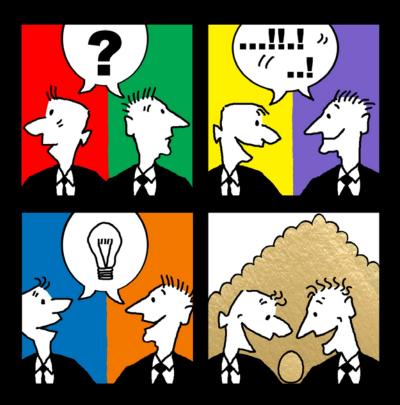
COMPLEMENTORS:

Their Effects on New Value Creation by SMEs in the Dutch Printing Industry



Matheus J.M. Habets

COMPLEMENTORS:

THEIR EFFECTS ON NEW VALUE CREATION BY SMES IN THE DUTCH PRINTING INDUSTRY

DISSERTATION

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Chapter 1: Introduction

As business is relentless, enterprises are continuously striving to outperform competition. In mature businesses where products, processes and profits are similar, there are a lot of ways to stay ahead in this race. For example, firms can cut costs to bring cheaper products to the market, they can open sales offices abroad to create a bigger market or they can renew their business to deliver more value. In this dissertation I will explore the phenomenon of business renewal and describe it as new value creation.

Please consider the following illustration of the Dutch printing industry. It will show concisely, and in the dissertation's empirical context, why new value creation matters:

>>> For centuries, the printing industry has served civilisation well. Distributing and conserving knowledge, news or other data have been their main tasks and are indirectly accountable for the wealth of modern society (Porter, 1990). Printing used to be a locally organised business with high levels of craftsmanship (Wallace & Kalleberg, 1982). Years of experience, specialised equipment and unambiguous market needs gave a lot of printing companies a sustainable reason for existence, but also kept them small in organisational size¹. These features made almost every printing company unique. This enabled them to add customer value in a way competitors couldn't. However, competitive advantage is volatile.

Overtime, as in many industries, propelling economic forces increased business dynamics. Markets went global and customers became more demanding. To meet those requirements, the printing business has become an industry in which technology has made enormous leaps. Since Gutenberg's invention of the mechanised printing press in 1454, printing speed, quality and efficiency have improved dramatically. Printing capacity has increased so much that it is currently outstripping demand (Dantuma, 2009; EuropeanCommission, 2007; GOC & KVGO, 2009). What remains is a market that has a surplus of similar print offerings and buyers that select mainly on price. In other words, a large part of these offerings offer minimal distinctive value and printing companies face a striking challenge: to prevent commoditisation. <<<

This example shows that industries, once they become mature, are exposed to forces that squeeze their margins. These dynamics are not unique to Dutch printing firms but can be seen in many mature and commoditised industries. Consequently, many successful enterprises in commodity businesses remain profitable by transforming their basic products (that everybody offers) into value-added services and solutions (unique offerings) (Matthyssens & Vandenbempt, 2008; Rangan & Bowman, 1992). In recent decades, this process of new value creation has proven to be one of the most useful tools to renew mature businesses. However, the creation of value is anything but a daily routine and hardalmost impossible - to manage alone. SMEs (Small and Medium Sized Enterprises) in particular have problems allocating sufficient resources (e.g. knowledge, finance, market power) to innovating their offerings, creating new value (Hanna & Walsh, 2002; Hewitt-

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¹ 98,3 % of Dutch printing firms is smaller than a 100 FTE (Full Time Equivalent) (GOC & KVGO, 2009).

Dundas, 2006) and increasing their chances of survival (Cefis & Marsili, 2006; EuropeanCommission, 2010). Consequently, SMEs actively engage in networks of relationships to overcome their lack of resources (Katila & Shane, 2005). By means of their networks they are able to supplement their own resource portfolio (Eisenhardt & Schoonhoven, 1996; Gulati, 1995) and create the necessary competitive advantage (Garud & Karnøe, 2003). These networks of external relationships are thus crucial for SMEs to create new value and often consist of several roles such as customers, suppliers and complementors. In this dissertation I will focus on the impact of the complementor relationship on new value creation.

The complementor provides mutual customers with offerings that increases the value of the focal firm's offering. (E.g. coffee and coffee machines, cars and gas stations or DVD's and DVD players). Currently, firms increasingly exploit the benefits of complementors in their businesses (Nalebuff & Brandenburger, 1996; Schilling, 2003; Yoffie & Kwak, 2006) and complementors are receiving more and more scholarly attention as well (Adner & Kapoor, 2010; Boudreau, 2008, 2010). In the empirical field of this dissertation, the Dutch printing industry, the use of complementors to create new value is notable (Boer & Teunen, 2008; EuropeanCommission, 2007; Romano, 2006): Many printing firms are collaborating with partners outside their traditional value chain to complement their printed matter with marketing software, multimedia or warehousing solutions. Despite these insights, I observe a need to delve deeper into the role that complementors play in the creation of new value.

This need stems initially from (1) a more general requirement for research that shows how firms can move from basic products (commodities) into solution or service-based offerings (new value creation) (Araujo & Spring, 2006; Jacob & Ulaga, 2008; Matthyssens & Vandenbempt, 2008). At the beginning of the introduction I suggested that this is a challenge that many firms in mature industries are currently facing. (2) Most previous research on complementors and new value creation has been focused on the role of complementarities and complementary products that put the emphasis on the resource (e.g. Lee, Venkatraman, Tanriverdi, & Iyer, 2010; Shapiro & Varian, 1999; Teece, 1986; Van den Ende, Jaspers, & Gerwin, 2008). In contrast, little research has specifically delved into the role of the complementor relationship (I will discuss this in Chapter Two). (3) Finally, the practitioner's need for further research can be demonstrated as well. Brandenburger and Nalebuff (1996) argue that complementor relationships are typically "double-edged". Enterprises have the tendency to overestimate the commonalities and underestimate the potential for conflict. On the one hand, they see interesting opportunities to jointly increase their businesses, the win-win situation. On the other hand, strategic agreements have to be made, technical standards need to be set and revenues to be shared. This requires negotiation and tensions will often arise in dividing the "market pie". Surprisingly few firms invest heavily in understanding their complementors (Yoffie & Kwak, 2006) and assessing the consecutive risks (Adner, 2006). Consequently, insights into the role of complementors could help to improve the success rate of this type of collaboration. In summary, there is particular interest on both the practitioner's and the scientific side in a scholarly study on complementor relationships and their role in new value creation. This leads to the following main research question:

Main Research Question

What is the effect of complementor relationships on new value creation by SMEs in the Dutch printing industry?

Outline of the study

The dissertation is designed to follow the empirical cycle (De Groot, 1961; Swanborn, 1987) and is organised as follows: Chapter 1 has guided the reader through the key concepts and introduced the empirical field, leading to the development of the main research question. Chapter 2 begins with the dissertation's central definitions and an exploration of the management literature. This chapter is designed to create focus, by outlining the current scientific field and identifying concrete research opportunities. Chapter 3 contains a qualitative study which delves deeper into the role of complementor relationships on new value creation. This demonstrates underlying principles and specific effects through a real case study. Chapter 4 is the first theory testing chapter and outlines the hypotheses and the research model. Based on the literature of social cognitive embedding, complementors are compared with suppliers and related to firm innovation performance. Chapter 5 describes the data collection method and Chapter 6 displays the results. A conclusion and suggestions for follow up research are given in Chapter 7. Finally, the bibliography and APPENDICES A, B, and C, which contain the operational measures, the histograms of the research variables and the normal P-P plots & scatterplots of the regression residuals.

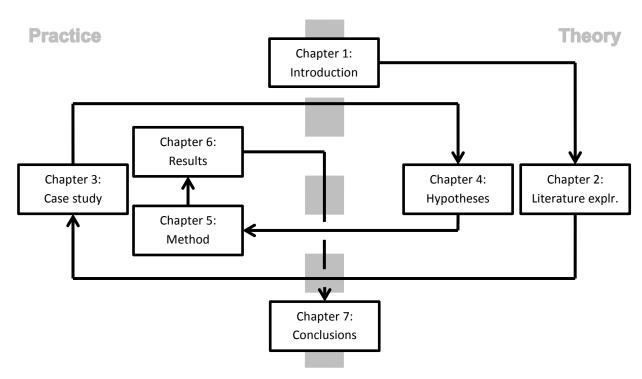


Figure 1: Outline of the dissertation

Chapter 2: Definition and exploration of key concepts

Setting the stage: new value creation, the value net and complementors

Creating value is the aim of every generic strategy (Porter, 1996), the aim of every entrepreneur (Van der Veen & Wakkee, 2004) and rejuvenates an organisation (Matthyssens, Vandenbempt, & Berghman, 2006). Although there are several types of value (e.g. relationships, activities, perceived), the focus in this dissertation is on the value of the offering and follows Porter's (1985, p. 38) classic definition: "The amount buyers are willing to pay for what a firm provides them". "New" value refers to the extent that customers perceive the created value as new.

In carrying out business activities for new value creation, enterprises develop various types of relationships. To conceptualise these different relationships, I follow the enterprise's value net (Nalebuff & Brandenburger, 1996; Ritter, Wilkinson, & Johnston, 2004). The value net defines four types of relationships that cover the overall portfolio of a focal enterprise (see Figure 2). In this net the interdependencies describe how the set of enterprises is able to create value for an intermediate or final customer.

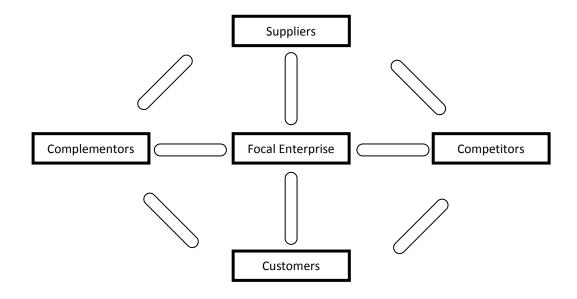


Figure 2: A focal enterprise's value net (adapted from Nalebuff and Brandenburger (1996); Ritter, Wilkinson, and Johnston (2004)).

The value net roles are: (1) A supplier who provides a focal firm with an offering critical to function² and receives credits in return; (2) A customer who obtains an offering from the

5

² Critical to function means that the offering of the focal firm would not work or not be complete without it.

focal enterprise in exchange for credits; (3) A competitor who decreases the value of a focal firm's offering (4) And finally, the current focus of this dissertation, the complementor who increases the value of a focal firm's offering.

Establishing a complementor definition

A small number of complementor definitions can be found in the literature. I decided to establish my own definition because, in relation to the main research question, there are some concepts missing from existing definition, while other parts of these definitions can be effectively adopted. The definitions I use to establish my complementor definition on can be found in Table 1.

Table 1: Complementor definitions

	Other complementor definitions	Author(s)
A	"A player is a complementor if customers value your product more when they have that player's product than when they have your product alone".	(Nalebuff & Brandenburger, 1997, p. 31)
В	"Relationships with complementors: Firms develop relationships with many other types of firms whose outputs or functions increase the value of their own outputs"	(Ritter, et al., 2004, p. 177)
С	"A customer may also need to bundle other offers alongside the focal actor's product in order to utilize it. We refer to such offers, which are bundled downstream by the customer, as complements".	(Adner & Kapoor, 2010, p. 309)
D	"High tech firms often encourage suppliers of complementary goods to join their technology platforms in order to stimulate network effects".	(Boudreau, 2008, p. 1)
Ε	"Complementors are companies that independently provide complementary products or services directly to mutual customers"	(Yoffie & Kwak, 2006, pp. 89-90)

I will start with Definition A: "A player is a complementor if customers value your product more when they have that player's product than when they have your product alone" (Nalebuff & Brandenburger, 1997, p. 31) (See also Table 1, A). I mentioned before that there are many types of value (e.g. relationships, monetary, perceived). This definition is useful in that it includes value in the eyes of the customer. It thus emphasises customer value and gives the definition specificity. The definition also suggests an increase in value by offering a product additional to the focal enterprise's product. It puts the focus on the offering, a lower abstraction level rather than a higher abstraction level such as available resources. Note that Definition A mentions players, which for this study can be immediately narrowed down to enterprises.

My main critiques for Definition B, "Relationships with complementors: Firms develop relationships with many other types of firms whose outputs or functions increase the value of their own outputs" (Ritter, et al., 2004, p. 177) (see also Table 1, B) are that it suggests that

complementors increase value by offering an additional output like a product or a service. However, it places insufficient emphasis on (1) value in the eyes of the customer and (2) the *difference* between a complementor and a supplier. According to Definition B, a supplier could increase the value of the focal enterprise's output as well. The definition thus creates too much ambiguity.

The next two definitions are less direct (see Table 1, C, D). Definition C, "A customer may also need to bundle other offers alongside the focal actor's product in order to utilize it. We refer to such offers, which are bundled downstream by the customer, as complements" (Adner & Kapoor, 2010, p. 309), is valuable because it takes the value net into account; it describes the "focal actor" and emphasises the importance of customers as well. However, it does not specifically mention that these "complements" come from the complementor relationship. It also states that the customer needs to bundle the offerings in order to utilise the product, which does not necessarily imply that there is a value increase.

Definition D "High tech firms often encourage suppliers of complementary goods to join their technology platforms in order to stimulate network effects" (Boudreau, 2008, p. 1) (See also Table 1, D) is interesting because it points out a very specific characteristic of a complementor relationship: that it stimulates network effects (on which I will elaborate in the next two sections). However Definition D states that a complementor is a supplier of complementary goods, when according to the value net those are distinct roles.

The definition I used in this dissertation is primarily based on that of Yoffie's and Kwak's (2006, pp. 89-90) (see also Table 1, E). Their definition that "Complementors are companies that independently provide complementary products or services directly to mutual customers" removes most issues with the other definitions described above. If the definitions are projected onto the value net (see Figure 1), Definition E is also most explicit on some structural characteristics. These are: (1) the value net shows that a complementor does business directly with the customer, in contrast to the supplier who conducts business indirectly or through the focal firm. (2) The value net also shows that the complementor and the focal firm share the same mutual customers. Definition E includes these issues. One final addition comes from the creation of the word complementor. The pure word "complementor" was first proposed by the former CEO of Intel Corporation, Andy Grove. However, Nalebuff and Brandenburger were the scholars that introduced the word complementors to a broader audience. They did this in their book Co-opetition (1996) which is founded on the idea that as business is competition, there are no neat dividing lines between friends and enemies. Slogans like "Sleeping with the enemy", "Froes and Frenemies", and "co-opetition" are still proposing that firms should "convert" their competitors into complementors. This shows that enemies can become friends and vice versa. For example, fashion shops in the City Centre cooperate in attracting customers but are competitors in the actual selling of fashion. This implies that the enterprises in the value net play a role.

The above arguments lead to the following complementor definition:

Definition 1: A focal firm's complementor is a role played by a firm that independently and directly provides mutual customers with an offering that increases the value of the focal firm's offering.

The challenges and continuing with the literature exploration

Since the main research question has been developed and the core concepts have been defined, it is time to embed them in relevant and recent literature. Based on the introduction and the research question, there are two major challenges for SMEs in their continuous struggle to survive:

- To prevent from "commoditisation" by the creation of new value;
- To overcome the problem of "lack of resources" by successfully collaborating with complementors.

These problems have been debated in different types of management literature (e.g. in marketing, strategic management, entrepreneurship and new product development literature). However the dissertation's core terms leave too much room to directly pinpoint a specific scientific field and come up with clear research opportunities. Consequently more focus is needed. The purpose of the next two sections is (1) to select and link in with a scientific field and (2) define the core research opportunity. More precisely, I will follow a two-step approach in which the first section is about a concise exploration of the literature that delivers an overview on which management field is most valuable for the main research question. The second step is designed to come up with the next level of focus. It delves deeper into the selected management field and presents a more concrete research opportunity. These consecutive steps will provide support in selecting a theoretical lens and deriving relevant hypotheses that can be tested later on in the dissertation.

Exploring previous work: complementors, complementarity and new value creation

Although the role of complementors in new value creation is not unfamiliar in management research (E.g. Boudreau, 2008; Nalebuff & Brandenburger, 1997; Ritter, et al., 2004), a literature search found that very few studies took the complementor relationship as the main unit of analysis. Because there are many functional commonalities between *complementarity* and complementors, this broader body of literature is considered to be useful and is subsequently included. A comprehensive overview of key findings is given in the remainder of this section.

This section starts with recognising three primary streams of literature that have explored how complementors & complementarity affect the creation of new value. The three streams - economic, capabilities and marketing perspectives - provide distinct, but occasionally, overlapping, explanations for complementarity and new value creation (see Table 2). The economic perspective analyses complementors as an efficient solution to the risks of

economic transactions. The capabilities perspective places complementors in the context of competitive rivalry and resource sharing to enhance market power. The marketing perspective sees complementors as a vehicle by which organisational knowledge is adapted and exchanged to create customer value. Nowadays, the three primary streams have shared interests and often complement each other on their shortcomings. The current scientific field of complementarity and new value creation is called "mixed". It favours network theory to delve deeper into the complexity of social relationships in business and seems to label new value creation with innovation.

Table 2: Streams overview of complementor, complementarity and new value creation research

Perspective	Value creation by	Type of value	Begins in/with	Dominant unit of analysis
Economic	Transactions with	Monetary	~1940 Schumpeter	Meso, Macro
Capabilities	Resource combining	Unique / strategic	~1960 Penrose	Micro
Marketing	Relationship knowledge	Customer	~ 1960 Yellen	Micro
"Mixed"	All sorts of cor	mbinations	~2000	None

The economic perspective

The most fundamental perspective is the economic perspective. It mainly looks at how *transactions* between entities generate (monetary) value, often referred to as economic profit. The economic perspective looks at how economies of scale and scope arise and often uses mathematical derivations to "model" reality. This perspective argues that firms use their external relationships when that governance form is most efficient as compared with internalisation or market transactions. This is achieved under the conditions of bounded rationality, by minimising production and transaction costs and pursuing value by acquiring assets and resources (Parmigiani & Rivera-Santos, 2011).

The economic perspective bases its assumptions on the prevalence of markets that offer perfect competition. Complementors find their origin in early economic thoughts from around 1900. A well-known example is the work of Joseph Schumpeter (1942),important for today's mainstream economics because it recognises the existence of markets consisting of supply and demand and assumes that firms have *enemies* they compete with. It also assumes that firms must have *friends* they can benefit from (Walley, 2007). I consider these friends to form the fundament of the complementor role in creating value. The unit of analysis in the economic stream is predominantly at the level of industries (meso) to economies (macro) and to a much smaller extent at the level of relationships between firms (micro). These high levels of analysis (meso, macro) determine the role of complementors in creating *meso* or *macro value*.

"Positive network externalities" (Katz & Shapiro, 1985), that is the theory that value to customers is positively related to the size of the entire system, is one of the most notable economic theories that shows how value creation and complementors go hand in hand (e.g. telephone companies, postal services, software & hardware). "(Commodity) Bundling" is another economic theory that looks at the economic effects of firms who sell their goods in packages (Adams & Yellen, 1976). Here it is believed that the prevalence of bundling stems in part from the fact that firms dwell on complementarity in the consumption of bundled components and in part from cost savings in production, transactions and information associated with package selling (or the ability to sort customers into groups with different reservation price characteristics). Bundling usually takes a public policy focus and investigates how it may lead to monopolies and is another example of the economic view's research orientation. Finally, the economic Theory of Complementarities (TOC) (Milgrom & Roberts, 1990), is an economic theory that originates in manufacturing and can be used within the context of a firm. The TOC asserts that if coordinated investments in a system of complementary variables are made it would yield (a) lower costs and (b) higher returns compared to the sum of the independent, uncoordinated investments. In other words, the TOC implies that a firm which competes on complementary offerings could potentially become more profitable if they take care of the creation of synergy advantages.

The capabilities perspective

The capabilities view looks mainly at how *resources* are combined to create (unique/added) value. The capabilities view stems from traditional strategy research that looks at the ability of a firm to manage - usually its resources or assets - and improve its competitive position in relation to its rivals. Therefore, the *value* that is being created originates mostly from Porter's (1985) line of thought, which states that value should be unique and lead to sustained competitive advantage.

A lot of research in the capabilities perspective recognises the important role of complementor relationships, however indirectly. This work is usually about the complementarity of *resources* to create firm value. This comes from the fundamental role that the **R**esource **B**ased **V**iew (RBV) (Penrose, 1959) plays in the capabilities stream. It argues that resources are heterogeneous and immobile across firms and that the true uniqueness of the resources creates competitive advantage (Barney, 1991). In other words, with complementor relationships firms can make their resource portfolio more unique. Although the micro level of analysis is prevalent in this perspective, it is not always clear whether the *complementarity* comes from other firms, other products/services, or other knowledge (Ennen & Richter, 2010). Nevertheless, the capabilities perspective has been receiving a lot of attention and contains several sub streams where the tangible/intangible assets/resources of a complementor are applied to create value.

Table 3 gives a short overview of the most obvious streams and their contributions to the research question:

Table 3: Overview capabilities stream

Capability theory	View of complementarity and new value creation	Key author(s)
Profiting from Technological Innovation	States that in order to make profits from technological innovations, <i>access</i> to external complementary assets matter. Innovating firms thus need to decide to integrate and collaborate when imitation is easy and markets do not work well.	(Teece, 1986)
Strategic Alliance	Companies share unique resources because they have a strategic need to reinforce their position and because firms possess a strong social position with other knowledge to attract or engage partners to mutually create value. Thus look for complementarity of alliance's capabilities.	(Eisenhardt & Schoonhoven, 1996)
R&D Alliances (also co- makership / co-design)	Part of the strategic alliance, non-equity based partnership, specifically focused on the co-development of new markets and technologies for new value creation.	(Hagedoorn, 2002)
Collaboration Networks / Strategic Networks	In order to innovate and create value companies need to see their network as a resource and manage it, for their network provides them with innovation knowledge or resources. Thus firms should look for complementarity in their network.	(Ahuja, 2000; Gulati, Nohria, & Zaheer, 2000)
Open Innovation	Firms can and should use external as well as internal ideas, and internal and external paths to market, as they search to develop their technology to create value. Thus openness of firm towards environment complements its value creation process.	(Chesbrough, 2003)
Co-opetition	Uses the value net to describe how different roles in a focal firm's network contribute to value creation. Here the complementor is described as a specific role that adds value to the focal firm's offering. They are used to set up joint technology standards or develop new products or technologies together. On downstream activities like sales, service, or distribution, usually more competition can be recognised.	(Nalebuff & Brandenburger, 1996; Walley, 2007)
"Six" Forces Framework	Sometimes mentions the role of complements as the sixth force in the original porter 5 forces framework. However in later work Porter states that complements are not necessarily bad (or good) for the value creation of an industry. Thus complements affect value creation through the way they influence the five forces.	(Porter, 1980, 2008)

The marketing perspective

The marketing view, mainly takes into account how exchange between *relationships* creates (customer) value. The marketing perspective sees complementors as a vehicle by which organisational knowledge of shared customers is adapted and exchanged into valuable offerings. Traditional marketing research rose in the 1960s after firms noted the importance of market pull instead of market push (Håkansson, Harrison, & Waluszewski, 2004). It stems from economic research but narrows value creation down to mainly customer value in

buyer-seller relationships (micro level). Consequently, it seemed to have restricted itself in not looking at sources other than the buyer-seller relationship and has received more and more critique from current marketing theorists. The Industrial Marketing and Purchasing (IMP)-school in particular suggests that we should rethink marketing (Håkansson, et al., 2004). They specifically argue that the role of networks, and thus third parties like complementors, should not be underestimated. Value creation is now not the main task of the seller. The IMP School's research shows that distributors, suppliers, customers, endusers et cetera. significantly contribute to these issues as well.

Table 4 gives a short overview of some of the most prominent marketing theories that investigate collaboration with complementors and new value creation:

Table 4: Overview marketing stream

Marketing	View of complementarity and new value creation	Key author(s)
theory		
IMP view on	It is no surprise that the IMP-school often recognises the role of	(Håkansson,
complementarity	complementarity. This is elaborated in work where it is seen as a	1987;
	typology of "horizontal complementary cooperation", or in later work	Håkansson &
	where it has been seen as some kind of trigger to share resources or activate relationships bonds.	Snehota, 1995)
Brand alliances	The value of two (or more) current brand names is paired into one	(Rao & Ruekert,
(B2B ³), Co-	(composite). Complementarity evolves from attracting more	1994;
branding (usually	marketplace exposure, warding off threats of private label brands or	Washburn, Till,
in B2C ⁴)	sharing promotion expenses.	& Priluck, 2000)
Value Co-	Is seen as the process by which the resources of two companies are	(Borys &
creation (B2B)	combined in order to achieve something that one of the parties could	Jemison, 1989;
	not achieve alone. Thus, complementarity flows from sellers with	Forsstrom,
	sellers (and sometimes sellers with customers) joining forces to offer the customer "something".	2005)
Value Co-	Is that unique value is created in extensive interaction with <i>consumers</i> .	(Prahalad &
creation (B2C)		Ramaswamy,
		2004)
Supplementary	Is about capturing the value of add-on services on a "naked / core"	(Anderson &
services	offering. So, complementary value comes from additional service	Narus, 1995)
	offerings, offered by the same seller.	
Horizontal	Refers to chains of similar/related business entities that conduct joint	(Morrison,
Marketing	distribution through co-operation and joint marketing services.	1994)
Systems	Complementarity comes from the collaboration of entire/connected	
	supply chains and is more oriented towards the meso level.	

³ is Business to Business

⁴ is Business to Consumer

Symbiotic	Is a broadly defined terminology that emphasises that two or more	(Varadarajan &
Marketing	companies are independent but eventually try to increase their mutual	Rajaratnam,
	market potential. The complementary relationship that exists between	1986)
	their offerings is a major factor that fosters the formation of symbiotic	
	relationships.	

The current state of complementor and new value creation research

Current research looks mainly at how *combinations* of the preceding streams are made. It suggests applying network theory and has evolved out the general acceptance of social behaviour in business. In contrast to the economic, capabilities and marketing perspectives, current research doesn't explicitly use a dominant way of looking at complementors and new value creation at all (see Table 5). It also sees innovation as quite similar to new value creation. Before directions for the follow-up research are discussed, I will elaborate on the distinctions between the three primary streams and *why* the streams are currently merging.

All the streams contribute to research on complementors and new value creation in their own specific way. Although, the economic, capabilities and marketing perspectives share several commonalities, they differ mainly in the objectives attributed to firms. The economic perspective argues that firms transact by the mode which minimises the sum of production and transaction costs. The capabilities perspective argues that firms acquire resources by the mode which creates value through improving a firm's competitive position. The marketing perspective argues that firms act to maximise relationship value, to satisfy customer needs. In the context of this exploration this means that the economic perspective may be useful in analysing problems within the process of bargaining with complementors, the marketing in maintaining and building sustainable complementor relationships, whereas the decision itself may stem from the acquisition of complementary resources to ensure a stronger market position (capabilities perspective).

The objectives attributed to firms sound distinct but in exploring the literature, most recent articles were hard to place in one of the three primary streams. This leads to three observations:

1) Firstly, a lot of research starts with one of the primary perspectives but directs its conclusions into another perspective. For example, Schilling (2003) talks extensively about the effect of network externalities and value creation, a theory rooted in the economic perspective. However, she attributes a lot of the success factors to strategically managing relationships, an area I assigned to the marketing perspective (see for more examples Table 5). The starting point tends to be journal dependent (i.e. economic, marketing or capabilities journal). This is logical because a marketing journal contains the most relevant literature for exploring a marketing related research question.

Table 5: Overview of the current complementor and new value creation research

Journal	Research topic		Stream		Author
		Eco.	Cap.	Mkt.	
Calif. Manage Rev	Looked at value creation by using the effect of network externalities, she relates a lot of the success factors to the management of relationships.	Х		Х	(Schilling, 2003)
Market Sci	Argued that marketing theories and recent ideas on network externalities need to be more effectively incorporated into the new value creation process.	X		X	(Hauser, Tellis, & Griffing, 2006)
J Mar- keting	Examines how firms' network features influence the value (stock market rewards) from a new marketing perspective.	X		X	(Swaminath an & Moorman, 2009)
Strategic Manage J	Take an economic perspective (TOC) and capabilities perspective (RBV) in explaining complementarity based hyper competition.	Х	X		(Lee, et al., 2010)
Strategic Manage J	Take a relationship perspective on inter-firm resource combinations in explaining alliances or acquisition choices of firms.		Х	Х	(Lihua & Edward, 2007)
Acad Manage J	Take a relational network perspective to explain alliance formation. Market complementarity and resource compatibility affects the formation process significantly.		X	Х	(Mitsuhashi & Greve, 2009)
Strategic Manage J	Make a comparison between the resource based view and institutional focus consisting of legitimacy and status on firm alliances.		X	Х	(Zhiang, Haibin, & Bindu, 2009)

- 2) It is also observed that research methods like multi-level, qualitative followed-up by quantitative, or longitudinal methods are used and mixed much more now (E.g. Hitt, Beamish, Jackson, & Mathieu, 2007; Nieto & Santamaría, 2010; Ulaga & Eggert, 2006). Where the economic stream is traditionally dominated by econometric derivations, the capabilities and marketing streams show most change in the combining of these techniques.
- 3) Finally, new published work on complementors and new value creation in the economic stream is very limited in recent years. The marketing stream represents the bulk of articles and the capabilities stream faces, strangely, a lagging publication record. This finding is remarkable because the capabilities stream still receives a lot of scholarly interest (E.g. Teece, 2007; Wang & Ahmed, 2007). As there is sufficient

interest in this stream, I would assume there should be a significant portion of publications on complementors and new value creation as well, but this is not the case.

So what is happening here, why is it so hard to place current work in one of the three streams? And why are the economic and capabilities perspectives publishing less? Are the traditional boundaries of the three streams fading? I will argue that these problems have something to do with an increasing acceptance among scholars of (1) the general importance of social behaviour in business; (2) an increasing need for analysing relationships with a network approach and (3) a close relationship between the terminology of new value creation and innovation.

Firstly, the acceptance by management scholars of the importance of social behaviour in business has directed current research towards sociological theories and mixed research approaches (Eisenhardt & Graebner, 2007). This forms a legitimate reason why management scholars are reluctant to use ideas and research techniques from economic theory. The economic perspective has a tendency to see market exchange as rational activity in which price is key and firms strive only to maximise their profits (Granovetter, 1985; Keseljevic, 2007), whilst one of the most fundamental and well proven propositions of Granovetter's work (1985) is that economic action is strongly affected by networks of social relationships.

Secondly, relationships play a central role in the social behaviour of firms. As interest in social behaviour in business has grown, an increased need for analysing relationships with a network approach has emerged as well (Wilkinson & Young, 2002). No business is an island (Håkansson & Snehota, 1989) and an increasing amount of new business offerings arise not from any single individual or organisation alone but through collaborative effort (Bell, 2005). Networks are of key-importance for new value creation and innovation, especially for SMEs (Hanna & Walsh, 2002). Customers, suppliers, competitors and end-users all have their specific roles in creating new value. The general focus is thus shifting away from dyadic, one-on-one, relationships to networks of relationships (Anderson, Håkansson, & Johanson, 1994; Batt & Purchase, 2004).

As networks of relationships are receiving more and more attention, the importance of *network roles* and their major contribution to new value creation is becoming clearer as well (e.g. Faems, Van Looy, & Debackere, 2005; Knudsen, 2007; Nieto & Santamaría, 2007). The relatively fresh "discovery" of the importance of network roles is probably one of the main reasons that only a handful of recent studies have taken the complementor relationship as the main unit of analysis. Consequently, more research is needed to highlight the importance of network roles in value creation and innovation (Dhanaraj & Parkhe, 2006).

Although I have argued that the three streams are currently merging into one, the reasons given above are insufficient to explain the limited number of publications using a capabilities

perspective as a starting point. The close relationship between the terminology of new value creation and innovation may explain why the capabilities stream has fewer publications. In marketing the concept of value has always had a central position (Ravald & Grönroos, 1996), while in contrast the capabilities perspective often uses the concept of *innovation* to tackle the problem of commoditisation. Just like new value creation, innovation is the main engine that fuels the viability of a firm's business, offering extraordinary opportunities and enabling firms to gain higher margins or set foot in new markets (Pittaway, Robertson, Munir, Denyer, & Neely, 2004). Innovation is acclaimed in marketing (Hult, Hurley, & Knight, 2004; Matthyssens, et al., 2006; Sood & Tellis, 2005) but in the capabilities stream in particular to lead to sustained competitive advantage and to revitalisation of mature businesses (Capaldo, 2007; Laursen & Salter, 2006; Stopford & Baden-Fuller, 1994). SMEs also find innovation valuable in fighting commoditisation; it helps them to increase sales (O'Regan, Ghobadian, & Gallear, 2006), stay competitive in global markets (Madrid-Guijarro, Garcia, & Van Auken, 2009) and increase their chances of survival (Cefis & Marsili, 2006).

Schumpeter (1934) argued that innovation is considered to be a way to create value. Other publications (E.g. Adner & Kapoor, 2010; Matthyssens, Vandenbempt, & Berghman, 2004; Matthyssens, et al., 2006) that use innovation as their central principle, mention the concept of new value creation as well, and vice versa (e.g. Hauser, et al., 2006). There are therefore no clear reasons why the concept of innovation is different to the concept of new value creation in beating the commodity challenge. The concepts seem to be intertwined. However, a literature search on *innovation*, complementors & complementarity shows a very remarkable finding: it shows that those most *recent* articles label new value creation with innovation (see also Table 6).

Table 6: Some key articles on Complementors, complementarity, and innovation

Journal	Title	Key author(s)
Harvard Bus Rev	With friends like these	(Yoffie & Kwak, 2006)
Strategic Manage J	Value creation in innovation ecosystems: how the structure of technological interdependence affects firm performance in new technology generations	(Adner & Kapoor, 2010)
Acad Manage Rev	Orchestrating Innovation Networks	(Dhanaraj & Parkhe, 2006)
J Prod Innovat Manag	Interorganizational Collaboration and Innovation: Toward a Portfolio Approach	(Faems, et al., 2005)
Manage Sci	Open Platform Strategies and Innovation: Granting Access vs. Devolving Control	(Boudreau, 2010)
Technovation	Technological Collaboration: Bridging the Innovation Gap between Small and Large Firms	(Nieto & Santamaría, 2010)

Conclusions of the literature exploration

The purpose of this section was to narrow down complementor and value creation research and link in with a relevant academic field. In this literature exploration, I firstly looked at the development of the concept of complementor relationships and new value creation research. I noted that little research takes the complementor relationship as the main unit of analysis and that most research considers the role of complementarities and complementary products with an emphasis on the more abstract resource. I noticed as well that the three main streams of complementor and new value creation literature start from different points of view, but currently recognize less strict boundaries. The increasing acceptance of the importance of social behaviour in business and, more importantly, the increasing need to analyse relationships within a network approach, have played a central role in shaping the current field. This field is of topical interest among management scholars and offers a substantial amount of research opportunities. It has therefore triggered the decision to link in with this field. An additional challenge within the current field is that most recent complementor articles use the term innovation to argue about new value creation. From this point on I have decided to primarily follow the innovation literature. It has the largest number of actual publications in relation to complementor relationships (see also Table 6). Additionally, in my empirical field new value creation is easier to understand in terms of innovation, as it is at a lower abstraction level which makes the concept easier to operationalise (this will be discussed in Chapter 4).

Research opportunities: complementors, suppliers and innovation

This section will outline the next step in developing the dissertation's central focus. By building on the general findings in the previous section, a more concrete research opportunity will be developed from the remaining literature.

The literature on complementor relationships and *innovation* indicates that that the role of complementors is becoming increasingly important (e.g. Adner & Kapoor, 2010; Boudreau, 2008, 2010); all new offerings are nowadays somehow dependent on *other* offerings to create *complete* solutions for customers (Katz & Shapiro, 1985; Schilling, 2003). For instance a printing company that prints payment slips depends heavily on bailiff services. A printing company that prints personalised brochures depends heavily on postal services, advertising agents or "Publish on Demand" developers. Companies have to deal with adaptation and bundling of these complements with their own focal innovations, as the value to customers depends on the *entire* system.

At the same time a firm's own new offering faces substantial challenges in design and manufacturing as well. Due to increasing complexities and specialisations in technologies, firms have to - more than ever - rely on suppliers (Pittaway, et al., 2004). In general, the value of suppliers in the innovation process is very high. The integration of suppliers in the innovation process has been recognised as one of the major factors leading to boundary-

transcending innovation (Kaufmann & Todtling, 2001; Lincoln, Ahmadjian, & Mason, 1998; Ragatz, Handfield, & Scannell, 1997). For instance a printing company that wants to print ultra-high resolution brochures depends heavily on proper creation software in pre-press and sophisticated printing machines in the press. Suppliers are thus key players in providing a firm with the components and resources critical to innovate.

This brings me to the *core research opportunity* of this dissertation, which is that in order to successfully innovate, it is not enough to bundle offerings with complementors, as SMEs are dependent on the inputs of their suppliers as well.

Successful innovation is thus dependent on the position of the focal firm relative to its environment. Where suppliers are locate in upstream activities of the focal firm's value chain and complementors downstream, first research shows that asymmetries arise in managing the process. Adner and Kapoor (2010) show that greater upstream innovation challenges enhance the benefits that accrue to technology leaders, while greater downstream innovation challenges erode these benefits. For example, the company Airbus pioneered the super-jumbo passenger aircraft. The upstream suppliers had major challenges in designing new engines or more powerful hydraulic systems and delivered important contributions in making the airplane technologically feasible (technological benefit enhancement), while the airplane could only become a success if airports were able to receive an oversized plane, regulators to develop new safety procedures or simulator manufacturers to update the crew's training programmes (technological benefit erosion). Adner and Kapoor's findings have led to a request for coming research to further explore the asymmetries between complementors and suppliers in other empirical settings and innovation contexts.

In addition, Yoffie and Kwak (2006) argue that enterprises base most strategic choices on extensive competitor, supplier or customer analyses but hardly investigate common interests with complementors. As a result, people often face difficulties in distinguishing a complementor from a supplier. In fact, both roles add customer value to the offering of the focal enterprise, but this is perceived as the primary task of a supplier. This problem is amplified by the use of a wide variety of closely related supplier roles (e.g. science partners, co-suppliers, consultancy firms, distributors)(See for network roles overview: Pittaway, et al., 2004). This results in ambiguity in the way the term suppliers is operationalised and utilised in the innovation literature. In some cases the supplier is actually a complementor. Going more into detail, it can be seen that complementors differ substantially from suppliers.

In terms of the general relationship structure (see also Table 7, rows a & b), suppliers are part of the value chain, where the supplier plays an important role in supplying the focal enterprise with inputs that are transformed into offerings. The supplier conducts *no* direct business with the focal enterprise's customers (see also "links" in Figure 1). In contrast, complementors are part of *other* affiliated value chains. They are affiliated as the value chains come together at a mutual customer and the offerings solve a problem more "completely". Thus, suppliers are vertical relationships and complementors horizontal.

In terms of relationship functions - like production, innovation and new value creation (see also Table 7, row c & d) – I argue that suppliers produce offerings that are bundled upstream by the focal enterprise and complementors produce offerings that are bundled downstream by customers. A supplier offers components whereas a complementor offers complements (Adner & Kapoor, 2010) or complementary goods. Suppliers help to improve the "standalone" benefits of an offering. In contrast, complementors - who offer complementary goods – help to improve the value of a set of goods, which forms a complete solution for customers (Habets, van der Sijde, von Raesfeld, & Groen, 2010). As a result, the focal enterprise, by having complementors, may benefit from positive network externalities. In which case, the value of the offering increases with the number of other users of the same or equivalent offering. So the value of a technological innovation to users depends on more than one factor. Aside from its stand-alone benefits and costs, user value is also driven by the size of its installed base and the availability of complementary goods (Katz & Shapiro, 1985; Schilling, 2003). The availability of 'complementary goods' together with the 'size of the installed base' seems to trigger a self-reinforcing cycle and introduce unique strategic challenges (Stabell & Fjeldstad, 1998). A large installed base attracts producers of complementary goods while the availability of complementary goods attracts users, increasing the installed base; it is like a chicken-and-egg situation. Visualizing innovations this way explains why superior technological innovations might still fail. Consider the Windows operating system; it is often said not to be the best system available, but it has the largest installed base and offers the greatest number of complementary programs. "Thinking in complements is a different way of thinking about business, it is about finding a way to make the pie bigger rather than fighting with competitors over a fixed pie" (Nalebuff & Brandenburger, 1996 p.24).

Table 7: Differences between suppliers and complementors

	Suppliers	Complementors
A	Suppliers conduct no direct business with customers of the focal enterprise (FE); FE is customer of supplier	Complementors do business directly with customers of the FE; Complementor & FE have mutual customers
В	Suppliers form a <i>vertical</i> relationship with FE; value chain logic (Stabell & Fjeldstad, 1998)	Complementors form a <i>horizontal</i> relationship with FE; links value chain with <i>other</i> value chain, value network oriented (Stabell & Fjeldstad, 1998)
С	Suppliers offer <i>components</i> bundled by FE (Adner & Kapoor, 2010)	Complementors offer <i>complements</i> bundled by customers (Adner & Kapoor, 2010)
D	Offering of supplier adds <i>critical</i> value to the FE's offering; the FE's offering would not function without it	Offering of complementor adds <i>extra</i> value to the FE's offering; both offerings have "stand-alone" features and may benefit from positive network externalities (Schilling, 2003)

Conclusions of the research opportunities

So far there has been little research conducted that is specifically about the innovation challenges of the focal firm in working with complementors *and* is simultaneously explicit about the innovation challenges confronted in working with suppliers. Although firms are strongly dependent on both, this made me decide to make this the core research opportunity in this dissertation. This section emphasises the research opportunity by demonstrating that complementors differ significantly from suppliers (see also Table 7) and that asymmetries arise due to position of the roles relative to the focal firm (Adner & Kapoor, 2010). Previous innovation research has not distinguished between the roles sufficiently. The *main purpose* of the coming chapters is thus to delve deeper into the role that complementors play in innovation and to disentangle it from the role of suppliers.

Before I develop hypotheses, I will consider a case study from the Dutch printing industry. This will provide insights into typical drivers and effects of "complementor and supplier relationships in innovation". Where, as here, there is limited current literature available, case studies have proven to be particularly valuable (Eisenhardt, 1989).

Chapter 3: A case study of an innovation in which a complementor plays a role

The main purpose of conducting a case study is to find underlying principles of complementor relationships and their effects on new value creation. In other words, based on the main research question, the aim is to get a sharpened understanding of *how* a complementor contributes to the innovation performance of the focal firm and what might become important to look at more extensively later on in the dissertation.

Specific attention is given to my core research opportunity, which is that the complementor role needs to be compared with its "asymmetric" supplier role. If only the relationship between a complementor and a focal firm in creating new value is considered, their unique value contribution may not become clear. Unique means in comparison with/or relative to other contributions, so it is important to make observations beyond the dyad and look at networks of relationships. An observatory field study on a small printing firm's value net and its new value creation project (= innovation) was therefore conducted.

Case selection

In order to find answers on the above purpose, a data collection approach needed to be developed. At first a focal printing firm needs to be included that has (1) recently marketed an innovation and (2) done this in close collaboration with a complementor, a supplier and the other value net roles (see also Figure 3).

Following the assumption that value and innovation are bound up with each other, it was decided to delve deeper into the single value contributions of each role in the innovation. This value is determined by identifying the perceived customer benefits (technical, economic service and social) of the innovation *in relation* to its next best alternative (Anderson & Narus, 1998; Anderson, Narus, & van Rossum, 2006). This is considered to be a reliable method to assess value qualitatively (Ulaga & Eggert, 2006). To obtain more robust findings I made use of "triangulation" techniques, which means that in this research the mentioned value contributions of one role are verified by/compared with the assessments of the other roles.

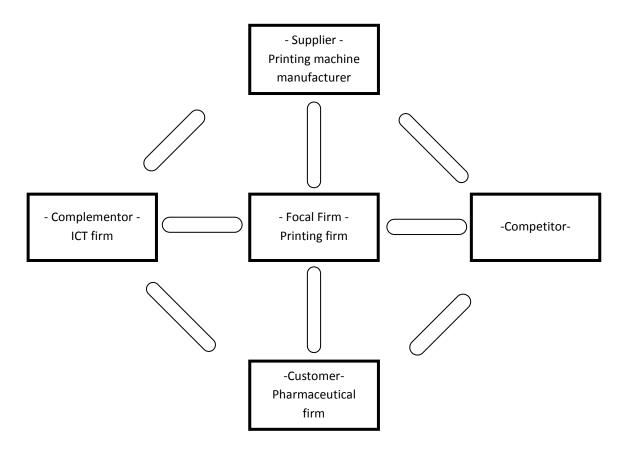


Figure 3: The analysed Dutch printing firm's Value Net (adapted from Nalebuff and Brandenburger (1996) & Ritter, Wilkinson, and Johnston (2004)).

This led to the following interview procedure: Around the summer of 2009, I visited all four companies, whose names are anonymised for privacy reasons. At each, I conducted a voice recorded semi-structured interview, lasting one to two hours. The interview was in three parts. The first part was a general discussion about the interviewee and their company. Next all parties were asked how the innovation came into existence and why they considered this innovation to be valuable. The purpose of this part was to ensure that respondents considered a specific use situation and were prepared to compare it with alternative products or innovations. In the last part of the interview I asked the respondents to describe how each role created value in the innovation and - if possible - to provide examples. To facilitate this, the respondents were asked to describe the activities of every role in the innovation, which in turn allowed me to examine the different perceived benefits in the relationship. Special attention was of course given to the comparison with the next best alternative of a comparable innovation. In this way it was possible to (1) pinpoint the separate new value contributions in the respondents' own language and (2) analyse the competitor, although indirectly, as well. After the face to face interviews were conducted, a report was made that was checked with the interviewees for factual accuracy.

The structure of the case study is as follows: Firstly, an overview of the four companies giving some general descriptions of the interviewees and their companies. Secondly, a description of the joint innovation, followed by an assessment of value contributions per

role. Finally, the case study concludes with a discussion which gives direction for the theory testing chapters.

The "Print on Demand" (PoD) innovation and the four companies

Print on Demand (PoD) is a printing technology and a business process, in which new copies of a book or other document(s) are not printed until an order has been received (http://en.wikipedia.org/wiki/Print on demand, 2012). One of the most obvious strengths of PoD is that it enables printing enterprises to make a connection between digital printing and document management software. This connection helps them to create profitable, single and customised copies and consequently offer new value to customers. The focal enterprise, the supplier and the complementor all make specific value contributions to the PoD innovation. PoD is considered to be the central innovation in this case study.

The Focal Firm: a small (~30 FTE) Dutch printing company, located in the western part of the Netherlands. The firm was founded in 1920 and has been through many changes (e.g. a management buy-out, an accommodation fire and the introduction of disruptive digital production technology). It was an early adopter of digital printing and yielded profits through a successful digital printing spin-off. Innovation is still a high priority for the firm and this can be seen in its workflow optimisations, warehousing solutions and document creation. The interviewees for the focal firm are the general manager and the business development manager.

The Complementor: a small (~10 FTE) ICT company, that provides customers of printed matter with a print on demand software package. The complementor was founded in 1998 and had its origin in the computerisation of lay-outs and templates. The firm is a complementor because its software is complementary to print (it increases the value of print) and shares/targets the same customers as the focal firm. The interviewee is the cofounder/owner of the complementor firm. Managing sales & services is one of his main activities.

The Supplier: is a large sized (325 kFTE) developer & manufacturer of all types of computing electronics. They operate in global consumer and business markets. This case study is focused on its digital printing equipment for professional printing, which is produced by an acquired subsidiary from Israel. The first machines were introduced around the mid-'90s, but due its technological advantages and changing market demands, the business continues to grow. The supplier sells its (critical) machinery and consumables to the focal firm and does not directly conduct business with the customers of the focal firm. The interviewee is the country manager for the Netherlands.

The Customer is part of a large (50 kFTE) pharmaceutical company that develops, produces and sells drugs worldwide. It consists of several subdivisions, operating in different fields. One of these divisions has been using the software application from the complementor and printed materials from the focal firm for almost four years now. The division's headquarters

coordinated the software implementation among other foreign offices. The interviewee is the graphic service manager, who is mainly responsible for the graphic service team whose main objective is to continuously improve internal printed communication processes.

Case study findings

The value contributions of the focal firm on the "PoD innovation"

Since the 1920s, the focal firm has been producing printed materials, mainly for business customers. They did this, on a local scale, with loyal customers that liked working together. Printing machinery was probably *their* main asset, until rapid technological progress led to printing becoming more and more of a commodity product. Currently, offset (=traditional) printing still forms an important part of the focal firm's income. However, this area is commoditised and faces many threats: The focal firm's general manager recognises a step change in the scale of the market. The market faces overcapacity and small margins on traditional print. The focal firm's general manager says: "About 5 years ago we implemented a strategy that if we wanted to survive in the printing business we had to offer value again. It would be a matter of course that this would be achieved with digital print". A decade ago, digital printing became suitable for professional printing. Initially the focal firm started working with digital printing machines as some kind of fondness for the technology, but over the years, the increasing threats to the traditional printing business made them recognise the real opportunities of this new technology.

Both the focal firm's general manager and the complementor argue that the focal firm was among the first Dutch printing companies that captured the value of digital printing. The focal firm's business developer says: "A lot of printing enterprises make the mistake of using digital print only to produce smaller print runs more efficiently, and forget to exploit the true opportunities that digital print offers, (like for instance variable data printing). This results in the same chicken and egg situation that is happening on the traditional offset machines. As a matter of fact they only make paper dirty." As an example of their effective digital printing strategy, they mention a highly profitable spinoff. This spin-off produces photo books composed by consumers via the internet and it is still one of the fastest growing companies in the Netherlands. The experience and knowledge gained from this somewhat unexpected success has been used by the focal firm in the development of new offerings. The focal firm's business developer says: "Currently we're developing a broad range of digital applications and internet services to ease the efforts of customers with marketing and publication. Many say that internet will dislodge print, we believe that internet and print reinforce each other, print is just becoming different, it is not the conventional way anymore. The trick for this transformation process -that is producing a large amount of unique documents- is managed well by us". However, this transformation process could not be achieved by the focal firm alone and is one of the main reasons they collaborate intensely with the complementor.

It can be seen that the focal firm, in contrast to traditionally-oriented printing companies, is able to offer a substantial amount of new value to customers. The technical benefits of

digital printing enable the focal firm to customise prints more effectively. In other words, digital printing enables variable data printing. This means that every copy can contain unique or personalised information (= social benefit), resulting in higher exposure rates of printed matter.

Economic benefits of digital printing include lower set-up costs, which makes small runs much more attractive. In traditional offset printing, plates have to be manufactured separately for each colour and set of documents. Consequently, the machine operator needs a lot of time before the first print can come out of the offset printer. To prevent paying start-up costs too often, customers order more material than is usually necessary. Start-up costs with digital printing are much smaller, inducing customers to order differently. This leads to smaller stock levels and reduces the waste of outdated material.

In respect to service benefits, the technique enables the focal firm to offer much shorter delivery times, additional prints can always be supplied quickly and customers can get their print materials more quickly or when they really need it.

The value contributions of the complementor on the "PoD innovation"

The two founding entrepreneurs were employed as communications/PR director and software engineer in a large automation firm and were confronted with the problem of realising efficient and flexible production of communication material. There were too many printed materials in stock, people did not comply with the corporate lay-out and errors in trial prints happened regularly. They started to develop their own software using the internet, templates and PDF-files to streamline it into production. The complementor says: "At this time, digital printing was scarcely out of the egg. When the technology grew to maturity, an organising site was quickly added. That is how our business started off".

The complementor currently offers the customer an online platform they can use to order printed matter insightfully and efficiently. When the order is received, the focal firm is one of the partners that is responsible for manufacturing, storing or delivering the printed matter. The two companies need each other to offer the full PoD innovation. Both the complementor and the focal firm acquire customers for their joint offering. In this case study the complementor is the corresponding contact of the customer.

The focal firm's general manager is very pleased with the programme: "They did a good job in developing a very open and accessible programme for a very acceptable pricing level. The competition offers programmes that are 4 to 5 times more expensive and have fewer features". The complementor himself says that they do not really have competitors. There are, however, some parties that "irritate" them. There is a software company that uses aggressive marketing very effectively. But there are fewer technological benefits to their programme. The complementor says: "In contrast, our programme covers and guides the entire marketing chain online".

Another technical benefit of the PoD innovation is that all kinds of added services like fulfilment (printed matter delivered at the customer's doorstep) and media creation, and many more add-ons are possible. The system has value because it is compatible with the bulk of manufacturing equipment. There is another hardware supplier of printing machinery that "pretends" (according to complementor) to offer these options in their system, but at the same time, are restricted by their business model. The supplier's system cannot be open because money is partly earned through equipment sales and prints on its equipment (the consumables), so the more prints ordered, the more money made. Consequently printing machinery from competing suppliers would interfere with print production on their own equipment and thus the supplier's POD software is barely compatible with competing machinery. This is a way to protect the supplier's business. This is a problem because printing firms usually buy printing machines from several suppliers. The complementor says: "In contrast, we are trying to build a platform that may become a worldwide leader because we are trying to share as much as possible with partners" (= social benefit).

Finally, the complementor has a service advantage over other programmes, created by sharing the manufacturing facilities of worldwide printing firms. For instance, when a Dutch customer has a job for the Japanese market, they can easily use the software application to outsource the job to a certified Japanese printing company. In other words, the print on demand innovation with all its benefits can be offered in foreign countries as well.

The value contributions of the supplier on the "PoD innovation"

The supplier is one of the leading manufacturers of professional digital print equipment. They started marketing these professional printers in 2001. They did not pioneer these machines themselves, but acquired an Israeli firm which developed them. Since then efficiency, quality and effectiveness have improved a lot. This, combined with changing market demands, means they have yearly sales increases in dozens of percent.

The supplier sells only the digital printing machine to the focal firm. He says his company's main focus is on selling machines followed by creating income through sales of consumables and service contracts. They distinguish themselves from other digital print suppliers with the use of colour inkjet technology. This is confirmed by the focal firm, the complementor and the customer. All roles state that the next best alternative uses toner technology which does not deliver the same print quality.

The supplier states that their competitors sell more printers and are more aggressive marketers, but they do not achieve the same production reliability or the same 24x7 service quality. Although they are competitors they have a kind of armed peace. The supplier says: "We suppliers are more involved in capturing print volume from traditional print". This can be seen in brochures, sales pitches or the new management tool the supplier wants to apply. "With this tool we try to explain how our customers (= focal firms) can make their production process more cost efficient. So from an economic point of view, it is most profitable to work with digital printers."

The ability to print variable data is another key technological benefit over traditional machines. In relation to the PoD software, the supplier offers relatively few tools. The supplier says: "This just has no real priority yet, customers need to give shape to it their selves. By the way, by selling the equipment we are doing a good job anyway. However, we recognise the new market potential, and employ some solution architects in London. For now we are mainly developing workflow optimisation programmes, our external part is therefore probably less dedicated. Perhaps in a few years our strategy will change - when there is a leading platform, as you can tell we're good at acquisitions".

The value perceptions of the customer on the "PoD innovation"

Perceptions of the customer: The customer organisation consists of many foreign subsidiaries and had problems around consistent labelling, outdated stock and inefficient document creation. About four years ago the customer attended a "zero waste marketing" conference. It was here that the complementor attracted the attention of the customer. After a sales pitch and comparisons with competing offerings, the customer selected the complementor because of their "one stop shopping concept" and the flexibility of the PoD innovation; printed matter can be delivered anywhere easily and is not tied to one printing firm. The PoD innovation's most significant competitive advantage was the clear technical benefit of the software. It had a much higher speed for the PDF-engine, which is used for document proofing. At that time internet speed was either slow or very expensive and the customer feared that this would threaten a successful implementation amongst the foreign subsidies.

According to the customer, the PoD innovation is not all roses and has some minuses compared to the next best alternatives. The customer says: "Hypothetically speaking, if the speed of all the competitive PoD innovations was the same, the complementor would not have become the preferred supplier". The customer found the complementor's offering much more complex to use and hardly intuitive. The customer says: "It consists of three modules and our employees need a course to work with it". Additionally, since the complementor is a small firm they regularly perceive capacity problems in their customer service. The sales price was not an issue, the price was not significantly different from competitors.

Speaking about the focal firm, the customer says that they want to avoid contact with other marketing parties besides the complementor. This is why they chose the "one stop shop concept", it minimises their marketing relationships (= social benefit). The customer says the focal firm is a small and well organised printer that manages its stocks for Europe. They offer offset quality with the supplier's machine, which is what was required by the customer, and deliver a good job.

Case study discussion and conclusions

Value creation discussion

The case study findings show that there are hardly any differences in perceptions about the value contribution of each firm's role. All the parties seem to broadly agree on what value they deliver and what the customer values most⁵. Table 8 gives an overview of these value contributions and the perceptions of the customer:

Table 8: Overview of the separate value contributions to the PoD innovation

Benefits	Focal firm	Complementor	Supplier	Perceptions of customer
Technical	Masters to print a large amount of unique documents (TM/NM)	 Covers and guides the entire marketing chain (TM/NM) Open system (NM) 	 Variable data printing machinery (TM) High quality printing machinery (NM) 	More consistent document creation (TM) Speed of PDF proofing (NM)
Economic	 Lower set up costs small runs (TM) 	• Lower operation costs (TM)	 Lower set up costs machinery (TM) 	 Marketing assets are controlled more efficiently (TM/NM)
Service	 Shorter delivery time (TM) Ease of marketing and publication efforts (NM) 	 Worldwide printer network (TM/NM) 	• 24x7 service quality (NM)	• "One stop shopping" concept (TM/NM)
Social ⁶	Tighter relationships by personalisation of documents (NM)	 Formation of strategic partnerships by sharing knowledge (NM) 	 Keeps up the sales promises (NM) 	Reduction of the amount of marketing parties (TM/NM)

Note that these value contributions are the relative benefits; "TM" relates to benefits compared with the next best alternatives on the **T**raditional **M**arket, "NM" means benefits on the **N**ew **M**arket against other Print on Demand innovations.

As stated earlier, value becomes visible when comparing the innovation with the next best alternative. One prevalent observation is that all interviewees compare the PoD innovation with *two* next best alternatives: on the one hand the PoD innovation is compared with traditional offset print (see also Table 8, Traditional Market (TM)), on the other hand it is compared with other PoD innovations (see also Table 8, New Market (NM)). Given the main

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⁵ Although it is interesting to note that focal firm, supplier, and complementor think that value comes from the broad range and sophisticated technicalities of their innovation, while the customer is much more concerned about the ease of use and support.

⁶ In this case study the respondents hardly mention social benefits. The explanation for this might be that the social benefits are at a higher abstraction level and subsequently hidden in the other benefits. For example, the creation of "stronger relationships" is a social benefit that counts for every role that takes part in the POD innovation. At the same time this general social benefit forms the fundament for higher levels of trust and reputation, and thus accounts for the more concrete service benefits of the "one stop shop", "worldwide printer network" or "24x7" service quality. In other words, it appears that the social benefits are drivers of the other benefits.

purpose of this case study, which is to assess how the complementor relationship provides support to the focal firm in the creation of new value, gives an interesting direction for follow-up.

In general, most value within the *traditional* market originates in the printed matter. Benefits come mainly from making the production process more efficient and effective (e.g. lowering set up costs) and partly from product improvements (e.g. variable data printing). In contrast, on the *new* market there seems to be a shift away from solely selling printed matter. Here much more value is created by added services *around* the printed matter. In other words, printed matter is seen as a part of the entire marketing process. If further is taken into account that the value of the PoD innovation, is not only created by collaboration between the complementor and the focal firm, but with the supplier's support as well. This may lead to some profound answers to the case study's research question.

Firstly, most value on the traditional market originates not in the contributions of the complementor but in the contributions of the supplier. The supplier is actively involved in improving the technological (e.g. inkjet technology) and economic benefits (more efficient small runs) of the printed matter. As mentioned earlier, the supplier puts a lot of effort into capturing volume from traditional printing, which is predictable as for them there is a clear business case. Market demands are changing to demand smaller runs and digital printing helps a focal firm to fulfil these demands more effectively than traditional offset printing. The focal firm's general manager says: "We chose the supplier because we were operating the supplier's competitor machines as well, given our customer's demands and the changing market dynamics we were convinced that we could work best with the supplier".

Although the supplier's machines make variable data printing possible, they are not so helpful to focal firms in transforming variable data printing into a PoD innovation. All the parties (besides the customer) recognise that suppliers face big constraints in their business model to marketing an open PoD software system. The focal firm's business developer says: "Selling hardware remains the core business of the supplier, software is more a suppositious child". The supplier agrees: "we do not have a policy to stimulate these developments. Entrepreneurs know best what their customers want". On the assumption that PoD software is important for variable data printing and as they are not afraid of "missing the PoD bus", the supplier does not feel threatened by software firms at all: "These programmes are just one of the means that enlarges the number of digital prints. So, yes please".

Conversely the complementor, while they do support the focal firm on the traditional market in the creation of variable data, they are not the key player in achieving the core benefits like lower set up costs and the actual printing of variable data. In fact, the complementor adds an almost "commoditised" software application that helps the focal firm to create and manage variable content. The main benefits for the focal firm from the complementor's software are that they do not have to work with other software systems because everything is integrated in the application. In the end, both the supplier and the

complementor are important for the focal firm to create the PoD innovation, although on the traditional market, the role of the supplier is perceived to be more unique and important.

However on the new market, the complementor offers also an application tailored to a broader "marketing assets" customer problem. Here more value is created by the complementor than the supplier. The complementor even confidently argues that they are the one that truly adds value: "I believe that we offer more cost reduction because we can optimise the complete marketing chain and not only the printed matter. In fact we focus much more on the (end) customer and his marketing problems and much less on the focal firm that wants to deliver printed matter. The supplier has no real relationship with the customer and subsequently cannot do this". The focal firm's general manager says: "From my background I know similar offerings to the complementor's. The complementor adds a solution, without conducting big investments. Maintenance is zero; it is developed from a marketer's point of view. The complementor has become a very important partner of ours. Even on top of s printing alone, it has become very interesting to sell the programme and we now have different business models for that".

From the findings described above it can be noted that the supplier and the complementor are both responsible for the value of printed matter on the traditional market. However, the interviewees find that the supplier has a bigger contribution in creating value on the traditional market than the complementor. On the new market there is a much bigger role for the complementor.

Additionally, if the value of the traditional market is compared with the new market it can be seen that the perceived value on the traditional market is limited. The customer says: "If we talk about the true value of printed matter, this is possibly limited, although printed matter is one of the major communication carriers". The focal firm's general manager says more or less the same: "At many organisations printing is a closing entry people want to manage as efficient as possible". The value on the new market is perceived to be much bigger. The focal firm's business developer says: "If this offering is sold to the customer, printed matter is a derivate. It contains functions that do not lead to printed matter. Customers choose our offering because we solve a problem as document management advisors". So on the new market, value is created by tackling a more primary customer problem: customers are helped with the management and control of all their marketing activities. This implies that the printed matter is more a "by-product" of the bigger marketing processes; and the value of the PoD innovation is more significant on the new market than on the traditional market. More importantly, it implies that the biggest value contribution is largely the results of the complementor relationship.

Based on the above empirical findings, two conclusions can be derived:

- It is of particular interest to compare the impact of the complementor and supplier roles on innovation value. Both roles are important for new value creation, but they contribute to different parts of the focal firm's offering. To gain more insights in the complementor role, the supplier needs to be taken into account as well.
- 2) In terms of the *amount* of innovation value, the complementor relationship adds more new value to the focal firm's offering than the supplier relationship.

There are more conclusions that can be drawn on basis of the case study. The *amount* of new value created, (=value added), is not the only factor on which complementors and suppliers offer different support to the focal firm in preventing commoditisation. Both roles appear to affect the *time* that the innovation is first sold to customers (= time to market) as well. Where the value added of the innovation is mostly about the market impact of the new offering, time to market of the innovation is more about the *responsiveness* of a firm in complying with market demands and is found to be important as well. The time to market factor may be interesting to include because it shows how a focal firm attains or defends competitive advantage by bringing innovations to the market more quickly (Leiponen & Byma, 2009) and may profit from, for example, first mover advantages (Lieberman & Montgomery, 1988).

Let me elaborate on this by means of the findings. At first, for the focal firm it is noticed that the traditional market is still responsible for a large share of total turnover. Consequently, for the short term continuity of their business, it is of great importance to hold this position. At the same time, the traditional market is perceived to be much more mature and commoditised than the new. This means that the value of the offerings is quite similar, competition is distinct and customer demands are obvious. However, the traditional market is a very familiar market with few unknown parameters. This implies that if the focal firm innovates on the traditional market it knows what to expect. It is able to estimate costs and benefits better, making innovation decisions less difficult. But on the traditional market, the competition is very likely to also implement similar innovations. The focal firm's general manager said that almost every printing firm is investing heavily in digital printing equipment. The dynamics on the traditional market shift the advantage away from whether a focal firm innovates or not to when the focal firm innovates. So every value improvement, even a small one, is of great importance to the focal firm in holding the traditional market position and outperforming the competition just a bit better.

The findings show that the supplier mainly focusses on capturing print volume from traditional offset printers. They perceive the traditional market as sufficiently profitable and possess most knowledge of it as well. The supplier therefore provides more support on areas where the focal firm can make smaller print runs more efficient and effective, the low-hanging fruits, than on the more risky and complicated variable data printing. The supplier does this because its business model, based on the use of consumables, is initially dependent on sales of printed matter. So the incentives for a supplier come from helping the

focal firm to secure its position on the traditional market, which can be done by an improved time to market. For the complementor this is not the case.

Building on these findings, it was noted that the value contributions of the supplier are more focused on the traditional market. On this traditional market it was perceived that the PoD innovation did not create as much value as on the new market. Less value relates to innovations that are incremental and less disruptive, which is argued to make innovations easier and quicker to implement (Garcia & Calantone, 2002). Here again a difference in the two specific roles can be noted.

Finally, logical reasoning triggers the assumption that in this process the supplier, who manufactures machines to supply an existing market more efficiently, gives a focal firm a lot of advice on how best to apply the machines (e.g. optimise work flows, replace offset print and subsequently reduce costs). The parties have known each other for some time and speak the same "language of print", which helps them to exchange information more effectively and efficiently. In contrast, the complementor offers added solutions that the focal firm can apply in markets other than the traditional printed matter market. The value change is bigger, market demands are much more unclear and more exploration is needed in order to successfully market the innovation. In this case the information exchanged between the complementor and the focal firm is much more diverse. Where the complementor talks about the marketing problems of the customer, the focal firm is used to talk about the printed matter. Parties probably need more time to get the offerings in line with and adjusted to each other in order to provide the best offer to the new market. For example, the findings show that the supplier's contribution is mainly an improvement on the traditional market. Consequently, the role for the focal firm as a printing manufacturer does not directly change, whereas the contribution of the complementor gives the focal firm a completely new role as "document management advisors".

In summary, there are three findings that show why the time to market of the innovation is expected to be important to include further. First, the *stakes* of a supplier in helping the focal firm to market its machinery are higher for the supplier than for the complementor's software. Secondly, the *value added* is considered to be bigger with complementors than with suppliers, which makes innovations easier to implement. Thirdly, the *information* that is shared with the complementor is much more diverse than that which is exchanged with the supplier. Based on the main purpose, another conclusion can now be derived:

3) The factor "time to market" may lead to better insights into small firms innovating with suppliers and complementors. From the case study it can be deduced that supplier relationships improve the time to market of the focal firm's offering more than complementors.

The previous argument that postulates that the diversity of information may create a different effect for a complementor than for a supplier on the time to market, can be used

for another conclusion too. Obviously, the concept of diversity serves as a *driver* as well. Diversity is in the management literature often expressed as the cognitive distance between two (or more) relationships and indicates to what extent knowledge and skills are different. (E.g. Wuyts, Colombo, Dutta, & Nooteboom, 2005). Firms embed with each other to bridge the cognitive distance. This affects the firm's innovation performance as well (Gilsing, Nooteboom, Vanhaverbeke, Duysters, & van den Oord, 2008). Following previous arguments, one can imagine that embedding suppliers is easier due to the cognitive distance being smaller than for embedding complementors. All these arguments put together enable me to formulate an additional conclusion:

4) A focal firm's cognitive embedding with a complementor in comparison with a supplier may explain different effects on innovation.

Interrelationship discussion

If relational differences between the complementor and supplier are considered, another observation can be made: there seems to be a "relational split". On the one hand are the vertical relationships along the supply chain. These are healthy relationships but not strongly embedded. For example, the customer says about the complementor: "I cannot say that our relationship with the complementor is a big success, it is more a good footing, aimed at the long run. There is sufficient trust, although we perceive that the relationship is slightly under pressure due to their capacity problem". The supplier says about the focal firm: "nice people, the relationship is going fine, especially at the beginning with the current entrepreneur". The focal firm's business developer says about the supplier: "We both focus on a long term relationship, it is sustainable, other suppliers much less so." As mentioned before, the relationships between the supplier and the complementor, and the customer and the focal firm are not direct and cannot be valued accurately.

At the other hand there is one strongly embedded horizontal relationship, the complementor with the focal firm. They are very fond of each other, for example the complementor says about the focal firm: "It is a true partner that invests a lot in the relationship, they risk their neck. We discuss many things and talk to each other often. We both connect many customers to our offering. We also have the courage to invest in each other, take no opportunistic actions and hold agreements. We faced the same pain that ties us together." The focal firm's general manager says about the complementor: "For me it is important that we have a style of working that matches and will determine the success... I trust the complementor a lot, I have the courage to go with him to customers, I think I even trust him blindly; they won't go to customers behind my back... Further, the complementor is becoming a very strategic partner in the further development of variable data printing; we like to lean on each other".

What can be derived from these quotes is that an embedded relationship between the complementor and the focal firm has probably contributed a lot to making the PoD

innovation a success. The degree of social embeddedness with the supplier was obviously of less importance, although the value contributions of the supplier are important too. In the case study the tightness of the relationship between the focal firm and the complementor seem to have a great effect on the ability of the focal firm to create new value, while the tightness with the supplier relationship is obviously of less importance. This finding leads to more specific questions, which are, in relation to the main research question, interesting to explore. For instance, is it always the case that a focal firm needs to embed its complementor more than its supplier? Another question would be what happens with the creation of new value if a focal firm embeds its complementors even more, and what if it embeds suppliers less? Is there an optimum involved or are there dark sides of complementor and supplier embeddedness to be recognized? For some time it has been known that social embedding can have a great impact on the performance of the focal firm (Granovetter, 1985), however specific effects of the single roles are underexplored in current research (Dhanaraj & Parkhe, 2006). In my case study the roles seem to cause an asymmetric effect as well. For follow-up research it is thus of particular interest to delve deeper into the drivers of supplier and complementor embeddedness. Therefore I come up with another conclusion for follow-up research and is formulated as follows:

5) A focal firm's social embeddedness with a complementor in comparison with a supplier may lead to diverse effects on new value creation

Conclusions

In this case study I gave a detailed description of a Dutch printing firm that jointly created new value with its value net. The main aim was to get a sharpened understanding of how a complementor helps the focal firm in the creation of new value has led to some interesting insights. The case showed that the focal enterprise would not have achieved the PoD innovation in collaboration with the complementor alone. The value contributions of the supplier were crucial as well. These value contributions are expressed in terms of benefits. The supplier's benefits stem mainly from making the production process more efficient and effective, and only partly from product improvements (e.g. variable data printing). In contrast, the benefits of the complementor facilitated the focal firm in making a shift away from only selling printed matter. Here value is derived from the benefits *around* the printed matter.

The main conclusions of Chapter 2 are confirmed and supplemented by the conclusions of the case study. They are that in order to assess the effects of complementor relationships on new value creation it is not enough to look at the role in isolation; it has to be compared with the supplier role as well. Further I argued that the complementor has a bigger contribution to the amount of value of the focal firm's innovation (=value added), whereas the supplier is more involved in helping the focal firm to become more efficient and maintain its current market position by marketing the innovation more quickly (= time to market). Finally, social cognitive embedding seems to be an important driver that enables me to

distinguish a complementor from a supplier and to better understand their asymmetric effects on innovation performance.

In summary, Chapters 1-3 give sufficient grounds to follow-up this research by deriving hypotheses and empirically assessing the role of social cognitive embedding of complementor relationship in comparison with supplier relationships and relating it to the ability of the focal firm to innovate.

Chapter 4: complementor and supplier hypotheses on innovation performance

This chapter's purpose is to disentangle complementors' and suppliers' impacts on innovation performance. It is divided into 4 sections. Hypotheses will be derived on the theoretical basis of (1) cognitive distance & absorptive capacity and (2) social embeddedness. Section (3) will consider the explanatory innovation performance concept and some additional innovation performance hypotheses and finally section (4) will present the research model to be empirically tested.

Cognitive distance and absorptive capacity - the role of diversity

In order to innovate enterprises need resources. Enterprise resources are defined as all self-controlled assets, tangible as well intangible, that are valuable, rare, inimitable, and non-substitutable, to gain sustained competitive advantage (Barney, 1991). It is virtually impossible to hold all resources necessary to innovate internally. So enterprises often collaborate with other enterprises to overcome the problem of a lack of resources (Katila & Shane, 2005). They want to effectively make their own resource portfolio complete and innovate successfully (Eisenhardt & Schoonhoven, 1996; Gulati, 1995). Although I acknowledge that more types of resource are necessary for innovation, in this chapter I will use the knowledge resource to derive the hypotheses.

Knowledge has been argued to be *the* critical resource that sets a firm apart from others (Kogut & Zander, 1992, 1996; Spender, 1996). It limits and at the same time enables a firm to take action and distinguish itself from competition (King & Zeithaml, 2003). Knowledge is a unique resource because it can be used by multiple relationships simultaneously, within or outside the firm (Knott, 2003). Companies accumulate knowledge throughout their existence and can be viewed as a reservoir of knowledge and skills. Together with existing knowledge, new knowledge can be assimilated or created through learning (Kogut & Zander, 1992; Shane, 2000).

In the context of this dissertation the process of knowledge accumulation can be seen as small companies engaging in *networks* of learning. It is argued that these companies - who are actively involved in these learning networks - expand their competencies and know-how (Powell, Koput, & Smith-Doerr, 1996), and enlarge their initial resources and skill endowments (Becker & Dietz, 2004; Gulati, 1995). A substantial amount of partner heterogeneity within these networks is important, because collaboration with *different* relationships is expected to enhance innovation due to the greater quantity and variety of knowledge to be shared (Knudsen, 2007; Nieto & Santamaría, 2007). Empirical evidence from Feams *et al.*(2005) shows that the more firms engage in different inter-organisational collaboration, the more likely they are to innovate successfully. The same is true for the 'diversity of partner' findings in a study by Nieto and Santamaria (2007) - they positively affect the innovation performance.

In other words, *diversity* is crucial for innovation (Nooteboom, Van Haverbeke, Duysters, Gilsing, & van den Oord, 2007; von Raesfeld, Geurts, Jansen, Boshuizen, & Luttge, 2012). Diversity is associated with the degree to which knowledge and skills are different, which introduces the notion of cognitive distance (Wuyts, et al., 2005). Higher degrees of cognitive distance go hand in hand with higher degrees of novelty. This has a positive effect on, for example, learning by interaction and stems from the idea that in order to innovate enterprises need diversified knowledge to create opportunities with.

However, there is a flipside. Too high degrees of cognitive distance make it hard for companies to innovate. In order to innovate, enterprises need levels of cognitive distance that allow them to "absorb" each other's knowledge (Cohen & Levinthal, 1990; Cowan & Jonard, 2009). As mentioned earlier, knowledge absorption is achieved by learning, but learning is more efficient when there is a common knowledge base (Nooteboom, et al., 2007). Thus, enterprises should achieve enough mutual understanding to learn from each other before diverse knowledge can be translated into feasible innovations (Wuyts, et al., 2005).

If these two relationships are plotted in a graph, it results in an inverse U-shape relationship for the effectiveness of learning (and the subsequent innovation performance). The innovation performance curve can be drawn as the mathematical product of (1) a line representing the absorptive capacity that decreases with more cognitive distance and (2) a line that represents the novelty which increases with more cognitive distance (see also Figure 4).

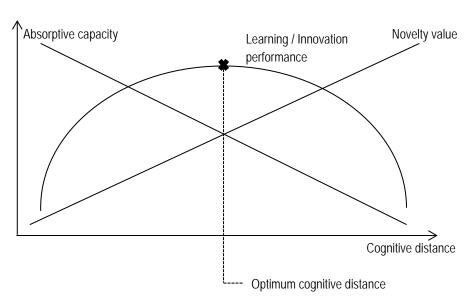


Figure 4: Optimum cognitive distance (Nooteboom, et al., 2007)

In considering empirical evidence, Laursen and Salter (2006) find that the innovation performance has an inverted u-shape function on the number of network sources (e.g.

suppliers, clients, conferences), and that an optimum exists. Laursen and Salter (2006) relate this result to the "search depth". Organisations need to search their network for ideas and partners, however they often have to go through a period of trial and external sourcing. It requires extensive effort and time to build up an understanding of the norms of different external knowledge channels (Katila & Ahuja, 2002; Laursen & Salter, 2006). Other evidence offers similar observations: Diverse networks deliver more diverse knowledge and information. However, they also use more resources to analyse all the different bits of information that arrive at a much quicker pace (Gnyawali & Madhavan, 2001). De Jong and Freel (2010) provide evidence for these costs by showing that higher R&D expenditures are positively related to collaboration with more distant organisations. The last implication of diverse networks is that the risk of strategic drift is bigger as well. This is because enterprises are changing their knowledge base continuously, which makes it hard to integrate or absorb the knowledge (Ahuja & Katila, 2004).

Complementor diversity

Let me project these contingency findings on the complementor and supplier roles and derive the first set of cognitive distance and absorptive capacity hypotheses. Please take into account that much of the above mentioned research mainly looked at the relationship's *dyad* (E.g. Nooteboom, et al., 2007), whereas I am looking at the *portfolio* of relationships. Firstly the complementor:

Complementors form horizontal relationships with the focal firm. Complementors operate in different industries with their own specific dynamics. Consequently, interests and strategies are often unaligned with the focal firm (Yoffie & Kwak, 2006). For example, a coffee brewer collaborates with a coffee machine manufacturer (coffee & coffee machines), a car manufacturer with an oil refinery (cars & petrol stations) or a movie maker with an electronics manufacturer (DVDs and DVD players). One can imagine that commonalities in this type of relationship are much harder to find. Compared to a group of actors in the same supply chain, relationships with complementors differ significantly in, for instance, pricing, technology and strategy.

Every complementor is thus a rich source of diverse knowledge. Because this research is at the portfolio level (and not the dyad level), I assume that every complementor relationship is at a *constant* cognitive distance with the focal firm. In order to increase levels of cognitive distance, the focal firm has to include more complementor relationships, because higher degrees of cognitive distance lead to higher degrees of novelty. I have also argued that too high degrees of cognitive distance come at a price. They will cause problems in absorbing knowledge and negatively affect novelty. This would happen if the firm forms relationships with too many complementors. In other words, the challenge is to include a number of complementors that create sufficient cognitive distance to create something new, but not so many as to prevent mutual understanding and innovation. The complementor hypothesis that can now be proposed follows the theoretical argument of an inverted U-shape: At the

beginning more complementor relationships will lead to a higher innovation performance until the optimum is reached and the overload of complementor relationships starts to form a burden (See also Figure 5). This leads to hypothesis $H1_{C}$:

$H1_{C}$: There is an "inverted u-shape effect" of the cognitive distance with complementors on the focal enterprise's innovation performance

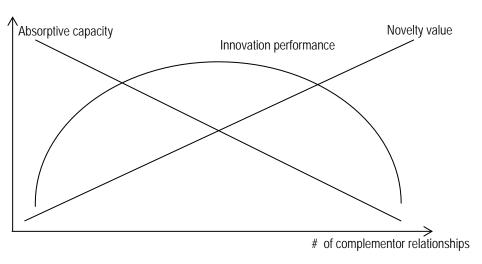


Figure 5: Cognitive distance depending on the amount of complementor relationships (adapted from Nooteboom *et al.* (2007))

Supplier diversity

In contrast to complementors, suppliers form a vertical relationship with the focal firm. This means that both parties operate within the same industry and have a greater alignment of interests and commonality in dynamics (Yoffie & Kwak, 2006). For example if a focal firm is a car manufacturer that is doing good business, its suppliers of manufacturing equipment, bodywork and interior fabrics profit as well. During the 2008 financial crisis, people delayed replacing their car but did not stop using it. This created problems for the focal firm and its suppliers but not for the complementors like petrol or car maintenance stations.

Again, because this research is at the portfolio level I assume that every supplier relationship is at a *constant* cognitive distant with the focal firm. To increase the cognitive distance a focal firm forms more relationships with suppliers to create a bigger pool of knowledge that increases the novelty value but lowers the absorptive capacity. So far, the effects of supplier relationships are in line with complementor relationships. However, I argue that more supplier relationships do not create more *diversity* of knowledge: For this statement I refer to a recent finding by Knudson (2007), who found that enterprises tend to collaborate with partners from their own industry (the suppliers). In these relationships similar knowledge is circulated, which ultimately endangers the creation of new knowledge. The findings of Knudson are similar to fundamental postulations in social network theory. This states that firms forming too close relationships face an increased risk of redundant information (Burt,

1995), tunnel vision, or lock-ins (Grabher, 2004) and subsequently have lower levels of novelty and innovation performance.

In addition, relationships with suppliers have higher levels of dependency than complementor relationships. Because the resources exchanged in supplier relationships are argued to be of *critical* importance for the focal firm, the focal firm cannot function without them. This strong dependency is found to enhance communication, collaboration and adaptation, because companies want to reduce uncertainty and manage their supply chain more effectively (Noonan & Wallace, 2006; Petersen, Ragatz, & Monczka, 2005). The strong dependency also leads focal firms and their suppliers to form close relationships and speak the same language. The cognitive distance is thus lower for suppliers as compared to complementors.

Putting the arguments together: having a couple of supplier relationships leads to more diverse knowledge and increased levels of cognitive distance. However the more suppliers are involved, the greater the chances that similar knowledge is being exchanged and the novelty value is lower. This implies that the cognitive distance slowly subsides with the number of supplier relationships until eventually a "cut off" point comes into existence. At this cut off point it is expected that increase in cognitive distance is insignificant, keeping the absorptive capacity and subsequent novelty value at constant levels. When these effects are plotted in a graph (see also Figure 6), it can be seen that the innovation performance line moves towards an asymptotic maximum depending on the mathematical product of the novelty value and absorptive capacity. Higher levels of supplier dependency lead to the absorptive capacity line starting higher and the novelty value line lower compared to complementors.

In summary, in theory it is expected that a higher number of supplier relationships leads to diminishing returns on innovation performance. This leads to the following hypothesis H1_S.

H1_s: There is a "diminishing returns effect" of the cognitive distance with suppliers on the focal enterprise's innovation performance

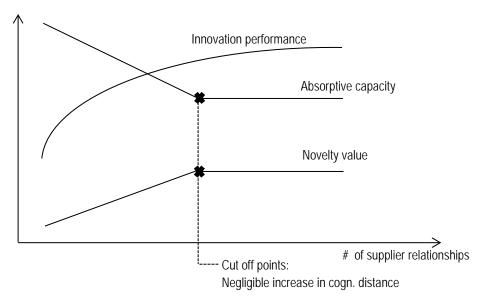


Figure 6: Cognitive distance depending on the number of suppliers

Social embeddedness

No business is an island (Håkansson & Snehota, 1989). All enterprises have relationships with other enterprises. Over time, networks arise, enterprises become close, fixed firmly and deeply in these relationships, until they become embedded. In general, recognising embeddedness has led to a new understanding of why small enterprises can exist (Granovetter, 1985). In comparison with large enterprises, small enterprises possess scarce or limited resources. Therefore, in order to innovate and overcome the problem of a lack of resources (Katila & Shane, 2005), networks are of key importance (Hanna & Walsh, 2002).

A network with a high degree of embeddedness consists of dense connections between the actors. These dense relationships foster trust building and the *exchange* of resources between actors. On the other hand, a low degree of embeddedness means that the network is more loosely coupled. This has specific advantages over dense networks in terms of the *access* to new or diversified knowledge. Although the discussion on high versus low embedded networks is often presented as two opposing views, it seems that the effectiveness of degree of embeddedness is dependent on certain contingencies (Ahuja, 2000; Burt, 2004; Gilsing, et al., 2008; Vanhaverbeke, Gilsing, Beerkens, & Duysters, 2009), and it is looked at why next.

Since management scholars took up Granovetter's (1973, 1985) discussion of the role of embeddedness in social and economic processes, a lot more research has been conducted on this topic. A high degree of embeddedness, the *Coleman view*, takes place when a group of enterprises enter into long-term relationships to take individual as well as collective advantage of each other. Embedded networks face reputation effects and limit the opportunities for opportunistic behaviour (Coleman, 1988; Hagedoorn & Duysters, 2002). As

a result, evidence shows that enterprises which are part of a strongly embedded network perceive more advantages in partnering success (Hagedoorn, 2006) or the acquisition of strategic capabilities (McEvily & Marcus, 2005). A high degree of embeddedness also helps enterprises to improve their competitive position (Gimeno, 2004). It enables them to share risks, learn more and decrease the time to market (Uzzi, 1996). Subsequently, the build-up of trust, a reputation mechanism, has been found to be of key importance (Hagedoorn & Duysters, 2002; Uzzi, 1997). Regarding innovation and collaboration, empirical evidence collected by Ahuja (2000) and in an earlier stage by Walker *et al.* (1997) shows that a high degree of embeddedness positively affects innovation performance. However, excessive embeddedness has some kind of interlocking effect. Due to a high degree of reputation and trust in the network, enterprises become loyal to their close relationships, which inhibits the creation of "fresh" alliances (Gilsing, et al., 2008; Gulati, et al., 2000; McEvily & Marcus, 2005). Secondly, the information within the network is redundant (Burt, 1995) because "everyone knows what everyone knows" (Gilsing, et al., 2008, p. 1721).

The Burt view stems from the idea that in order to innovate, enterprises need diversified information to create opportunities with. In networks where the degree of embeddedness is low, the chance of discovering new opportunities is higher. Enterprises constrained in these types of networks face more ways of alternative thinking, giving them more options to create new combinations (Burt, 2004). Innovative enterprises/entrepreneurs are especially alert to discovery. This alertness goes together with a unique skill in discovering opportunities; they know where to look for the right knowledge (Kirzner, 1973). Networks with more diversified information are thus preferable for idea generation. Consequently, McEvily and Zaheer (1999) found empirical evidence that advice on the acquisition of competitive capabilities had a negative impact on the degree of embeddedness. Burt (1995) showed that enterprises achieve superior returns if they depend on disconnected and internally disorganised markets. Shipilov (2006) found similar results within the Canadian investment banking industry. Banks full of structural holes performed better. However, Sampson (2007) found that alliances contribute far more to enterprise innovation when the diversity is moderate, rather than low or high. So within the Burt view, searching for opportunities has some pitfalls. Less embedded networks not only deliver more information, they also deliver it more quickly than more embedded networks. At the same time, previous research has shown that it costs more resources to analyse all the different bits of information that arrive at this quicker pace (Gnyawali & Madhavan, 2001). This puts firms at an increased risk of strategic drift, as firms are changing their knowledge base continuously, which makes it more difficult to integrate or absorb (Ahuja & Katila, 2004).

In conclusion, a significant body of research has shown that the degree of embeddedness affects the innovation performance of an enterprise in several ways. A low degree is needed for the diversity of information and knowledge that leads to novelty. In contrast, a high degree of embeddedness is needed to build up trust for successful collaboration. In order to derive hypotheses, I will give a precise definition of embeddedness and relate it to the role

of suppliers and complementors in innovation processes. In order to do so, it is important to recognise two types of embeddedness: "relational embeddedness" and "structural embeddedness" (Gulati, 1998; Rowley, Behrens, & Krackhardt, 2000).

Relational embeddedness

Gulati (1998, p. 296) argues that "Relational embeddedness or cohesion perspectives on networks stress the role of direct cohesive ties as a mechanism for gaining fine-grained information". In this dissertation this means that the strength of a tie - as a function of the extent and time of knowing each other and the frequency of contact - determines the degree of relational embeddedness. A strong tie means that there is an embedded relationship between two enterprises, with all the subsequent pros and cons described above. A strong tie takes a lot of time and effort to reap its benefits. In contrast, a weak tie takes less effort or resources and therefore more relationships can be maintained simultaneously, to create the advantages of diversity (Ahuja, 2000) (see also Figure 7, A). However, in this dissertation the weak tie argument of "fewer resources to maintain more relationships simultaneously" might not be completely applicable.

After all, complementors operate in industries with different dynamics and unaligned strategies (Yoffie & Kwak, 2006). Complementors are thus more "diverse" compared to a focal enterprise than suppliers, which operate in the same industry as the focal enterprise. This assumes that the cognitive distance is greater as well. To gear up each other's offerings for innovation, internal mind sets and resources need to become compatible and adjusted. To some extent, in order to innovate, enterprises need to lower the cognitive distance to allow "absorption" of each other's knowledge (Cohen & Levinthal, 1990; Cowan & Jonard, 2009). In the previous section I argued that absorbing knowledge is achieved by learning, and that learning is more efficient when firms possess a common knowledge base (Nooteboom, et al., 2007). As a result, the enterprises in a "complementor - focal enterprise relationship" need to interact more intensely than in a "supplier - focal enterprise relationship". In order to bridge the cognitive distance gap, the ties with complementors should thus be stronger. This is in line with previous research that found that the cognitive distance decreases as the interaction becomes more intense (McAllister, 1995) and results in the following hypothesis H2:

H2: Complementors will be more relationally embedded with the focal enterprise than suppliers

Innovations that add more value are often of a more radical nature (Garcia & Calantone, 2002) but come at a price. Innovations with a higher value are more ambitious and novel, which goes hand in hand with more resources, knowledge, and "cognitive bridges" to market them successfully (Gilsing, et al., 2008). In other words, the added value is affected positively, given the condition that the tie is strong enough to absorb the knowledge. Consequently, enterprises form close relationships to obtain this complementary know-how (Teece, 1986) and to speed up development times (Uzzi, 1996). Stronger ties enable the

parties in the relationships to understand things that really matter and anticipate them better; they make the cooperation more efficient and effective (Gilsing, 2005). This leads to the following hypotheses H2c:

H2_C: The stronger the relational embeddedness with a complementor, the higher the innovation performance of the focal enterprise will be

and H2s:

H2_s: The stronger the relational embeddedness with a supplier, the higher the innovation performance of the focal enterprise will be

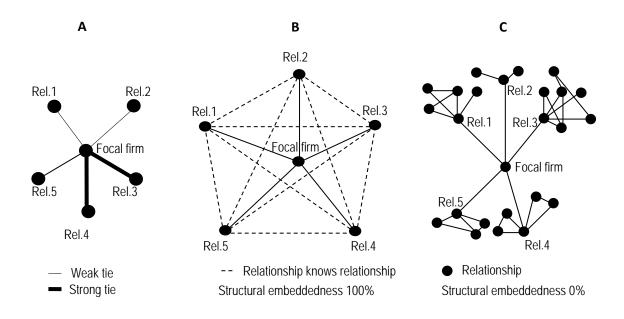


Figure 7: Configurations of different network structures

Structural embeddedness

A relationship with an enterprise goes beyond the dyadic (one on one) relationship. It is also about the network in which a focal enterprise operates. Structural embeddedness is defined as the degree to which an enterprise's relationships know each other. A focal enterprise has multiple relationships. If all these enterprises are familiar with each other, the focal enterprise has a maximum degree of structural embeddedness (100%) (see also Figure 7, B). If they do not know each other, and the focal enterprise is the only linkage between them and the other relationships, the structural embeddedness is at a minimum (0%). Then it has the advantage of being on a structural hole and able to receive a variety of information from the sub-networks around it (Burt, 1995) (see also Figure 7, C). This is in line with Gulati's definition (1998, p. 296): "Structural embeddedness or positional perspectives on networks go beyond the immediate ties of enterprises and emphasize the informational value of the structural position these partners occupy in the network".

Now, if enterprises start innovating with complementors, then according to my definition they have to look outside their traditional value chain (network) and make links with other value chains (new networks) they are not familiar with. The chances that the enterprises in the new network know each other are lower than the chances that they know each other within the current network. Further, bringing an innovation to the market with a complementor is perceived to be a bigger challenge than doing so with a supplier. The focal enterprise and the complementor already face their own internal technological challenges in bringing the innovation to the market (Adner & Kapoor, 2010). Both the complementor and the focal enterprise are responsible for managing innovation knowledge for their own industry and it is thus more likely that suppliers will be more structurally embedded. This leads to the following hypothesis H3:

H3: Complementors will be less structurally embedded in the network of the focal enterprise than suppliers

Given the arguments on the degree of diversity, I expect that a focal enterprise will receive more diverse knowledge from a complementor than from a supplier (Nooteboom, et al., 2007). Furthermore, in a complementor relationship it is unlikely that the enterprises will want to maintain contact with all of the partner's relationships. This appears to be unnecessary and inefficient (Gilsing, 2005); again, both the complementor and the focal enterprise are thus responsible for managing innovation knowledge for their own industry. This leads to the following hypothesis H3_C:

$H3_C$: The less structurally embedded complementors are in the network of the focal enterprise, the higher the innovation performance of the focal enterprise will be

Suppliers operate in the same industry as the focal enterprise and are more familiar with each other's businesses. Given the fact that "everyone knows what everyone knows" (Gilsing, et al., 2008), innovations with suppliers are also more of the same. The diversity argument is of much less importance than the trust argument. According to the general arguments about embeddedness, a more densely structurally embedded network engenders higher levels of trust and better reputations, which are argued to positively affect the innovation performance (Hagedoorn & Duysters, 2002; Uzzi, 1997) and results in the following hypothesis H3_S:

H3_s: The more structurally embedded suppliers are in the network of the focal enterprise, the higher the innovation performance of the focal enterprise will be

Innovation performance

This section delves deeper into the innovation performance influenced by complementor and supplier relationships and is aimed at (1) finding appropriate factors for the innovation performance concept and (2) deriving four additional hypotheses (H5 – H7).

Innovation offers enterprises opportunities (Schumpeter, 1934) and enables them to gain higher margins or set foot in new markets. It is argued that innovation is a broad and complex concept that traverses many facets of organisations (Chan, Musso, & Shankar, 2008). Consequently, it is difficult to pinpoint what innovation and innovativeness are (Danneels & Kleinschmidt, 2001; Garcia & Calantone, 2002). To obtain a holistic view about innovation, Nooteboom (2000) recognises (1) different *types* of innovation (like product, process, organisational), (2) different *degrees* of innovation (like incremental vs. radical, continuous vs. discontinuous, new to the firm/world) and (3) different *levels* of innovation (such as within a team, firm, industry).

This has the following implications that lead to an increased focus of the innovation performance concept used in this study: An offering is defined to be an innovation when customers perceive it as (re)new(ed). When talking about innovation performance, I refer to the ability of a focal firm to renew its offerings. The bigger or faster the renewal, the higher the performance. In Nooteboom's (2000) innovation terms this means that (1) the innovation type is a product or a services innovation. (2) The innovation degree is the relative amount or result of newness and the (3) innovation level is on the firm level and includes only first tier relationships. Finally, it is acknowledged that innovation is a part of the entrepreneurial process where business opportunities are (a) recognised and (b) exploited (Shane & Venkataraman, 2000). This dissertation is focused on the innovation exploitation stage and not on the stage where ideas are being generated.

To derive some additional hypotheses, I will make use of the findings from my case study. In general, case studies are argued to be an increasingly popular technique to reduce rich qualitative data and pinpoint relevant drivers⁷ (Eisenhardt & Graebner, 2007). So far, I have found two components, expressed in factors, of innovation performance that seem to disentangle the supplier and complementor roles. These factors are (1) the value added and (2) the time to market of the innovation. Two other factors (3) share of new products to turnover and (4) the number of marketed innovations, serve as supplementary components

.

⁷ Take for example the factor/metric "customer satisfaction about m a new product" in relation to "revenue growth due to a new product". When illustrated by Apple's I-Pad (a tablet pc), different drivers can be recognised. "Customer satisfaction" may be created by the ease of use and elaborate technical features of the I-Pad, whereas the "revenue growth" may be dependent on subsequent marketing efforts, brand reputation or lockin effects on customers. In other words, all innovation factors play an important role in explaining the ability of a firm to innovate. However, not all innovation factors are useful in pinpointing *specific* innovation effects of complementors in relation to suppliers.

From a theoretical to a more practical issue that illustrates the value of the conducted case study. Theorising about the innovation performance factors does not confirm whether these factors are useful in the empirical context. e.g. theoretically, the increase in market share may be affected differently by complementors than by suppliers; however in the empirical field most printing firms are hardly aware of, interested in, or occupied with market shares. Which makes this factor hardly reliable and thus impracticable. The case study has enabled me to make a better grounded *selection* of factors.

to make the innovation performance concept more solid. All are supported by literature (see also Table 9).

Table 9: Overview of output innovation factors adapted from Chan, Musso and Shankar (2008)

#	Factor ranked no.1 in terms of importance	%
1	Revenue growth due to new products or services	16
2	Customer satisfaction with new products or services	13
3	Share of new products to turnover in given time period	8
4	Number of new products or services launched	8
5	Return on investment (=ROI) in new products or services	6
6	Profit growth due to new products or services	4
7	Potential of entire new product/service portfolio to meet growth targets	3
8	Changes in market share resulting from new products/services	3
9	Net present value (=NPV) of entire new product/service portfolio	2

[&]quot;N" = 633, "%" is respondents who use more than 3 innovation factors, innovation factors ranked less than 2% are not shown.

Added value

Due to the fact that innovations can be incremental or radical (Garcia & Calantone, 2002), and most enterprises are operating in a mature industry and are beating the commodity magnet(Rangan & Bowman, 1992), the amount of value added is an important explanatory factor in the concept. The more value, the greater the margins. Besides my case study finding, in which I showed that the complementor is perceived to tackle a larger and more primary customer problem and thus deliver more value added than the supplier, there is also some supplier research that looks at this. For example, Song and Thieme (2009) found that when suppliers are involved in market intelligence gathering activities they have a positive effect on incremental innovations, but a negative effect on radical innovation. All these arguments have resulted in selecting the added value as an explanatory factor of the innovation performance concept. They also enable me to derive a hypothesis:

H4_{I-III}: The social cognitive embeddedness effects of complementor relationships on reducing the focal firm's added value will be stronger than those of the supplier relationships.

Expressed in mathematical terms: on the factor "added value" the absolute value of the slope of $H1_c > H1_s$, $H2_c > H2_s$, $H3_c > H3_s$.

Time to market

Because the industry is dynamic and most technologies are available to all printing firms, the empirical context might invoke copying behaviour. This makes the time needed to market an innovation an important issue for staying ahead of the competition. Empirical evidence from Leiponen and Byma (2009) suggests that small firms hardly rely on formal ways of protecting their innovations by patents, but give a clear preference to speed to market. Handfield, Ragatz, Petersen and Monczka (1999) argue that there is extensive research on the benefits of including suppliers in the innovation process, of which a quicker response to market changes is one of the most appealing. In my case study it is postulated as well that suppliers exercise a positive influence on the time to market of the focal firm, in contrast with complementors (see also the value creation discussion of the case study in Chapter 3). In summary, the above arguments have led to the selection of the time to market as an explanatory factor for the innovation performance concept. They also enable me to derive an additional hypothesis:

H5_{I-III}: The social cognitive embeddedness effects of supplier relationships on reducing the focal firm's time to market will be stronger than those of the complementor relationships.

Expressed in mathematical terms: on the factor "time to market" the absolute value of the slope of $H1_C < H1_S$, $H2_C < H2_S$, $H3_C < H3_S$.

Share of new products to turnover

The third factor concerns the percentage of new products in the firm's total turnover in the last three years, and is adapted from Chan et al. (2008) and the OECD (2005). Because the industry typically innovates by introducing new products and services, this factor is considered to be a good indicator of the innovation performance of a printing enterprise. This factor is also found to be a valid indicator not dependent on firm size (Lööf & Heshmati, 2002). This factor is a ratio and subsequently does not have the disadvantage of measuring perceptions. It thus supplements the power of the innovation performance concept. Neither the theory nor the case study give me sufficient arguments to expect that supplier relationships will generate a higher (or lower) share of new products to turnover than complementor relationships. This leads to the following hypothesis:

H6_{I-III}: There will be no difference in social cognitive embeddedness effects between complementor and supplier relationships on the focal firm's share of new products to turnover.

Expressed in mathematical terms: on the factor "share of new products to turnover" the absolute value of the slope of $H1_C = H1_S$, $H2_C = H2_S$, $H3_C = H3_S$.

Number of marketed innovations

The last innovation performance factor concerns the number of marketed innovations in the last three years. This factor is needed because the value added and the time to market are expressed in averages. A firm is much more innovative if it is able to deliver the same added value and the same time to market for 10 innovations than for only one. In other words the number of marketed innovations is a proper metric because it shows the size of the innovation *portfolio*. I previously contended that supplier relationships are expected to generate lower amounts of value added and shorter time to market on innovations compared to complementor relationships. I thus assume that innovations with supplier relationships are more of an incremental kind, are marketed quicker and are therefore more common. These arguments lead to my final hypothesis.

H7_{I-III}: The social cognitive embeddedness effects of supplier relationships on the number of the focal firm's marketed innovations will be stronger than those of the complementor relationships.

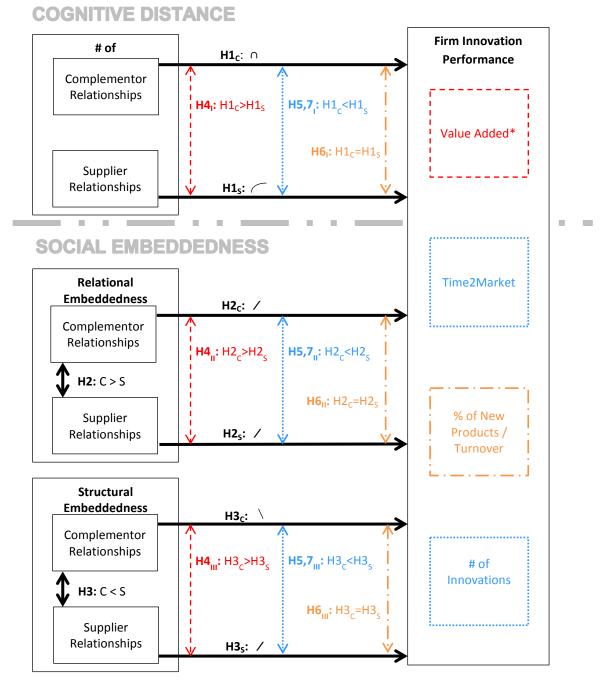
Expressed in mathematical terms: on the factor "number of marketed innovations" the absolute value of the slope of $H1_c < H1_s$, $H2_c < H2_s$, $H3_c < H3_s$.

Final research model

The previous sections have resulted in a final research model (see also Figure 8). In this model I show that innovation performance is affected in different ways by the cognitive distance and social embeddedness with supplier and complementor relationships. More specifically, I formulated 20 hypotheses of which:

- H1, consisting of two hypotheses, argues that the cognitive distance with complementor relationships has an inverted u-shape effect and with supplier relationships a diminishing returns effect on the focal firm's innovation performance.
- H2, consisting of three hypotheses, argues that the focal firm is more strongly relationally embedded with the complementor than with the supplier and that relational embeddedness has, regardless of the role, a positive effect on the focal firm's innovation performance.
- H3, consisting of three hypotheses, argues that the focal firm is less structurally embedded with the complementor than with the supplier, and that structural embeddedness has a positive effect on the focal firm's innovation performance with the supplier and a negative one with the complementor.
- H4 H7, consisting of twelve hypotheses, delve deeper into the effects per single innovation performance factor. It argues that supplier relationships will have a stronger effect on reducing the focal firm's time to market and the amount of innovations marketed than complementor relationships. In contrast, complementor

relationships are expected to exercise a stronger effect on the value added than supplier relationships. No difference in the effect of supplier or complementor roles is expected with regard to share of new products to turnover.



- C → complementor relationships
- S → supplier relationships
- * \rightarrow please note that the factor (/metric) "Value Added" is not the same as the concept of "New value creation"

Figure 8: Research model with 20 complementor and supplier hypotheses

Chapter 5: Research design and data collection

Empirical setting: the Dutch printing industry

The Dutch printing industry is a typical industry. In 2009 it consisted of 2578 enterprises, of which **S**mall and **M**edium-sized **E**nterprises (SMEs) accounted for the biggest share: 94% of the enterprises have fewer than 50 employees and only 44 enterprises have more than 100 employees (www.kvgo.nl, 2009).

The industry has been in business for quite some years. Currently, it can be characterized as 1) capital-intensive and 2) dynamic. Capital-intensive, because the contribution to the gross domestic product (1.1%) is twice as large as the national employment rate (5.1‰) (www.kvgo.nl, 2009; http://www.cia.gov/library/publications/the-world-factbook, 2009). Dynamic, because it is undergoing a lot of technological and market change (Boczkowski & Ferris, 2005; Cox & Mowatt, 2003; Hardstone, 2004; Hayes, 2008; Nijhof & Streumer, 1998). Although an early prediction of the paperless office ("The Office of the Future," 1975) has not materialised, the printing sector is an industry on which computer-based technology has already made an enormous impact. The extensive digitising of products and processes has created many threats as well as opportunities (Boer & Teunen, 2008; EuropeanCommission, 2007; Hultén, Viström, & Mejtoft, 2009; Romano, 2006; Smyth, 2006).

Some threats are the result of a sophisticated, broadly available printing technology. This technology has left little space for distinctive product features and makes true craftsmanship hardly necessary (Wallace & Kalleberg, 1982). Further, since printing is not really tied to one place and there is currently a general technical labour shortage, Dutch enterprises also suffer from higher personnel costs than Eastern European and other fast developing countries. As a result, the Dutch printing industry has been focusing on computerisation and process optimisation to lower costs further and secure their competitive position. To achieve this, they have invested heavily in new manufacturing equipment. This equipment is only provided by some very large, high-tech OEMs (Original Equipment Manufacturers) (e.g. Xerox, Heidelberg and HP). Their effective and efficient machines have outperformed the printing demand and caused the next dominant threat: overcapacity (Dantuma, 2009; GOC & KVGO, 2008). This threat is amplified by the type of market served. Printing enterprises serve markets that are often dependent on marketing expenses, which are in return very sensitive to economic recessions. Given all these characteristics, it is not surprising that price competition rules, profit margins are squeezed (Matthyssens, et al., 2006), and many companies are vanishing (see also Table 10).

Table 10: Number of Dutch printing firms and workers (GOC & KVGO, 2004, 2005, 2006, 2007, 2008, 2009)

Year	2004	2005	2006	2007	2008	2009	2010
# of firms	3417	3183	2991	2899	2797	2578	2298
# of workers	50077	47900	46416	43937	42042	39574	31225

To get out of this position, printing enterprises are putting a lot of effort into innovation. As shown in the previous sections, enhancing innovation in a mature industry is hard to achieve for a single enterprise and even harder for small enterprises (Hanna & Walsh, 2002; Hewitt-Dundas, 2006). Printing SMEs have limited resources (e.g. R&D or financial) to develop better performing technologies or to achieve scale advantages to improve their competitive position. However, what they can do is buy new technologies from the OEMs and deploy them to enhance the value of their offerings. This has led to two broad streams of innovation: 1) technological and 2) market-oriented innovations (or a combination of both) (Garcia & Calantone, 2002).

In the first stream, mostly suppliers offer all kinds of semi-manufactures to enable printing enterprises to enhance the value of their current offerings. These benefits are usually incremental technological modifications such as paints to apply 3D effects, photo-editing software which tricks the eye into printing "real" copies or paper with CO2 production compensation.

On the other hand, many printing industry-related reports (Vachon & Klassen, 2006; W@tch, 2005a, 2005b) and Dutch specialist journals like Graficus, Compress and Print Matters have been discussing another compelling business opportunity: digital printing. Nowadays, even for higher volumes, traditional offset printing (which accounts for the bulk of printing) is more and more being replaced by this printing technique (EuropeanCommission, 2007). The market demands have enhanced the attractiveness of digital printing as well; the average size of runs has decreased but the number of runs has increased (EuropeanCommission, 2007). The other advantage is that the fixed production costs (e.g. machinery, start-up, cleaning) for digital printing are much lower. This results in smaller and more up to date stock because it can be "printed on demand".

Ultimately, the digital printing technique has one very evident advantage over traditional print: every printed sheet can be completely different from the previous one. When fitted into a more market-oriented concept, this means that printed matter can be used to conduct direct marketing with customer databases or printing can be combined with multimedia applications, warehousing & freighting or other services like CRM (Customer Relation Management) or bailiffs. These offerings have become much more service-oriented and have a broader scope than printing alone (Matthyssens, et al., 2004). In terms of the dissertation's focus, the new concepts are often offered by a printing enterprise in close

collaboration with an enterprise outside the traditional printing industry. They are offered with complementors.

In summary, the empirical context of the mature and commoditised Dutch printing industry is well suited to testing my hypotheses. SMEs need to exploit new offerings but can not do so alone; both suppliers and complementors contribute to improving their innovation performance.

Procedure

The sample set for my research consists of all print-producing enterprises that are active in the Netherlands. I selected the enterprises by means of the membership list of the Royal Dutch Printing Industry Association (=KVGO); about 80% of printers are members. Due to a significant risk of "different" bookkeeping by some enterprises, I decided to filter out all enterprises smaller than 6 FTE. This was important because my survey gleaned financial data from annual reports which the smaller, usually non limited, companies do not have to complete strictly. The remaining 476 enterprises that comprised my population were contacted by mail and then by telephone. Some 108 enterprises agreed to take part in interviews, giving a response rate of 18%. If an enterprise did not want to participate, they were asked for their reason. In most cases, "no time", "not interested" or "not willing to share financial data" were the reasons given.

The geographical dispersion of the respondents can be considered to be good (see Figure 9). Although when looked carefully, two centres of gravity can be recognized: one is situated in the west, which is representative because most printing firms are located there (GOC & KVGO, 2009). The other centre of gravity is located in the eastern part of the Netherlands, the Twente region. This is not really representative but due to the limited numbers⁸ it is unlikely to bias the outcomes.

Because the companies were informed in advance that this research is about their enterprise's innovation performance, a self-selection bias towards the companies that are truly occupied with innovation is expected⁹. The enterprises were visited on site by the same interviewer around autumn 2009. The respondents in the sample had an average age of 44, most were male (95.4%), were the owner / entrepreneur (66%), and had a general manager/CEO (72%) function. The other respondents had no company shares (33%) and had another managing function (28%) (see for more sample characteristics Table 11).

⁸ The eastern point is probably caused by the fact that my employing research organisation, the University of Twente, is more well-known in this area and consequently respondents are more willing to collaborate.

⁹ This self-selection bias is suggested by: firstly, 92% of the companies indicating that innovation has a "high" to "substantial" priority in comparison with 6% with "low" and only 2 % "no priority". Secondly, on the assumption that innovation is associated with higher financial returns, my sample showed a three yearly average EBITA of 9,4 % (S.D. 9,0%) which is in sharp contrast with the industry dynamics of enterprises closing down (GOC & KVGO, 2004 – 2009). Thirdly, only 3 % of the companies have marketed no new products or services in the last three years, the others have an average of 4,7 (S.D. 2,2) new products/services.



Figure 9: Dutch geo-locations of respondents

Before the interview took place, the interviewer prepared by reading the respondent's website. On arrival at the company they had an informal talk about innovation, in order to explain concepts and the interview protocol. Next an online questionnaire form was filled in. Directly after the interview, the respondent received feedback about his/her interview results in an automated benchmark report. All these steps helped to prevent non-response and increased the quality of the data.

Table 11: Overview of sample characteristics

Characteristic	Average	St.Dev	Min.	Max.	N		
Firm							
Level of education	31.9% no/low	, 59.0% med	liocre, & 9.1%	higher educ.	102		
Level of experience	9.6% 0-2years	s, 14.0% 2-5y	ears, & 76.4%	6 >5years	102		
Enterprise Size	38.9 (FTE)	58.5	6	420	108		
Enterprise Age	58.8 (Years)	47.3	3	306	108		
Annual turnover increase	11.0 (%)	16.5	-25.3	47.4	102		
Annual value added / FTE	77.9 (k€)	19.6	28.5	126.6	102		
Annual gross profit (EBITA)	9.4 (%)	9.0	-7.2	25.0	102		
R&D intensity (% in FTE)	3.1 (%)	2.0	.0	7.9	108		
Absence rate	3.0 (%)	1.9	.10	8.4	88		
Respondent							
Age	43.9 (years)	7.83	23	62	108		
Gender	95.4% male v	s. 4.6% fema	ale		108		
Function	72% CEO / ge	72% CEO / general manager vs. 28% manager other					
Ownership	66% co-owne	r / entreprer	neur vs. 34% r	no shares at all	108		

Variables

To increase validity the dependent, the independent and the control variables are based on existing and tested scales (see for the questionnaire APPENDIX A).

Dependent variables

This dissertation is focused on four aspects of the dependent innovation performance concept: (1) the "Value Added" variable (see also Table 12, variable 7). (2) The "Time to Market" variable (see also Table 12, variable 8). (3) The "share of new products to the total turnover" (See also table 12, variable 9) variable and finally (4) the "amount of innovations" (See also table 12, variable 10). The variables are measured as follows:

- 1) AVERAGE VALUE ADDED: is defined by the (average) focal firm's perceived increase in customer value from its innovations. In order to measure the value added, the respondents were asked to list all newly marketed products and services from the last three years and for each entry tick a box that best matches the customer value improvement compared to existing solutions. An entry receives the score 1 when it offers very little added value up to the score 5 for very much value added. The score 0 was assigned when a respondent had listed no marketed innovation and subsequently could not deliver added value. For every respondent I computed the average value added which resulted in 108 data points.
- 2) AVERAGE TIME TO MARKET: which is defined by the (average) time the focal firm starts developing the innovation to its first sale. To measure this variable as accurately as possible, the respondent's listed innovations were shown again and for every innovation they had to tick a box that best matched development time (before first sale). The entries varied between a long time to market (> 2 years) to a short (< 4 weeks). For every respondent I estimated a time to market in months and computed

- the average. This resulted in 105 data points, 3 respondents had no innovations and subsequently no time to market could be determined.
- 3) % NEW PRODUCTS TO TURNOVER: the third innovation performance variable, which is the percentage of total turnover from new products in the last three years to the total turnover. To measure this variable as accurately as possible, the list of newly marketed products and services and the annual reports were used to estimate the subsequent financial value for each company. This resulted in 106 data points.
- 4) # OF MARKETED INNOVATIONS: which is defined as the number of (re)new(ed) products or services the firm has marketed over the last three years and is the last innovation performance variable. The data entries for this variable could be easily derived from the respondent's innovation list already used to estimate the "value added" and the "time to market". This resulted in 108 data points.

Table 12: Variable characteristics (N=108)

#	Variable	Measure	Mea	St.Dev	Min.	Max.
	• Item		n			
Inde	ependent social cognitive embedding					
1	Cognitive distance of suppliers	Scale ₍₀₋₅₎	1.56	1.31	0	5
	 # of supplier relationships 					
2	Cognitive distance of complementors	Scale ₍₀₋₅₎	1.06	1.03	0	4
_	# of complementor relationships	- II I				
3	Relational embeddedness of suppliers	Ordinal	1.90	1.28	.00	3.67
	Extent of knowing supplierFrequency of speaking supplier	Ordinal ₍₀₋₄₎ Ordinal ₍₀₋₄₎				
	Duration of supplier relationship	Ordinal ₍₀₋₄₎				
4	Relational embeddedness of complementors	Ordinal ₍₀₋₄₎	1.76	1.43	.00	4.00
	 Extent of knowing complementor 	Ordinal ₍₀₋₄₎				
	Frequency of speaking complementor	Ordinal ₍₀₋₄₎ Ordinal ₍₀₋₄₎				
5	 Duration of complementor relationship Structural embeddedness of suppliers 	Scale ₍₀₋₁₎	.36	.32	.00	1.00
5	Relationship(s) know supplier	Scare(0-1)	.50	.52	.00	1.00
6	Structural embeddedness of complementors	Scale ₍₀₋₁₎	.37	.36	.00	1.00
•	Relationship(s) know complementor	(0-1)				
Dep	endent innovation performance					
7	Average value added	Ordinal ₍₀₋₅₎	2.98	.90	0	4.80
8^{\dagger}	Average time to market	Scale (months)	9.13	6.11	.50	30
9 [‡]	% new products to turnover	Scale _(0-100%)	12.6	8.26	0	35
10	# of innovations marketed	Scale _(# of innov's)	4.73	2.21	0	11
Con	trol					
11	Enterprise size	Scale _(FTE)	38.9	58.5	6	420
12	Enterprise age	Scale _(found. year - 2009)	58.8	47.3	3	306
13	R&D intensity	Scale _(R&D FTE / ΣFTE)	.03	.02	.00	.08

[†] is N =106, [‡] is N =105

Independent variables

The network role variables are derived from McEvily and Zaheer (1999) and further developed by myself. As explained in the previous chapters, it is commonly accepted that in the eyes of respondents "adding resources" is perceived as the primary task of a supplier and that many firms are thus not aware that some suppliers may actually be their complementors. To prevent unnecessary complexity in the questionnaire resulting from introducing a complementor role, I decided to assign the roles afterwards.

To determine the network roles the respondents were asked first to list their 5 most important relationships, not employed by their company, and secondly to indicate if they were a 1) customer, 2) supplier, 3) competitor or 4) "different" (to be expounded). Respondents grouped their complementors *under* the supplier heading because I showed them a definition of supplier as: "a relationship that provides your firm with resources".

The next question enabled me to disentangle complementors from suppliers. I asked them if the relationship (1) does or (2) does not directly conduct business with the respondent's customers. If it does it is a complementor, if not it is a supplier. This question is based on the argument that if resources are bundled by the focal firm it is a supplier, if they are bundled by the customer it is a complementor (Adner & Kapoor, 2010).

The remaining roles are the "competitor" and the "different" roles. The different role was expounded by the respondent, together with a check whether the relationship conducts business with the respondent's customers. I also argued that a focal firm sometimes collaborates with its competitors (e.g. in setting industry standards or developing platform technologies (Walley, 2007)). This led to the argument that relationships play a *role* depending on the activity. In the case of this dissertation, if a respondent listed a competitor it is changed into a complementor relationship because these are the 5 most important contacts they rely on for *innovation*.

With this information it was possible to assign all the final roles used for the analysis. The 108 respondents together have 168 supplier, 114 complementor and 227 customer relationships. 31 of the 540 relationships are missing or the role could not be determined. The assignment process is displayed in a flowchart (see Figure 10)

The assignment of complementor and supplier relationships makes up two cognitive distance and absorptive capacity variables. The COGNITIVE DISTANCE OF SUPPLIERS variable (see also Table 12, variable 1) is computed by counting the amount of supplier relationships per respondent and the COGNITIVE DISTANCE OF COMPLEMENTORS variable (see also Table 12, variable 2) is computed by counting the amount of complementor relationships per respondent.

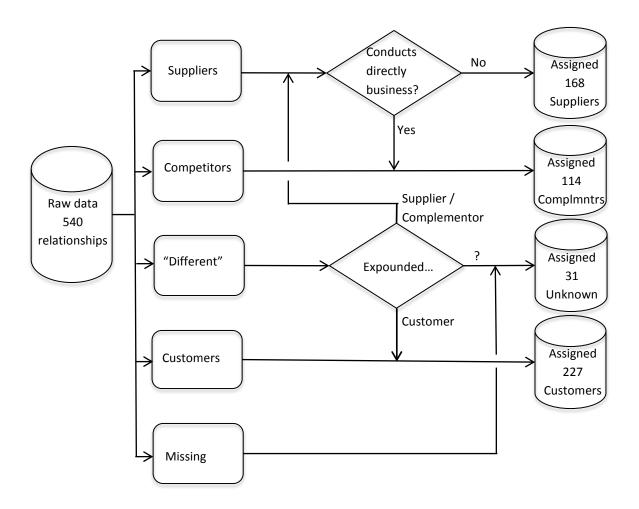


Figure 10: Flowchart that displays role assignment

The embeddedness variables are based on the previous work of McEvily and Zaheer (1999). The RELATIONAL EMBEDDEDNESS OF SUPPLIERS/COMPLEMENTORS variables are defined by strength of ties with the relationship(s). The variables are constructs (see also Table 12, variables 3,4) and are the computed average per role of (1) the extent and (2) time of knowing each other and (3) the frequency of contact the respondent has with its 5 listed relationships for innovation (see also Equation 1).

Equation 1:
$$Rel. Emb_{(S,C)} = \frac{\sum_{S,C}^{n}(Ext. \ of \ knowing + Time \ of \ knowing + Freq. \ of \ speaking)}{n_{(S,C)}}$$
 s = supplier role c = complementor role n = amount of s or c relationships

The STRUCTURAL EMBEDDEDNESS OF SUPPLIERS/COMPLEMENTORS variables (see also Table 12, variables 5,6) are defined by the degree to which a relationship knows the other relationships (see also Equation 2).

Equation 2:
$$Struc. Emb_{(S,C)} = \frac{\sum_{S,C}^{n}(Relationships\ know\ each other)}{n_{(S,C)}}$$

$$s = \text{supplier\ role}$$

$$c = \text{complementor\ role}$$

$$n = \text{amount\ of\ s\ or\ c\ relationships}$$

All the embeddedness values were obtained by showing the respondent per relationship a list from which they had to pick the best matching values (see APPENDIX A, Table 23). If a respondent perceived multiple relationships with the same role, the averages were computed and used in the analysis.

Control variables

The control variables are based on prior research (Bell, 2005; Laursen & Salter, 2006) that indicated that ENTERPRISE SIZE (see also Table 12, variable 11) and R&D INTENSITY (See also Table 12, variable 13) are positively related to innovativeness and ENTERPRISE AGE (see also Table 12, variable 12) negatively. The enterprise size is measured by the total workforce in Full Time Equivalents (FTE). The enterprise age was computed by subtracting the enterprise's foundation year from the interview year (=2009). The R&D intensity was estimated by a ratio consisting of the workforce assigned to innovation divided by the enterprise size (in FTE).

Estimation procedure

Data exploration

At first, the data was explored with histograms and scatter plots to check for normality (see also APPENDIX B for the histogram with normal curves of each variable). Here it was noticed that the normal curves of the control variables ENTERPRISE SIZE (mean 38.9 FTE & S.D. 58.5), ENTERPRISE AGE (mean 58.8 years & S.D. 47.3) and R&D INTENSITY (mean .03 R&D FTE / total FTE & S.D. .02) were all strongly skewed to the left. Spikes were also observed in the left of the histograms of all embeddedness variables. Both issues are taken into account and dealt with by data transformation and by adding dummy variables later.

The variables, including the ones to be transformed, were then checked for outliers using boxplots. The % OF NEW PRODUCTS TO TURNOVER variable, suffered from 3 outliers (The biggest is 35% > 32% (32% is 1.5x the Inter Quartile Range (IQR) + Quartile 3 (= 15% + 17%))) and 2 missing data points. The AVERAGE TIME TO MARKET variable had one outlier and 3 missing data points, whereas the # OF MARKETED INNOVATIONS variable had 4 outliers. However, none of these values were extreme cases (which is > 3x the IQR + Quartile 3). The control variables COMPANY SIZE and COMPANY AGE did have extreme cases, but these variables will be transformed. In summary, the outliers of the aforementioned variables are kept in mind but not excluded from further analysis. Multiple robustness tests will show if these data points have too much influence on the research model.

I composed the sample characteristics and Pearson's correlation table (see Table 13). For all data analysis I used IBM SPSS Statistics 19.0 for windows.

Table 13: Sample characteristics and Pearson's correlation of research model (N=108)

#	Variable	Mean	S.D.	1	2	3	4	5	6	7	8	9	10	11	12
Indep	pendent social cognitive e	embeddir	ng												
1	Cog. dis. suppl.	1.56	1.31	-											
2	Cog. dis. compl.	1.06	1.03	292**	-										
3	Rel. emb. suppl.	1.90	1.28	.673**	151	-									
4	Rel. emb. compl.	1.76	1.43	112	.732**	036	-								
5	Struc. emb. suppl.	.36	.32	.626**	085	.694**	.024	-							
6	Struc. emb. compl.	.37	.36	113	.639**	.018	.826**	.129	-						
Depe	ndent innovation Perforr	mance													
7	Value added	2.98	.90	.009	.062	029	.067	.011	.180	-					
8 [†]	Time to market	9.13	6.11	.153	110	.040	.015	055	.009	010	-				
9 [‡]	% new prod./turnov.	12.64	8.26	101	129	148	.016	110	005	.276**	083	-			
10	# of innovations	4.73	2.21	.091	051	.033	171	.009	153	.278**	082*	.209*	-		
Conti	rols														
11	Enterprise size	38.9	58.5	034	.185	.050	.033	.131	.129	.027	.119	022	.062	-	
12	Enterprise age	58.8	47.3	.143	057	.078	146	.084	159	.125	039	152	006	.200*	-
13	R&D intensity	.03	.02	.039	121	.080	132	.052	109	.250**	176	.257*	.285**	014	.077

[†] is N =105, [‡] is N =106, * is p < .05 (two-tailed), ** is p < .01 (two-tailed)

Data transformation

During the data exploration it was found that all control variables were too skewed. The variables were therefore transformed by re-assigning them into ordinal scales. The domains¹⁰ were carefully chosen in such a way that a normal dispersion of the data could be seen again (see also Table 14).

Table 14: Domains of the transformed control variables

Ordinal	11 Enterprise size	12 Enterprise age	13 R&D intensity
0	FTE ≤ 10	-	R&D% = 0
1	10 < FTE ≤ 20	YEAR ≤ 8	0 < R&D % ≤ 0.025
2	20 < FTE ≤ 50	8 < YEAR ≤ 30	$0.025 < R\&D \% \le 0.05$
3	50 < FTE ≤ 100	30 < YEAR ≤ 60	R&D % > 0.05
4	FTE > 100	YEAR > 60	-

The variable TIME TO MARKET is the only negatively coded variable in the innovation performance construct. This means that a higher time to market relates to a lower innovation performance and is confusing in combination with the direction of the other three innovation variables. In order to ease the interpretation of the analysis the TIME TO MARKET variable were reversed by subtracting every data point from the maximum value 36 months.

Next, the cognitive distance and absorptive capacity hypotheses are argued to be an inversed u-shape relationship in the case of complementors ($\mathrm{H1}_{c}$) and a diminishing returns relationship in the case of suppliers ($\mathrm{H1}_{s}$). When analysed in a linear Enter regression using SPSS, this implied that some additional transformations needed to be made.

For the diminishing returns hypothesis the inverse of the COGNITIVE DISTANCE OF SUPPLIERS variable was computed. The inverse has the shape of a "diminishing effect" and was found by the SPSS curve fit function to be the closest estimator to transform the data into a linear line. However, before this was possible the value "1" was added to transpose every data point. Some respondents had no suppliers in their network (and 1 divided by the value 0 is not possible).

In order to test the inverse u-shape hypotheses for the COGNITIVE DISTANCE OF COMPLEMENTORS variable, its mean was subtracted from every single data point. This gave me the centred value. The next step was to multiply every centred value data point by itself which resulted in the squared centred value. The other 4 embeddedness hypotheses - $H2_{c,s}$ and $H3_{c,s}$ are expected to be a linear relationship and H2,3-7 are descriptive and consequently do not need to be transformed.

¹⁰ The domains of the control variable ENTERPRISE AGE have a second meaning as well. Firms younger than 8 years are new on the market and trying to become mature. Because most companies are family owned, 30 years is around the time the owner resigns and leaves the firm to their successor.

Robustness tests for the innovation performance construct

A **Pr**incipal **C**omponent **A**nalysis (PCA) was conducted to explore whether the theoretical innovation performance construct is supported by the data for the four innovation variables (see also Table 15). The **K**aiser-**M**eyer-**O**lkin (KMO) measure showed a sampling adequacy problem, KMO = .57 ("barely acceptable" according to Field (2009)). All KMO values for the individual variables were between .55 and .61 which is just above the acceptable limit of .5 (Field, 2009). The Barlett's test of sphericity χ^2 (6) = 6.06, p = 0.416, indicated that the correlations between items are also too small for PCA. The Cronbach's alpha of .185 (4 items, N = 103 valid relationships) shows a significant reliability problem. The results of the consecutive tests made me decide to *drop* the innovation performance construct and continue the analysis for the four separate innovation variables.

Table 15: Summary of the exploratory factor analysis for the innovation performance construct

		Component Factor Loadings
#	Variable	Innovation Performance
7	Average added value	.573
8	Average time to market	.448
9	% new products / turnover	.664
10	# of innovations marketed	.576
	N	105
	Eigenvalue	1.302
	% of variance	32.55
	Cronbach's alpha	.185

Robustness tests of H2, H3, H4 |-||| till H7 |-|||

To test H2 and H3 I used an independent sample t-test. These descriptive hypotheses are measured on the relationship level ($N_{\text{supplier relationships}}$ =168; $N_{\text{complementor relationships}}$ =114).

Before the t-test was executed, the Cronbach's alpha was computed for the other construct in this research, the relational embeddedness: 0.597 (3 items, N = 509 valid relationships) which is "critical" (Field, 2009). Because the value of the alpha positively depends on the number of squared items in the scale (and I have only three) I added an additional step. The average correlation of the three items was computed and is still a respectable r = .27 and accept the scale for sufficient reliability.

H4_{I-III} till H7_{I-III} were tested with a one sample t-test, measured on the firm level. For this test I used the absolute value of the unstandardized regression coefficients (|B| and SE B). These values come from the regression matrices on which I will elaborate in the next section.

Robustness test of H1_{S,C}, H2_{S,C}, and H3_{S,C},

To test the $H1_{s,c}$, $H2_{s,c}$, and $H3_{s,c}$ which are on the firm (micro) level, multivariate regression analysis was used. Four dependent variables means 4 linear regressions can be computed.

To test the robustness of the regression analysis (because there are some outliers), I first used the Cook's distance test for influential cases. The threshold value is >1 (Cook & Weisberg, 1982), but I found no disturbing cases (for test results see footnotes Tables 18 - 21). I computed the Mahalanobis distance as an additional control for influential cases. Although some data points have values of Mahalanobis distance >"10", only 4 cases truly exceed the threshold distance of "15"(Field, 2009). 3 of these 4 cases with a higher Mahalanobis distance concern the same outliers found during data exploration on the enterprise size variable. In other words, the bigger firms may slightly bias the research model¹¹. However according to the Cook's distance there is no need to exclude these points from the analysis, since it does not have a large effect on the regression models (Field, 2009).

/COMPLEMENTORS Further robustness checks were conducted to check for multicolinearity issues. Subsequently six Pearson's r's > 0.7 were found (see Table 13). One significant correlation value (r = 0.694) is between the RELATIONAL EMBEDDEDNESS OF SUPPLIERS and the STRUCTURAL EMBEDDEDNESS OF SUPPLIERS variables, the other (r = 0.826) is between RELATIONAL EMBEDDEDNESS OF COMPLEMENTORS and the STRUCTURAL EMBEDDEDNESS OF COMPLEMENTORS variables. There are comparable correlation values between the social embeddedness variables and the cognitive distance of the supplier (r = 0.673 & 0.626) and the complementor (r = 0.732 & 0.639). This multicolinearity issue is caused by the fact that a substantial part of the sample does not have supplier relationships (n = 27; 26.0%) or complementor relationships (n = 35; 33.7%). As a result these observations score "0" on both the relational and structural embeddedness variables, causing observation spikes in the left of the histograms, as already observed in the data exploration. To deal in the regression analysis with these high correlation values I added two dummies. The dummy variables Supplier (Mean 0.71; St.Dev 0.45) and Complementor (Mean 0.64; St.Dev 0.48)) contain a binary coding and indicate with the value "1" that the focal firm has at least one supplier or complementor relationship and with the value "0" there is no such relationship. The dummy effects are not significant, indicating that having a complementor or a supplier relationship would have biased the results. I also conducted a Variance Inflation Factor test (VIF), but I found no concerning values above 5 in the independent variables (O'Brien, 2007). As the final step in dealing with the multicolinearity, I checked that the independent "SE B's" values in the regression analysis do not differ by a factor > 10 from each other. This is not the case.

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 $^{^{11}}$ In the time to market regression, I recoded the enterprise size variable into 4 dummy variables to check for linearity of the variable. I found that only the biggest firms exercise a negative effect on the time to market, the classes below <100 FTE all showed a positive effect. Although the effects are not significant at the p < .05 level, this again shows that bigger printing firms may bias the results.

Robustness checks were also conducted to check the general assumptions of the model. I will start with heteroscedasticity. A collection of random variables is heteroscedastic, if there are sub-populations that have different variabilities (variance) than others. As I planned to conduct a regression analysis the potential existence of heteroscedasticity is of concern, because the presence of heteroscedasticity can invalidate a regression analysis that assumes that the effect and residual (error) variances are uncorrelated. To test for heteroscedasticity I computed the standardised residual for every regression analysis (*ZRESID) and plotted it against the standardised predicted value (*ZPRED). The graphs (see Figures APPENDIX C) should look like a random array of dots evenly dispersed around the value zero. If the plot funnels out or any sort of curve can be seen; then the chances are that there is respectively heteroscedasticity in the data or another assumption, that of linearity, is violated (Field, 2009). For all the regressions the above two assumptions were not violated. To test for normality of residuals, I used the normal P-P plot to see if the observed values were in line with the expected values (see Figures APPENDIX C). Because the straight line in the P-P plot represents the normal distribution, I noticed that some observations deviated from the line. This made me decide to conduct a Kolmogorov-Smirnov (K-S) test on the standardised residuals to see whether they deviate significantly from normality. The K-S showed nonsignificant results, indicating a normal distribution (see Table 16 for test results).

Table 16: Test results of regression standardised residuals for normality

	K	olmogorov-Smirno	v
Standardised residual	Statistic	df	Sig.
Value added	.044	108	.200*
Time to market	.096	105	.018
% of new products to turnover	.065	106	.200*
# of innovations marketed	.043	108	.200*

^{*} is lower bound of true significance

Finally, in order to improve the explanatory power of the regression analyses, some additional steps were taken. The 4 regressions were also computed by transforming the control variables (1) COMPANY SIZE and (2) COMPANY AGE with the natural logarithm and (3) keeping the R&D INTENSITY untransformed. This is a common technique for skewed (control) variables, however it did not lead to an improvement in the explained variance of the regressions. The R&D INTENSITY even decreased the robustness, because its outlying values became too influential. Another improvement step was tested on the Time to Market regression. Because only the control variables load significantly and the independent variables stay behind, I computed the *median* values of the dependent AVERAGE TIME TO MARKET variable and ran the regression analysis again. In comparison with the *mean* values currently used, no real difference in the explained variance or the significance levels of the independent variables could be seen. The final improvement dealt with the response rate of

18%. This response rate allows me to correct the standard error (SE B) in the regression analysis (Cochran, 1977 Eq.2.33 - p.30).

Equation 3:
$$\sqrt{1 - \frac{n}{N}}$$

$$n = \text{sample size}$$

$$N = \text{total population}$$

This means that given Equation three, the population size of 476 (N), and the sample size of 108 (n), an SE B correction factor of 0.88 can be computed. The results are incorporated into the regression analysis and the significance levels are adjusted.

Chapter 6: Results

In this chapter, the sections successively present the following analyses of the results:

- The results of two descriptive t-tests (H2,3) on the relationship level, which analyse the difference in social embeddedness between the complementor and the supplier.
- The results of four regression analyses on the firm level. The analyses are conducted to test the hypotheses of social cognitive embedding with complementor and supplier relationships on the ability of a focal firm to innovate (H1_{s,c}, H2_{s,c}, and H3_{s,c}).
- The results of twelve, firm level, one-sample t-tests (H4_{I-III} till H7_{I-III}), which analyse the difference between the respective social cognitive embedding effects on the ability of a focal firm to innovate.

Results of differences in social embeddedness

The results show that complementors are significantly more relationally embedded to the focal enterprises than suppliers (see Table 17; p = .019), the ties with complementors are thus stronger. Therefore, I may accept H2. Notably, the results also indicate that complementors are significantly *more* structurally embedded than suppliers (See Table 17; p = .036). This means that complementors are better known by the other relationships than suppliers and goes against the direction of my hypothesised relationship (H3).

Table 17: Independent sample t-test

Нур.	Embeddedness	Network role	N	Mean	St.Dv.	t-value	Sig.	Result
H2	Relational	Complementors	114	2.79	.61	2.07	.019	Accept
	(C > S)	Suppliers	168	2.63	.63			
Н3	Structural	Complementors	114	.593	.29	-1.80	.036	Reject (reverse
	(S > C)	Suppliers	168	.528	.30			significance)

p is < .05 (one-tailed)

Results of social cognitive embedding on the innovation performance

Regression results and its explained variance

What can be noted is that three out of four regressions show a significant explained variance for every model (1-4). This variance varies between the values 9.5% (see Table 18; Model 2; Adjusted R2) and 15.0% (see Table 20; Model 2; Adjusted R2). Only the regression model time to market is not found to be significant (see Table 19; Model 1-4; Adjusted R2 max. 1.4%; p > .05) and will be excluded from further regression results. What can also be seen is that the difference in the explained variance between Model 1 and the others (Models 2-4) remains roughly the same (Δ of 3.9% maximum (see Table 20; Adjusted R2 Model 2 – Adjusted R2 Model 1) and Δ of 1.9% minimum (see Table 21; Adjusted R2 Model 1 – Adjusted R2 Model 3). This leads to the result that the control variables have a bigger effect on the explanatory power of the model than the social cognitive independent variables.

Table 18: Multiple regression matrix of cognitive distance and social embeddedness on the value added (N=108)

			1			2			3			4	
		В	SE B	В	В	SE B	β	В	SE B	β	В	SE B	β
Con	stant	2.174	.285		2.150	.318		2.005	.323		3.169	.637	
Con	trol												
11	Enterprise size	.133	.067	.170*	.140	.069	.179*	.109	.067	.140	.122	.070	.156*
12	Enterprise age	010	.080	011	.004	.080	.005	.029	.080	.032	.045	.080	.048
13	R&D intensity	.370	.094	.317**	.385	.095	.330**	.399	.094	.342**	.395	.094	.339**
Cog	nitive distance												
1‡	Cog. dis. suppl.				.089	.250	.031				895	.570	309
2 [†]	Cog. dis. compl.				.144	.086	.165*				.210	.194	.240
2 [†]	Cog. dis. compl. ²				099	.063	159				132	.092	212
Soci	al embeddedness												
3	Rel. emb. suppl.							059	.078	084	244	.129	347*
4	Rel. emb. compl.							113	.092	180	255	.142	403
5	Struc. emb. suppl.							.025	.321	.009	145	.344	051
6	Struc. emb. compl.							.928	.366	.374*	1.073	.374	.432**
	Adjusted R ²	.098			.095			.129			.132		
	F	4.865**			2.875*			3.269**			2.629**		

^{*} is p < .05 level (one tailed); ** is p < .01 (one tailed); variable is: *transformed 1/(x+1), *centred around the grand mean, *squared; Cook's distance (max) is .17

Table 19: Multiple regression matrix of cognitive distance and social embeddedness on the time to market (N=105)

	endent variable: Time t	<u> </u>	1			2			3			4	
		В	SE B	В	В	SE B	β	В	SE B	β	В	SE B	β
Con	stant	23.578	2.145		22.358	2.391		23.624	2.499		19.700	5.415	
Con	trol												
11	Enterprise size	322	.491	060	438	.496	082	277	.511	052	553	.604	103
12	Enterprise age	.469	.571	.075	.472	.574	.075	.454	.589	.073	.335	.583	.054
13	R&D intensity	1.407	.712	.171*	1.585	.720	.193*	1.559	.739	.190*	1.501	.730	.182*
Cog	nitive distance												
1 [‡]	Cog. dis. suppl.				1.247	1.782	.064				6.131	4.250	.314
2 [†]	Cog. dis. compl.				.474	.624	.080				1.359	1.446	.230
2 [†]	Cog. dis. compl. ²				.396	.458	.095				002	.678	001
Soci	ial embeddedness												
3	Rel. emb. suppl.							861	.583	181	353	.969	.074
4	Rel. emb. compl.							.064	.682	.015	422	1.038	098
5	Struc. emb. suppl.							3.298	2.368	.172	4.933	2.514	.258*
6	Struc. emb. compl.							026	2.703	002	-1.312	2.721	077
	Adjusted R ²	.009			.014			012			.014		
	F	1.298			1.240			.826			1.153		

^{*} is p < .05 level (one tailed); ** is p < .01 (one tailed); variable is: [‡] transformed 1/(x+1), ^{‡‡} transformed (32-x), [†] centred around the grand mean, ² squared; Cook's distance (max) is .10

Table 20: Multiple regression matrix of cognitive distance and social embeddedness on the % of new products to turnover (N=106)

			1			2			3			4	
		В	SE B	В	В	SE B	β	В	SE B	β	В	SE B	β
Con	stant	13.503	2.620		10.795	2.840		14.477	3.017		5.057	6.663	
Con	trol												
11	Enterprise size	080	.619	011	.139	.613	.019	.050	.634	.007	.351	.690	.049
12	Enterprise age	-1.972	.734	231**	-1.863	.721	219**	-1.975	.747	232**	-1.910	.736	224**
13	R&D intensity	3.049	.875	.282**	3.035	.862	.281**	3.238	0.891	.300**	3.236	.875	.300**
Cog	nitive distance												
1 [‡]	Cog. dis. suppl.				5.915	2.238	.223**				7.003	5.221	.264*
2^{\dagger}	Cog. dis. compl.				300	.775	037				-2.965	1.786	370*
2^{\dagger}	Cog. dis. compl. ²				-1.070	.570	189*				037	.847	007
Soci	al embeddedness												
3	Rel. emb. suppl.							-1.116	.730	173	128	1.184	020
4	Rel. emb. compl.							.525	.858	.090	2.117	1.295	.364
5	Struc. emb. suppl.							.622	3.034	.024	1.727	3.194	.065
6	Struc. emb. compl.							-1.464	3.407	064	-1.568	3.424	069
	Adjusted R ²	.111			.150			.105			.139		
	F	5.371 **			4.078**			2.755*			2.690**		

^{*} is p < .05 level; ** is p < .01 level; variable is: [‡] transformed 1/(x+1), [†] centred around the grand mean, ² squared; Cook's distance (max) is .07

Table 21: Multiple regression matrix of cognitive distance and social embeddedness on the # of innovations (N=108)

рер	endent variable: # of ini	novations (1							2				
			1		-	2			3			4	
		В	SE B	В	В	SE B	β	В	SE B	β	В	SE B	β
Con	stant	2.403	.680		2.621	.765		2.868	.794		6.466	1.776	
Con	trol												
11	Enterprise size	.398	.161	.207**	.386	.165	.201*	.407	.166	.212*	.389	.169	.203*
12	Enterprise age	021	.190	009	040	.194	018	058	.196	026	038	.195	017
13	R&D intensity	1.042	.225	.364**	1.023	.230	.358**	.999	.231	.349**	.993	.231	.347**
Cog	nitive distance												
1‡	Cog. dis. suppl.				455	.602	064				-2.801	1.397	394*
2^{\dagger}	Cog. dis. compl.				125	.208	059				.799	.477	.373*
2^{\dagger}	Cog. dis. compl. ²				.125	.153	.082				224	.226	147
Soci	ial embeddedness												
3	Rel. emb. suppl.							028	.193	016	534	.317	309*
4	Rel. emb. compl.							038	.226	025	523	.347	338
5	Struc. emb. suppl.							.124	.790	.018	380	.843	054
6	Struc. emb. compl.							596	.899	098	298	.916	049
	Adjusted R ²	.143			.125			.124			.134		
	F	6.974 **	k		3.559**			3.156**			2.660**		

^{*} is p < .05 level; ** is p < .01 level; variable is: [‡] transformed 1/(x+1), [†] centred around the grand mean, ² squared; Cook's distance (max) is .14

Regression results of the control variables

I will begin with the control variable ENTERPRISE SIZE. It has a positive and significant effect on the value added of the innovations (see Table 18; Model 1, 2, &4; Variable 11; p < .05) and the amount of marketed innovations (see Table 21; Model 1 - 4; Variable 11; p < .05). In other words, bigger firms not only market more innovations but they achieve a higher value added as well.

The control variable ENTERPRISE AGE shows only one significant effect, on the share of new products to turnover regression (see Table 20; Model 1 - 4; Variable 12; p < .01). An older firm has a smaller share of new products to turnover.

From all the control variables is the R&D INTENSITY the most consistent and powerful predictor. This means that of the three controls, the R&D intensity significantly and positively affects every dependent innovation variable best (see Table 18 - 21; Model 1 - 4; Variable 13; B = \uparrow ; p < .05). In terms of successfully improving the *entire* innovation performance, the company has to allocate more time for employees to spend on innovation.

Regression results of the cognitive distance variables

The regression results tell me that there is a significant "diminishing returns" effect of the COGNITIVE DISTANCE OF SUPPLIERS on the % NEW PRODUCTS TO TURNOVER (see Table 20; Model 4; Variable 1; p < .05). In other words, more supplier relationships give the focal firm a higher share of new products to turnover, but the effect decreases. On the number of marketed innovations a strong, significant and reversed "diminishing returns" effect can be seen (see Table 21; Model 4; Variable 1; p < .05). This is a bit harder to interpret but it means that the more supplier relationships the less marketed innovations, but this effect diminishes with an increased number of supplier relationships.

The COGNITIVE DISTANCE OF COMPLEMENTORS is significant on the same innovation variables as for the supplier. However, only the centred variable significantly affects the # OF MARKETED INNOVATIONS positively (see Table 21; Model 4; Variable 2; p < .05) and the % NEW PRODUCTS TO TURNOVER negatively (see Table 20; Model 4; Variable 2; p < .05). The squared variable of COGNITIVE DISTANCE OF COMPLEMENTORS is not significant, which means that there is a linear relationship with the dependent variables and not an inverted U-shape.

Regression results of the relational embeddedness variables

The regression results show two significant results for the RELATIONAL EMBEDDEDNESS OF SUPPLIERS variable. For both results, the stronger the tie with a supplier, the lower the AVERAGE VALUE ADDED (see Table 18; Model 4; Variable 3; p < .05) and the lower # OF MARKETED INNOVATIONS (see Table 21; Model 4; Variable 3; p < .05).

The data shows no significant relationships for the RELATIONAL EMBEDDEDNESS OF COMPLEMENTORS.

Regression results of the structural embeddedness variables

The STRUCTURAL EMBEDDEDNESS OF SUPPLIERS shows one significant relationship. It exercises a significant and positive effect on the AVERAGE TIME TO MARKET variable (see Table 19; Model 4; Variable 5; p < .05). In other words, the more the suppliers know the other innovation partners of the focal firm, the quicker it markets its innovations. However, the explained variance of the regression model is above the threshold (p < .05). As previously mentioned, it leads to exclude this relationship from the significant results.

The STRUCTURAL EMBEDDEDNESS OF COMPLEMENTORS loads strong and significant on the AVERAGE VALUE ADDED variable (see Table 18; Model 4; Variable 6; p < .05). This means that the more the complementors know the focal firm's other innovation relationships, the higher the added value of the focal firm's innovations.

Regression results projected on the hypotheses

These results have the following implications for the hypotheses ($H1_{s,c}$, $H2_{s,c}$, and $H3_{s,c}$). For the cognitive distance, $H1_{s}$ argues that there will be a diminishing returns effect of the cognitive distance with suppliers on firm innovation performance. For the number of marketed innovations an reverse significance can be found. Hypothesis $H1_{s}$ therefore cannot be confirmed. $H1_{c}$ argues that there will be an inverted u-shape effect of the cognitive distance with complementors on firm innovation performance. Only a linear effect on the number of marketed innovations is found, leading to rejection of this cognitive distance hypothesis ($H1_{c}$).

The relational embeddedness hypotheses $(H2_{S,C})$ argue that stronger relational embeddedness with complementors and suppliers will positively affect the focal firm's innovation performance. All these hypotheses have to be rejected. The only significant link is between relational embeddedness with suppliers and value added and the number of innovations marketed and this effect is the reverse of that suggested by the hypothesis.

Finally the structural embeddedness hypotheses ($H3_{S,C}$). One significant result can be found: the higher the structural embeddedness with complementors the higher the value added. However, this is against the hypothesized direction and leads to reject $H3_{S,C}$.

Table 22: Overview of hypotheses H1_{S,C} - H3_{S,C} and empirical test results

Нур.	Description	IP-factors	Result	Remark
H1 _S	There is a "diminishing returns" effect of the	Value Added	Reject [†]	
	cognitive distance with suppliers on the focal	% NewPr/Turn	Accept	
	enterprise's innovation performance.	# of Innov.'s	Reject	Opposite sign. to hyp.
H1 _C	There is an inverted u-shape effect of the	Value Added	Reject [†]	
	cognitive distance with complementors on	% NewPr/Turn	Reject	Negative linear sign.
	the focal enterprise's innovation performance.	# of Innov.'s	Reject	Linear significance

H2 _s	The stronger the relational embeddedness	Value Added	Reject	Opposite sign. to hyp.
	with a supplier, the higher the innovation	% NewPr/Turn	Reject [†]	
	performance of the focal enterprise will be.	# of Innov.'s	Reject	Opposite sign. to hyp.
H2 _C	The stronger the relational embeddedness	Value Added	Reject [†]	
	with a complementor, the higher the	% NewPr/Turn	Reject [†]	
	innovation performance of the focal enterprise will be.	# of Innov.'s	Reject [†]	
H3 _s	The more structurally embedded suppliers	Value Added	Reject [†]	
	are in the network of the focal enterprise,	% NewPr/Turn	Reject [†]	
	the higher the innovation performance of the focal enterprise will be.	# of Innov.'s	Reject [†]	
H3 _c	The less structurally embedded	Value Added	Reject	Opposite sign. to hyp.
	complementors are in the network of the	% NewPr/Turn	Reject [†]	
	focal enterprise, the higher the innovation performance of the focal enterprise will be.	# of Innov.'s	Reject [†]	

[†] hypothesis is rejected due to insignificance p ≥ .05

Results of differences in effects of social cognitive embedding

Hypotheses 4_{I-III} state that the effects of social cognitive embedding of complementor relationships on the value added will be stronger than those of the supplier's. This implies that the structural embeddedness hypothesis can be accepted (see Table 22; H4_{III}; t = 18.98; p < .01). The relational embeddedness and the cognitive distance hypotheses need to be rejected due to respectively reverse (see Table 22; H4_{II}; t = 13.73.; p < .01) and non-significant relationships (see Table 22; H4_{II}; t = -.59; p \geq .05).

Hypotheses 5_{I-III} state that the effects of supplier relationships on the time to market will be stronger than the complementor's. Besides the relational embeddedness hypothesis (see Table 22; $H5_{II}$; t = -.50; $p \ge .05$), the hypothesised relationships can be accepted (see Table 22; $H5_{III}$; t = 14.81, 10.01; p < .01).

Hypotheses 6_{I-III} state that there will be no significant difference of effects between complementor and supplier relationships on the share of new products to turnover. H6 $_{I-III}$ need to be rejected as the t-tests show that there are two significant effects, one in favour of the supplier, on the cognitive distance (See Table 5; H6_I; t = 13.53; p < .01), and one in favour of the complementor on the relational embeddedness (see Table 22; H6_{II}; t = -11.67; p < .01). The structural embeddedness hypothesis is not significant for the share of new products to turnover (see Table 22; H6_{III}; t = .35, p \ge .05).

Finally, from hypotheses 7_{I-III} all but one need to be rejected. The test results show that there are two non-significant relationships (see Table 22; H $7_{II,III}$; t = -.25, -.69; p \geq .05). The significant results show, as hypothesised, that the cognitive distance effect of supplier relationships has a higher slope on the number of innovations marketed than the complementor's (see Table 22; H 7_I ; t = -18.92; p < .01).

Table 22: One sample t-test on difference of effects (N=108)

Нур.	#	Variable	В	SE B	t-value	Sig.	Result
Value	adde	ed (C > S)					
H4 _I	1‡	Cog. dis. suppl.	895	.570	13.73	P < .01	Reject (Oppos. sign. to hyp.
	2 [†]	Cog. dis. compl. ²	132	.092			
H4 _{II}	3	Rel. emb. suppl.	244	.129	59	P ≥ .05	Reject (not significant)
	4	Rel. emb. compl.	255	.142			
H4 _{III}	5	Struc. emb. suppl.	145	.344	18.98	P < .01	Accept
	6	Struc. emb. compl.	1.073	.374			
Time	to ma	arket [§] (S > C)					
H5 _I	1‡	Cog. dis. suppl.	6.131	4.250	14.81	P < .01	Accept
	2 [†]	Cog. dis. compl. ²	002	.678			
H5 _{II}	3	Rel. emb. suppl.	.353	.969	50	P ≥ .05	Reject (not significant)
	4	Rel. emb. compl.	422	1.038			
H5 _{III}	5	Struc. emb. suppl.	4.933	2.514	10.01	P < .01	Accept
	6	Struc. emb. compl.	-1.312	2.721			
% of r	new p	products to turnover ^{§§}	(S = C)				
H6 _I	1‡	Cog. dis. suppl.	7.003	5.221	13.56	P < .01	Reject (are significant)
	$2^{^{\dagger}}$	Cog. dis. compl. ²	037	.847			
Н6п	3	Rel. emb. suppl.	128	1.184	-11.67	P < .01	Reject (are significant)
	4	Rel. emb. compl.	2.117	1.295			
H6 _{III}	5	Struc. emb. suppl.	1.727	3.194	.35	P ≥ .05	Reject (not significant)
	6	Struc. emb. compl.	-1.568	3.424			
# of ir		ations (S > C)					
H7 _I	1‡	Cog. dis. suppl.	-2.801	1.397	-18.92	P < .01	Accept
	2 [†]	Cog. dis. compl. ²	224	.226			
H7 _{II}	3	Rel. emb. suppl.	534	.317	25	P ≥ .05	Reject (not significant)
	4	Rel. emb. compl.	523	.341			
H7 _{III}	5	Struc. emb. suppl.	380	.843	69	P ≥ .05	Reject (not significant)
	6	Struc. emb. compl.	298	.916	88		

p is < .05 (one-tailed) hypotheses are accepted; $^{\$}$ is N = 105; $^{\$\$}$ is N = 106; |...| is absolute value; variable is: $^{\$}$ transformed 1/(x+1), $^{\$\$}$ transformed (32-x), † centred around the grand mean, 2 squared

Chapter 7: Conclusions

Many firms in a commoditised market renew their offerings to stay ahead of the competition. This process of new value creation is perceived to be difficult, often because firms lack sufficient or the right resources. **S**mall and **M**edium sized **E**nterprises (SMEs) in particular have to rely on their networks to find the necessary resources for new value creation. Relationships in these networks play different roles, that all make specific contributions: one of these roles is the -not so familiar and under researched -complementor relationship. The complementor relationship and its effects on new value creation by Dutch printing SMEs, forms the starting point of this thesis.

To delve deeper into the complementor role and new value creation, I firstly conducted an exploration of the management literature. This enabled me to link into a scientific field and define the core research opportunity. Next, I conducted an observational field study of a small printing firm's value net. This helped me to discover underlying principles and specific effects by looking at a real case. Finally, I conducted a quantitative study in the Dutch printing industry to test my hypotheses. The hypotheses aim to disentangle complementor and supplier relationships on the basis of social cognitive embedding and relate this to small firm innovation performance.

The literature exploration on complementor relationships and new value creation showed that this area is underexplored. This is part of a need for more innovation research with a network approach, emphasising the importance of network roles (Dhanaraj & Parkhe, 2006; Pittaway, et al., 2004). The literature exploration also indicated that in the case of innovation it is of particular interest to disentangle the complementor from the supplier role and this is consequently my core research opportunity. I found that suppliers differ from complementors in terms of respectively, a) conducting *no direct* business versus *direct* business with customers, b) forming *vertical* instead of *horizontal* relationships, c) offering *components* not *complements* and d) offering *critical* value versus *added* value. This results in asymmetries arising due to the position of the roles relative to the focal firm (Adner & Kapoor, 2010).

The core findings of the case study show that the focal enterprise in collaboration with the complementor alone could not have achieved the innovation. The value contributions of the supplier are crucial as well. The value contributions of the supplier lie mainly in optimising the *production process* to secure a better position on the traditional printed matter market, improving the focal firm's time to market. In contrast, the contributions of the complementor are targeted at renewing the *offering* and helping the focal firm to move away from the commoditised printed matter market. The complementor mainly aims to increase the innovation's added value. It can therefore be concluded that the main findings of the case study confirm and supplement the research opportunity identified through the literature exploration. They add to the research opportunity by suggesting that

complementors and suppliers have different effects on the value added and the time to market of the focal firm's innovation and that social cognitive embedding seems to be an important driver in disentangling complementors and suppliers.

The core findings of the quantitative study show that social cognitive embedding with complementors and suppliers does play a distinct role in the ability of a Dutch printing firm to innovate. Consequently, it shows there are significant relationships, but not always in line with the hypothesised direction. From the perspective of cognitive distance's impact on innovation performance, the results show that there is a strong "diminishing returns" effect of cognitive distance with suppliers on the focal enterprise's share of new products to turnover. There is also a reversed and "diminishing returns" effect of cognitive distance with suppliers on the focal enterprise's amount of innovations marketed. In other words, the more supplier relationships, the lower the amount of marketed innovations and the higher the share of new products to turnover, but with a diminishing effect. The focal firm's cognitive distance with complementor relationships negatively affects the amount of innovations marketed and the share of new products to turnover. Next, I looked at the concept of social embeddedness. A complementor relationship is relationally and structurally more embedded with the focal firm than a supplier relationship. The effects of social embeddedness on innovation performance are: a stronger tie (higher relational embeddedness) with suppliers negatively affects the value added of the innovations and amount of innovations. On structural embeddedness, the more complementors are familiar with the other innovation partners of the focal firm, the higher the added value. For suppliers this structural embeddedness appears ¹² to regress positively with time to market. Finally, the difference in the effects: the significantly tested effects of social cognitive embedding are stronger for supplier than for complementor relationships on time to market and number of marketed innovations. In other words, suppliers show a higher correlation between the two innovation factors and social cognitive embedding. On the innovation factors, value added and share of new products to turnover, both roles can have a stronger effect. This depends on the underlying social cognitive embedding factors.

These results have led to my most fundamental contribution, which involves the existence of complementors. Although the existence of the complementor role has been debated in more qualitative studies (e.g. Habets, et al., 2010; Nalebuff & Brandenburger, 1996; Yoffie & Kwak, 2006), this thesis is among the first to confirm that the complementor relationships in innovation do exist and truly differ from suppliers, based on a quantitative research approach. To my knowledge so far only Adner and Kapoor (2010) have conducted a similar line of research. Although their study draws its conclusions (a) in an ecosystem (beyond first tier relationships) (b) in an R&D oriented industry consisting of large firms (the semi-conductor industry) and (c) using market shares to show the impact of their innovation success. In contrast, my study follows (a) a portfolio perspective (first tier relationships) on

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¹² regression model is not significant

how (b) SMEs in a commoditised market enhance their focal innovation performance (c) on a broader set of innovation indicators.

The existence and effects of the complementor relationship lead to my next contribution, which is to greater sensitivity in the network literature on partner heterogeneity. Most network research tends to class the partners into a varied set of organisational forms, e.g. consultants, science partners, trade organisations, (co-)suppliers, universities, research institutes (Pittaway, et al., 2004). My theoretical arguments and empirical results show that, for instance, a university can play the role of a supplier, but also the role of a complementor and subsequently contribute differently to the innovation performance of a focal firm. In a similar vein, Knudsen (2007) has argued that it is not so much the type of relationship itself that determines innovation but much more the types of knowledge (supplementary versus complementary) exchanged. I suggest further research is needed to come up with a uniform and holistic model of the relationships a focal firm can have. This model needs to be based on the resources being exchanged.

I also argue that firms who want to use their network to innovate successfully require first clarity on what specific innovation aspect improvement is needed. Network research has not given many insights into this as it has predominantly focused on a firm's patent activity. In contrast, this research shows that successful innovation is a complex interplay of a) social cognitive embedding with supplier and complementor relationships and b) different aspects of innovation performance (value added and time to market of the innovation, share of new products to turnover and the amount of innovations marketed). With the theory of cognitive distance in particular, I noticed supplier relationships had opposite effects to complementor relationships on innovation. In terms of organisational learning theory, where novelty is created by the cognitive distance with a relationship, my contribution can be given in terms of 1) new empirical insights that the theory of cognitive distance and absorptive capacity may recognize different effects on novelty depending on the network role. 2) Introducing a new way of operationalizing cognitive distance (requested by Wuyts et al. (2005)). If scholars assign network roles in their research beforehand, the effects of cognitive distance on novelty may also become clear.

Limitations and further research

My research has some implications which are interesting for further research. Firstly, the results show that an increased complementor cognitive distance has a positive effect on the amount of marketed innovations but a negative effect on the share of new products to turnover. This finding is remarkable because it appears that complementors help improve the innovation performance in the short run, but fail in the true pay-off (in the long run). The data makes me conclude that an increase in cognitive distance with complementors creates a knowledge gap that is hard to bridge. I question this assumption because in this research innovation performance is measured over the last three years while complementor relationships are (in this industry context) relatively young. Previous research has shown

indications that alliance experience could be an important moderator in collaboration success (Rothaermel & Deeds, 2006). As experience in working with complementors is relatively low, this may be a plausible explanation why long term gain was limited with complementors but not with suppliers. Too little experience of working with complementors could also be an explanation for the observed linear negative effect, where I hypothesised an inverted U-shape. I therefore recommend other researchers to include alliance experience in their research or conduct longitudinal research on the evolution of complementor relationships for innovation.

Another limitation of this research is that I found few significant results for the social embeddedness variables, in contrast to others (e.g. Ahuja, 2000; Coleman, 1988; Granovetter, 1973). I believe this might be due to the relatively small sample size used in this study or may be caused by one of two theoretical issues.

Firstly, the main discussion within the Burt view is based on less embedded relationships profiting from more diversity. My approach derives its diversity ideas by distinguishing between 1) suppliers in the same industry (= low diversity in comparison with the focal enterprise) and 2) complementors in different industries (= high diversity in comparison with the focal enterprise). The findings show that complementor relationships have a stronger relational embeddedness but, strangely, also a stronger structural embeddedness, which is at odds with Burt's idea (1995) that the opportunities of diversity mainly come from being on a structural hole. With this finding I question the intuitive assumption that high degrees of relational embeddedness are associated with high degrees of structural embeddedness and vice versa.

For the on-going Burt versus Coleman discussion, I contend that suppliers need to be handled differently depending on the innovation strategy, while complementors do not. If enterprises have a strategy to market innovations more quickly, it appears that they have to keep the structural embeddedness with the suppliers high (Coleman view). If more innovations are needed or the innovation needs to deliver more value added, enterprises need to relationally embed suppliers less (Burt view) and here structural holes are favourable. Regarding complementors, I found that a higher degree of structural embeddedness affects the value added of the innovations positively (Coleman view). In a broader sense, it is found that a one-dimensional network approach (like the Coleman vs. Burt view) faces problems in creating a full understanding of innovation with complementors and suppliers. The results show that successful innovation is to a large extent contingent on other resources as well (e.g. innovation strategies, R&D intensities or firm size). Therefore multidimensional network research, such as the Entrepreneurship in Networks (EiN) model (E.g. Groen, 2005; Kirwan, Van der Sijde, & Groen, 2006), is a promising direction for further research.

Next a lot of my hypotheses, results and conclusions are made in the specific industry setting of the Dutch printing industry. As mentioned earlier, this industry is mature, commoditised

and is a contrast to industries where technologies have a lot of potential to improve. Due to the complexity of the technology in these younger industries, offerings with complementors might not be compatible at all. A dominant design or platform to profit from network externalities may be lacking in these industries as well. This makes it preferable to innovate first with more "aligned" suppliers who talk much more the same language. In other words, I believe that for innovation in a high-tech setting the risk of excessively large levels of diversity is so high for complementors that it will prevent the absorption of knowledge. The differences could be so big that *all* positive complementor effects from diversity identified in this study may become negatives. The limitation of industry setting creates my most important suggestion for follow-up. Further research needs to verify my complementor and supplier findings on innovation in other empirical settings.

Despite its limitations, this research is a next step in showing the importance of the complementor relationship for new value creation. I believe that I have given both practitioners and scholars new insights into how and why the distinction with the suppliers matter. Moreover, firms can use both roles to improve their innovation performance but have to be aware of the dark sides. Knowing this may help managers to optimise their business network to profit the most.

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APPENDICES

A: Operational Measures

5R: Network of innovation relationships

5R) Please write the initials of the five most important business relationships, not employed by your enterprise, that contribute to product or service innovation? The new/renewed products or service must deliver added value for your customers compared to the predecessors. [Initials]

Ro: Network roles & cognitive distance and absorptive capacity

Ro-a) Which of the four roles does the relationship fulfil?

A "customer" is somebody that purchases your products. [1) Customer]

A "supplier" is somebody that supplies you with resources (E.g. raw material, semimanufactures, or services) that your enterprise needs to function. [2) Supplier]

A "competitor" is somebody that reduces the value of your products. [3) Competitor]

You can fill in "Different" for other third parties. [4) Different, please indicate..........]

NB: if the relationship plays multiple roles, pick the most dominant one.

Ro-b) If "Supplier" or "Different": Please indicate if the relationship does business with your customers as well. [Yes, No, Don't know]

RE: Relational embeddedness

Please choose the box that indicates best;

RE-a) how well you know each other? [0) Hardly at all, 1) Little, 2) Quite well, 3) Well, 4) Very Well]

RE-b) how much contact you have? [0) Hourly, 1) Daily, 2) Weekly, 3) Monthly, 4) Yearly]

RE-c) how long this relationship has existed? [0) $0 - \frac{1}{4}$ year, 1) $\frac{1}{4} - 1$ year, 2) 1-2 years, 3) 2-5 years, 4) >5 years]

SE: Structural embeddedness

SE-a) Please indicate in the table if the given relationships know each other with "Yes" or don't know each other with "No". [Yes, No]

Table 23: Example of how network questions were displayed in the questionnaire

	Initials (5R)	Network roles (Ro)		Relational embeddedness (RE)		Structural embeddedness (SE)				
		a) Role	b) Buss.	a) Well	b) Contct.	c) Time	2knows	3 knows	4 knows	5 knows
1		1-4,	Y/N/?	0 – 4	0 – 4	0 – 4	Y/N	Y/N	Y/N	Y/N
2		1-4,	Y/N/?	0 - 4	0 - 4	0 - 4	Х	Y/N	Y/N	Y/N
3		1-4,	Y/N/?	0 - 4	0 - 4	0 - 4	Х	Х	Y/N	Y/N
4		1-4,	Y/N/?	0 - 4	0 - 4	0 - 4	Х	Х	Х	Y/N
5		1-4,	Y/N/?	0 - 4	0 - 4	0 - 4	х	х	х	х

IP: Innovation performance

IP) Can your write down all new products or services that your enterprise marketed in the past three years? Small variations can be ignored, and the new/renewed product or service must deliver added value for your customers compared to predecessors.

Next, choose for every innovation the box that indicates best,

IP-a) How did your customers perceive the value improvement of these innovations in comparison with existing solutions? [1) very little, 2) little, 3) substantial, 4) high, 5) extremely high]

IP-b) The development time your enterprise needed before these innovations could be marketed [5) 1-4 weeks, 4) 1-6 months, 3) $\frac{1}{2}$ -1 year, 2) 1- 2 years, 1) >2 years]

IP-c) What is the average share of these innovations to the total turnover of the last three years? Please use your annual reports of 2006, 2007, & 2008 and the formula below: [%]

$$=\frac{100\%}{3} \cdot (\frac{Turnover\ new\ products\ '06}{Total\ turnover'06} + \frac{Turnover\ new\ products\ '07}{Total\ turnover'07} + \frac{Turnover\ new\ products\ '08}{Total\ turnover'08})$$

Co: Control

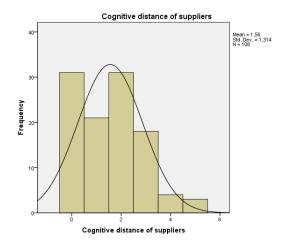
Co-a) How many people does your enterprise currently employ? [FTE]

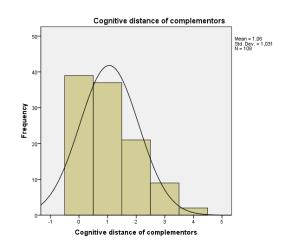
Co-b) In what year was your enterprise founded? [YEAR]

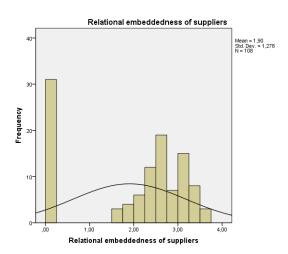
Co-c) Could you indicate your enterprise's workforce that is actively involved in product or service innovation? [FTE.....]

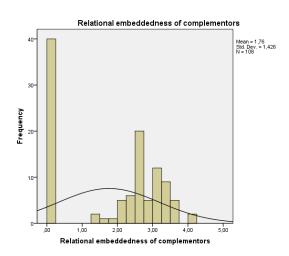
B: Histograms with normal curves of variables

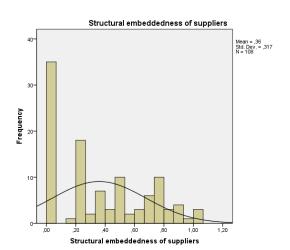
Independent social cognitive embedding variables

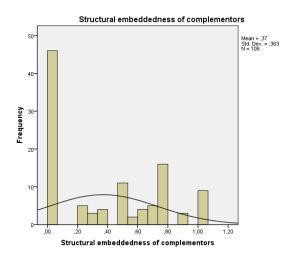




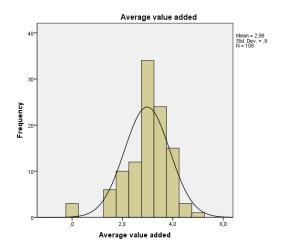


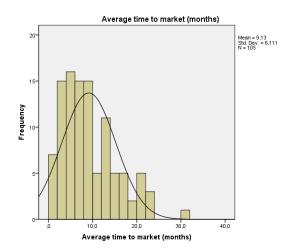


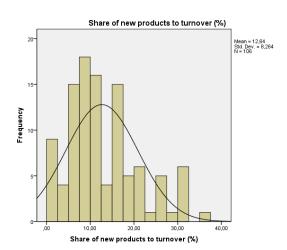


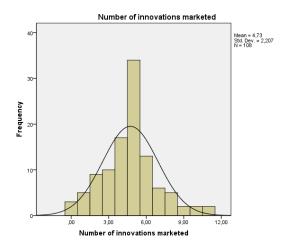


Dependent innovation performance variables

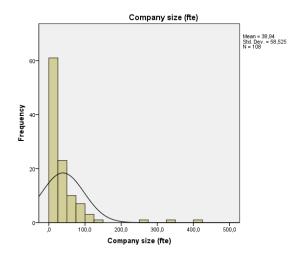


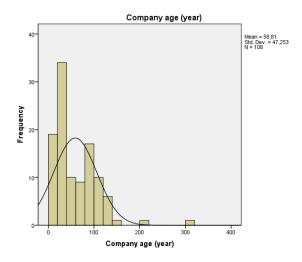


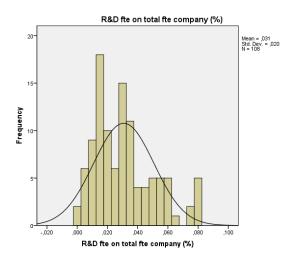




Control variables

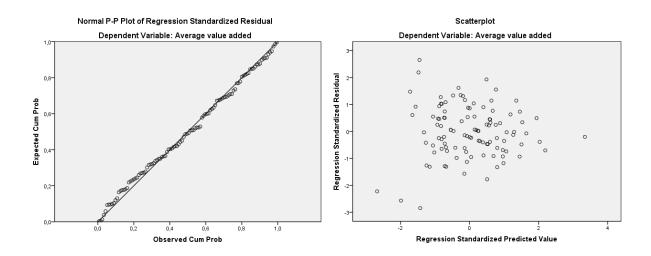




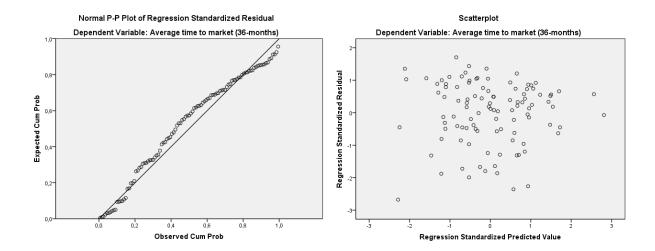


C: Normal P-P plots and scatterplots of the regression residuals

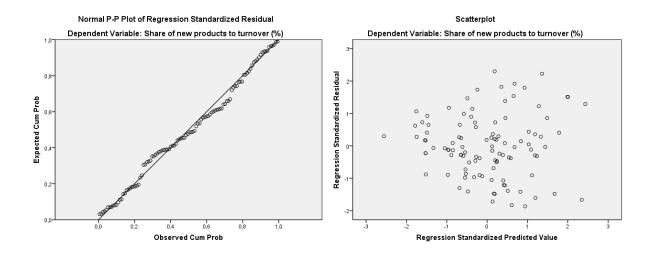
Value added regression



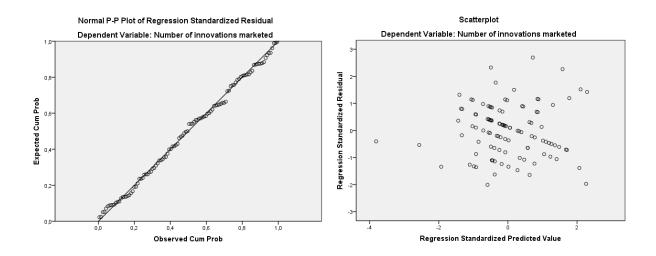
Time to market regression



Share of new products to turnover regression



Number of innovations marketed regression



Summary in Dutch / Nederlandse samenvatting

In een markt met veel vergelijkbare producten, vernieuwt menig bedrijf zijn aanbod om de concurrentie voor te kunnen blijven. Dit proces van nieuwe waardecreatie wordt dikwijls als moeilijk ervaren. Vaak omdat bedrijven niet over voldoende of de juiste hulpbronnen beschikken. Vooral kleine en middelgrote bedrijven (MKB) moeten een beroep doen op hun netwerken om de nodige middelen voor nieuwe waardecreatie te vergaren. De relaties binnen deze netwerken vervullen daarbij een rol, bijvoorbeeld die van toeleverancier concurrent en klant, die afhangt hun eigen specifieke bijdrage. Een van deze rollen is de, weinig bekende en matig onderzochte, complementorrol. Complementors zijn bedrijven die direct zelfstandig complementaire producten of diensten leveren gemeenschappelijke klanten. Enkele praktijkvoorbeelden zijn: (1) koffie en koffiezetapparaten, (2) computer hardware en software en (3) auto's en tankstations. De complementorrelatie en de effecten van deze relatie op nieuwe waardecreatie van het Nederlandse grafiemedia MKB, vormen het startpunt van dit proefschrift.

Om dieper op de complementorrol en nieuwe waardecreatie in te gaan, wordt ten eerste een verkenning van de managementliteratuur uitgevoerd. Hierdoor sluit de dissertatie aan bij een recente wetenschappelijke stroming en is het mogelijk om de kern onderzoekskans te formuleren. Vervolgens wordt er middels een observerende case studie het waardenetwerk van een grafiemediabedrijf centraal gesteld, om onderliggende principes en specifieke effecten aan de hand van de praktijk bloot te leggen. Ten slotte wordt een kwantitatief onderzoek in de Nederlandse grafiemedia uitgevoerd om de afgeleide hypothesen te testen. De hypothesen op basis van sociale cognitieve verankering, ontwarren de complementorvan een toeleveranciersrelatie en relateren hun invloed aan de innovatiekracht van het MKB.

Uit de literatuurverkenning is gebleken dat de rol van complementorrelaties in nieuwe waardecreatie onderbelicht is in het huidige managementonderzoek. Deze bevinding vloeit voort uit een behoefte aan meer innovatieonderzoek met een netwerkbenadering die de nadruk legt op het belang van netwerkrollen. De literatuurverkenning laat ook zien dat in het geval van vernieuwing, het belangrijk is de complementor van de leveranciersrol te ontwarren en vormt daarbij de kern onderzoekskans. Er wordt aangetroffen dat leveranciers en complementors van elkaar verschillen in respectievelijk: a) het doen van *geen directe* versus *directe* zaken met klanten, b) het vormen van *verticale* versus *horizontale* relaties met het MKB, c) het aanbieden van *componenten* in plaats van *aanvullingen* (complementen) en d) het leveren van *kritische* waarde ten opzichte van *toegevoegde* waarde. De verschillen resulteren in groeiende asymmetrische effecten als gevolg van de positie van de rollen ten opzichte van het MKB bedrijf.

De belangrijkste bevindingen van de case studie laten zien dat het MKB de innovatie niet alleen in samenwerking met de complementor heeft kunnen bereiken. De bijdragen van de leverancier zijn nét zo cruciaal. Daarbij liggen de waarde bijdragen van de leverancier

voornamelijk in het optimaliseren van het productieproces om een betere positie op de traditionele drukwerk markt te verwerven. Deze helpt het MKB bij het verbeteren van de "vermarktingstijd". Dit in tegenstelling tot de complementor, zijn bijdragen zijn gericht op de vernieuwing van de aanbieding en de hulp aan het MKB om uit het hoge competitieve segment van de drukwerkmarkt te stappen. De complementor richt zich dus voornamelijk op het vergroten van de toegevoegde waarde van de innovatie. Hieruit kan worden geconcludeerd dat de belangrijkste bevindingen van de case study de kernonderzoekskans bevestigen maar ook aanvullen. De case laat namelijk zien dat toeleveranciers en complementors verschillend de vermarktingstijd en de toegevoegde waarde van de innovaties beïnvloeden en dat sociale cognitieve verankering hierin een verklarende rol kan spelen. Deze bevindingen helpen om een complementor van een toeleverancier verder te ontwarren.

De belangrijkste bevinding van het kwantitatieve deel is dat sociaal-cognitieve verankering met complementors en toeleveranciers een significant onderscheidende rol speelt in het innoverende vermogen van het MKB. Nader toegelicht: met behulp van een vragenlijst, afgenomen bij 108 Nederlandse grafiemedia bedrijven, zijn drie vormen van netwerk verankering getest: (1) Cognitieve verankering heeft betrekking op het kennisverschil tussen het MKB en zijn externe contacten (bijvoorbeeld een complementor of een toeleverancier). Sociale verankering bestaat uit (2a) hoe sterk de relatie is tussen het MKB en zijn externe contacten (relationele verankering) en (2b) hoe hecht de relaties van de externe contacten onderling is (structurele verankering). De cognitieve verankering laat zien dat hoe hoger het kennisverschil met een toeleverancier, hoe lager het aantal vermarkte innovaties, maar hoe hoger het aandeel nieuwe producten aan de omzet, dit effect neemt wel af. Bij de complementor leidt een groter kennisverschil tot minder vermarkte innovaties en ook een lager aandeel nieuwe producten aan de omzet. Bij de sociale verankering is te zien dat een complementorrelatie relationeel en structureel meer verankerd is dan een toeleveranciersrelatie. Als er naar de effecten van sociale verankering op innovatie wordt gekeken, blijkt het volgende: een sterkere relatie met een toeleverancier heeft een negatieve invloed op de toegevoegde waarde van de innovaties en een negatieve invloed op het aantal vermarkte innovaties. Hoe hechter het netwerk van het MKB met de complementor is, hoe hoger de toegevoegde waarde en hoe korter de ontwikkeltijd van de innovaties zijn.

Aan de hand van deze studie wordt geconcludeerd dat complementors bestaan. Hoewel het bestaan van de complementor rol al in meer kwalitatieve studies besproken is, is dit proefschrift een van de eerste dat op basis van een kwantitatieve methode aantoont dat complementors voor het verhogen van nieuwe waardecreatie bestaan. Het bestaan en de effecten van de complementor relatie leiden tot de volgende wetenschappelijk contributie waarin een nuance kan worden aangebracht binnen de netwerkliteratuur en haar partnerheterogeniteit. Het meeste netwerkonderzoek heeft de neiging om de partners te onderscheiden op een gevarieerde reeks van organisatievormen zoals consultants, wetenschapspartners, brancheorganisaties, (co-) leveranciers, universiteiten, onderzoeks-

instituten et cetera. De theoretische argumenten en empirische resultaten van deze studie laten zien dat bijvoorbeeld een universiteit de rol van een toeleverancier kan spelen, maar ook de rol van een complementor en daarmee op een andere manier bijdraagt aan de innovatie prestaties van een MKB bedrijf. Met deze studie wordt aangetoond dat bedrijven die hun netwerk willen gebruiken om succesvol te innoveren eerst duidelijk moeten weten welk specifiek innovatie aspect er verbeterd dient te worden, om vervolgens met de sociaal cognitieve verankering van hun relaties hierin te sturen. Toekomstig onderzoek wordt geïndiceerd om een uniform holistisch model van de externe relaties die een bedrijf kan hebben te ontwikkelen en dit bij voorkeur te testen in andere empirische omgevingen.

Epilogue / Nawoord

Promoveren doe je niet alleen. Nu ik er op terug kijk is het doen van een promotieonderzoek mijn grootste intellectuele uitdaging ooit geweest. Deze uitdaging kende veel mooie momenten maar helaas ook minder mooie. Omdat de eindstreep nu echt in zicht komt, is het moment aangebroken om de mensen te bedanken die mij bij mijn promotietraject ondersteund hebben:

Om te beginnen, Peter van der Sijde, je hebt me "verleid" tot het doen van een promotieonderzoek. De eerste periode hebben we intensief en productief samengewerkt. Het succesvol afronden van het Innomedi@ project en twee refereed journal publicaties zijn daarvan het mooie bewijs. Helaas heb ik niet het gehele traject van jouw optimisme mogen genieten. Maar ik heb al vernomen dat je in Amsterdam de mensen net zo inspireert.

Ariane, op al onze bedrijfs-, beurs- of conferentiebezoeken hadden we het altijd gezellig! Ook jou wil ik bedanken voor je inzet, je geduld en je kennis op het gebied van netwerken in theorie en praktijk. Daarnaast was het voor mij een leerzame ervaring om studenten van jouw vak spelenderwijs te mogen onderwijzen met het "supply chain game" college.

Aard, mijn promotor. Ik dank je voor jouw divergerende kwaliteiten met vaak scherpe en vernieuwende inzichten, het geduld, je snelle besluitvorming, het organisatorisch mogelijk maken van deze promotie en het stimuleren en aanbieden van ontwikkeling op andere professionele AIO gebieden. De gedeelde interesse in techniek, en in het bijzonder die in tweewielige scheurijzers, hebben gemaakt dat wij elkaar altijd spannende en soms ietwat te stoere verhalen konden vertellen. Beste Aard, is het nu toch niet de hoogste tijd voor een BMW?...

Peter Geurts, de juiste persoon op het juiste moment. Peter ik dank jou voornamelijk voor het creëren van grip. Het proefschrift had ik zonder jouw inzet niet tot aan de finishlijn gekregen. Ik ben nog steeds onder de indruk van je kunsten op het gebied van analyse en statistiek, de heerlijke koffie en de ontelbaar vele "weetjes".

De Innomedi@ project partners; de EUREGIO (als financier), het Dienstencentrum, FH-Münster, IBI, HWK Münster-Osnabrück, Uni-Wuppertal en Ed, ook jullie verdienen mijn dank voor de leerzame praktijk ervaringen, de goede relaties die we hebben opgebouwd, de mooie resultaten die onze samenwerking heeft opgeleverd en de ondersteuning bij de gegevensverzameling. Voor dit laatste dank ik ook voor de hulp van mijn student assistenten; Shira, Mark en Steven. Ook alle bedrijven waar ik interviews heb mogen houden, hartelijk bedankt voor de interesse en het vrijmaken van tijd. Monique, jou bedank ik voor het unieke kaft ontwerp, je complementor strip is nu al de meest gelezen passage van de hele dissertatie!

Verder wil ik mijn promotie commissie, alle Nikos, Oohr, de secretaresses Hela en Gloria en andere MB collegae bedanken. Maar vooral ook de promotie "uitverkorenen" en soms

"lotgenoten" (Annemien, Erwin, Maarten, Michèl, e.a.), jullie maakten het promoveren extra leuk en vormden tegelijkertijd een belangrijke steunpilaar voor advies en motivatie. Onze werkrelatie is uitgegroeid tot een echte vriendschap. Kodo, David, you as well guys for being great friends, buddies and beating me constantly with ping pong. Joris, jou bedank ik natuurlijk niet alleen voor je invloedrijke rol als coauteur van mijn beste conferentie artikel, maar ook als mede pionier binnen het InnoDoctors avontuur. Voor de gastvrijheid, een steeds weer overtreffende "Lidl" lunch maar vooral voor echte ondernemerschapsinspiratie met experimenten bedank ik Gilles en zijn team van Beernink & Meijer Business Development hartelijk.

Nu ben ik aangekomen bij de laatste personen die ik bedanken wil. Om te beginnen mijn paranimfen "sunshine" Kasia, en kameraad Huib voor hun assistentie tijdens de verdediging. Jullie hebben deze belangrijke taak niet voor niets gekregen! Daarnaast mijn familie, Pa, Ma, Vera en Bert voor de steun, een luisterend oor en het "kweken" van doorzettingsvermogen. "Doa hanna au net zom vergessa" auch ein großes Dankeschön an die Familie Rudolf für das Interesse und ihre Unterstützung aus dem Schwäbischen. Tenslotte de allerbelangrijkste steunpilaar en toeverlaat; Tanja, mijn vrouw en grote liefde. Ik dank je voor je geduld, het grenzeloze vertrouwen en vooral voor je motiverende woorden wanneer ik weer eens aan niets anders dan promoveren kon denken. Je stond altijd voor mij klaar, jou dank ik dan ook het meest! Laat de toekomst maar komen!

About the author

Educational background

'93 – '99	VWO - St. Janscollege, Hoensbroek, The Netherlands
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'00 – '04	Mechanical Engineering - Fontys University, Eindhoven, The Netherlands
	(Bachelor of Science degree)
'04 – '06	Business Administration - University of Twente, Enschede, The Netherlands
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′06 – ′12	Doctoral Candidate on Innovation & Entrepreneurship – Nikos, University of
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	(Doctor of Philosophy degree)

Publications

Journal publications

- Habets, M. J. M., Voordijk, J. T., & Van der Sijde, P. C. (2011). The Adoption of Innovative Asphalt Equipment in Road Construction. *Construction Innovation: Information, Process, Management,* 11(2), 229-245
- Habets, M. J. M., Van der Sijde, P. C., & Voordijk, J. T. (2007). Adoption of Innovative Production Technologies in the Road Construction Industry. *International Journal of Innovation and Technology Management*, 4(3), 283-304.

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- Habets, M. J. M., Heuven, J. M. J., Raesfeld, A. M., & Groen, A. J. (2010). Complementors Suppliers and Innovation Performance: a Network Perspective. *Paper presented at the SMS 30th Annual International Conference* (Eligible for best paper award), Rome.
- Habets, M. J. M., Raesfeld-Meijer, A. M., & Van der Sijde, P. C. (2009). Complementors and Market Innovation: an Exploratory Study in the Dutch Printing Industry. *Paper presented at the Academy of Management Conference*, Chicago.
- Habets, M. J. M., Ridder, A., Von Raesfeld Meijer, A., & Van der Sijde, P. C. (2007). The Role of Complementors for Market Innovation. *Paper presented at the 15th HTSF Conference*, Manchester.
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- Habets, T. (2011). Anticiperen essentieel bij innoveren. *Graficus*. Managementmedia bv, Hilversum. Mei: 56-59.
- Habets, T. (2011). Marktgericht Innoveren. *Graficus.* Managementmedia bv, Hilversum. April: 52-55.
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ABSTRACT: New value creation by SMEs (Small and Medium Sized Enterprises) is often the result of collaborative efforts. Collaborations with complementors - firms that independently provide complementary products or services directly to mutual customers like coffee and coffee machines, hardware and software or cars and petrol stations - contribute significantly to new value creation, but are underexplored in current research. This dissertation delves into the role that complementor relationships play in the creation of new value and takes the commoditised Dutch printing industry as the empirical field. Starting from an economic, capabilities and marketing perspective, I explore the management literature on the expected role of complementors and complementarity in the new value creation process and argue that it is of particular interest to disentangle complementors and suppliers, and relate them to firm innovation performance. Then, by drawing on a case study from the Dutch printing industry and using the literature of social cognitive embedding, I am able to formulate hypotheses. These are tested in the quantitative section, with an 18% response rate. The results show that, as with suppliers, complementors are key relationships for successful innovation. However, both complementors and suppliers can have negative as well as positive impacts on a firm's innovation performance and each has a stronger impact on certain aspects of performance. I thus conclude that complementor relationships are a valuable resource for Dutch printing firms in fighting the problem of commoditisation, though managers first need clarity on what specific aspect of innovation needs to be improved. Suggestions for further research are to develop a uniform holistic model of the external relationships a firm can have and preferably test it in other empirical settings.

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