that the reason why a firm engages in an outsourcing relationship matters for its effect on product innovation performance.

Not all the models fulfil the assumption of parallel lines, which assumes that the parameters are constant over the different thresholds. However, rejecting the null hypothesis of this test does not necessarily mean that there is also a practical significant deviance that makes the results insignificant (Kim, 2003). Consequently, not fulfilling this assumption statistically is not very informative and thus this 'flaw' in some of the models will be taken for granted. Multi collinearity diagnostics -VIF statistic- did not indicate any unexpected problems (except perhaps for the independent effect of absorptive capacity in model two); only those models with interaction terms had some high VIF values, which is inevitable with interaction terms included in the model. All models passed the log-likelihood test and Pearson Chi-Square test.

The table below gives an overview of the hypotheses and their respective outcomes.

[23] The interaction effect was also modelled with geographical distance as distance-measure. The coordinates to calculate the distances were obtained from the CIA factbook. The corresponding interaction terms with offshoring RnD and with offshoring production are both non-significant. This supports the idea that geographical distance is too short-sighted to measure the distance in -possible- knowledge spillover relationships.

Overview of the Hypotheses Testing

1.	*The percentage of manufacturing/RnD activities that is outsourced has a negative effect on product innovation performance.*	Not supported
2.	*The relationship between product innovation performance and outsourcing manufacturing/RnD is characterized by an inverted U-shape.*	Not supported
	➔ **Too much outsourcing leads to a hollowing of the organisation's innovative capabilities**	
	Manufacturing	Not supported
	RnD	Not supported
3.	*Absorptive capacity positively moderates the relationship between outsourcing manufacturing/RnD and product innovation performance.*	Not supported
	➔ **Absorptive capacity is important to leverage the knowledge a firm taps in to via outsourcing**	
	Manufacturing	Not supported
	RnD	Not supported
4.	*Offshoring manufacturing/RnD negatively influences product innovation performance.*	*Rejected*
5.	*The 'distance' between the reference country (the Netherlands) and the offshoring country negatively moderates the relationship between offshoring manufacturing/Rnd and the product innovation performance of the firm.*	*Partly supported*
	➔ **Offshoring has a negative effect on the relationship between outsourcing and innovation**	
	Manufacturing	*Partly supported, partly rejected*
	RnD	*Rejected*
6.	*Outsourcing manufacturing/RnD activities with the intention to access external knowledge positively moderates the relationship between outsourcing manufacturing/RnD and product innovation performance.*	Not supported
7.	*Outsourcing manufacturing/RnD activities with the intention to reduce cost, does not moderate the relationship between outsourcing manufacturing/RnD and product innovation performance.*	Supported
	➔ **Firms that outsource with strategic motives beyond cost driven reasons have increased innovative performance**	
	Manufacturing	*Partly supported*
	RnD	*Partly supported*

Table 12: Overview of the results for the hypotheses testing.

3.4.4 Discussion of the Results

This section will put the obtained results in perspective and will try to explain the outcomes.

Size shows a constant positive effect together with RnD intensity expenditures. Based on this observation it can be concluded that the more a firm spends -relatively- on RnD, the better its innovative performance. Translated into the context of the model in chapter one, this could mean better absorptive capacity -supported by the .4 positive correlation coefficient displayed in the previous section-, more internal knowledge or external knowledge acquisition and possibly more inventions. The size variable shows that there is a positive diminishing return -remember the log transformation!- of size on product innovation performance. Both results are in line with literature, as already referred to in previous sections.

The results from the hypotheses testing do not support the inverted U-shaped relationship between outsourcing and product innovation performance, nor is there support for a 'linear' relationship. The question if outsourcing leads to a hollowing of the organisations innovative capabilities remains unanswered. The lack of significant results on this part of the research could be due to the fact that -taken together- the advantages obtained through outsourcing regarding innovation from section 2.2 do not outweigh the disadvantages (and vice versa). For instance, following the reasoning of Kotabe (1998) outsourcing manufacturing could lead to a loss in linkages between different activities in a firm, offsetting the proposed advantage of access to specialized knowledge by Quinn (1999). The data do not expose a preference for either the positive side or negative side of the earlier mentioned trade-off in the hypotheses-section. The supposed slack resources and extra managerial attention generated by outsourcing activities, do not seem to have the decisive effect that was anticipated. In search of a plausible explanation, one could think about which activities are outsourced, but more importantly why activities are divested. For instance, if an activity is outsourced to reduce cost or -equivalently- to turn internal, fixed cost into variable cost motivated by bad economic prospects that ask for cost-cutting, it is not that likely that the obtained resources are 'slack' in a sense that they can be reinvested. Rather, the organisation might choose to 'take the money' or put it at use in paying off debts. In an effort to overcome this distorting element reason variables have been added, as is done for the hypotheses six and seven. The analyses did not indicate that outsourcing with the aim to access external knowledge influences the relationship between outsourcing and innovative performance. In line with Adams and Marcu (2004), there is no significant result for the interaction term with the outsourcing reason 'cost' either. The latter is supportive to the argument above.[24] The careful reader might refute the latter statement, since it has been argued that outsourcing leads to a loss in knowledge and as such should have a negative effect on the innovative performance of the firm. However, imagine you were to outsource in order to cut cost, wouldn't you first outsource those activities that are not essential to the continuation of the organisation? Consequently, 'divesting' these non-core activities, will probably lead to a marginal loss of relevant knowledge. If it were to be more core related activities, this reasoning does not hold, also because of the forgone possibilities of future opportunities (Hoecht & Trott, 2006). Unfortunately, this aspect -core/non-core- is not accounted for. The lack of significant result for outsourcing could also be caused by a deficiency in the absorptive capacity of a firm, as

[24] Of course, since the null-hypothesis is not rejected as the H_0 represents the assumption that the effect is zero, this result should be interpreted with care. Rejection is statistically more valid than acceptance of H_0.

this is a prerequisite to materialise some the benefits of outsourcing, especially in the field of knowledge development. Hypothesis three is used to test this element. Unfortunately, no moderating effect of absorptive capacity is found on the relationship between outsourcing and innovation. A possible explanation for this lack of a significant result, is the fact that merely having a well developed absorptive capacity is not enough. What really matters is if a firm utilises its absorptive capacity, which could for instance be more of a strategic matter. Having the capabilities is one thing, putting it into practice is another thing. A second plausible explanation can be found in the model developed in the previous chapter regarding the process of innovating. The effect of the interaction term could be distorted by other factors, such as a lack of creativity to translate the assimilated knowledge in useful inventions or because the firm uses outsourcing as a tool to rigorously demarcate the boundaries of the firm (recall the TCE-perspective). Consequently, there is no external knowledge to absorb; put differently the organisation divests that specific knowledge-part and does not want to have anything to do with it anymore. The latter is a valid justification for the above mentioned lack of supportive result with respect to outsourcing in general as well. The accessed knowledge through outsourcing production and RnD can also be too marginal to produce any substantial accumulation of the knowledge base of the outsourcing firm. The obtained result conflicts with that of Tsai (2001), stated in the hypotheses-section. However, this can be explained by the fact that he specifically focussed on -and measured- network positions that provide access to knowledge, whereas this study focuses on outsourcing production and RnD which are not necessarily employed solely to access external knowledge. Another discrepancy lies in the measurement of absorptive capacity. Whereas this study applies a sophisticated measure that incorporates the different aspects of absorptive capacity, Tsai simply equates absorptive capacity with RnD intensity expenditures. Finally, it could be that the proposed relationship between outsourcing and innovation is non-existent. Or, which is perhaps more likely given the theoretical part, it could be that the effect is highly dependent upon the specific situation. The hypotheses-section already illustrated that there appears to be a trade-off and contingent to the situation the effect can be either positive or negative. The ambiguous nature of the relationship might have led to the insignificant results. Such a contingent relationship is also found with *technological* performance and outsourcing (Leiblein et al., 2002). Unfortunately, the author is not aware of any other studies that examine the same -or similar- relationship to compare the obtained results.

The results indicate that outsourcing RnD does not necessarily lead to a better innovative performance, despite the expected specialized knowledge and labour division advantages of the receiving firm. According to the analyses, what matters are the extent to which the organisation adheres to an innovation strategy, the size of the firm and its expenditures on research and development.

The data show, that although outsourcing in general does not appear to be related to product innovation performance, offshoring does. According to the analysis, offshoring manufacturing or RnD activities have a positive effect on the probability that the firm ends up in a higher category of the dependent variable. Especially offshoring of production exhibits a strong significant, positive relationship. At the same time, the interaction term of 'distance' from the outsourcing firm to the firm that has taken over the activity with offshoring production shows a weak significant -p-value <.1-, negative effect on innovative performance. What does this mean? First of all, it appears that offshoring -either production or RnD- in general, positively influences the

product innovation performance of the firm. Secondly, a discrepancy exists between outsourcing manufacturing and outsourcing RnD: distance seems to moderate the effect of offshoring manufacturing on the dependent variable, yet this does not hold for offshoring RnD. The result for manufacturing is in line with hypothesis five. The outcome supports the idea that distance / proximity affects the effectiveness of interaction / linkages and depresses knowledge spillover (regardless of the size of the spillover). Some extra analyses did not indicate that firms that offshore production score higher on RnD intensity, absorptive capacity or innovation strategy. This supports the idea that the result really substantiates the reasoning used to deduce the hypothesis. The absence of a significant interaction term with offshoring RnD, is probably caused by the small number of observations of this variable (only fifteen firms in the sample offshore a part of their RnD activities).

As stated earlier, besides a significant interaction effect, offshoring exhibits an independent, positive significant effect as well, contrary to hypothesis four. Apparently, offshoring production / RnD positively influences the firm's product innovation performance.[25] But why does outsourcing to a firm abroad have a positive effect on innovative performance and domestic outsourcing does not? Could it be that firms that offshore are more aware of the pitfalls that accompany offshoring activities? It is plausible to argue that firms nowadays are aware of the knowledge spillover / communication problems associated with offshoring given the abundance of information in literature (illustrated in the hypotheses section). Perhaps, offshoring firms have incorporated structures to overcome these issues. That is, firms have acted on the problems signalled by literature and have been able to reduce the disadvantages of offshoring (favouring the trade-off for innovation). Another possible explanation for the positive effect of offshoring manufacturing could be that firms keep more complex activities close to themselves.[26] Consequently, offshoring manufacturing is likely to include simple activities that encapsulate little knowledge. As a result, the trade-off between the loss in knowledge through outsourcing and the possible generated slack resources that can be reallocated to innovative activities can favour innovation. Would the offshored activity be too complex of nature, the relationship would probably be negative, due to the trade-off. This could explain why the effect is not found for domestic outsourcing of manufacturing: the activities are more complex, establishing a balance between the benefits and hinders of outsourcing. In addition, the generated slack resources are likely to be higher for outsourcing abroad to -cheaper- countries such as China, as compared to domestic sourcing. Unfortunately there is no information about the complexity of the RnD activities that are offshored. Accordingly, the reasoning cannot be verified for offshoring RnD. The trade-off for offshoring RnD favours innovation, despite the weaker linkages suggested in literature. However, in his PhD-research Deependra Moitra (2008) has found an interesting explanation for the positive relationship between innovative capability and offshoring RnD,

[25] However, the number of observations for RnD is very small and the offshoring RnD-variable is only significant at the 10 % level, therefore the result with respect to RnD activities should be interpreted with care.

[26] This statement is supported for manufacturing by the findings of last year's research within the same population, see http://www.maakhetmaarwaar.nl/index.php?option=com_content&task=view&id=562&Itemid=26 , viewed on November 14th 2008.

which is actually quite similar to that of the effect of offshoring manufacturing.[27] His findings indicate that: *"…by offshoring R&D firms not only freed-up R&D capacity at headquarters to pursue new and exploratory innovation tasks but also expanded their overall R&D capacity."* (Moitra, 2008, p. 349) It is also stated that organisations offshore incremental innovation activities and indicated that offshoring RnD activities allows firms to gain additional RnD capacity for the same budget. The offshoring of incremental innovation activities together with the freed-up RnD capacity gives the firm the possibility to simultaneously pursue exploitative and exploratory innovations; i.e. to become an *ambidextrous* organisation (Moitra, 2008).[28] This ambidexterity ought to lead to better innovative capabilities. Placed in the context of the present research, this means that the positive effect of offshoring RnD on product innovation performance can be attributed to: 1. The generated slack resources at the offshore RnD unit -i.e. the firm gains extra RnD capacity / knowledge for the same budget- and 2. The positive effect of offshoring RnD on the ambidexterity of the organisation, which ought to lead to more product innovations. Especially the first advantage is likely to be absent at a firm that engages in a -more-expensive domestic outsourcing relationship of RnD activities. And although the second advantage can also be obtained by means of domestic sourcing, the effect will be stronger with offshore RnD sourcing given the first advantage. Taken together, this reasoning explains why a positive effect is found for outsourcing to foreign firms but not for domestic outsourcing.

Finally, there is an intriguing outcome that deserves to be point of discussion: strategic intent towards innovation makes the effect of absorptive capacity on the dependent variable obsolete.[29] The variables show a high correlation of .4 and the Kruskall Wallis test show that they go hand in hand. But in the end, it appears that the effect of strategic intent 'overshadows' the effect of absorptive capacity. Put differently, it appears that absorptive capacity intermediates the relationship of strategic intention to innovation and product innovation performance. The interaction effect did not indicate a significant relationship, supporting the idea that there exists a mediating relationship between the two variables, instead of a moderating relationship. The interdependency becomes even more obvious when the measurements of the two variables are compared.

Items STR_Innov: *emphasis on...*	**Items ABSORP**
- New product introduction - Introduce more product varieties - Invest more in R&D - Reduce new product development cycle - Introduce new production processes - Introduce more product features	- Knowledge is shared and distributed internally - We invest a great deal in training - Most of our staff is highly skilled and qualified - We have considerable capacity for technological development - We are capable to effectively use external acquired knowledge - We spend relatively much on RnD

Table 13: Comparison of the items of STR_Innov with the items of ABSORP.

[27] Do note that his case-study research focuses on software firms. Nevertheless, his reasoning is also intuitively plausible for production firms.

[28] For more detailed information about ambidexterity of organisations you are referred to He and Wong, 2004.

[29] This observation comes forward in the extensive testing of many different regression models. Although model two shows a weak significant relationship for absorptive capacity, it is likely that multi collinearity due to the presence of interaction terms is to blame. This idea is strengthened by the fact that any significant effect of ABSORP is absent in any other model, unless strategic intent to innovation is excluded from the regression or unless there are only few variables (and thus a large number of residuals to be explained).

Clearly the items of the ABSORP variable are subjected to the extent that a firm follows an innovation strategy (see Table 13). For instance, if a firm emphasises new product introduction, it will probably hire highly skilled personnel and invest a great deal in training. The score on the items of STR_Innov will have its implication on the realisation of the items of the ABSORP variable. This is further illustrated by the fact that firms that score higher on STR_Innov also tend to be in a higher category for ABSORP.[30] Given the close relationship between the variables and given that STR_Innov overpowers ABSORP, it is plausible to conclude that following an innovation strategy influences the organisation's absorptive capacity. This possible relationship is also stressed by Lane et al. (2006), but they do not empirically test their assumption. An interesting outcome, one might say!

Besides the interdependency of both variables, there is a strong, positive independent effect of STR_Innov as well. This outcome hints in the direction that strategy really matters. Following an innovation strategy makes it more likely to end in a higher category of product innovation performance. This could be due to the fact that the organisation is more suited for innovation, given that it is one of the pillars of the organisation. For instance, from the perspective of Figure 6 in section 2.4.1, such a firm is prone to have better complementary assets to commercialise the product innovation or to have better structures that improve creativity to translate the knowledge into an invention as compared to a firm with no innovative intentions. Similarly, if innovation is an important part of the firm's strategy it is likely that the firm deals more consciously with the aspect product innovation as compared to a firm that mainly focuses on cost. Consequently, a better product innovation performance is to be expected from the former. In all the analyses, STR_Innov is highly significant -p-value <.01- and every time it is included in the model it exhibits a positive effect. It seems to be the most important explanatory variable of all the variables in this study. Moreover -as is depicted by the correlation table- all other proven significant variables are correlated with strategic intent to innovation. Let it be beyond question that strategic intention towards innovation manifested itself to be the key to a strong product innovation performance.

The results indicate that in the Dutch production industry, outsourcing of manufacturing or RnD does not influence the product innovation performance of these firms, regardless of the reason why they outsource and regardless of their absorptive capacity. However, firms that offshore production or RnD do have a better product innovation performance. Outsourcing to foreign firms appears to generate slack resources or to gain extra RnD capacity which lead to improved product innovation performance. On top of that, organisations that follow an innovation strategy also have an improved innovative performance, partly due to a better absorptive capacity. Production firms that invest heavily in RnD are also likely to recoup the benefits from their investments.

Taken together, the data suggest that it is not outsourcing that matters for innovative performance, but offshoring and whether or not the firm strives for innovation. The emphasis on striving for innovation will determine the perspective from which the firm acts; it offers the firm a framework to accommodate its actions. Nevertheless, it could be that outsourcing brings along some kind of trade-off with respect to knowledge loss / assimilation and slack resources, as is

[30] This statement is based on cross tabulation, not included in the appendix.

indicated by the significant results for offshoring. Moreover, it is plausible to argue that the strategic intent towards innovation helps to determine if the trade-off is favourable for innovative performance or not (for instance by the stimulation of absorptive capacity or the investment intensity in RnD). Such a contingency approach is also advocated by Leiblein et al. (2002) in the context of outsourcing and technological performance. In the authors opinion, it doesn't matter to a firm which 'tools' it uses, but with what intent. For example, if a firm were to ask whether it should outsource a part of its production to increase product innovation performance, the answer would be that that specific question is irrelevant. What does matter is if the firm acts with the intent to innovate. This is hinted by the data in that RnD intensity and strategic intent are important, but outsourcing is not. In other words: *practice what you preach!*

4. CONCLUSION

In this section the practical implications of the research are stated. Subsequently, some of the limitations of this study are stressed and other research recommendations are posed. Finally, the main research question is answered and conclusions are drawn.

4.1 Policy Implications and Recommendations

The results indicate several policy implications for the Dutch production industry. First of all, if management were to stimulate innovation, they should consider offshoring simple manufacturing activities that embody little knowledge or RnD activities to enhance their RnD capacity. This can be beneficial to the innovativeness of the organisation and therefore for society as well since it will lead to economic prosperity. Hence, based on this research the concern of people, unions and governments that offshoring RnD or production is, for instance, detrimental to employment rates, can be tempered. Instead the Dutch administration ought to stimulate such offshoring activities. However, when management decides on where to offshore production activities to, they should take the 'distance' to the offshoring country into account. The government could facilitate this process by promoting countries with a relatively small -cultural- distance to the Netherlands.

An important managerial implication for managers in the Dutch production industry, is the effect of the organisation's strategic intent to innovation. Apparently, a proper innovation strategy is more important for innovation than the decision to outsource production or RnD. On top of that, organisations that want to improve their absorptive capacity should put a greater emphasis on their innovation strategy. The improved absorptive capacity can assist in improving innovativeness of the organisation. Once again, the important role of an innovation strategy is an essential managerial implication that has come forward in the present research.

4.2 Limitations and Further Research Recommendations

Despite the care with which this research has been done, there are some serious limitations. For instance, there is only a relatively small sample size: only 112 firms completed the questionnaire. Therefore, it can be questioned to what extent the outcomes represent the entire Dutch production industry. Especially with respect to outsourcing / offshoring of RnD activities, the number of observations should increase, to improve validity of the results. The sector distribution is not optimal either: some lines of industry are overrepresented and vice versa. The 'new' construct of absorptive capacity is another limitation. Other studies should verify the validity of the construct to make sure that it really measures what it should. Besides, to restrain the scope of the research complementary assets -see section 2.4.3- were not taken into account

in the regression models. This would have further purified the effect of outsourcing on innovation and could have provided evidence to explain why the effect of outsourcing on product innovation is absent. Finally, the data were self-reported by managers; they had to assess the answer. Obviously these kinds of data are less valid as compared to factual, objective data. Though everyone had the same problem, which could have mitigated the effect on the results, there is definitely some 'noise' in the data (some might, i.e. have overestimated their product innovation performance). Unfortunately, this problem is inherent to this method.

Several future research recommendations originate from this research. For example, it is recommendable to incorporate the role of complexity of the outsourced activity in the model. Especially regarding offshoring, this appears to be an important element. But also including the complementary assets of a firm can be a valuable improvement, as is stated in the limitations section. Another interesting possibility is to broaden the scope of the research by investigating the relationship between outsourcing and other types of innovation (i.e. process innovations, social innovations, etc.). This will contribute to a more complete understanding of how outsourcing relates to innovation in general and if there are any discrepancies between different types of innovation and their interdependence with outsourcing. Likewise, one could also study different outsourcing activities, for instance marketing and / or sales, and examine how they relate to innovation. And although this research is focussed on outsourcing to external parties, it would be interesting to see if similar results regarding innovative performance are obtained for captive offshoring in inter-business unit sourcing. Linkages are supposed to be more closely connected, since both parties operate within a hierarchy. Of course, captive offshoring is not outsourcing, however it can be argued that captive offshoring is not so much different from offshoring to an external party, since distance will probably still have its effect. It offers an opportunity to empirically test if there is a significant difference between offshore outsourcing and captive offshoring (which could lead to best-practise recommendations). A more general research recommendation is to investigate if the results also hold for different countries and for different types of firms. For instance, given the many differences one should carefully interpret the results of this research in the light of service-providing firms. Finally, the finding of a possible relationship between strategic intent to innovation and absorptive capacity offers a new interesting research opportunity. Path analysis will certainly contribute to a better understanding of how these two variables relate to product innovation performance or to innovation in general.

4.3 Conclusion

In this study a theoretical, knowledge-based framework has been developed to assess the effect of outsourcing on innovation. Based on this framework several hypotheses were deduced to answer the main research question:

> *"To what extent does outsourcing manufacturing or RnD influence the product innovation performance of organizations in the Dutch production industry?"*

As far as the author is aware of, this is the first attempt to study the present relationship for the Dutch production industry.

Empirical evidence obtained from 112 firms indicates that offshoring manufacturing or RnD -as a way of outsourcing- has a positive effect on the innovativeness of Dutch production firms. In addition, for offshoring manufacturing this relationship was moderated by the 'distance' between the Netherlands and the country to which the activity was offshored. The positive effect of offshoring production can be explained by presuming that the offshored activities are simple of nature and only lead to a marginal loss in knowledge and that the gained slack resources are allocated to strengthen activities directed to innovation; the trade-off favours innovation. For RnD activities, the gained access to a larger RnD capacity at lower cost can have inspired the positive relationship with product innovation performance. No significant effect was found for outsourcing in general. The data did not offer evidence for the assumption that the absence of a significant relationship between outsourcing and innovation was caused by a lack of absorptive capacity or dictated by the reason why the activity was sourced to an external party. A plausible explanation is that the relationship between outsourcing and innovation is highly contingent to the specific situation, distorting an unambiguous relationship.

Other interesting results -but which are beyond the scope of the research question- are that RnD expenditures as percentage of the firm's sales is positively significant and that the strategic intent to innovation is positively related to product innovation performance. The latter effect is quite strong and even makes the effect of absorptive capacity obsolete. This finding suggests that absorptive capacity is influenced by the emphasis a firm puts on its innovation activities; it is dependent on the strategic intent to innovation.

Taken together, there appears to be a significant relationship between offshoring and product innovation performance in the Dutch production industry. In addition, the strategic intention of the firm to innovation seems to be a crucial aspect in the innovative power of a production firm in the Netherlands. One could definitely say that they practice what they preach…

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6. APPENDICES

Contents

6.1 Normality Test Product Innovation Intensity

As can be deduced from the Kolmogorov-Smirnov test, the dependent variable "percentage of sales obtained with new / significantly improved products" is not normally distributed; with a p-value of <.05 the null-hypothesis is rejected that the variable is normally distributed. This finding is visually supported by the Q-Q Plot. The data is also checked for outliers on this variable, and those that were designated by the boxplot in Figure 14, appeared to be valid measures.

Table 14: Test of Normality.

N = 142	Kolmogorov-Smirnov(a)		
	Statistic	df	Sig.
% of sales obtained with new / significantly improved products	.158	142	.000

a Lilliefors Significance Correction

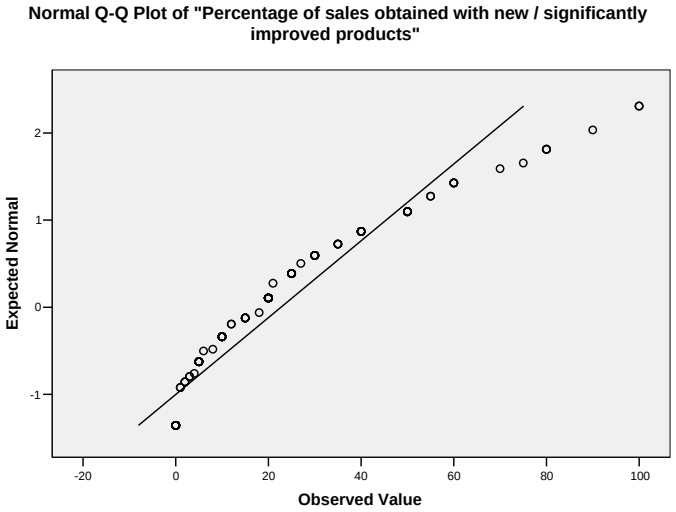

Figure 15: Q-Q Plot of the dependent variable.

Figure 14: Boxplot of the dependent variable.

6.2 Categorisation of the Dependent Variable

Figure 16 depicts the distribution of the different categories of product innovation performance. The picture clearly shows that lower categories are more likely. The SPSS help-file in Figure 17 imposes a Negative log-log function as the appropriate link function for the ordinal regression. Lower categories being more likely is not that strange, given the fact of life that it is costly and difficult to innovate. Besides, a firm will also want to recoup its investments for product development and therefore will not cannibalise its products too fast.

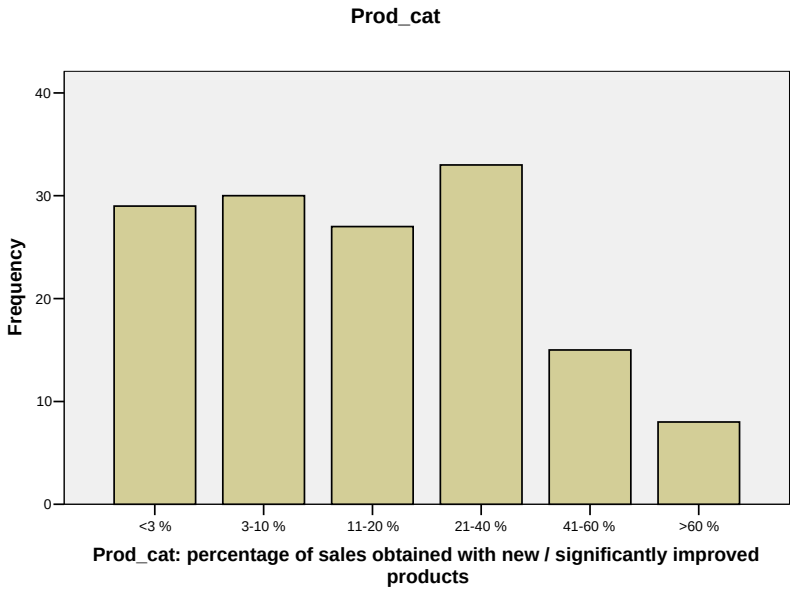

Figure 16: Distribution of the dependent variable over the different categories.

Function	Form	Typical application
Logit	$\ln\left(\frac{\gamma}{1-\gamma}\right)$	Evenly distributed categories
Complementary log-log	$\ln(-\ln(1-\gamma))$	Higher categories more probable
Negative log-log	$-\ln(-\ln(\gamma))$	Lower categories more probable
Probit	$\Phi^{-1}(\gamma)$	Analyses with explicit normally distributed latent variable

Figure 17: SPSS help-file table about the different link functions.

6.3 Outsourcing Reasons

Table 15 depicts the variable constructs and their alpha-coefficient. The cost reason to outsource RnD is not really a construct, since it consists of only one variable. It was chosen to omit the other cost questions that were asked with respect to outsourcing production from the questionnaire, since -in essence- it comes down on the same thing. It offered to opportunity to shorten the questionnaire. In order to create the construct, the average score on the relevant items was calculated.

Respondents were asked the following question: *Indicate the degree of importance that each of the following reasons played in making the decision to outsource manufacturing / RnD activities (1 = not important at all – 5 = extremely important):*

Item:	Construct	Item:	Construct
Reduce cost	***Man_cost***	Reduce cost	***RnD_cost***
Reduce fixed cost	***= .87***		***= N/A***
Reduce labor cost			
Reduce operational cost			
Access to specialized knowledge	***Man_access***	Access to specialized knowledge	***RnD_access***
Access to specialized capabilities	***= .86***	Access to specialized capabilities	***=.77***
Access to qualified personnel		Access to qualified personnel	

Table 15: Overview of the outsourcing reason constructs.

6.4 Sector Classification

Table 16 states the different ISIC-codes per category.

Variable name	Sectors
SECT_Other	15_Manufacture of food products and beverages
	18_Manufacture of wearing apparel
	21_Manufacture of paper and paper products
	22_Publishing, printing and reproduction of recorded media
	36_Manufacture of furniture
	37_None of the above
SECT_Metal	28_Manufacture of fabricated metal products, except machinery and equipment
SECT_MachBig	29_Manufacture of machinery and equipment
	34_Manufacture of motor vehicles, trailers and semi-trailers
	35_Manufacture of other transport equipment
SECT_MachSmall	30_Manufacture of office, accounting and computing machinery
	31_Manufacture of electrical machinery and apparatus
	32_Manufacture of radio, television and communication equipment and apparatus
	33_Manufacture of medical, precision and optical instruments, watches and clocks
SECT_SophMat	23_Manufacture of coke, refined petroleum products and nuclear fuel
	24_Manufacture of chemicals and chemical products
	25_Manufacture of rubber and plastic products
	26_Manufacture of other non-metallic mineral products

Table 16: Overview of the sector classification.

6.5 Summary of the Variables that are Used

Variable name	Description
Prod_cat	Product innovation performance, percentage of sales obtained with products that are new or significantly improved in the last three years
Size	Natural logarithm of the number of FTEs in the firm
RnD_cat	RnD intensity, percentage of sales spend on RnD divided in categories
ABSORP	Absorptive capacity of a firm
STR_Innov	Strategic intention to / emphasis on innovation
SECT_Other	Dummy variable to control for sector differences
SECT_Metal	Dummy variable to control for sector differences
SECT_MachBig	Dummy variable to control for sector differences
SECT_MachSmall	Dummy variable to control for sector differences
SECT_SophMat	Dummy variable to control for sector differences
OUT_ManExt	Percentage of manufacturing that is outsourced to an external organization
OUT_RnDExt	Percentage of RnD that is outsourced to an external organization
sq_OUT_ManExt	Quadratic term of outsourcing manufacturing
sq_OUT_RnDExt	Quadratic term of outsourcing RnD
OUT_ManExt_off	Percentage of manufacturing that is outsourced to an external organization abroad
OUT_RnDExt_off	Percentage of RnD that is outsourced to an external organization abroad
ManDistance	Non-physical distance measure to account for the distance to the country to which the firm offshores manufacturing
RnDDistance	Non-physical distance measure to account for the distance to the country to which the firm offshores RnD
Man_access	The extent to which a firm outsources manufacturing in order to access external knowledge
Man_cost	The extent to which a firm outsources manufacturing in order to reduce cost
RnD_access	The extent to which a firm outsources RnD in order to access external knowledge
RnD_cost	The extent to which a firm outsources RnD in order to reduce cost

Table 17: Definitions of the variables.

6.6 Regression Tables

This section will reproduce the output tables from SPSS per model. For each model the following tables are reproduced: parameter estimates, test of parallel lines, different R-squared measures, model fit information -log likelihood-, and goodness of fit (pearson Chi-Square). Furthermore, the case processing summary will be stated only once, since it is the same for each of the models.

Model 1

Case Processing Summary

		N	Marginal Percentage
Prod_cat	1.00	20	17.9%
	2.00	24	21.4%
	3.00	23	20.5%
	4.00	25	22.3%
	5.00	14	12.5%
	6.00	6	5.4%
Valid		112	100.0%

Parameter Estimates

							95% Confidence Interval	
		Estimate	Std. Error	Wald	df	Sig.	Upper Bound	Lower Bound
Threshold	[Prod_cat = 1.00]	4.107	1.032	15.847	1	.000	2.085	6.130
	[Prod_cat = 2.00]	5.016	1.067	22.102	1	.000	2.925	7.107
	[Prod_cat = 3.00]	5.858	1.096	28.544	1	.000	3.709	8.007
	[Prod_cat = 4.00]	7.051	1.136	38.496	1	.000	4.824	9.278
	[Prod_cat = 5.00]	8.399	1.200	49.008	1	.000	6.048	10.751
Location	Size	.167	.071	5.600	1	.018	.029	.305
	RnD_cat	.353	.118	8.864	1	.003	.120	.585
	ABSORP	.241	.203	1.416	1	.234	-.156	.638
	STR_Innov	.653	.214	9.339	1	.002	.234	1.071
	SECT_Other	-.178	.418	.181	1	.670	-.997	.641
	SECT_Metal	.039	.422	.008	1	.927	-.789	.867
	SECT_MachBig	.450	.375	1.436	1	.231	-.286	1.185
	SECT_MachSmall	.484	.469	1.066	1	.302	-.435	1.404
	SECT_SophMat	0(a)	.	.	0	.	.	.
	OUT_ManExt	.004	.004	1.366	1	.242	-.003	.012
	OUT_RnDExt	.011	.009	1.587	1	.208	-.006	.029

Link function: Negative Log-log.
a This parameter is set to zero because it is redundant.

Test of Parallel Lines(c)

Model	-2 Log Likelihood	Chi-Square	df	Sig.
Null Hypothesis	325.608			
General	266.583(a)	59.025(b)	40	.027

The null hypothesis states that the location parameters (slope coefficients) are the same across response categories.
a The log-likelihood value cannot be further increased after maximum number of step-halving.
b The Chi-Square statistic is computed based on the log-likelihood value of the last iteration of the general model. Validity of the test is uncertain.
c Link function: Negative Log-log.

Pseudo R-Square

Cox and Snell	.406
Nagelkerke	.420
McFadden	.152

Link function: Negative Log-log.

Model Fitting Information

Model	-2 Log Likelihood	Chi-Square	df	Sig.
Intercept Only	383.997			
Final	325.608	58.389	10	.000

Link function: Negative Log-log.

Goodness-of-Fit

	Chi-Square	df	Sig.
Pearson	529.737	545	.672
Deviance	325.608	545	1.000

Link function: Negative Log-log.

Model 2

Parameter Estimates

							95% Confidence Interval	
		Estimate	Std. Error	Wald	df	Sig.	Upper Bound	Lower Bound
Threshold	[Prod_cat = 1.00]	5.041	1.213	17.274	1	.000	2.664	7.418
	[Prod_cat = 2.00]	5.967	1.252	22.729	1	.000	3.514	8.420
	[Prod_cat = 3.00]	6.817	1.279	28.396	1	.000	4.310	9.324
	[Prod_cat = 4.00]	8.021	1.314	37.283	1	.000	5.447	10.596
	[Prod_cat = 5.00]	9.382	1.369	46.949	1	.000	6.698	12.066
Location	Size	.189	.073	6.670	1	.010	.046	.333
	RnD_cat	.344	.121	8.044	1	.005	.106	.582
	ABSORP	.508	.262	3.754	1	.053	-.006	1.021
	STR_Innov	.608	.219	7.744	1	.005	.180	1.037
	SECT_Other	-.046	.432	.011	1	.915	-.893	.800
	SECT_Metal	.114	.432	.069	1	.792	-.732	.960
	SECT_MachBig	.524	.389	1.818	1	.178	-.238	1.287
	SECT_MachSmall	.526	.482	1.191	1	.275	-.418	1.470
	SECT_SophMat	0(a)	.	.	0	.	.	.
	OUT_ManExt	.036	.025	2.114	1	.146	-.012	.084
	OUT_RnDExt	-.012	.086	.019	1	.891	-.181	.157
	sq_OUT_ManExt	5.56E-006	.000	.001	1	.974	.000	.000
	sq_OUT_RnDExt	5.97E-005	.000	.051	1	.821	.000	.001
	ABSORP * OUT_ManExt	-.009	.006	2.250	1	.134	-.020	.003
	ABSORP * OUT_RnDExt	.005	.024	.048	1	.826	-.043	.053

Link function: Negative Log-log.
a This parameter is set to zero because it is redundant.

Test of Parallel Lines(b)

Model	-2 Log Likelihood	Chi-Square	df	Sig.
Null Hypothesis	322.837			
General	.000(a)	322.837	56	.000

The null hypothesis states that the location parameters (slope coefficients) are the same across response categories.
a The log-likelihood value is practically zero. There may be a complete separation in the data. The maximum likelihood estimates do not exist.
b Link function: Negative Log-log.

Pseudo R-Square

Cox and Snell	.421
Nagelkerke	.435
McFadden	.159

Model Fitting Information

Model	-2 Log Likelihood	Chi-Square	df	Sig.
Intercept Only	383.997			
Final	322.837	61.160	14	.000

Link function: Negative Log-log.

Goodness-of-Fit

	Chi-Square	df	Sig.
Pearson	538.997	541	.516
Deviance	322.837	541	1.000

Link function: Negative Log-log.

Model 3

Parameter Estimates

							95% Confidence Interval	
		Estimate	Std. Error	Wald	df	Sig.	Upper Bound	Lower Bound
Threshold	[Prod_cat = 1.00]	3.903	1.037	14.173	1	.000	1.871	5.934
	[Prod_cat = 2.00]	4.855	1.072	20.506	1	.000	2.754	6.957
	[Prod_cat = 3.00]	5.758	1.104	27.178	1	.000	3.593	7.922
	[Prod_cat = 4.00]	7.012	1.147	37.401	1	.000	4.765	9.259
	[Prod_cat = 5.00]	8.381	1.212	47.838	1	.000	6.006	10.756
Location	Size	.153	.071	4.700	1	.030	.015	.292
	RnD_cat	.355	.119	8.961	1	.003	.123	.588
	ABSORP	.264	.204	1.677	1	.195	-.136	.664
	STR_Innov	.595	.220	7.341	1	.007	.165	1.025
	SECT_Other	-.345	.416	.688	1	.407	-1.161	.471
	SECT_Metal	.050	.419	.014	1	.905	-.772	.872
	SECT_MachBig	.552	.364	2.299	1	.129	-.161	1.265
	SECT_MachSmall	.484	.467	1.074	1	.300	-.432	1.400
	SECT_SophMat	0(a)	.	.	0	.	.	.
	OUT_ManExt_off	.020	.006	11.368	1	.001	.009	.032
	OUT_RnDExt_off	.021	.013	2.814	1	.093	-.004	.046

Link function: Negative Log-log.
a This parameter is set to zero because it is redundant.

Test of Parallel Lines(c)

Model	-2 Log Likelihood	Chi-Square	df	Sig.
Null Hypothesis	316.373			
General	272.512(a)	43.861(b)	40	.311

The null hypothesis states that the location parameters (slope coefficients) are the same across response categories.
a The log-likelihood value cannot be further increased after maximum number of step-halving.
b The Chi-Square statistic is computed based on the log-likelihood value of the last iteration of the general model. Validity of the test is uncertain.
c Link function: Negative Log-log.

Pseudo R-Square

Cox and Snell	.453
Nagelkerke	.468
McFadden	.176

Link function: Negative Log-log.

Model Fitting Information

Model	-2 Log Likelihood	Chi-Square	df	Sig.
Intercept Only	383.997			
Final	316.373	67.624	10	.000

Link function: Negative Log-log.

Goodness-of-Fit

	Chi-Square	df	Sig.
Pearson	520.846	545	.765
Deviance	316.373	545	1.000

Link function: Negative Log-log.

Model 4

Parameter Estimates

		Estimate	Std. Error	Wald	df	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
Threshold	[Prod_cat = 1.00]	3.570	1.034	11.928	1	.001	1.544	5.597
	[Prod_cat = 2.00]	4.554	1.067	18.204	1	.000	2.462	6.646
	[Prod_cat = 3.00]	5.500	1.101	24.942	1	.000	3.341	7.658
	[Prod_cat = 4.00]	6.810	1.147	35.284	1	.000	4.563	9.057
	[Prod_cat = 5.00]	8.203	1.212	45.816	1	.000	5.828	10.579
Location	Size	.143	.074	3.710	1	.054	-.003	.288
	RnD_cat	.384	.126	9.267	1	.002	.137	.631
	ABSORP	.210	.206	1.032	1	.310	-.195	.614
	STR_Innov	.567	.221	6.599	1	.010	.134	.999
	SECT_Other	-.459	.418	1.206	1	.272	-1.279	.360
	SECT_Metal	-.076	.425	.032	1	.858	-.910	.758
	SECT_MachBig	.398	.373	1.137	1	.286	-.334	1.129
	SECT_MachSmall	.450	.481	.875	1	.350	-.493	1.393
	SECT_SophMat	0(a)	.	.	0	.	.	.
	ManDistance	.501	.309	2.631	1	.105	-.104	1.107
	RnDDistance	.016	.609	.001	1	.979	-1.177	1.209
	OUT_ManExt_off	.044	.015	7.973	1	.005	.013	.074
	OUT_RnDExt_off	.113	.089	1.582	1	.208	-.063	.288
	RnDDistance * OUT_RnDExt_off	-.158	.161	.958	1	.328	-.474	.158
	ManDistance * OUT_ManExt_off	-.027	.015	3.328	1	.068	-.057	.002

Link function: Negative Log-log.
a This parameter is set to zero because it is redundant.

Test of Parallel Lines(c)

Model	-2 Log Likelihood	Chi-Square	df	Sig.
Null Hypothesis	311.202			
General	299.964(a)	11.239(b)	56	1.000

The null hypothesis states that the location parameters (slope coefficients) are the same across response categories.
a The log-likelihood value cannot be further increased after maximum number of step-halving.
b The Chi-Square statistic is computed based on the log-likelihood value of the last iteration of the general model. Validity of the test is uncertain.
c Link function: Negative Log-log.

Pseudo R-Square

Cox and Snell	.478
Nagelkerke	.494
McFadden	.190

Link function: Negative Log-log.

Model Fitting Information

Model	-2 Log Likelihood	Chi-Square	df	Sig.
Intercept Only	383.997			
Final	311.202	72.794	14	.000

Link function: Negative Log-log.

Goodness-of-Fit

	Chi-Square	df	Sig.
Pearson	523.050	541	.702
Deviance	311.202	541	1.000

Link function: Negative Log-log.

Model 5

Parameter Estimates

							95% Confidence Interval	
		Estimate	Std. Error	Wald	df	Sig.	Upper Bound	Lower Bound
Threshold	[Prod_cat = 1.00]	4.082	1.082	14.237	1	.000	1.961	6.202
	[Prod_cat = 2.00]	5.130	1.121	20.941	1	.000	2.933	7.327
	[Prod_cat = 3.00]	6.046	1.153	27.509	1	.000	3.787	8.306
	[Prod_cat = 4.00]	7.339	1.200	37.400	1	.000	4.987	9.692
	[Prod_cat = 5.00]	8.764	1.272	47.478	1	.000	6.271	11.257
Location	Size	.182	.075	5.911	1	.015	.035	.329
	RnD_cat	.319	.122	6.798	1	.009	.079	.559
	ABSORP	.279	.221	1.587	1	.208	-.155	.712
	STR_Innov	.513	.218	5.534	1	.019	.086	.940
	SECT_Other	-.120	.444	.073	1	.787	-.990	.750
	SECT_Metal	.171	.447	.147	1	.701	-.705	1.048
	SECT_MachBig	.602	.392	2.353	1	.125	-.167	1.371
	SECT_MachSmall	.940	.505	3.468	1	.063	-.049	1.929
	SECT_SophMat	0(a)	.	.	0	.	.	.
	OUT_ManExt	-.001	.018	.002	1	.966	-.037	.035
	OUT_RnDExt	-.120	.081	2.210	1	.137	-.279	.038
	Man_access	-.161	.152	1.122	1	.290	-.459	.137
	Man_cost	.357	.160	4.988	1	.026	.044	.670
	RnD_cost	.158	.199	.629	1	.428	-.233	.549
	RnD_access	-.059	.179	.108	1	.742	-.409	.291
	OUT_RnDExt * RnD_cost	.020	.013	2.097	1	.148	-.007	.046
	OUT_RnDExt * RnD_access	.018	.013	1.953	1	.162	-.007	.043
	OUT_ManExt * Man_cost	.001	.004	.064	1	.800	-.007	.009
	OUT_ManExt * Man_access	-.002	.003	.211	1	.646	-.008	.005

Link function: Negative Log-log.
a This parameter is set to zero because it is redundant.

Test of Parallel Lines(c)

Model	-2 Log Likelihood	Chi-Square	df	Sig.
Null Hypothesis	308.452			
General	246.086(a)	62.366(b)	72	.784

The null hypothesis states that the location parameters (slope coefficients) are the same across response categories.
a The log-likelihood value cannot be further increased after maximum number of step-halving.
b The Chi-Square statistic is computed based on the log-likelihood value of the last iteration of the general model. Validity of the test is uncertain.
c Link function: Negative Log-log.

Pseudo R-Square

Cox and Snell	.491
Nagelkerke	.507
McFadden	.197

Link function: Negative Log-log.

Model Fitting Information

Model	-2 Log Likelihood	Chi-Square	df	Sig.
Intercept Only	383.997			
Final	308.452	75.544	18	.000

Link function: Negative Log-log.

Goodness-of-Fit

	Chi-Square	df	Sig.
Pearson	576.905	537	.113
Deviance	308.452	537	1.000

Link function: Negative Log-log.

Berenschot

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