CORNELIS VINCENT HEIJ

Innovating beyond Technology

Studies on how management innovation, co-creation and business model innovation contribute to firms' (innovation) performance

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Innoveren is meer dan technologie alleen:

Studies hoe managementinnovatie, co-creatie en businessmodel-innovatie bijdragen aan (innovatie)prestaties van bedrijven

Thesis

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Cornelis Vincent Heij

born in
Krimpen aan den IJssel, The Netherlands

Erasmus University Rotterdam

Doctoral committee:

Promoters: Prof.dr. H.W. Volberda
Prof.dr.ing. F.A.J. Van Den Bosch

Other members: Dr. S.M. Ansari
Prof.dr. J. Birkinshaw
Prof.dr. F. Damanpour

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To my father, mother and brother.

PREFACE: a journey of being a PhD candidate

In October 2010 I passed a billboard with the text "The art of combining tradition with innovation". It was about a month after I had defended my master's thesis, which is for many graduates one of those times to consider and take action concerning the next step(s) in life. Having passed that billboard at an airport and waited at the gate for the "now boarding" sign to illuminate, I realized that the text on that billboard also applied to me. Following my interests I studied technology management with 'commercialization' as a specialization at a polytechnic university (TH Rijswijk) before starting my master in business administration at the Rotterdam School of Management, Erasmus University. In my master's thesis, ambidexterity, i.e. combining exploration and exploitation, played a pivotal role. Accordingly, when the supervisor of my master's thesis informed me of a position to conduct academic *and* more applied research on the technological *and* non-technological determinants of ambidexterity, my decision to go for it was actually relatively quickly made. And indeed, this new part of the 'journey of life' as a project manager at the INSCOPE-Research for Innovation *and* as a PhD candidate turned out to be highly valuable, inspirational and pleasurable.

Some of you may wonder who the supervisor of my master's thesis was who was suggesting to me that I should do all of this. Well, it is the same person who was my supervisor while I was a PhD candidate: Prof.dr. Henk Volberda. Over time, I got to know him not only as a supervisor who tried to make the most of my potential, but also as a colleague to realize projects, and with whom I could share thoughts in less formal settings. Henk, I very much appreciate the confidence you have shown in me by providing me with lots of freedom to accomplish activities.

Prof.dr.ing. Frans Van Den Bosch was also my supervisor while I was a PhD candidate. I consider Frans as a 'nestor' in our department, who is keen to advance our understanding of a certain topic in the right way. Frans, thank you very much for your helpful suggestions for completing this dissertation. Moreover, I appreciated our conversations about other than work-related matters, such as about which breweries to visit.

As Amelia E. Barr (1913, p. 146) once said, "the great difference between voyages rests not with the ships, but with the people you meet on them". That is something I have certainly found in the process of completing the studies in this

dissertation. There are many people whom I am indebted to, such as my dear colleagues Aybars Tunçdoğan, Carolien Heintjes, Diana Barbara Perra, Eva van Baren, Guilhem Bascle, Jacomijn Klitsie, Lonneke Roza, Marten Stienstra, Patricia de Wilde-Mes, Saeed Khanagha, Thijs Geradts, Wilfred Mijnhardt, and many more. A special word of thanks must go to Rick Hollen for not only being my room-mate, but also for the enjoyable and insightful conversations we had about a broad range of topics.

Above all, special thanks go to the people closest to me: my father (Leen), mother (Corrie), and brother (Piet). Father, among other things, I really appreciate sharing your advice and experience with all kinds of issues (you are really like MacGyver with your creative and practical solutions regardless of what the issue is), our tours to numerous places, and the fact that you always stand by to support, whatever the time or day of the week. Mother, I cannot emphasize enough my gratitude for what you have done and how much you mean to Piet and me. Just like Leen, you are always standing by to help or to proactively support with all kinds of matters. Brother, I can say many things about you – and many times I have had to say sorry to you. I usually appreciate your witty remarks and it looks like the older we get, the more alike we become.

Accordingly, I would like to dedicate this dissertation to all of you who contributed to making me who I am. The time spent working on this dissertation to advance our understanding of innovation has been an exciting journey with all of you. I thank you all for joining me on this voyage.

Cornelis Vincent ‘Kevin’ Heij

Krimpen aan den IJssel, August 2015

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CHAPTER 1. Introduction: technological innovation versus non-technological types of innovation

1.1 Introduction

For many of today's organizations, competitive advantages are becoming more and more temporary and new ones therefore have to be developed (Giesen, Riddleberger, Christner, Bell, 2010; McGrath, 2013; Volberda *et al.,* 2011). Developments such as shorter product life cycles, the convergence of technologies and industries, increases in the number of low-cost competitors, and changing customer preferences create dramatic changes in the economy (Govindarajan and Trimble, 2005; Smith, Binns, Tushman, 2010; Teece, 2007). Such trends change the competitive game: they make it more difficult for firms to differentiate themselves (Casadesus-Masanell and Ricart, 2010; Prahalad and Ramaswamy, 2004), and they may reduce the life expectancy of incumbents (Casadesus-Masanell and Ricart, 2011). The expectation is that such changes will become more extensive, and will take place more frequently and more rapidly in the near future (Giesen *et al.,* 2010; Smith *et al.*, 2010). Past success is no guarantee of success today (Venkatraman and Henderson, 2008; Teece, 2010), nor does success today guarantee future success (Govindarajan and Trimble, 2011).

To survive in today's business environments, firms need to be different and smarter than their competitors (Hamel and Prahalad, 1994; Voelpel, Leibold, Tekie, Von Krogh, 2005; Volberda, 1998). Innovation is generally considered to be the cornerstone of competitive advantage, economic progress, prosperity and social wealth (e.g., Chandy and Tellis, 1998; Schumpeter, 1934). As Andriopoulos and Lewis (2009, p. 709) have stated, "in today's dynamic world, innovation may pose the ultimate advantage and challenge for organizations."

Varios scholars (e.g., Chesbrough, 2007; Crossan and Apaydin, 2010; Damanpour, Walker and Avellaneda, 2009) have made a distinction between different types of innovation, such as technological innovation, management innovation, open innovation, and business model innovation. Compared to technological innovation, non-technological types of innovation have received relatively limited attention from academics (e.g., Crossan and Apaydin, 2010; Damanpour, 2014; Orlikowski, 1992; Volberda, Van Den Bosch, Heij, 2013). For instance, Damanpour (2014, p. 1266)

stated that "innovation has been primarily conceptualized as a technology-based phenomenon, despite acknowledgement by economic and organizational scholars of the importance of research on innovation beyond the technological domain". Various types of non-technological innovation have recently received increased attention as sources of competitive advantage (e.g., Birkinshaw, Hamel, Mol, 2008; Chesbrough, 2007; Damanpour and Aravind, 2012; Teece, 2010; Volberda, Van Den Bosch, Mihalache, 2014). Non-technological types of innovation such as management innovation and business model innovation are typically more difficult to protect than technological innovation, with patents, for instance, and they are usually less observable and discrete, and more context-specific (e.g., Birkinshaw and Mol, 2006; Teece, 2010; Ettlie and Reza, 1992; Sabatier, Mangematin, Rouselle, 2010).

Without questioning the importance for firms of conducting technological innovation, various management scientists (e.g., Damanpour *et al*., 2009; Sirmon, Hitt, Ireland, Gilbert, 2011; Teece, 2010; Volberda *et al*., 2013) have argued that technological innovations *alone* are not a guarantee of success, but rather provide potential for a competitive advantage. For example, Teece (2010, p. 183) has stated that "clearly technological innovation by itself does not automatically guarantee business or economic success – far from it." Building on a generic categorization of the innovation process, new technological knowledge needs to be (1) transformed into output such as products, services, and operational processes, and this output needs to be (2) aligned to customer needs but also to provide a means of differentiating the organization from its competitors in order to be successful (Baregheh, Rowley, Sambrook, 2009; Pavitt, 2005). Besides the amount of technological knowledge, an organization's ability to apply that knowledge is a crucial determinant of innovation success (Hansen, Perry, Reese, 2004; Taylor and Greeve, 2006; Volberda and Van Den Bosch, 2005). Because of this, examining the role of non-technological types of innovation in turning technological knowledge into product and service innovations and subsequently into commercial success can provide important new insights into how organizations can extract greater value from technological knowledge. By utilizing their knowledge in this way, organizations can increase their chances of surviving and prospering: effectiveness at leveraging knowledge is expected to become a key indicator of leading firms (Griffin *et al*., 2013).

1.2 Three types of non-technological innovation: management innovation, co-creation with customers, and business model innovation

Before examining various types of non-technological innovation, we first provide a conceptualization of innovation and of technological innovation.

Innovation

Innovation is a multidimensional concept that has been defined in numerous different ways (Crossan and Apaydin, 2010; Damanpour and Aravind, 2012). In the field of innovation within organizations, "scholars have generally defined innovation as the development and use of new ideas or behaviors in organizations" (Damanpour and Wischnevsky, 2006, p. 271). However, this generic perspective on innovation contains many underlying dimensions, some of the most significant being what the new idea or behaviour is about (e.g., a new product or a new business model), the degree of newness (e.g., radically new or incrementally new), and from whose perspective it is new (e.g., new to the firm or new to the world) (e.g., Baregheh *et al*., 2009; Crossan and Apaydin, 2010; Garcia and Calantone, 2002). In their literature review of innovation studies, Baregheh *et al*. (2009) found that scholars have focused in particular on the type of innovation, followed by the extent to which it is new. Of the various types of innovation, considerable attention has been given to technological ones: products, services, operational processes or technologies in general (Baregheh *et al*., 2009; Crossan and Apaydin, 2010).

Technological innovation

Technological innovation can be associated with the introduction of new technological knowledge that relates to how to do things differently or better in terms of a firm's production system, its operational processes, or its products and services (e.g., Dosi, 1982; Barge-Gil and López, 2014; Betz, 2011; Chesbrough, Di Minin, Piccaluga, 2013; Teece, 1986). Technological innovation is usually associated with investment in research and development (R&D), in information technology, and patents (Archibugi, 1992; Coombs and Bierly, 2006; Stock, Greis, Fischer, 2002). Table 1.2.1 provides several definitions of technological innovation.

Table 1.2.1: Definitions of technological innovation.

Authors:	Definition:
Utterback (1971, p. 77):	"an invention which has reached market introduction in the case of a new product, or the first use in a production process, in the case of a process innovation."
Abernathy and Clark (1985, p. 3):	"a sequence of activities involving the acquisition, transfer and utilization of information."
Teece (1986, p. 288):	"certain technological knowledge about how to do things better than the existing state of the art."
Garcia and Calantone (2002, p. 112):	"the technological development of an invention combined with the market introduction of that invention to end-users through adoption and diffusion."
Popadiuk and Choo (2006, p. 303):	"the knowledge of components, linkages between components, methods, processes, and techniques that go into a product or service."
Damanpour *et al.* (2009, p. 654):	"new elements introduced into an organization's production system or service operation for producing its products or rendering its services to the clients."
Crossan and Apaydin (2010, p. 1168-1169):	"Technological innovations include products, processes, and technologies used to produce products or render services directly related to the basic work activity of an organization."
Mothe and Thi (2010, p. 315):	"Technological innovation is usually seen as encompassing product and service innovation. […] This includes significant improvements in technical specifications, components and materials, incorporated software, user friendliness or other functional characteristics."
Camisón and Villar-López (2014, p. 2892):	"Technological innovation involves product and process innovations."

Technological innovation has been conceptualized at different levels of abstraction (e.g., Damanpour, 1987; Volberda *et al*., 2013); It has been referred to as the introduction of (1) new technological knowledge, or (2) of technological process innovations and product/service innovations which embody that new technological knowledge (e.g., Bergek, Jacobsson, Carlsson, Lindmark, Rickne, 2008; Geels, 2005). Both perspectives have been considered as a process and as an outcome (e.g., Abernathy and Clark, 1985; Baregheh *et al*., 2009; Decarolis and Deeds, 1999). In the first perspective on technological innovation, the emphasis is on the generation of new technological knowledge, and on a new "technological knowledge field" that is embodied in a new technological process, product, or service (Bergek *et al*., 2008, p. 411; Betz, 2011). The second perspective on technological innovation puts a stronger

emphasis on the transformation of new technological knowledge into a technological process, product or service innovation (Bergek *et al*., 2008; Pavitt, 2005). This includes, for instance, a new tool, machine, operational method, product or service (Bergek *et al*., 2008; Damanpour, 1987; Pavitt, 2005), and they are typically clustered into two different, though related, types: technological process innovations and product/service innovations (e.g., Afuah, 1998; Hollen, Van Den Bosch, Volberda, 2013; Mothe and Thi, 2010; Porter, 1985). Compared to the first perspective where the focus of attention is on new technological knowledge as the level of analysis, in the second perspective on technological innovation the focus is more on the level of analysis of a technological process, product or service innovation in which new technological knowledge is embodied (Bergek *et al*., 2008).

Building on the generic categorization of the innovation process (e.g., Baregheh *et al.*, 2009; Pavitt, 2005) and recognizing the potential variations in how efficient organizations are at turning new technological knowledge into output (Cruz-Cázares, Bayona-Sáez, García-Marco, 2013; Katila and Ahuja, 2002; Stock *et al*., 2002), we differentiate between new technological knowledge and the realization of product and service innovations. This is in line with other earlier research (e.g., Danneels, 2002; Hill and Rothaermel, 2003; Slater and Mohr, 2006).

Classification of various types of innovation

Scholars have distinguished various other types of innovation besides technological innovation (e.g., Damanpour and Evan, 1984; Emery, 1959; Kimberly and Evanisko, 1981; Schumpeter, 1983). Among the most prominent classifications of innovation types are radical innovation versus incremental innovation, and technological innovation versus administrative, organizational or management innovation (Cooper, 1998; Crossan and Apaydin, 2010; Damanpour *et al.*, 2009). Drawing on the categorization of innovation types presented in the OECD's Oslo Manual (2005), various scientists (e.g., Camisón and Villar-López, 2014; Hervas-Oliver and Sempere-Ripoll, 2014; Mothi and Thi, 2010) have considered management innovation and marketing innovations as non-technological innovations as opposed to process and product innovations. The list of innovation types outside the domain of technological innovation can be extended to include other types, such as open innovation and business model innovation (Baden-Fuller and Haefliger, 2013; Chesbrough, 2007; Damanpour *et al*., 2009). Drawing on these classifications of

innovation types, this dissertation focuses on three relatively under-researched non-technological types of innovation (see also Table 1.2.2) that recently have received increased recognition as important sources of competitive advantage, namely:

1) Management innovation (e.g., Birkinshaw *et al.*, 2008; Damanpour and Aravind, 2012; Volberda *et al*., 2014);
2) Co-creation with customers (e.g., Chatterji and Fabrizio, 2014; Prahalad and Ramaswamy, 2004; Vargo and Lusch, 2008);
3) Business model innovation (e.g., Amit and Zott, 2001; Baden-Fuller and Haefliger, 2013; Teece, 2010).

Table 1.2.2: Three relatively under-researched types of non-technological innovation.

Type of innovation:	Definition chosen in this dissertation:	Illustrative references:
Management innovation	"the generation and implementation of a management practice, process, structure, or technique that is new to the state of the art and is intended to further organizational goals" (Birkinshaw *et al*., 2008, p. 829).	Birkinshaw, 2014; Birkinshaw *et al.*, 2008; Damanpour and Aravind, 2012; Hamel, 2006; Volberda *et al*., 2014.
Co-creation with customers	"a joint activity between a supplier and a customer in which the two parties share information, which is then jointly interpreted and integrated into a shared relationship-domain-specific memory that changes the range or likelihood of potential relationship-domain-specific behaviour" (Selnes and Sallis, 2003, p. 80).	Chatterji and Fabrizio, 2014; Chesbrough, 2003; Foss *et al*., 2011; Prahalad and Ramaswamy, 2004; Vargo and Lusch, 2008.
Business model innovation	The introduction of a fundamentally new or improved logic how a firm creates and captures value (Björkdahl and Holmén, 2013; Casadesus-Masanell and Zhu, 2013; Markides, 2006).	Amit and Zott, 2001; Baden-Fuller and Haefliger, 2013; Chesbrough, 2010a; Markides and Oyon, 2010; Teece, 2010.

These three relatively new types of innovation are known to be key variables in the capacity of organizations to turn technological innovation into commercial success or to catalyze this process (e.g., Chesbrough, 2007; Damanpour *et al*., 2009; Slater and Mohr, 2006; Teece, 1986, 2010). They can be related to one another (e.g., Amit and Zott, 2012; Chesbrough, 2007; Teece, 2010), but in line with much prior research (e.g., Crossan and Apaydin, 2010; Mol and Birkinshaw, 2009; Walker, Damanpour,

Avellaneda, 2011; Foss, Laursen, Pedersen, 2011), we focus on these three types of innovation individually, taking into account the unique characteristics and effects of each (see also Figure 1.2.1).

Figure 1.2.1: Management innovation, co-creation, and business model innovation as three related, though different, types of non-technological innovation.

Management innovation

Management innovation can be defined as "the generation and implementation of a management practice, process, structure, or technique that is new to the state of the art and is intended to further organizational goals" (Birkinshaw *et al*., 2008, p. 829). Management practices are daily activities undertaken by managers (Mol and Birkinhaw, 2009). Management processes are routines that govern managerial work (Birkinshaw *et al*., 2008). Organizational structure reflects the way how responsibility is allocated (Hamel, 2007). Management techniques involve procedures applied to realize a goal or task (Birkinshaw *et al*., 2008; Hamel, 2007). These management practices, processes, structures and techniques are strongly interrelated (Birkinshaw *et al*., 2008; Mol and Birkinshaw, 2009). Basically, management innovation involves changes in how managers perform their job, changes

which are aimed at addressing particular problems a firm is facing (Hamel, 2006). It is associated with the social part of a firm's socio-technical system (e.g., Damanpour and Aravind, 2012; Damanpour *et al*., 2009), and examples include the moving assembly line, the multidivisional form (M-form), and self-organizing teams (Birkinshaw *et al*., 2008; Vaccaro, 2010; Van Den Bosch, 2012).

Although management innovation has a significant overlap with administrative innovation and organizational innovation (Damanpour and Aravind, 2012; Volberda *et al*., 2013), the concepts differ with respect to their scope (Birkinshaw *et al.*, 2008; Vaccaro, 2010). For instance, administrative innovation is usually centered more narrowly on human resource policies and organizational structure. Organizational innovation has a relatively broad scope since it has been associated with all kinds of innovation that an organization may undertake (Birkinshaw *et al.*, 2008; Crossan and Apaydin, 2010; Vaccaro, 2010).

The nature of management innovation as less tangible, discrete and more organization-specific than technological innovation, and more difficult to replicate, makes it a vital source of competitive advantage (Ansari, Fiss, Zajac, 2010; Hamel, 2006; Mol and Birkinshaw, 2006, 2009). According to Mol and Birkinshaw (2006, p. 29), "there is an implicit and widespread, yet often unfounded, belief that technological innovation matters more than management innovation". Management scientists have speculated about different perspectives on the relationship between technological innovation and management innovation (e.g., Hollen *et al*., 2013; Mothe and Thi, 2010); technological innovation can enable management innovation (e.g., Evan, 1966; Hecker and Ganter, 2013), management innovation can enable technological innovation (e.g., Camisón and Villar-López, 2014; Mothe and Thi, 2010), and both types of innovation can have a combined effect on firm performance (e.g., Damanpour *et al.*, 1989; Damanpour *et al*., 2009). However, research on management innovation "is still in its early stage" (Damanpour and Aravind, 2012, p. 446), and various scholars (Damanpour, 2014; Sapprasert and Clausen, 2012; Volberda *et al*., 2014) have urged that more research is needed to investigate how management innovation is related to technological innovation.

Co-creation with customers

The development of a new technology is often separated from the customers' actions and the benefits that derive from that new technology (Orlikowski, 1992). Alongside a more internal way of achieving product and service innovations, there is also a way which is more open and which involves external partners (Chesbrough, 2007; Berthon, Hulbert, Pitt, 2004; Van de Ven, 1986). O'Reilly and Tushman (2013) suggest that research on exploitation and exploration is expected to shift towards more beyond the organizational-level.

Of the various ways in which co-creation can take place (e.g., Chesbrough, 2003; O'Hern and Rindfleisch, 2010), relationship learning has recently received considerable attention in the literature as it has been recognised as an important source of competitive advantage (Jean, Sinkovics, Kim, 2010; Selnes and Sallis, 2003). Relationship learning can be defined as "a joint activity between a supplier and a customer in which the two parties share information, which is then jointly interpreted and integrated into a shared relationship-domain-specific memory that changes the range or likelihood of potential relationship-domain-specific behaviour" (Selnes and Sallis, 2003, p. 80). Examples of interactions in which relationship learning can take place include operational meetings, customer visits, telephone discussions (Selnes and Sallis, 2003) and trade shows (Ling-yee, 2006).

Relationship learning can take place with a broad range of external partners such as customers, suppliers and competitors (e.g., Brandenburgers and Nalebuff, 1997; Kang and Kang, 2010). Relationship learning has been examined mainly in inter-organizational settings (Chatterji and Fabrizio, 2014), and scholars have looked at various characteristics, including its depth and breadth (e.g., Foss, Lyngsie, Zahra, 2013; Laursen and Salter, 2006). Relationship learning with customers as end-users has recently received increased attention as an important source of competitive advantage (e.g., Foss *et al*., 2011; Prahalad and Ramaswamy, 2004; Vargo and Lusch, 2008). For example, Prahalad and Ramaswamy (2004, p. 5) have stated that "the future of competition, however, lies in an altogether new approach to value creation, based on an individual-centered co-creation of value between customers and companies."

The more traditional view on the value creation process, i.e. "supply side driven logic" (Teece, 2010, p. 172) in which products and services are simply

produced by the firm and sold *to* customers, has made way for a stronger emphasis on developing relationships *with* them in which customers' needs and knowledge are taken more into account (e.g., Sanders and Stappers, 2008; Van de Ven, 1986; Vargo and Lusch, 2008). This enables an organization to attract, develop, maintain and protect relationships with customers (Harkar and Egan, 2006; Jean *et al*., 2010), with the aim of increasing sales (MacDonald, 1995) and profitability (Kalwani and Narayandas, 1995; Selnes and Sallis, 2003). Moreover, such relationships enable an organization to tap into external knowledge bases and to increase the value of its own new and existing technological knowledge (e.g., Chesbrough, 2003; Bierly, Damanpour, Santoro, 2009; Prahalad and Ramaswamy, 2004).

Business model innovation

Business models have received increased attention from the mid-1990s onwards (e.g., Casadesus-Masanell and Ricart, 2010; Zott *et al*., 2011). In this relatively new level of analysis, how an organization conducts business is looked at more holistically (Björkdahl and Holmén, 2013; Hamel, 2000; Zott, Amit, Massa, 2011). According to Venkatraman and Henderson (2008, p. 260), "it is no longer adequate to innovate in narrow domains – products, processes and services. […] we need to innovate more holistically – namely: the entire business model." However, there is no uniform understanding of what a business model stands for (e.g., Spieth, Schneckenberg, Ricart, 2014; Zott *et al*., 2011), and this makes it problematic to examine business model innovation (Björkdahl and Holmén, 2013; Casadesus-Masanell and Zhu, 2013).

Despite this lack of a common understanding, business model conceptualizations generally involve the notion of value creation and value capture (Massa and Tucci, 2014; Spieth *et al*., 2014; Zott *et al*., 2011). Accordingly, innovation in a business model entails introducing a fundamentally new logic, or at least making a substantial advance in the existing logic, of how a firm creates and captures value (Björkdahl and Holmén, 2013; Casadesus-Masanell and Zhu, 2013; Markides, 2006). This can entail changing components and interactions in key activities or the revenue model, for example (e.g., Aspara, Lamberg, Laukia, Tikkanen, 2013; Johnson, Christensen, Kagermann, 2008; Morris, Schindehutte, Allen, 2005). Business model innovation is argued to be an important source of competitive advantage (e.g., Giesen *et al*., 2010; Massa and Tucci, 2014; Zott *et al*.,

2011), but it generally ranks third on the innovation agenda of firms, after new products and services and the quest for new technologies (Mitchell and Coles, 2003).

Baden-Fuller and Haefliger (2013, p. 419) have stated that "business models are fundamentally linked with technological innovation, yet the business model construct is essentially separable from technology". Firms can develop business models around new or existing technologies, products and services in order to connect them to a market, including unmet customer needs, in such a way that they can capture an adequate amount of the value created for customers (e.g., Johnson *et al*., 2008; McGrath, 2010; Teece, 2010). According to Chesbrough, "a mediocre technology pursued with a great business model may be more valuable than a great technology exploited via a mediocre business model" (Chesbrough, 2010a, p. 354) and "a better business model often will beat a better idea or technology" (Chesbrough, 2007, p. 12). Besides commercializing technologies, products and services, business models can be used to commercialize the value of management innovation and co-creation. Both of these types of innovation may also be required to realize business model innovation (e.g., Itami and Nishino, 2010; Markides and Oyon, 2010; Teece, 2010).

1.3 Research aim

This dissertation investigates how three major types of non-technological innovation – management innovation, co-creation with customers, and business model innovation – contribute to firm performance. Building on the innovation process in which technological knowledge needs to be transformed into product and service innovations which is subsequently fundamental in influencing firm performance (e.g., Baregheh *et al*., 2009; Pavitt, 2005; Jansen, Van Den Bosch, Volberda, 2006), we differentiate between two kinds of firm performance: innovation performance, i.e. product and service innovations, and overall firm performance. One benefit of differentiating between these two types of firm performance is that this enables us to provide new insights in an organization's efficiency during specific stages of the technological innovation process (Cruz-Cázares *et al*., 2013).

Product and service innovations have been associated with technological innovations in which new technological knowledge is embodied (e.g., Benner and Tushman, 2002; Popadiuk and Choo, 2006; Wei *et al*., 2014). They can be further divided into exploitative and exploratory product and service innovations, both of

which are fundamental for organizational survival (e.g., Benner and Tushman, 2002; Levinthal and March, 1993; March, 1991). Research on the antecedents of exploitation and exploration is burgeoning (see, for instance, Lavie, Stettner, Tushman (2010) or O'Reilly and Tushman (2013) for an overview). Various scholars (e.g., Chatterji and Fabrizio, 2014; Mol and Birkinshaw, 2006, 2012) have suggested that management innovation enables technological innovation in general or that co-creation with customers contributes to both types of product and service innovations. However, many questions still remain as to how management innovation and co-creation with customers contribute to exploitative and exploratory product and service innovations.

Product and service innovations are a crucial engine for corporate renewal (Danneels, 2002; Kwee, Van Den Bosch, Volberda, 2011), but a common assumption made by strategy scholars is that product and service innovations "automatically lead to increased profit for the innovating firm(s)" (Baden-Fuller and Haefliger, 2013, p. 422). A new product often requires a new business model (Johnson *et al*., 2008) and business model innovation can be a source of competitive advantage for a firm with a similar strategy, technology, products or services to its competitors (Chesbrough, 2007, 2010a; Mitchell and Coles, 2003; Teece, 2010). Business models do not only encompass how a firm creates value for its customers with its offering, but also how it can turn a reasonable amount of that value into profit for itself (Chesbrough, 2007; Teece, 2010; Zott *et al*., 2011).

To make further advances in our understanding of how business model innovation increases the value of technologies, products and services (Baden-Fuller and Haefliger, 2013; McGrath, 2010) we first need to address the lack of clarity on what business model innovation stands for (e.g., Casadesus-Masanell and Zhu, 2013; Spieth *et al*., 2014) and gain additional insight into how it influences firm performance (Schneider and Spieth, 2013). A fundamental aim of this dissertation is therefore to advance our understanding of how management innovation, co-creation with customers, and business model innovation contribute to firm performance: either innovation performance, i.e. exploitative and exploratory product and service innovations, or overall firm performance.

In terms of how those three types of non-technological innovation contribute to firm performance, there are still many questions regarding the particular conditions in which this happens. The value of knowledge and innovation is very dependent on

the context (Damanpour, 1991; Galunic and Rodan, 1998; Van Wijk, Jansen, Lyles, 2008). In their meta-analysis of empirical studies on the performance effect of innovation, Rosenbusch, Brinckmann, and Bausch (2011, p. 441) found that contextual factors "affect the impact of innovation on firm performance to a large extent". Scholars have applied contingency theories to explain these variations (Damanpour and Wischnevsky, 2006), looking at whether they are related to environmental dynamism (e.g., Damanpour and Gopalakrishnan, 1998; Jansen *et al*., 2006) or to firm age (e.g., Rosenbusch *et al*., 2011), for example. A second fundamental aim of this dissertation is to provide new insights into how multiple contextual factors can help to explain variations in the effect that management innovation, co-creation with customers, and business model innovation have on firm performance.

Overall, the aim of this dissertation is to:

> Increase our understanding of how, and under which conditions, three major non-technological types of innovation, i.e. management innovation, co-creation with customers, and business model innovation, contribute to firm performance.

Five studies are used in this dissertation to achieve its overall aim. Figure 1.3.1 depicts the overarching conceptual model of these five studies. Table 1.3.1 outlines the various characteristics of each study in this dissertation. As can be seen in both the figure and the table, we examine antecedents of exploratory and exploitative product and service innovations, how different types of business model innovation influence firm performance, and how various contextual factors influence those relationships.

Scholars (Birkinshaw *et al*., 2008; Volberda *et al*., 2014) have identified a number of different theoretical perspectives on management innovation, such as the rational perspective and the institutional perspective. Following authors such as Birkinshaw *et al.* (2008), Damanpour *et al.* (2009), Mol and Birkinshaw (2009), and Walker *et al.* (2011), the perspective taken in this dissertation's studies of management

Table 1.3.1: Overview of the five studies in this dissertation.

Study	I	II	III	IV	V
Central research question:	What are common and emerging research domains, and research priorities in the field of management innovation?	How does management innovation moderate the relationship between R&D and radical product innovations?	How do new management practices contribute to a firm's exploitative innovation performance and how does organizational size moderate this relationship?	How does relationship learning with customers contribute to exploitative and exploratory innovation, and how does connectedness within an organization moderate this relationship?	How does environmental dynamism moderate the relationship between different types of business model innovation, i.e. replication and renewal, and firm performance?
Research method:	Conceptual study	Large-scale survey/ ordinary least squared analyses	Large-scale survey/ ordinary least squared analyses	Large-scale survey/ ordinary least squared analyses	Large-scale survey/ ordinary least squared analyses
Dependent variable(s):	Management innovation	Radical product innovations	Exploitative product and service innovations	Exploitative and exploratory product and service innovations	Firm performance
Independent variable(s):	Various (e.g., managerial, intra-, inter-organizational antecedents)	Investment in R&D	New management practices, i.e. management innovation	Relationship learning with customers	Two basic types of business model innovation: replication and renewal

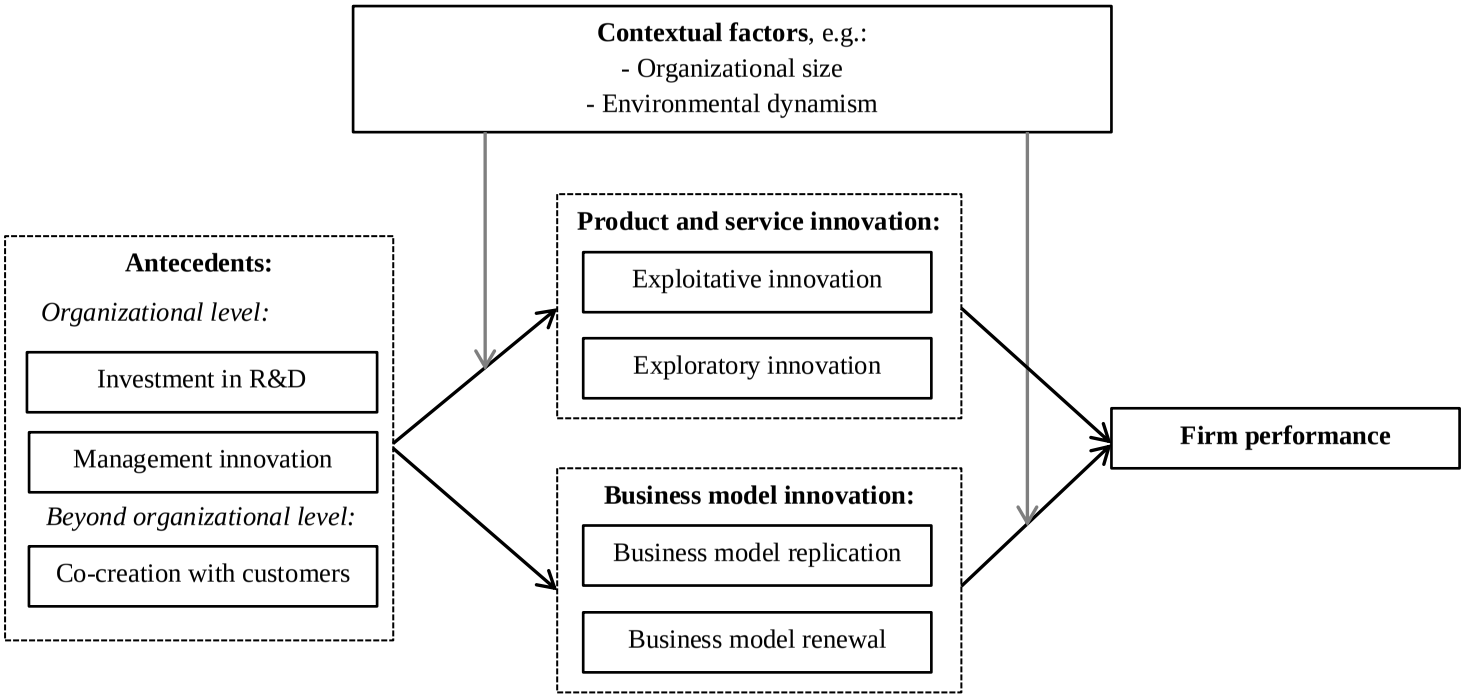
Moderating variable:	Various (e.g., environmental conditions)	Management innovation	Organizational size	Organizational connectedness	Environmental dynamism
Level of analysis:	Various	Firm	Firm	Firm and its customers	Firm
Data collection:[1]	Literature review	Cross-industry survey of Dutch organizations (2010)	Cross-industry survey of Dutch organizations (2010)	Survey of Dutch health care providers (2012)	Cross-industry survey of Dutch organizations (2012)
Sample size:	-	730	839	356	502
Main findings:	● Identifying common areas of research in terms of antecedents (managerial, intra- and interorganizational), dimensions, outcomes, and contextual factors relating to management innovation.	● At lower levels of management innovation, the relationship between R&D and radical product innovations has an inverted U-shaped effect.	● New management practices have an increasingly positive effect on a firm's exploitative innovation performance.	● Relationship learning with customers has an inverted U-shaped effect on exploitative innovation, while its effect on exploratory innovation is positive.	● Differentiation, conceptualization, and description of key characteristics of two types of business model innovation: replication and renewal. ● Environmental dynamism weakens the positive relationship between business model replication and firm performance.

(Table continues on the next page.)

[1] Number between brackets represents the year of data collection.

	● Pointing out emerging but under-researched themes: the relationship between technological innovation and management innovation, and their performance effects. ● Setting up a future research agenda and research priorities for management innovation research.	● This effect is J-shaped for firms with higher levels of management innovation.	● The larger the firm, the more the relationship between new management practices and exploitative innovation performance moves from a positive linear relationship towards a more J-shaped relationship.	● Organizational connectedness flattens the negative effect of higher levels of relationship learning with customers on exploitative innovation.	● The effect of business model renewal is stronger in environments characterized by intermediate and high levels of dynamism than in relatively stable settings, i.e. where there are low levels of environmental dynamism.

Figure 1.3.1: Overarching conceptual model.



innovation is most closely related to the dominant rational view on management innovation (Volberda *et al*., 2014). This perspective centers on how management innovation helps to improve organizational outcomes (Birkinshaw *et al*., 2008; Volberda *et al*., 2014) and typically starts with "commitment to a big management problem" (Hamel, 2006, p. 77). The study on co-creation with customers applies a complementary, relational view (Dyer and Singh, 1998) to examine how organizational performance can be improved by sharing knowledge.

Several studies in this dissertation apply the contingency view to assess the moderating role of internal and external factors like organizational size and environmental dynamism. The contingency theory approach involves the extent to which the effectiveness of managerial, organizational and other firm characteristics is contingent upon internal and external factors (Volberda and Elfring, 2001). Firms with fairly similar technologies can differ in how they transform those technologies into successful product and service innovations in the market (Laursen, 2012).

1.4 Research design

In attempting to address the relatively scarce amount of empirical research on management innovation, co-creation with customers, and business model innovation (e.g., Chatterji and Fabrizio, 2014; Hervas-Oliver and Sempere-Ripoll, 2014; Schneider and Spieth, 2013), for this dissertation we have conducted large-scale survey research to test our hypotheses in four studies (Studies II to V). We apply existing scales from the literature to measure our main constructs, but we develop new scales to measure business model innovation. Studies II and III contain data from the same survey, but the other two empirical studies each draw on a different dataset. Each survey targets members of senior management. Study I is a conceptual paper.

The data in Studies II, III, and V was collected through a mixed-mode survey (postal and web-based). Study IV contains data that was collected through a web-based survey. After the initial invitation by either e-mail or letter, our target respondents received a reminder before follow-up calls were made. In several surveys we also invited second respondents to participate. We also complemented the survey data with archival data. Hypotheses are tested with hierarchical regression analyses based on ordinary least squared analyses. More details on the method and analyses are presented in each individual study.

The various datasets applied in the four empirical studies are part of a larger overall program to quantify various types of innovation and map their development over time, namely the *Erasmus Competition and Innovation Monitor*. This monitor was developed by INSCOPE – Research for Innovation and is conducted annually to measure the level of non-technological types of innovation such as management innovation, co-creation and business model innovation. The aim of this initiative is to play "an increasingly important role in helping us to better understanding innovation and its impact on competititiveness of enterprises and countries" (Volberda *et al*., 2013, p. 2). This monitor is typically conducted among 10,000 organizations from a broad range of industries. The Erasmus Competition and Innovation Monitor started in 2006, and together with Prof.dr. Henk W. Volberda and Prof.dr.ing. Frans A.J. Van Den Bosch, the author of this dissertation is part of the core research team behind this project.[2] Besides annual surveys of firms in a broad range of industries in the Netherlands, the Erasmus Competition and Innovation Monitor has recently been expanded to cover specific industries, such as the Dutch 'top sectors', the Dutch health care industry, and financial advisory, and also other countries – including Belgium, Germany, Italy, Saudi Arabia and the United Kingdom.

Table 1.4.1: Academic, managerial and societal contributions of the Erasmus Competition and Innovation Monitor.

● Advances fundamental understanding of various types of non-technological innovation and their influence on technological innovation, productivity and the competitiveness of firms.
● Provides annual reports, and associated media coverage, to highlight the importance of various types of innovation and how they have developed over time.
● Enables participating organizations to compare their scores to the industry average on various types of innovation and indicators of firm performance.
● Erasmus Innovation Award made to the firm showing outstanding performance on various types of innovation.

The Erasmus Competition and Innovation Monitor, together with other initiatives such as the Community Innovation Survey (CIS), the INNFORM survey (e.g., Whittington *et al*., 1999), and surveys by Professor Nicholas Bloom, Professor

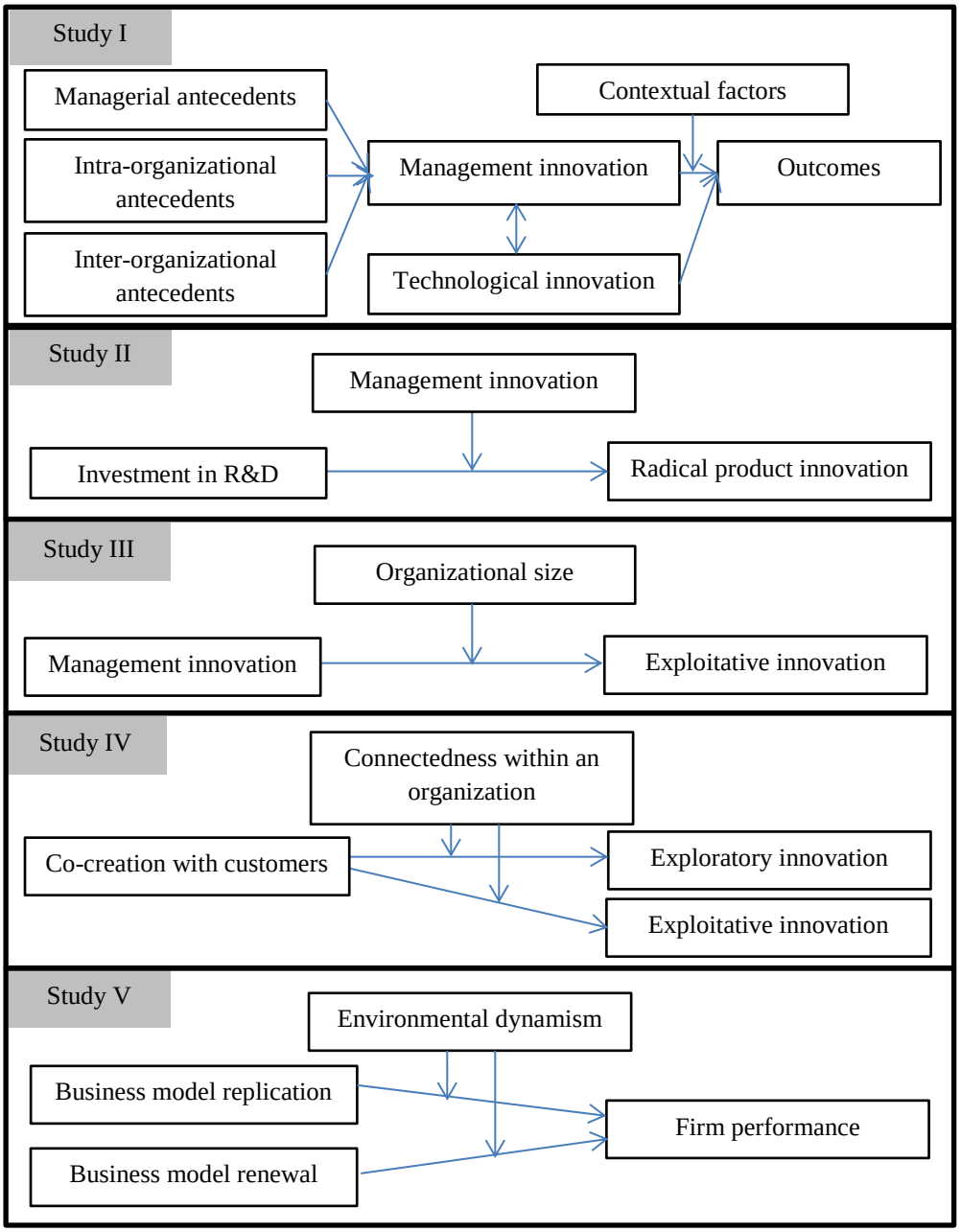
[2] The author is grateful for the involvement of Prof.dr. Justin Jansen and other colleagues in the versions of the Erasmus Competition and Innovation Monitor prior to the year 2011. He also acknowledges support from colleagues from other universities and organizations in collecting data from specific industries and other countries.

John Van Reenen and colleagues to quantify management practices (e.g., Bloom and Van Reenen, 2007; Bloom, Sadun, Van Reenen, 2010) represent increased efforts to systematically measure non-technological innovation across firms, industries, and countries. In addition to advancing our fundamental understanding of the topic, the Erasmus Competition and Innovation Monitor contributes to the society, including to the business community, in various other ways (see also Table 1.4.1). For instance, managers of firms which participate in the survey can compare their scores on various types of non-technological innovation and on various performance indicators to the industry average. Additionally, the research team of the Erasmus Competition and Innovation Monitor conducts interviews with senior managers from firms that show outstanding performance on various types of innovation. On the basis of this, a jury of representatives from employers and employee federations, governmental agencies, and industry associations then select a firm to receive the Erasmus Innovation Award for outstanding innovation performance.

1.5 Outline of dissertation

Chapters 2 to 6 each present a single study. These chapters each deal with one individual paper, and consist of a theoretical overview, methodology section and research findings (in the case of empirical studies), followed by discussion and implications. Chapter 7 provides an overview of the main findings and conclusions (see also Figure 1.5.2 and the end of this section). The remainder of this introductory chapter sets out in more detail the five studies in this dissertation. Figure 1.5.1 provides an overview of the main constructs of each study.

Figure 1.5.1: Conceptual model of the studies in this dissertation.



Study I: Management innovation: management as fertile ground for innovation

The first study in this dissertation provides an overview of existing research and research priorities in the field of management innovation. It highlights the need for, and the shift towards, more research on types of non-technological innovation and on management innovation in particular. It identifies common areas of research in terms of the antecedents (managerial, intra- and interorganizational), dimensions, outcomes, and contextual factors relating to management innovation. The study also highlights as emerging but still under-researched themes the relationship between technological innovation and management innovation, and their performance effects. This therefore suggests an agenda for future research and some priorities for management innovation research. This study not only provides a review of progress in innovation research, particularly with regard to management innovation research, but also lays the foundation for further scholarly discussion of important innovation research topics and on the crucial role of new modes of management.

Study II: How to leverage the impact of R&D on radical product innovations? The moderating effect of management innovation

Study II, and the following study, advance our understanding by addressing several of the research priorities in the field of management innovation that were identified in Study I. Study II investigates how an inverted U-shaped effect on radical product innovations is contingent upon management innovation. Out of a large-scale survey of ten thousand organizations in the Netherlands, 730 observations are included to test the hypotheses. Our findings support the hypothesis that investment in research and development (R&D) has an inverted U-shaped effect on radical product innovation for Dutch firms across a broad range of industries. Analyses of our data also indicate that this effect applies ceteris paribus to firms with lower levels of management innovation. However, in firms with high levels of management innovation, the effect of R&D on radical product innovations becomes J-shaped. These findings indicate that management innovation should be considered a key moderator in explaining a firm's effectiveness at transforming R&D into successful radical product innovations.

Study III: How do new management practices contribute to a firm's innovation performance? The role of organizational size

In contrast to Study II which examines how management innovation contributes to leverage the effect of R&D investment on radical product innovation, Study III investigates how management innovation contributes to realize exploitative product and service innovations. Additionally, this study includes the moderating role of organizational size in this relationship as a proxy for organizational complexity. We test the hypotheses with data from 839 respondents, derived from a survey distributed among 10,000 organizations in the Netherlands. The main findings suggest that new management practices, i.e. management innovation, have an increasingly positive effect on a firm's performance in exploitative innovation. However, the larger the firm, the more this relationship moves from a positive linear relationship towards one that is more J-shaped. These findings increase our understanding of how new management practices contribute to a firm's exploitative innovation performance and they highlight the fact that organizational size is an important contextual variable in this relationship.

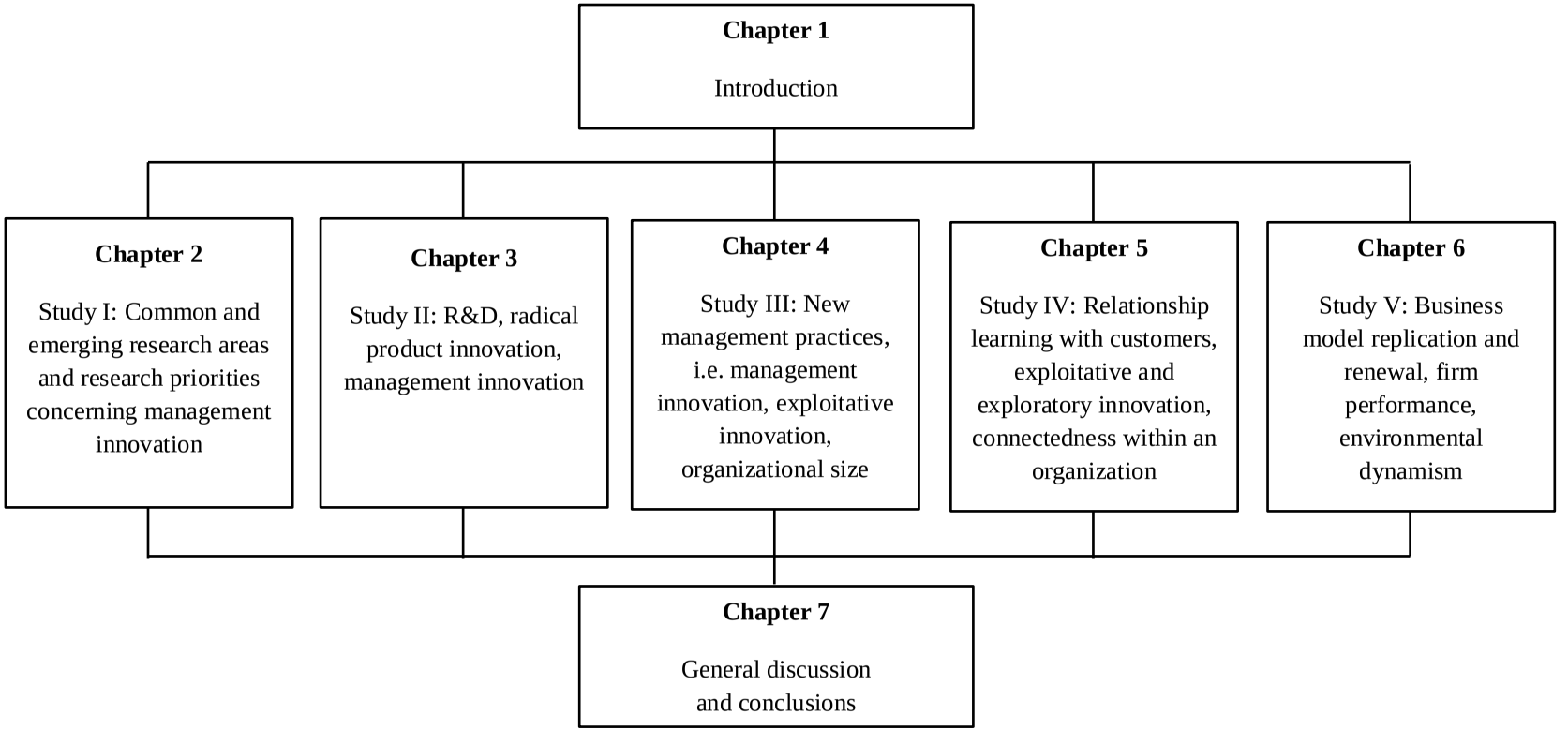
Study IV: How does co-creation with customers influence exploitative and exploratory innovation? The moderating role of connectedness within an organization

Study IV investigates how co-creation with customers, conceptualized as relationship learning, contributes to exploitative and exploratory product and service innovation and how these effects are contingent upon an informal coordination mechanism among organizational members within an organization: organizational connectedness. Hypotheses were tested with survey data relating to 356 Dutch health care providers. The findings indicate that relationship learning with customers has an inverted U-shaped effect on exploitative innovation, while its effect on exploratory innovation is positive. Organizational connectedness flattens the negative effect of higher levels of relationship learning with customers on exploitative innovation, but it does not significantly influence the effect of relationship learning with customers on exploratory innovation. These findings help to provide a greater understanding of how co-creation with customers influences an organization's innovation performance.

Study V: To replicate or to renew your business model? The performance effect in dynamic environments

Study V conceptualizes and sets out key attributes of two basic types of business model innovation: replication and renewal. Additionally, it provides arguments and empirical tests of how these two basic types of business model innovation contribute to firm performance, in particular at various levels of environmental dynamism. A large-scale survey of 10,000 organizations in the Netherlands enables us to test our hypotheses with 502 observations of senior managers. Our findings suggest that environmental dynamism weakens the positive effect of business model replication on firm performance. Business model renewal contributes more strongly to firm performance in environments that are characterized by intermediate and high levels of dynamism than in relatively stable settings with lower levels of dynamism. These findings indicate that environmental dynamism is a key contextual variable in the relationship between business model innovation and firm performance.

Figure 1.5.2: Outline of dissertation.



CHAPTER 2. Study I: Management innovation: management as fertile ground for innovation *

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CHAPTER 2. Study I: Management innovation: management as fertile ground for innovation

Abstract *Innovation is considered to be the primary driving force of progress and prosperity. Consequently, much effort is put in developing new technological knowledge, new process technologies and new products. However, evidence from both SMEs and large firms shows that successful innovation is not just the result of technological innovation, but is also heavily dependent on what has been called 'management innovation'. Management innovation consists of changing a firm's organizational form, practices and processes in a way that is new to the firm and/or industry, and results in leveraging the firm's technological knowledge base and its performance in terms of innovation, productivity and competitiveness. Recent research shows that management innovation explains a substantial degree of the variance of innovation performance of firms. More active stimulation of management innovation and its leverage of technological innovation will be crucial to improve the competitiveness of firms. However, only solid research can increase our understanding of what matters in various kinds of management innovations. Just as technological change requires systematic R&D, the development and diffusion of management innovations require systematic research on the crucial determinants of success. In this paper we will define management innovation, discuss the multidirectional causalities between technological and management innovation, and develop a framework that identifies common areas of research in terms of antecedents, process dimensions of management innovation, outcomes and contextual factors. Moreover, we will position the papers of this special issue in this framework and develop an agenda for future research into management innovation. We conclude this introductory paper by specifying the most important research priorities for further advancing the emerging field of management innovation.*

Keywords: management innovation, technological innovation, management practices, processes, structure.

2.1 Introduction to study I

As innovation is considered central to firms' competitive advantage, innovation research has become a cornerstone of strategic management inquiry. By far the greatest part of research has been devoted to understanding how firms can stimulate technological innovation (Crossan and Apaydin, 2010). More recently, however, some researchers have begun to revisit the benefits of management innovation. Management innovation refers to the introduction of management practices, processes and structures that are intended to further organizational goals (Birkinshaw, Hamel and Mol, 2008). The emergent dialogue consists of conceptual work (e.g., Birkinshaw *et al.*, 2008), historical outlines of various management innovations (e.g., Chandler, 1962; Mol and Birkinshaw, 2007) and empirical studies (e.g., Damanpour, Walker and Avellaneda, 2009; Vaccaro, Jansen, Van den Bosch, and Volberda, 2012a; Vaccaro, Volberda and Van den Bosch, 2012b).

Despite the recent surge in academic interest, management innovation remains an under-researched topic. Crossan and Apaydin's (2010) comprehensive and systematic literature review reveals that generally only 3% of innovation-related articles focus on management innovation. However, as recent work emphasizes the importance of management innovation for firm performance, both as a complement to technological innovation (Damanpour *et al.*, 2009) and as an independent phenomenon (Mol and Birkinshaw, 2009; Volberda and Van den Bosch, 2004, 2005), a better understanding of management innovation should be high on the research agenda. For example, Feigenbaum and Feigenbaum (2005, p. 96) argue that "the systematization of management innovations will be a critical success factor for 21st century companies". Moreover, Mol and Birkinshaw (2009, p. 1269) state that it is "one of the most important and sustainable sources of competitive advantage" as well as "needed to make technological innovation work" (Mol and Birkinshaw, 2006, p. 26).

The purpose of this introductory article is to advance our understanding of management innovation, its underlying dimensions, its antecedents, its impact on performance, and the contextual factors that affect management innovation. We first discuss the old paradigm and the new emerging model of innovation research. Subsequently, we further conceptualize management innovation in order to advance understanding and we develop an integrative framework that can be used to identify where research findings about management innovation converge and where gaps in

our understanding exist. Moreover, we point out several emerging research themes that have been under-researched, such as the relationship between technological and management innovation and its differential effects on performance. Finally, we specify the issues for further research derived from our integrative framework, position the articles in this special issue and how they contribute to our research agenda, and select five research priorities that in our view may speed up progress and knowledge advancement in the relatively young field of management innovation.

2.2 The old paradigm of industrial innovation under scrutiny

Innovation is considered to be the primary driving force of progress and prosperity, both at the level of the individual firm and of the economy in general (Schumpeter, 1934; Nelson and Winter, 1982; Tushman and Nadler, 1986). In particular, the ability to innovate has become increasingly central as studies have revealed that innovative firms tend to demonstrate higher profitability, greater market value, superior credit ratings, and greater chances of survival (Geroski, Machin and Van Reenen, 1993; Hall, 2000; Czarnitzki and Kraft, 2004). Notwithstanding these positive outcomes of innovation, innovation research itself is subject to creative destruction. The old paradigm of industrial innovation based on technological inventions seems today to be accompanied by many other forms of different types of innovations: organizational innovation (Damanpour *et al.*, 1989; Totterdill, Dhondt and Milsome, 2002), management innovation (Birkinshaw and Mol, 2006; Hamel, 2006), institutional innovation, and, sustainable development and eco-innovation (Kemp, Soete and Weehuizen, 2005). These new areas sometimes fit the old industrial innovation paradigm, but more often they raise new analytical challenges. New ways of carrying out research outside the industrial research laboratory, sometimes in collaboration with others, have started to emerge. Totally new forms of innovation without traditional research are becoming commonplace; 'open' innovation is being pursued by some (but not all) firms, involving much greater participation by users (Chesbrough, 2003; Prahalad and Ramaswamy, 2004; Von Hippel, 2005).

Moreover, non-technological innovation, often referred to as management innovation, is playing an increasingly important role in helping us to better understanding innovation and its impact on competitiveness of enterprises and countries. Management innovations can involve changing organizational form, applying new management practices and developing human talent with the effect of

leveraging the firm's knowledge base and improving organizational performance (Volberda and Van den Bosch, 2005; Volberda, Van den Bosch and Jansen, 2006).

2.3 The new paradigm of innovation research: various modes of non-technological innovation

What all of this suggests is that innovation as a research topic seems to be particularly prone to new innovative approaches. Hence, there is a need for a better conceptualization of the various notions of innovation. Scholars have produced a vast amount of research that addresses different types of innovation, predominantly technological. In this way, research has centred upon issues such as radical and incremental innovation (Dewar and Dutton, 1986; Ettlie, Bridges, and O'Keefe, 1984) and product and process innovation (Utterback and Abernathy, 1975). In spite of the undeniable importance of technological innovation, which has been prominent in academic literature and also contributed over the years to –amongst other things – the development of more advanced products, components, and production technology, other types of innovation have successfully been introduced outside the domain of technology.

As firms are faced with increased competition and an accelerating pace of technological change, they need to consider non-technological innovation that is more difficult to replicate (Teece, 2007) and may contribute to a longer lasting competitive advantage. These non-technological forms of innovations have been referred to as administrative innovation, organizational innovation, and management innovation. These concepts have a significant overlap and are used to discriminate from technological process innovations, and from product and service innovations (Damanpour and Aravind, 2012). However, despite their overlap, administrative innovation, organizational innovation, and management innovation are not identical. Administrative innovation has a narrower focus than organizational innovation, for example (Vaccaro, 2010). In comparison with management innovation, administrative innovation is typically associated with a narrower range of innovations around resource allocation, organizational structure and human resource policies (Evan, 1966), and excludes operations and marketing management (Birkinshaw *et al.*, 2008). The concept of management innovation is more encompassing as it refers to alterations in the way the work of management is performed (Hamel, 2006). Furthermore, organizational innovation has often been used in broader terms to span changes that

are either technological or administrative (e.g., Daft, 1978; Damanpour, 1991; Kimberly and Evanisko, 1981). In their review, Crossan and Apaydin (2010) defined organizational innovation in relatively broad terms by including any innovative activity of a firm. This definition however does not capture the managers' role as central actor within an organization or changes to how their work is performed (Birkinshaw *et al.*, 2008).

2.4 Management innovation research

Whereas technological innovation is concerned with the introduction of changes in technology relating to a firm's main activities (Daft and Becker, 1978), management innovation reflects changes in the way management work is done, involving a departure from traditional practices (i.e. "what managers do as part of their job on a day-to-day basis"); in processes (i.e. the routines that turn ideas into actionable tools; in structure (i.e. the way in which responsibility is allocated); and in techniques (i.e. the procedures used to accomplish a specific task or goal) (Birkinshaw *et al.*, 2008; Hamel, 2006, 2007; Vaccaro, 2010, p. 3). In relation to this, Birkinshaw and Mol (2006) propose that management innovation tends to emerge through necessity, as opposed to technological innovations that may first be developed in a laboratory and for which an application may subsequently be found. Further, due to its nature, management innovation is likely to constitute a rather diffuse and difficult-to-replicate attribute for any firm who successfully develops one (Birkinshaw and Goddard, 2009). Table 2.1 provides several definitions of management innovation. Birkinshaw *et al.* (2008, p. 829) define management innovation as "The generation and implementation of a new management practice, process, structure, or technique that is new to the state of the art and is intended to further organizational goals". Regarding the novelty of management innovation, 'new' can be entirely new to the world or new to the firm (Birkinshaw *et al.*, 2008).

Management innovation covers changes in the 'how and what' of what managers do in setting directions, making decisions, coordinating activities and motivating people (Birkinshaw, 2010; Hamel, 2006; Van den Bosch, 2012). These changes reveal themselves by new managerial practices, structures, and processes (Vaccaro, 2010) and they are context-specific (Mol and Birkinshaw, 2009), hard to replicate and ambiguous, making them an important source of competitive advantage (Birkinshaw and Mol, 2006; Damanpour and Aravind, 2012; Hamel, 2006). Although

a firm may build on the management innovations of other firms, its success is also determined by how those management innovations are adapted to the unique context of the organization (Ansari, Fiss and Zajac, 2010).

Table 2.1: Definitions of management innovation.

Authors:	Definition:
Mol and Birkinshaw (2009, p. 1269)	"The introduction of management practices that are new to the firm and intended to enhance firm performance."
Birkinshaw *et al.* (2008, p. 829)	"The generation and implementation of a management practice, process, structure, or technique that is new to the state of the art and is intended to further organizational goals."
Hamel (2006, p. 4)	"A marked departure from traditional management principles, processes, and practices or a departure from customary organizational forms that significantly alters the way the work of management is performed."
Kimberly (1981, p. 86)	"…any program, product or technique which represents a significant departure from the state of the art of management at the time it first appears and which affects the nature, location, quality, or quantity of information that is available in the decision-making process."

Classic types of management innovation are Ford's moving assembly line (Chandler, 1977) and the multidivisional structure of DuPont and General Motors (Chandler, 1962). More recent types of management innovation include Total Quality Management programmes (e.g., Zbaracki, 1998), ISO certifications (e.g., Benner and Tushman, 2002) and self-managed teams (e.g., Hamel, 2011; Vaccaro *et al*., 2012b). While change is a requirement for innovation, in itself it does not represent a management innovation (West and Farr, 1990). For example, downsizing may convey change to a firm, but cannot be regarded as management innovation if the managerial work itself continues unchanged (Vacarro, 2010). Genuine management innovation must involve substantial changes in how the organization is managed, reflected in the introduction of new practices, processes, structures and techniques.

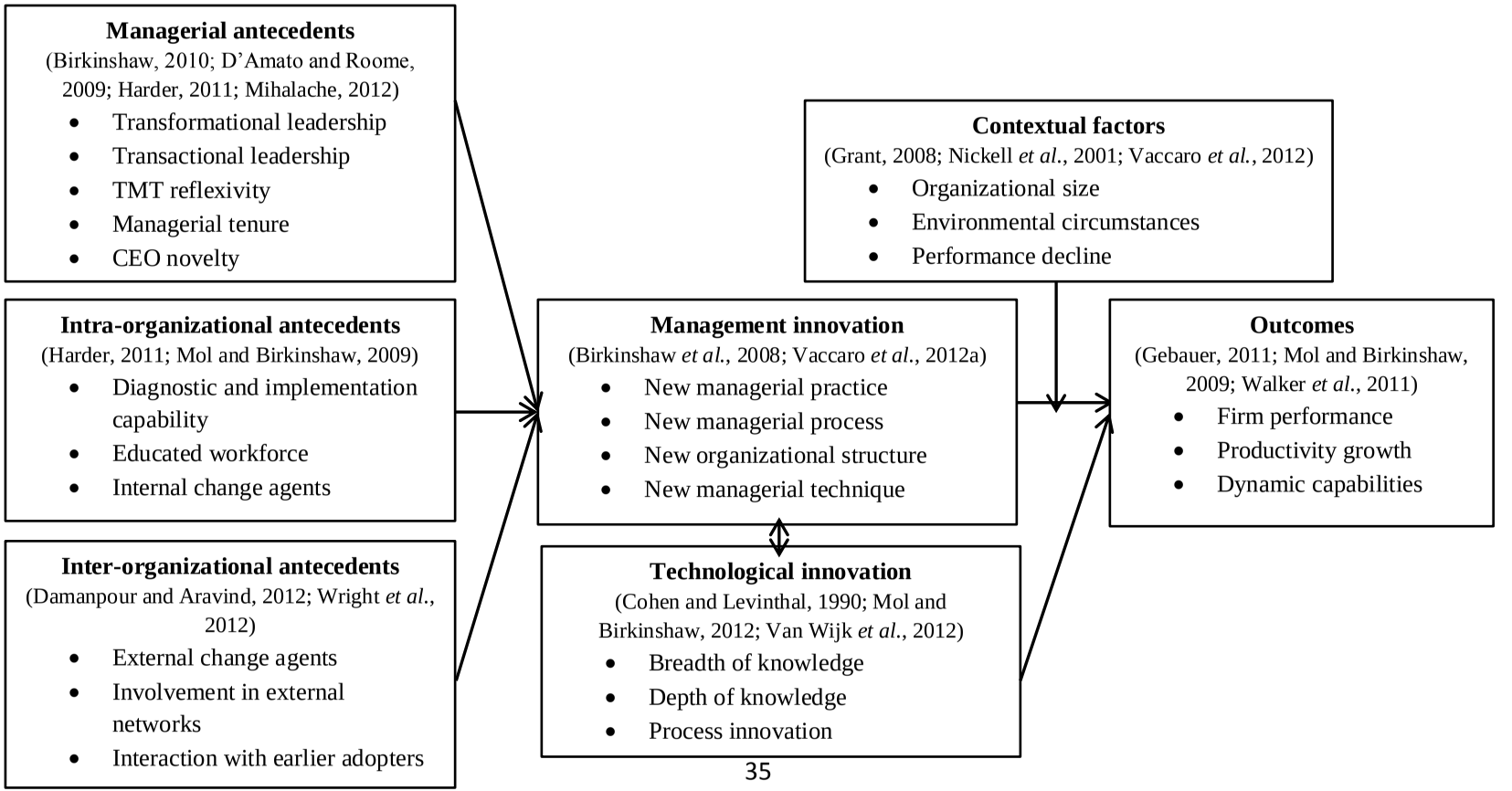
Management innovation usually has the purpose of increasing the effectiveness and efficiency of internal organizational processes (e.g., Adams, John, Phelps, 2006; Birkinshaw *et al.*, 2008; Walker, Damanpour, Devece, 2011). Consequently, management innovation increases the productivity and competitiveness of firms (Hamel, 2006) and enables economic growth (Teece, 1980). Nonetheless,

developing a management innovation is complex (Vaccaro, 2010) and involves internal and external change agents (Birkinshaw *et al.*, 2008). Internal change agents include a firm's managers and employees who are involved in the management innovation. External change agents can be consultants, academics or other external actors who influence the adoption of a management innovation (Birkinshaw *et al.*, 2008; Vaccaro, 2010). They initiate and drive the process (Birkinshaw *et al.*, 2008), and the typically intangible, tacit and complex management innovations emerge without a dedicated infrastructure (Vaccaro *et al.*, 2012a).

2.5 An integrative framework of management innovation

Innovation is a highly diverse field, as is evident in the multitude of theoretical perspectives and empirical constructs that have been brought to bear on the topic. To facilitate the accumulation of scientific knowledge of management innovation, we provide an integral framework that highlights the main antecedents and outcomes of management innovation (see Figure 2.1). The framework identifies common areas of research in terms of *antecedents* of management innovation (managerial, intra-organizational, and inter-organizational); *dimensions of management innovation* (new practices, processes, structures and techniques); *outcomes of management innovation* in terms of various dimensions of performance (e.g., firm performance, productivity growth, quality of work, group satisfaction); and *contextual factors* that affect management innovation (such as organizational size and competitiveness of the industry).

Figure 2.1: Integrative framework of management innovation.



The framework is used to identify where research findings about management innovation converge in this relatively new field and where gaps in our understanding exist. Below we discuss the building blocks and outcomes of management innovation as well as the contextual factors that affect it.

Managerial antecedents of management innovation.

Several scholars have investigated leadership variables (e.g., Birkinshaw, 2010; Vaccaro *et al.*, 2012a), Chief Executive Officer (CEO) and Top Management Team (TMT) demographics (such as CEO novelty, Harder, 2011, TMT reflexivity, Mihalache, 2012), and management characteristics (such as managerial tenure and managerial education, e.g., Damanpour and Schneider, 2006; Kimberly and Evanisko, 1981), and their effect on management innovation. Vaccaro *et al.* (2012a) showed in a large-sample study as well as in an in-depth case study of DSM Anti-Infectives (Vaccaro *et al.*, 2012b) that employing both transformational as well as transactional leadership behaviours enable a firm to pursue management innovation by permitting management to emphasize the realization of results while also encouraging experimentation with new management practices, processes, and structures. Transformational leaders inspiring team success and developing credible and courteous relationships based on shared goals enable the pursuit of changes in firms' management practices, processes and structures. Transactional leadership, on the other hand, can be useful in implementing management innovations by stimulating organizational members in their endeavour of meeting objectives by means of trusted management methods, and by setting objectives and rewarding a firm's members depending on their achievement of goals related to management innovations.

Intra-organizational antecedents of management innovation.

Others scholars have chosen to focus more on the micro-foundations of management innovation such as learning routines, resource allocation mechanisms and incentive systems in the organization. The paper by Khanagha *et al.* (2013) in this special issue shows that these micro-foundations are essential for realizing management innovations; we can see this in terms of new structural forms that facilitated the adoption of cloud computing. Moreover, a critical mass of internal change agents (Vaccarro *et al.* 2012b) and an educated workforce (Mol and Birkinshaw, 2009), are both essential for realizing management innovations. Following Birkinshaw *et al.* (2008), we propose that internal change agents play a

particularly relevant role as they are the individuals championing the introduction of management innovation in order to make organizations more effective. In a longitudinal study of the adoption of self-managing teams at the DSM Anti-Infectives plant (Vaccaro *et al.*, 2012b), internal change agents at different hierarchical levels contributed to the pursuit of management innovation. While plant managers took care of a conducive setting, front-line personnel and their managers were key change agents who implemented and operated with the new practices, processes, and structures at the operational level.

Inter-organizational antecedents of management innovation.

The pursuit of management innovation is also influenced by external change agents as new practices, processes or structures are often shaped by third parties such as consultants and academics (Birkinshaw *et al.*, 2008). In particular, consultants are seen by many as key agents in getting new management ideas and practices adopted within organizations (Sturdy, Clark, Fincham and Handley, 2009). Gaining knowledge from external sources and learning from partners are critical inter-organizational antecedents of management innovation (Damanpour and Aravind, 2012; Hollen *et al.*, 2013; Volberda, Foss and Lyles, 2010). Also, social embeddedness, network position, and other factors influence the absorption of new management innovations outside the firm or even outside the industry. The study by Hollen *et al.* (2013) in this special issue shows how management innovations of established process-manufacturing firms are triggered by the use of shared external test facilities. This intra-organizational context facilitated these firms to develop new-to-the-firm management activities to foster technological process innovation, namely setting objectives, motivating employees, coordinating activities and decision-making.

Technological innovation.

Technological innovation can be defined at different levels (Damanpour, 1987). At a narrower level, technological innovation involves the generation and adoption of a new idea concerning physical equipment, techniques, tools, or systems which extend a firm's capabilities into operational processes and production systems (e.g., Damanpour, 1987; Damanpour *et al.*, 2009; Evan, 1966; Schön, 1967). However, a discovery which provides no economic value and which never spreads beyond those who came up with the initial idea remains an invention (Garcia and Calantone, 2002). At a broader level, technological innovation also involves new

products, services, and processes to produce and deliver them (Crossan and Apaydin, 2010; Mishra and Srinivasan, 2005; Van Wijk *et al.*, 2012; Volberda, Oshri and Mom, 2012). Consequently, at this level it can be defined as the generation and adoption of a new idea into operational processes, production systems, products and services.

Dimensions of management innovation.

Mol and Birkinshaw (2009) distinguished several dimensions of management innovation. *Management practices* refer to "what managers do as part of their job on a day-to-day basis and include setting objectives and associated procedures, arranging tasks and functions, developing talent, and meeting various demands from stakeholders" (Birkinshaw *et al.*, 2008; Mol and Birkinshaw, 2009; Vaccaro, 2010, p. 3). For instance, Procter & Gamble's introduction of self-managing teams involved changing their managers' work in which employees got responsibility on setting their objectives and on making decisions about how and when tasks are accomplished (Vaccaro *et al.*, 2012a; Waterman, 1994). *Management processes* involve routines on governing managers' work to turn abstract ideas into tools. These routines contain performance assessment, strategic planning, and project management (Birkinshaw *et al.*, 2008; Hamel, 2007). For example, Procter & Gamble's introduction of self-managed teams involved new promotion and reward systems: skill levels - evaluated by associated team members - were a fundamental determinant of wages and promotion (Vaccaro *et al.*, 2012a). *Organizational structure* related to how an organization aligns efforts of its members and how it arranges its communication (Birkinshaw *et al.*, 2008; Hamel, 2007; Volberda, 1996). At the introduction of self-managed teams at Procter & Gamble, the organizational structure was changed by removing hierarchical layers. A *management technique* involves a tool, approach, or technique which is adopted in a business framework (Waddell and Mallen, 2001). One such new management technique is the balanced score card (Birkinshaw *et al.*, 2008).

Contextual factors that affect management innovation.

Several internal and external contextual variables trigger management innovation. For instance, larger firms have been shown to be more resourceful than smaller ones, but their need to introduce new management innovations is also greater (Kimberly and Evanisko, 1981; Mol and Birkinshaw, 2009). Moreover, work by Vaccaro *et al.* (2012a) showed that the effect of transformational leadership on management innovation increases with size. Apparently, transformational leadership

has little effect on the pursuit of management innovations in small firms. On the other hand, the study showed that transactional leadership affects management innovation mainly in small organizations. Challenging economic conditions also trigger management innovation, but may also constrain the number of options a firm has to respond because of limited resources (Nickell, Nicolitsas, Patterson, 2001). The need to adapt to changing environmental conditions is often what provides the spur to successful management innovation (Grant, 2008). For instance, scarcity of materials triggered the development of Toyota's lean management system (Grant, 2008). The study by Hecker and Ganter (2013) in this special issue shows how the level of product market competition affects technological as well as management innovation. They provide a contingency perspective on various types of innovation and find that, in management innovation, the intensity of competition has a positive effect on the firm's propensity to adopt workplace and knowledge management innovation.

Outcomes of management innovation.

Management innovation has a positive effect on the development of dynamic capabilities (Gebauer, 2011), on productivity growth (Mol and Birkinshaw, 2009), and on firm performance (Walker *et al.*, 2011). It is mainly related with the effectiveness and efficiency of internal organizational processes (e.g., Adams *et al.*, 2006; Birkinshaw *et al.*, 2008; Walker *et al.*, 2011). The hard performance outcomes typically used to measure management innovation include profitability, productivity, growth and (sustainable) competitive advantage. However, management innovation does not only result in the achievement of 'hard' goals, but also softer targets (Birkinshaw *et al.*, 2008). For instance, management innovation can decrease employee turnover (Hamel, 2011; Kossek, 1987), increase customer satisfaction (Linderman, Schroeder, Zaheer, Liedtke, Choo, 2004), and increase the satisfaction and motivation of other stakeholders, such as employees (e.g., Mele and Colurcio, 2006). It can also influence a firm's environmental impact (e.g., Martin, Muûls, Preux, Wagner, 2012; Theyel, 2000).

In the remainder of this paper, we further discuss the emerging themes of management innovation derived from our framework, address the performance implications, and raise some major issues for further research. Subsequently, we position the papers included in this special issue and explain how they address several issues of our research agenda. In the concluding section, we set some research priorities to further advance the field of management innovation.

2.6 Emerging research themes of management innovation

The framework of Figure 2.1 also points to emerging themes that are as yet under-researched. For instance, the multidirectional causalities between management innovation and technological innovation and the differential effects on performance are a source of much debate in the innovation field.

Debate 1: The relationship between management innovation and technological innovation.

Much research needs to be done to examine the relationship between these two forms of innovation. Although it has been argued that management innovation is often an antecedent of technological innovation (Mol and Birkinshaw, 2012), considerably more research is needed to examine how management innovation is related to technological innovation. Several papers in this special issue address this question. The socio-technical perspective implies that changes in the technical system should be matched with changes in the socio-system, i.e. management activities, of a firm to optimize its outcome (e.g., Damanpour and Evan, 1984). The paper by Hecker and Ganter (2013) in this special issue suggests that management innovation and new technological knowledge are positively related to each other. The paper by Hollen *et al.* (2013) provides an overview of three different perspectives on the relationship between management innovation and technological innovation: that technological innovation mainly precedes the achievement of management innovation, or vice versa, or that both types of innovation are mutually interdependent and are thus intertwined over time. Mol and Birkinshaw (2012) argued that management innovation often leads to technological innovation. However, other scholars (Heij, Volberda, Van Den Bosch, 2013) argued that management innovation and new technological knowledge have a J-shaped interaction effect on innovation success. Where there are low levels of management innovation, adjustments in management practices, processes, structures and techniques are not adequately aligned with, new technological knowledge in ways that enable the firm to achieve innovation success. Higher levels of management innovation show how better adjustment can lead to much greater innovation success (Heij *et al.*, 2013). Consequently, innovation processes are complex (Daft, 1978) and future research is needed to further uncover the relationship between management innovation and technological innovation.

Debate 2: The performance effects of management innovation versus technological innovation.

There is much ambiguity about the differential effects of management innovation versus technological innovation. The aim of future research should be to conduct a systematic investigation and development of the various ways in which management innovation and its leverage of technological innovation can be enhanced within a firm, between firms through open innovation networks, and during interaction with institutional stakeholders, as well as through better measurement and monitoring in general. In comparison to technological innovations - measured by deployment of budgets, numbers of scientists involved, numbers of patents or simply by R&D expenses as percentage of turnover - management innovations in terms of outstanding managerial capabilities, management practices (Bloom and Van Reenen, 2007) and organizing principles of innovation are more difficult to assess and quantify.

Despite the increasing awareness of the importance of management innovation for competitiveness, the empirical basis for measuring management innovation is still patchy and weak (cf. Armbruster, 2006). This is an important issue to address. The findings of the Erasmus Innovation Monitor covering the years 2006 to 2010 (Volberda *et al*., 2010) indicate that the attributes of management innovation are of great importance and explain about 50-75% of the variation in innovation performance between Dutch firms. Furthermore, in controlled experiments on management innovations in firms, TNO - a Dutch institute for applied research – reported productivity increases of firms that implemented management innovations (such as lean, self-managing teams) of up to 16% and a substantial reduction of throughput times (cf. Totterdill *et al.*, 2002). Moreover, Vaccaro *et al.* (2012b) show how the adoption of self-managing teams within DSM Anti-Infectives resulted in increased productivity (12%), improvements in process technology, savings in maintenance and operation, lower costs and better accomplishment of targets. But soft performance variables such as the increase in participatory behaviour in social processes, higher health standards, environmental upgrading, and even happiness, are also important outcomes of management innovation. For instance, putting in place new practices, processes and structures involving self-managing teams within DSM Ant-Infectives resulted in a greater sense of mission, more trust, improved interaction between different constituencies, more exchange of knowledge and a highly motivated and engaged workforce.

2.7 Future research agenda and positioning of the papers

In this special issue, we want to stimulate academic inquiry by providing a platform for sharing ideas and state-of-the art research on management innovation. On the basis of the integrative framework of management innovation and the emerging research themes which we derived from it, we developed a 'research agenda for future research in management innovation' (see Box A). In particular, we formulated a list of future research issues for which we have drawn on the conceptual contributions in the innovation literature, the multilevel antecedents of management innovation (managerial, intra-organizational, and inter-organizational), the consequences of management innovation, and the methodological approaches in management innovation research.

At a EURAM Mini-Conference on Management Innovation at the Rotterdam School of Management, more than 40 empirical, conceptual, and practitioner-oriented papers from a plurality of theoretical perspectives, units of analyses, contexts, and research designs were presented. In this special issue, we selected those papers that deepen our understanding of management innovation in several ways and provide answers to various future research issues (see Box B).

Hecker and Ganter (2013) examine in their paper how external contextual factors – product market competition and rapid technological change – are related to management innovation and technological innovation. The authors find that product market competition has an inverted U-shaped relationship with a firm's preference for introducing technological innovation, and has a positive relationship with management innovation. Furthermore, they provide new insights into how management innovation is associated with rapid technological change. The authors underline that the relationship between innovation and competition should include a contingency perspective.

Box A: Management innovation: future research issues.

- *Conceptualization of management innovation*:
  - What are the levels of analysis at which management innovation should be considered?
  - How to define management innovation on the basis of generic, context-neutral management activities?
  - How to define management innovation: as an encompassing construct (e.g. incorporating organizational innovation) and/or differentiation in several management innovation types?
  - Comparing different ways of defining management innovation and assessing their contribution to our understanding of management innovation?
  - How to conceptualize management innovation as an outcome vs. as a process?
  - How to define the degree of newness of management innovation?
- *Managerial antecedents of management innovation*:
  - Who are the actors that drive management innovation?
  - What is the role of top/middle/line managers in management innovation?
  - Is the generation of management innovation a top-down and/or a bottom-up process?
- *Intra-organizational antecedents of management innovation:*
  - What is the role of internal change agents?
  - What are the organizational conditions that stimulate the introduction of management innovations?
- *Inter-organizational antecedents of management innovation:*
  - What is the role of external change agents?
  - How does management innovation emerge in inter-organizational relations?
  - Which factors trigger management innovation in an inter-organizational context?
  - How to develop conceptual frameworks of management innovation focusing on the dynamics of co-evolutionary interactions at both firm and industry level?
- *Relationships between management innovation and technological innovation:*
  - How to conceptualize different causal relationships between management innovation and technological innovation?
  - How are management innovation and technological innovation related to each other over time and which conditions influence their relationship?
  - To what extent do complementarities exist between management innovation and technological innovation and how do these complementarities impact performance?
- *Consequences of management innovation*:
  - What are the implications of management innovation for firm performance in different environmental conditions?
  - To what extent does management innovation contribute to sustainable competitive advantage?
  - For what outcomes other than financial performance may management innovation be important?

(Table continues on the next page.)

- *Methodological approaches in management innovation research*:
  - How to measure management innovation?
  - How to develop appropriate scales for measuring management innovation?
  - How to obtain objective measures of management innovation?
  - How do conceptual frameworks, simulation and laboratory research, in-depth case studies, longitudinal case studies and international comparative survey research increase our understanding of management innovation?

The conceptual paper by Hollen *et al.* (2013) uses an inter-organizational perspective to examine how different new-to-the-firm management activities are required for performing technological process development in an external test facility, thereby enabling the firm to achieve technological process innovation. The authors argue that making use of this inter-organizational context and the associated required management innovation allow a firm to overcome intra-organizational tensions and so to reconcile competing pressures for exploration of new and exploitation of existing process technologies. One of the authors' conclusions is that an inter-organizational level of analysis broadens the group of external change agents that may influence management innovation.

The paper by Khanagha *et al.* (2013) examines how management innovation is related to the adoption of an emerging core technology. The authors argue that relatively few scholars have examined how management innovation is related to an incumbent's success in adopting an emerging technology. By studying the adoption of cloud computing in a large multinational telecommunication firm, the authors find that management innovation is required in order to accumulate knowledge of emerging technologies in a dynamic environment. They highlight how a novel structural approach enables a firm to overcome inertia and to adopt an emerging core technology.

These three papers can easily be plotted into our integrative framework of management innovation (see Figure 2.2).

The paper by Hollen *et al.* (2013) is mainly conceptual and takes both a firm and an inter-organizational perspective by examining how new-to-the-firm management activities enable technological process development in an inter-organizational context of an external test facility, leading to eventual technological process innovation within the firm. The paper provides new insights as to how

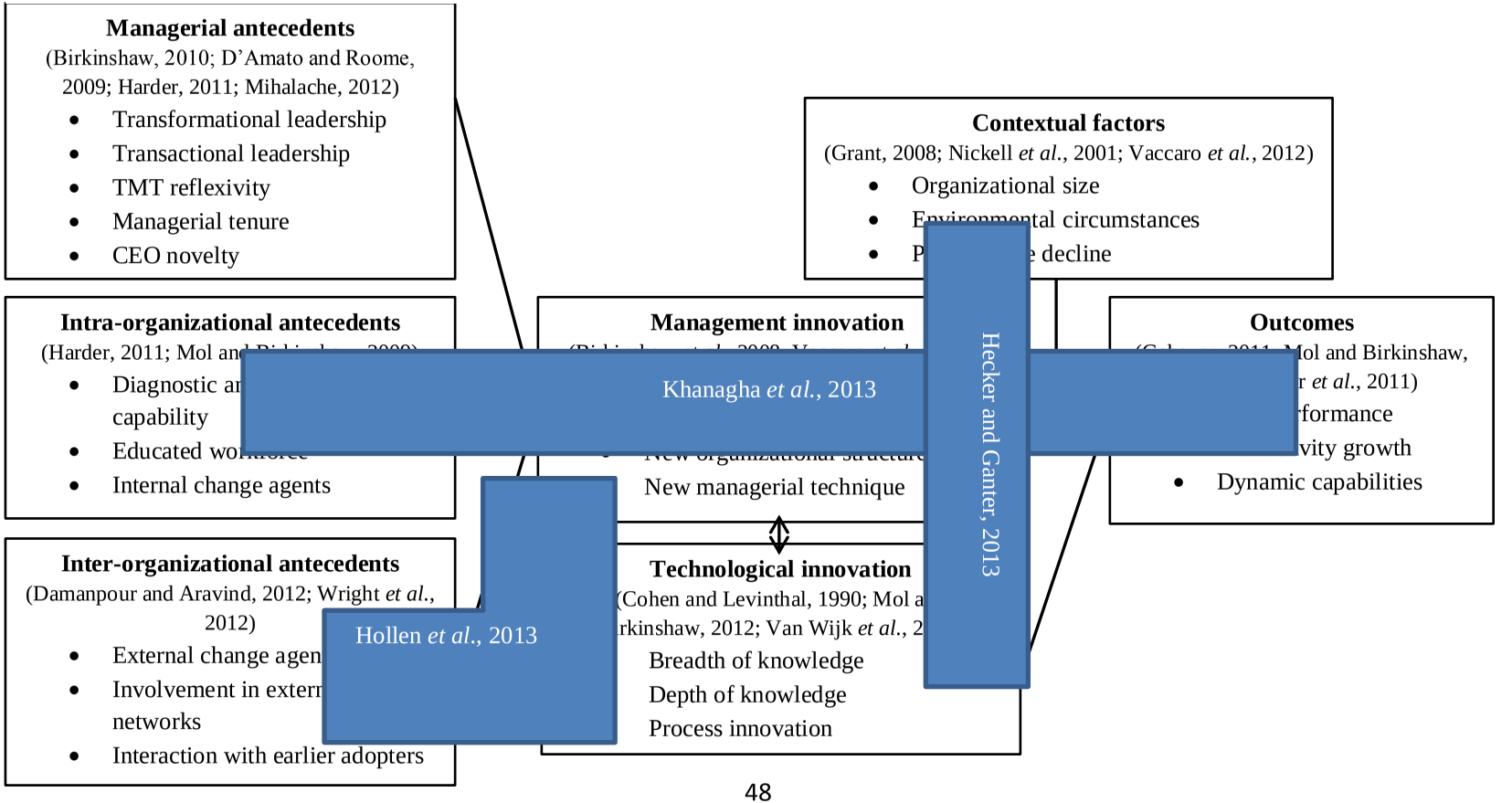
management innovation enables technological process innovation. By contrast, in their paper Khanagha *et al.* (2013) examine how management innovation enables technological innovation. They find that adaptation in the structure is a precursor of technology adoption. The paper by Hecker and Ganter (2013) complements these two papers. Using German data of the Community Innovation Survey (CIS), the authors examine how technological dynamic markets are associated with management innovation. They also provide new insights how the degree of product market competition influences technological innovation and management innovation. However, in contrast to Hollen *et al.* (2013) and Khanagha *et al.* (2013), these authors do not elaborate on the sequence of management innovation versus technological innovation, but do provide further insights in the significantly different determinants of technological and management innovation.

Box B: Contribution of the three papers regarding future research issues in the management innovation field.

Future research issue	**Hecker and Ganter**	**Hollen *et al.***	**Khanagha *et al.***
Conceptualization of management innovation	Based on empirical definition of organizational innovation and of various types of management innovation (OECD/EURSTAT).	Based on four conceptually separate and context-neutral sets of manage-ment activities (Birkinshaw, 2010).	New to the firm structures, practices and processes.
Managerial antecedents of management innovation	(-)	Management innovation is driven both top-down (key role of higher management) and bottom-up (key role of project leaders in external test facilities).	Learning routines of managers.
Intra-organizational antecedents of management innovation	R&D intensity; share of employees with a degree.	Management innovation is triggered by intra-organizational tensions to reconcile pressures for exploration and exploitation across subsequent phases of technological process innovation.	Routines and capabilities, resources and complementary assets, and incentive structures.
Inter-organizational antecedents and contextual factors of management innovation	Various, e.g. speed of technological change; intensity of competition; product homogeneity.	Management innovation is triggered by the inter-organizational context in the form of external test facilities available to firms for enabling technological process innovation.	Interaction of Technology Intelligence experts with outside partners such as Google, IBM, Intel and universities.

Relationships between management innovation and technological innovation	Relationship between intensity of competition and firm innovation types (i.e., technological innovation and three types of management innovation).	Three perspectives, with main focus on the perspective that both types of innovation are combined over time in an intertwined way.	Management innovation proceeds technological innovation: adaptation in structure is as precursor of technology adoption.
Consequences of management innovation	(-)	Difficult to imitate by competitors due to embeddedness in the context of inter-organizational relationships.	Adoption of an emerging core technology.
Methodological approaches in management innovation research	Quantitative analysis of public survey data (in Germany).	Development of a conceptual framework and propositions regarding the role of management innovation in enabling technological process innovation.	In-depth case study of a global telecommunication firm: semi-structured interviews, focus group sessions, and field study observations.

Figure 2.2: Integrative framework of management innovation.



2.8 Priorities in management innovation research

How should we continue our journey into management innovation research and focus on management as a fertile ground for innovation? Although research into management innovation has gained momentum over recent years, among all different subsets of innovation it is still relatively under-researched (Crossan and Apaydin, 2010). Considering our research agenda as described in Box A and the contributions of the papers as described in Box B, we therefore have to set priorities (see Box C).

Box C: Priorities in management innovation research.

- Conceptualizing and defining management innovation in complementary ways.
- Investigating complementarities between management innovation and technological innovation and the impact on performance.
- Pluralism in research methods including;
  - Developing conceptual frameworks regarding management innovation;
  - Management innovation laboratory research;
  - Longitudinal and in-depth case study research;
  - Comparative large-scale cross-country survey research among firms.
- Effects on exploratory innovation.
- Generic vs. firm-specific management innovations.

As emphasized before, the progress of research in management innovation and the accumulation of knowledge will depend on how management innovation is conceptualized and defined. While definitions can illuminate, too much variety can also hamper progress. Striking a balance therefore becomes imperative. We suggest, therefore, that with management innovation research currently in an embryonic stage of development, it is important to have some degree of variety in definition, though these definitions need to complement one another. The definitions of management innovation used by Hollen *et al.* (2013) and Hecker and Ganter (2013) illustrate this point: the first is based on a generic conceptual definition of management activities (Birkinshaw, 2010), while the latter provides three empirically-related sub-types of management innovation: workplace organization, knowledge-management, and external relations. In a similar way, Volberda *et al.* (2006) distinguished management innovation into new organizational forms, dynamic managerial capabilities, new ways of working, and co-creation. These theories and empirically-driven conceptualizations

address management innovation from different perspectives and may usefully complement each other.

The second priority is the need to understand how management innovation and technological innovation are related, taking a complementary perspective (Milgrom and Roberts, 1995). As discussed above, at present three perspectives could be discerned regarding the relationship between management innovation and technological innovation: management innovation preceding technological innovation, technological innovation preceding management innovation, and a third one, namely dual interactions between management innovation and technological innovation over time. In all three perspectives, management innovation and technological innovation are in a sense complementary. While technological innovations are developed within organizational boundaries (whether within the firm itself or within an external laboratory), management innovations seem to emerge through interactions with the outside world or, as Birkinshaw and Mol (2006, p. 82) observe, "on the fringes of the organization rather than the core". It is important to increase our understanding of the nature and temporal processes of complementarity in each perspective and of the subsequent impact on performance. A more co-evolutionary approach to studying the development and introduction of management innovation versus technological innovation over time, one which involves different levels of analysis and also takes into account institutional and environmental changes as well as the intentions of management, could be very promising (Huygens, Baden-Fuller, Van Den Bosch, Volberda, 2001; Volberda and Lewin, 2003).

Our third priority should be to examine the usefulness of pluralism in research methods as a means to increase up the contributions of management innovation research to establish a more coherent body of knowledge. Many articles on innovation are cross-sectional (Damanpour *et al.*, 2009) or focused on one type of innovation (Crossan and Apaydin, 2010). Future research should examine with a longitudinal research design how management innovation may complement other types of innovation. Longitudinal and in-depth case studies are important for unravelling causality issues, process dimensions and the role of power in implementing management innovation. Moreover, research on management innovation via simulations, laboratory research and participative field research will increase our understanding of complex management innovation processes involving several levels of analysis. Comparative research among firms using large-scale cross-country

surveys will reveal the impact on management innovation of factors such as the national institutional environment, but may also provide insights into how management innovation is diffused across countries, and what affects that process.

Over the last couple of years several such initiatives have been started in order to gain new knowledge on management innovation. These initiatives include the Management Innovation Lab (MLab) in London, the Management Innovation eXchange (MIX), and the Erasmus Competition and Innovation Monitor. In the MLab, academics, organizations, institutions and some other stakeholders work together to enable management innovation. The Erasmus Competition and Innovation Monitor, developed by INSCOPE, measures the level of management innovation of firms over time in the Netherlands. INSCOPE, a joint initiative by several universities and research institutes, aims to increase the fundamental understanding of management innovation and its influence on technological innovation, productivity and competitiveness of firms. In addition to the Erasmus Competition and Innovation Monitor, INSCOPE also conducts research on specific industry contexts, such as the Dutch care industry and the Port of Rotterdam. In collaboration with local partners, INSCOPE is also expanding its annual measurement of management innovation to cover other countries, such as Belgium, the UK, Germany and Italy. Such international measurements provide opportunities to detect differences between countries which can act as a foundation for increasing the competitiveness of firms or even certain industries or national economies as a whole.

The fourth priority concerns the effect of management innovation on exploration. Management innovation relates mainly to the effectiveness and efficiency of internal organizational processes (e.g., Adams *et al.*, 2006; Birkinshaw *et al.*, 2008; Walker *et al.*, 2011). However, few scholars have examined how management innovation contributes to exploratory innovation. To survive in the short term and in the longer run, firms need to invest sufficiently in exploration and exploitation (Levinthal and March, 1993; March, 1991) and process management practices may affect exploration (Benner and Tushman, 2002). For instance, Douglas and Judge Jr. (2001) argued that in firms with a more exploration-oriented structure, implementation of TQM practices is more strongly related to performance. Future research should examine how management innovation is related to exploratory innovation.

The fifth research priority is to examine the extent to which management innovations are generic or specific. The existing literature on management innovation is either conceptual (e.g., Benner and Tushman, 2003; Hamel, 2006) or operationalized as a specific type of management innovation, such as TQM or ISO certifications (e.g., Benner and Tushman, 2002). However, the operationalization of management innovation as a very specific type of management may raise certain concerns. For example, De Cock and Hipkin (1997) suggested that a specific management innovation has a rather short life expectancy, because managers quickly move beyond a specific management innovation to further improve organizational effectiveness. Additionally, the adoption and diffusion of management innovations are firm-specific, dependent on the context and do not generate uniform outcomes (Ansari *et al.*, 2010; Damanpour and Aravind, 2012; De Cock and Hipkin, 1997). Even within a certain management innovation, varying results can be obtained due to different practices that various firms implement (Benner and Tushman, 2002; Zbaracki, 1998). Furthermore, the distinction among specific management innovations can be rather vague and the underlying philosophies, tools and techniques of certain management innovations may have a large overlap (Currie, 1999; Parast, 2011). On the other hand, different types of management innovation may be interdependent (Currie, 1999) and firms that adopt particular innovations are more likely to adopt other, related management innovations (Lorente, Dewhurst, Dale, 1999). Future research should examine whether management innovation should be considered and measured as a generic construct or based on specific types of management innovation (Mol and Birkinshaw 2009; Van den Bosch, 2012; Vaccaro *et al.*, 2012a).

2.9 Conclusion

While innovation is surprisingly one of the most addressed topics in practitioner as well as academic outlets, most research has tended to address innovation as the development of new technology, products and services. As a consequence, technological innovation has dominated innovation research, with related notions such as product development, radical versus incremental innovation, as well as diffusion and adoption receiving most attention. However, falling trade-barriers, decreasing transaction costs, stagnating developed markets and overheating emerging markets are forcing firms to look for other areas in which to innovate as a means of gaining and maintaining competitive advantage. This entails a search not

only for new products and new technologies but also for changes in the nature of management within the firm - that is, management innovation.

In this spirit, this introductory article has briefly reviewed progress in innovation research and claimed that management itself may be a fertile ground for innovation. We have provided a clear conceptualization of this phenomenon and developed an integrative framework to advance our understanding of the various antecedents and outcomes of management innovation, as well as the contextual factors that affect management innovation. Moreover, we have provided a future research agenda and selected what are, in our view, the most important research priorities for advancing knowledge in the management innovation domain. We hope that the insights shared in this special issue will stimulate additional scholarly conversation on important innovation research topics as well as on the crucial role of new modes of management.

CHAPTER 3. Study II: How to leverage the impact of R&D on radical product innovations? The moderating effect of management innovation *

* This study has been submitted to *Research Policy*. Earlier versions of this study were presented at the *European Academy of Management Mini-Conference on Management Innovation* 2011, Rotterdam, The Netherlands; at the *European Academy of Management Annual Conference* 2012, Rotterdam, The Netherlands; at the second *2nd Tilburg conference on Innovation* 2012, Oisterwijk, The Netherlands; at the *28th Colloquium of the European Group for Organization Studies* 2012, Helsinki, Finland; at the *Strategic Management Society Annual Conference* 2012, Prague, Czech Republic; and at the *29th Colloquium of the European Group for Organization Studies* 2013, Montreal, Canada.

CHAPTER 3. Study II: How to leverage the impact of R&D on radical product innovations? The moderating effect of management innovation

Abstract *Although management innovation is argued to be an important source of competitive advantage, questions about how it is related to technological innovation in terms of influencing a firm's outcomes are still largely unanswered. In this study, we address the gap in the literature on how management innovation moderates the inverted U-shaped effect of research and development (R&D) on radical product innovations. Our findings from a large-scale survey among firms across multiple industries in the Netherlands indicate that R&D has an inverted U-shaped effect on radical product innovations, in particular for firms with lower levels of management innovation. However, in firms with high levels of management innovation, this effect becomes J-shaped. These findings indicate that management innovation should be considered a key moderator in explaining firms' effectiveness in transforming R&D into successful radical product innovations.*

Keywords: innovation, R&D, technological innovation, management innovation, radical product innovation

3.1 Introduction to study II

Although management innovation, i.e. new-to-the-firm management practices, processes, structures, and techniques (cf. Birkinshaw, Hamel, Mol, 2008; Volberda, Van Den Bosch, Heij, 2013), is argued to be an important source of competitive advantage (e.g., Hamel, 2006; Walker, 2008), research on this topic "is still in its early stage" (Damanpour and Aravind, 2012, p. 446). Management innovation is not only under-researched compared to technological innovation (Crossan and Apaydin, 2010; Peris-Ortiz and Hervás-Oliver, 2014), but there has also been very little investigation of its relationship with technological innovation (Birkinshaw *et al.*, 2008; Hervas-Oliver and Sempere-Ripoll, 2015; Volberda, Van Den Bosch, Mihalache, 2014).

Various management scholars (e.g., Hollen, Van Den Bosch, Volberda, 2013; Markus and Robey, 1988; Mothe and Thi, 2010; Orlikowski, 1992) have speculated that there may be different relationships between technological innovation and

management innovation. Research and development (R&D), i.e. introduction of new technological knowledge (e.g., Barge-Gil and López, 2014; Markard and Truffer, 2008), is considered to be a prominent hallmark of technological innovation (e.g., Evangelista, Perani, Rapiti, Archibugi, 1997; Sagar and Van Der Zwaan, 2006; Volberda *et al*., 2013) and it was regarded as "a, perhaps the, principal indicator of subsequent sales growth performance" (Franko, 1989, p. 449). However, higher levels of R&D alone are no guarantee of firm success (e.g., Lin, Lee, Hung, 2006; Sirmon, Hitt, Ireland, Gilbert, 2011; Teece, 2010). Having examined the consequences of management innovation, management scientists (e.g., Damanpour and Evan, 1984; Damanpour, Walker, Avellaneda, 2009; Walker, Damanpour, Devece, 2011) focused particular attention on its impact on overall firm performance, either independently or when combined with technological innovation. Many questions still remain, however, about how these two types of innovation are related to each other in terms of influencing a firm's outcomes (e.g., Damanpour and Aravind, 2012; Peris-Ortiz and Hervás-Oliver, 2014). This paper focuses on two gaps.

First, in their attempt to explain the mixed findings from previous research on the impact of R&D on firm performance (e.g., DeCarolis and Deeds, 1999; Coombs and Bierly, 2006; Lin *et al*., 2006), various scholars have focused on an inverted U-shaped relationship between the two (e.g., Erden, Klang, Sydler, Von Krogh, 2014; Yeh, Chu, Sher, Chiu, 2010). Others (Artz, Norman, Hatfield, Cardinal, 2010; Cruz-Cázares, Bayona-Sáez, García-Marco, 2013; Zhou and Wu, 2010) have stressed that, to explain these mixed findings, it is fundamental to look first at variations in how efficient a firm is at turning innovation inputs such as R&D into innovation outputs such as product innovations, and to distinguish product innovations into radical and incremental ones. R&D is found to have a curvilinear (inverted U-shaped) effect on the number of new products and services, i.e. radical product innovations (Acs and Audretsch, 1988; Graves and Langowitz, 1993). Management innovation is associated with a firm's social system and despite claims that it is important to change both a firm's technological system and its social system in order to spur firm performance (e.g., Damanpour and Aravind, 2012; Damanpour *et al*., 2009; Trist, 1981), prior research has not taken sufficient account of how the inverted U-shaped effect of R&D on radical product innovations is contingent upon management innovation.

Second, Birkinshaw *et al.* (2008) have developed an encompassing definition of management innovation in which they distil key characteristics that differentiate it

from other types of innovation (e.g., Damanpour and Aravind, 2012). However, prior research has focused mainly on specific types of management innovation (Battista and Iona, 2009; Walker *et al.*, 2011) such as the introduction of self-managed teams (e.g., Hamel, 2011; Vaccaro, Van Den Bosch, Volberda, 2012b) or new human resource management practices (e.g., Ichniowski, Shaw, Prennushi, 1997; Laursen and Foss, 2003). The empirical settings of innovation studies are also mainly in manufacturing-oriented industries (Damanpour *et al*., 2009; Franko, 1989). There is limited large-scale empirical research on both R&D and management innovation that spans several industries and, in particular, that is based on the definition by Birkinshaw *et al.* (2008) to measure management innovation (Černe, Jaklič, Škerlavaj, 2013; Damanpour and Aravind, 2012; Walker *et al.*, 2011). This brings us to the following research question: *How does management innovation moderate the relationship between R&D and radical product innovations?*

By addressing this research question, we advance our understanding of how R&D interacts with management innovation in order to realize radical product innovations. First, we make a theoretical contribution to the innovation literature, and to the management innovation literature in particular, by examining how management innovation moderates the inverted U-shaped effect of R&D on radical product innovations. Prior research (e.g., Damanpour *et al.*, 2009; Hollen *et al*., 2013; Mothe and Thi, 2010) has examined how technological innovation may lead to management innovation, or vice versa, and how both types of innovation have a combined effect on firm performance. In contrast, this paper examines how the effect of different levels of R&D on radical product innovations is contingent upon management innovation.

Second, we make an empirical contribution by testing this relationship with a large-scale survey among 10,000 Dutch firms across multiple industries. This enabled us to test the inverted U-shaped effect of R&D on radical product innovations across a broad range of industries in the Netherlands. We contribute new empirical insights concerning the importance of management innovation (Volberda *et al*., 2013), and we address the lack of large-scale empirical research across multiple industries on the relationship between technological innovation and management innovation with "more fine-grained measurement of management innovation" based on the definition of Birkinshaw *et al.* (2008) (e.g., Bloom, Sadun, Van Reenen, 2010; Damanpour, 2014, p. 1279; Volberda *et al*., 2014). Our findings show that R&D does indeed have an inverted U-shaped effect on radical product innovations. However, they also indicate

that where there are high levels of management innovation, this effect becomes J-shaped.

In the next section, we will review existing literature and develop hypotheses on the relationship between R&D and radical product innovations, including the contingent role of management innovation. Subsequently, we present our research method and analyses. Finally, we present our main empirical findings and discuss the major implications, the limitations of our study and suggestions for future research.

3.2 Literature review and hypotheses

R&D is about the introduction of new technological knowledge on how to do things different or better with regard to a firm's production system or operational processes, or its products and services (Barge-Gil and López, 2014; Betz, 2011; Chesbrough, Di Minin, Piccaluga, 2013; Teece, 1986). New technological knowledge acts as a new input aimed to achieve a new output (Battisti and Iona, 2009; Garcia and Calantone, 2002; Cruz-Cázares *et al*., 2013) and to convert input, such as raw materials or information, into output in new and better ways (Crossan and Apaydin, 2010; Daft, 1978; Emery, 1959).

New technological knowledge is not identical to product or service innovation, but acts as an input for it (e.g., Ahuja, Lampert, Tandon, 2008; Cruz-Cázares *et al.*, 2013; Danneels, 2002). For instance, the light bulb was introduced as a result of the emergence of a new knowledge base, i.e. knowledge of electricity, at a time when the dominant knowledge base revolved around the use of gas to generate light (Hill and Rothaermel, 2003). Radical product innovations are realized new products or services which incorporate new knowledge that goes beyond a firm's existing knowledge base and which are aimed at new markets or customers (Benner and Tushman, 2002, 2003; Danneels, 2002). This type of innovation is typically associated with distant search, experimentation, risk-taking, and variation (e.g., Benner and Tushman, 2002; Jansen, Van Den Bosch, Volberda, 2006; March, 1991).

In order to capture the benefits to be derived from new technological knowledge, the new knowledge needs to be integrated into a firm's existing knowledge base (e.g., Nerkar and Roberts, 2004; Pavitt, 2005; Zhou and Li, 2012) and utilized (e.g., Zahra and George, 2002; Zhou and Wu, 2010). Integrating new technological knowledge enables a firm to internalize what it has learned and alters its

Table 3.1: Empirical studies which have found an inverted U-shaped effect of the amount of generated technological knowledge on firm performance (1988–2014).

Study	Indicator of new technological knowledge	Operationalization of indicator	Is role of management innovation taken into account?	Dependent variable	Empirical setting
Acs and Audretsch (1988)	R&D expenditure	R&D expenditure (in U.S. $)	No	Number of new product, service or process innovations introduced in the market	Various U.S. manufacturing and service-oriented industries
Graves and Langowitz (1993)	R&D expenditure	R&D expenditure (in U.S. $)	No	Number of product introductions	Pharmaceutical industry
Ahuja and Lampert (2001)	Exploration of novel and emerging technologies	Patent citations	No	Breakthrough inventions (number of patents)	Chemicals industry
Katila and Ahuja (2002)	Search depth and search scope	Patent citations	No	Number of new products	Industrial robotic companies
Huang and Liu (2005)	R&D intensity	R&D expenditure (as % of net sales revenue)	No	Firm performance	Large Taiwanese companies
Leten, Belderbos, and Van Looy (2007)	Technological diversification	Number of patents in different technology classes	No	Technological performance (number of patent applications)	Various high-technology industries (e.g., pharmaceuticals and biotechnology, IT hardware)

Study II

Wu and Shanley (2009)	Exploration of new knowledge elements	Patent citations	No	Innovation performance (number of patents)	U.S. public electronic device firms
Belderbos, Faems, Leten, Van Looy (2010)	Explorative technological activities	Relative number of patents in technology classes	No	Firm performance	Various high-technology industries (e.g., chemicals and electronic firms)
Chen and Chang (2010)	Patent citations	Number of patents	No	Corporate market value	U.S. pharmaceutical industry
Yeh *et al.* (2010)	R&D intensity	R&D expenditures (as % of sales)	No	Firm performance	Taiwanese electronic and information technology firms
Zhou and Wu (2010)	Technological capability	Perceptual scale with a strong correlation ($p < 0.01$) with R&D intensity (as % of sales)	No	Exploration	Chinese high-technology sectors (e.g., electronics, IT, telecommunications)
Bracker and Krishnan (2011)	R&D intensity	R&D expenditures (as % of sales)	No	Tobin's q (market value of a firm/book value of assets)	S&P-listed firms with market value over U.S. $25 million
Zhang *et al.* (2012)	Patent H index	Number of patent citations	No	Firm performance	Pharmaceutical industry
Erden *et al.* (2014)	R&D-intensity	R&D expenditures (in U.S. $)	No	Firm performance	Biopharmaceutical firms

knowledge base (Zahra, Ireland, Hitt, 2000); for instance, the process of integration may help a firm to connect up dispersed knowledge within the organization and enable it to make links between new and existing knowledge in new and valuable ways (De Luca, Verona, Vicari, 2010; Laursen, 2012). The term 'integration' is associated with 'combination' or 'configuration' (Van Den Bosch, Volberda, De Boer, 1999), which is a key managerial task (e.g., Hansen, Perry and Reese, 2004; Sirmon *et al*., 2011). Utilization of new technological knowledge is about making practical use of it within a firm's operations (Zahra and George, 2002) and to transform it into new products and services (Zahra, 1996; Zhang, Benedetto and Hoenig, 2009).

Firms that are active in R&D may strive to generate even more new technological knowledge, are better able to detect new technological knowledge (Cohen and Levinthal, 1990; Griffith, Redding, Van Reenen, 2004) and can use the results of previous R&D to better understand, internalize and utilize more recent knowledge (Van Den Bosch *et al*., 1999; Zahra and George, 2002). However, engaging in higher levels of R&D may reduce the chances of success (Acs and Audretsch, 1988; Cyert and March, 1963) and potentially lead to a 'failure trap' in which a firm becomes less and less able to capitalize on its knowledge (Levinthal and March, 1993).

Although not focusing on the contingent role of management innovation, various scholars (e.g., Acs and Audretsch, 1988; Katila and Ahuja, 2002) have empirically found that two prominent and strongly related indicators of the amount of generated technological knowledge – i.e. R&D and patents (Coombs and Bierly, 2006; Stock, Greis, Fischer, 2002) – have an inverted U-shaped effect on a firm's innovation performance or on a firm's overall performance (see also Table 3.1). Of the fourteen studies listed in Table 3.1, seven focused on a firm's innovation performance. Two of these directly measured an inverted U-shaped effect of R&D on radical product innovations: Graves and Langowitz (1993) took a specific industry, i.e. pharmaceutical industry, for their empirical setting, while Acs and Audretsch (1988) used a relatively broad empirical setting which included various U.S. manufacturing and service-oriented industries. The empirical settings of eleven of the fourteen studies listed in Table 3.1 are specific manufacturing-oriented industries such as the electronic and pharmaceutical industries which are typically R&D-intensive (Zhang, Yuan, Chang, Ken, 2012).

R&D and radical product innovations

R&D broadens a firm's knowledge base (Zahra *et al*., 2000) by bringing in various forms of new knowledge to a firm's knowledge base (Wu and Shanley, 2009) and by combining it with existing knowledge (Ahuja and Lampert, 2001; Zahra *et al*., 2000). New knowledge and diverse variations in the knowledge base provide more and better opportunities to create useful combinations of knowledge (Katila and Ahuja, 2002; Laursen, 2012) which enable the realization of radical product innovations out of it (March, 1991; Zahra and George, 2002; Zhou and Wu, 2010).

R&D can also bring about major changes and can revise the frame of reference for a firm (Zahra and Chaples, 1993), i.e. revise its knowledge base. Revision of existing knowledge is in line with double-loop learning (Argyris and Schön, 1978) which is beneficial for radical product innovations (e.g., Forsman, 2009; Holmqvist, 2003; Subramaniam and Youndt, 2005). New technological knowledge which challenges a firm's beliefs and core assumptions enable a firm to rethink and renew operational processes and routines (e.g., Forsman, 2009; Holmqvist, 2003; Wu and Shanley, 2009) and drives a firm's recognition of new opportunities for radical product and market innovations (Foss, Lyngsie, Zahra, 2013).

However, higher levels of R&D can have an increasing marginal effect on radical product innovations (Acs and Audretsch, 1988; Graves and Langowitz, 1993). Integrating a greater amount of new technological knowledge and converting it into radical new products is more complicated and expensive and requires more advanced and sometimes conflicting types of knowledge integration (e.g., Chesbrough *et al*., 2013; Erden *et al.*, 2014; Grant, 1996). This reduces the degree in which higher levels of new technological knowledge are being transformed into radical product innovations, because the new knowledge is utilized at a lower rate (Acs and Audretsch, 1988; Ahuja and Lampert, 2001) and remaining "fruitful" opportunities to combine new technological knowledge with existing knowledge are also more scarce at higher levels of R&D (Ahuja and Lampert, 2001; Laursen, 2012, p. 1200).

Furthermore, the sheer volume of new technological knowledge at higher levels of R&D decreases a firm's ability to respond properly to the new knowledge (Katila and Ahuja, 2002) and can trigger confusion among organizational members (Ahuja and Lampert, 2001). Additionally, the associated "organizational inertia strongly discourages exploratory innovations" (Zhou and Wu, 2010, p. 550), because

radical product innovations require new technological knowledge to be incorporated into new processes, routines, and systems that deviate from or can even conflict with a firm's existing processes, routines, and systems (Benner and Tushman, 2002, 2003; Zhou and Wu, 2010). Thus, higher levels of R&D trigger excessive revision of a firm's existing organizational processes and routines, leading to fewer radical product innovations because of behavioral barriers among organizational members: a reduced ability to respond to new knowledge, confusion, and organizational inertia. Following prior research (e.g., Acs and Audretsch, 1988; Graves and Langowitz, 1993), this brings us to the following hypothesis:

Hypothesis 1: R&D has a curvilinear (inverted U-shaped) effect on radical product innovations.

R&D and radical product innovations: the moderating effect of management innovation

Management innovation can be defined in an encompassing way as "the generation and implementation of a management practice, process, structure, or technique that is new to the state of the art and is intended to further organizational goals" (Birkinshaw *et al*., 2008, p.829). In line with other scholars (e.g., Damanpour and Aravind, 2012; Mol and Birkinshaw, 2009; Vaccaro, Jansen, Van Den Bosch, Volberda, 2012a), we focus on management innovation that is new to the firm. Consistent with the rational perspective on management innovation, and following Birkinshaw *et al.* (2008), we assume that key individuals such as managers come up with "an innovative solution to address a specific problem that the organization is facing, and he or she then champions its implementation and adaption" (Birkinshaw *et al.*, 2008, p.828).

Management innovation is more diffuse and gradual than technological innovation, and more contingent upon actors and relationships within the highly complex social system of an organization (Birkinshaw and Mol, 2006). It is also less discrete and tangible, more organization-specific, and more difficult to replicate than technological innovation (e.g., Evangelista and Vezzani, 2010; Hamel, 2006; Walker, 2008). Management innovation is therefore more difficult to justify before implementation and to evaluate afterwards (Birkinshaw and Mol, 2006), and it creates more uncertainty and ambiguity for organizational members (Birkinshaw *et al*., 2008). On the other hand, these particular characteristics of management innovation – i.e.

risk, complexity and uncertainty – also make it potentially more valuable than technological innovation (e.g., Hamel, 2006; Mol and Birkinshaw, 2006; Walker *et al*., 2011).

Technological innovation and management innovation make different contributions to the innovation process (Daft, 1978; Kimberly and Evanisko, 1981). However, introducing technological innovation without management innovation, or vice versa, means that the complementary effects between them are not present (Damanpour and Gopalakrishnan, 2001; Wischnevsky and Damanpour, 2006) and will not lead to optimal performance outcomes (Damanpour *et al*., 2009) because the socio-technical system as a whole is sub-optimized (Damanpour and Aravind, 2012; Trist, 1981). The essence of complementarity, according to Milgrom and Roberts (1995, p.181), is that "doing *more* of one thing *increases* the returns to doing *more* of another".

There are different perspectives on the relationship between technological innovation and management innovation (e.g., Hollen *et al*., 2013; Mothe and Thi, 2010); technological innovation can enable management innovation (e.g., Evan, 1966; Hecker and Ganter, 2013), management innovation can enable technological innovation (e.g., Camisón and Villar-López, 2014; Mothe and Thi, 2010), and both types of innovation can have a combined effect on firm performance (e.g., Damanpour, Szabat, Evan, 1989; Damanpour *et al*., 2009).

Management innovation can be seen as a means to support technological innovation (Damanpour and Aravind, 2012; Kimberly and Evanisko, 1981; Prajogo and Sohal, 2006). Damanpour *et al.* (1989, p. 588) have stated that a management innovation "does not provide a new product or a new service, but it indirectly influences the introduction of products or services or the process of producing them". New technological knowledge and existing knowledge need to be bundled and leveraged to transform them into a competitive advantage and this is a key managerial task (Sirmon *et al*., 2011; Van Den Bosch *et al*., 1999; Volberda, Foss and Lyles, 2010). This requires new management practices, processes, structures, and techniques to be introduced intensively and in a synchronized way (Bloom *et al*., 2010; Ichniowski *et al*., 1997; Whittington *et al*., 1999) to make them work effectively (e.g., Battisti and Iona, 2009; Siggelkow, 2001; Whittington *et al*., 1999). For instance, for new technological knowledge to be integrated and used more effectively, a set of new human resource management practices such as new incentive pay plans, job flexibility,

and new communication plans concerning the introduction of team-based work structures can be required (Bloom *et al*., 2010; Ichniowski *et al*., 1997; Ichniowski and Shaw, 1999).

Some authors (Prajogo and Sohal, 2001, 2006; Wang, 2014) have presented arguments to suggest both positive and negative relationships between specific examples of management innovation such as Total Quality Management (TQM) practices and radical innovation performance. To explain these conflicting relationships, Prajogo and Sohal (2001) have built further on Spencer's (1994) association between TQM practices and various organizational models, e.g. mechanistic and organic, by suggesting that one needs to take into account that management innovation can be multidimensional in nature. Building on Daft's (1982) framework, Damanpour *et al.* (1989) have classified four types of organizations according to the level of technological innovation and management innovation. In their framework, a mechanistic organizational model is associated with low levels of both technological innovation and management innovation. An organic organizational model is associated with high levels of both technological innovation and management innovation, an administrative bureaucracy with low levels of technological innovation and high levels of management innovation, and a technical bureaucracy with high levels of technological innovation and low levels of management innovation (Daft, 1982; Damanpour *et al*., 1989).

We propose that management innovation may flatten the inverted U-shaped relationship between R&D and radical product innovations in such a way that the relationship starts to become more J-shaped; that is, management innovation may dampen the positive effect of lower levels of R&D, yet it may also offset the proposed negative effect of higher levels of R&D. We first provide arguments as to how management innovation moderates the relationship between lower levels of R&D and radical products innovations. Subsequently, we provide arguments as to how management innovation moderates this relationship at higher levels of R&D.

Lower levels of R&D and radical product innovations: the moderating role of management innovation.

Firms with lower levels of R&D but higher levels of management innovation have, compared to those with lower levels of management innovation, a larger imbalance between these two types of innovation: R&D does not reach the "threshold

value" required for it to have complementary effects with management innovation that positively influence firm outcomes (Damanpour *et al*., 1989, p. 592, 2009; Damanpour and Aravind, 2012; Trist, 1981). Building on the framework of Damanpour *et al.* (1989, p. 591), firms with lower levels of R&D but increasing levels of management innovation move towards an "administrative bureaucracy" in which they focus more on using existing knowledge more efficiently and streamlining existing operational processes (e.g., Benner and Tushman, 2002; Spencer, 1994; Walker *et al*., 2011). Where this occurs, it is likely to have a negative effect in terms of the firm's rate in turning lower levels of R&D into radical products innovations. A stronger focus on improving and using existing knowledge and on streamlining operational processes make it more difficult and less likely for the firm to deviate from that activity in order to realize radical product innovations out of lower levels of R&D (e.g., Benner and Tushman, 2003; Massini and Pettigrew, 2003; Prajogo and Sohal, 2001). In environments which are driven predominantly by efficiency and use of existing knowledge, managers also focus less and less on small amounts of new technological knowledge; they ignore it or do not notice it (Jansen, Tempelaar, Van Den Bosch, Volberda, 2009; Miller, 1990, 1992; Prajogo and Sohal, 2001). Consequently, they become less likely to have the knowledge base required to detect, understand and incorporate new technological knowledge which are needed to realize radical product innovations (Benner and Tushman, 2002, 2003; Cohen and Levinthal, 1990; Berthon, Hulbert, Pitt, 2004).

High levels of R&D and radical product innovations: the moderating role of management innovation.

Higher levels of R&D combined with higher levels of management innovation enables a firm to release complementary effects between them on firm outcomes than if there are only low levels of management innovation (Damanpour *et al*., 1989, 2009; Damanpour and Aravind, 2012; Milgrom and Roberts, 1995). Firms with higher levels of both R&D and increasing levels of management innovation move towards an organic organizational model (Daft, 1982; Damanpour *et al*., 1989, 2009) which is characterized by high levels of training and education of employees, limited standardization and formalization, loose couplings among networks of employees, and high flexibility (Burns and Stalker, 1961; Volberda, 1998). This kind of organizational context is more conducive for detecting, integrating and utilizing new technological knowledge and synthesizing it with existing knowledge and activities in order to

realize more radical product innovations from higher levels of R&D than is the case for firms with lower levels of management innovation (e.g., Stata, 1989; Van Den Bosch *et al*., 1999; Zhou and Li, 2012). Transforming higher levels of new technological knowledge into radical product innovations requires adjustment of and alignment with many complementary areas of knowledge and capabilities, such as from marketing and production (e.g., Hitt, Ireland, Lee, 2000; Nerkar and Roberts, 2004; Taylor and Helfat, 2009). Management innovation supports that transformation (Damanpour and Aravind, 2012; Prajogo and Sohal, 2006; Trist, 1981) by dealing with existing managerial and organizational barriers in order to integrate and utilize new technological knowledge more efficiently (Bloom *et al*., 2010; Piva, Santarelli, Vivarelli, 2005; Wischnevsky and Damanpour, 2006).

Accordingly, we posit that management innovation weakens both the positive effect of lower levels of R&D and the negative effect of higher levels of R&D on radical product innovations. Because we argue that higher levels of R&D has complementary effects with management innovation in settings with higher levels of the latter type of innovation, this flattening moderating effect of management innovation suggests that the inverted U-shaped effect of R&D on radical product innovations becomes more J-shaped as a firm's level of management innovation increases. From these arguments we expect that:

> *Hypothesis 2: Management innovation moderates the inverted U-shaped relationship between R&D and radical product innovations in such a way that the inverted U-shaped effect will be flatter, i.e. moves towards a J-shaped effect, in firms with high levels of management innovation than in firms with low levels of management innovation.*

3.3 Methods

Data collection

We drew a randomly selected sample of ten thousand Dutch companies from the REACH database to empirically test our proposed relationships. This commercial database contains information on companies registered with the Dutch Chamber of Commerce. The sample covered a broad range of industries and was restricted to firms with at least 25 employees. A member of the senior management team of those companies was invited to participate in the survey. After several reminders, it resulted

in 901 observations, which is a common response-rate in large-scale surveys (e.g., Jansen *et al*., 2009). The average age of senior managers in this survey is 49. The companies are from a broad range of industries, such as manufacturing (29% of observations), wholesale and retail (22%), real estate and professional services (17%), construction (11%), and transport and storage (6%). The average company is 31 years old and has 155 employees. We applied existing scales to measure our main constructs. Many items are based on perceptual seven-point scales, since managerial behavior is often captured better with perceptual measures than with archival measures (Bourgeois, 1980; Tsoukas and Chia, 2002). We also collected archival data to obtain data of several control variables and to verify the reliability of measures, if possible. Archival data was obtained from the REACH database.

Nooteboom (1991) has argued that differences in innovation activities can be attributed to three questions which should be viewed as separate; (1) Is a firm active with R&D? (2) How much does a firm invest in R&D? and (3) How effectively can a firm turn R&D into outputs? Following Nooteboom's (1991) approach, and because the focus of this paper is on leveraging the effect of R&D, we removed observations with no R&D. We thus removed 176 observations, leaving us with 730 useful observations for data analysis. The second and third of Nooteboom's questions was addressed in this paper by R&D investments (question 2) and the role of management innovation in the innovation effectiveness of a firm (question 3).

To assess single-informant bias, a second member of the senior management team was also asked to complete the survey. Eight percent of first respondents also have a second respondent. Based on intra-class correlation for the measures of management innovation and radical product innovation, the inter-rater agreement scores (r_{wg}) indicated with values of respectively 0.49 ($p < 0.01$) and 0.76 ($p < 0.001$) a 'moderate' to 'substantial' agreement between first and second respondent, according to the scale devised by Landis and Koch (1977). Pearson correlation coefficients indicated a strong consistency between the scores of the first and second respondent on management innovation ($r_{1,2}$= 0.33, $p < 0.001$) and on radical product innovations ($r_{1,2}$= 0.61, $p < 0.001$) (Jones, Johnson, Butler, Main, 1983).

We conducted several tests to assess non-response bias. Following Schilke (2014), there were no significant differences ($p > 0.10$) between early and late respondents based on an independent sample T-test for these constructs. Additionally, we examined whether the values for R&D investment for the participating

organizations differed from Dutch companies in the REACH database. Dutch companies which invest in R&D and with known values on it in the REACH database have on average a value of 4.23 (standard deviation: 4.87) with respect to the same time frame as responding firms. The average value on R&D investments of our responding firms did not deviate significantly from this value from the REACH database ($p > 0.05$). These findings did not provide indication of non-response bias in this survey.

We conducted several steps to assess common-method bias. By assuring respondents of confidentiality and asking every manager to return the questionnaire to the research team, we reduced the chances of common-method bias that can arise when respondents give their answers on the basis of social desirability, for example (Vaccaro *et al*., 2012a). To further reduce the chances of common-method bias, we compared the scores from the perceptual scales with archival data wherever possible. Moreover, a Harman's single-factor test with our full model (independent, dependent and moderating variables) indicated that all items loaded on a single factor explained less than half of the variance (31%), indicating that common-method bias was not a serious problem in this study (Podsakoff and Organ, 1986; Schilke, 2014).

We assessed the construct validity of our main latent variables (management innovation and radical product innovations) through exploratory factor analysis using a principal component analysis with varimax rotation. Two factors were identified with eigenvalues over Kaiser's criterion of 1, with each item loading clearly on to its intended factor. Items had communalities larger than 0.3, dominant loadings were at least 0.59 which is larger than the threshold value of 0.5, and cross-loadings were not more 0.21 which is within the acceptable limit of 0.3 (Briggs and Cheek, 1988). Using AMOS 21, we applied confirmatory factor analyses (CFA) (with each item restricted to loading on to its proposed construct) based on maximum likelihood procedures in order to validate the main measures from our exploratory factor analysis (Hair *et al*., 2006). The measures indicated that our data have an overall acceptable fit with our model (χ^2 /df = 4.73 < 5; goodness-of-fit index (GFI) = 0.94 ≥ 0.90; comparative fit index (CFI) = 0.93 ≥ 0.90; root-mean-square error of approximation (RMSEA) = 0.07 < 0.08) (Bentler and Bonett, 1980; Schilke, 2014). All factor loadings were above the 0.40 level recommended by Ford, MacCallum and Tait (1986) and their loadings on the proposed indicators were significant ($p < 0.01$), thereby indicating convergent validity of our measures (Anderson and Gerbing, 1988). A one-factor CFA model

provided a less acceptable fit to our model (χ^2 /df = 25.2; GFI = 0.65; CFI = 0.56; RMSEA = 0.19), indicating discriminant validity (Bagozzi and Phillips, 1982). Overall, our findings out of exploratory and confirmatory factor analysis provide support for convergent and discriminant validity of our main latent measures.

Reliability analyses based on Cronbach's α exceeded by at least 0.84 the threshold of 0.7 (Field, 2009). We mean-centered a firm's score on R&D and on management to avoid potential multicollinearity. The highest variance inflation factor (VIF) was 3.43, which is below the rule of thumb of 10 (Neter, Wasserman, Kutner, 1990). Therefore, there are no indications of potential multicollinearity.

Measurement

Dependent variable. Radical product innovations (α = 0.84) were operationalized using the measure devised by Jansen *et al.* (2006). This scale measures the frequency and degree of newness of realized radical product innovations (Simsek, 2009). For example, one item is: "We commercialize products and services that are completely new to our organization". The Appendix provides an overview of the main constructs. In line with Jansen *et al.* (2009) we also measured the correlation between the respondents' score on the measure of radical product innovations and the percentage of turnover over the past three years which could be attributed to products and services which are completely new to the organization. This significant correlation (r = 0.30, $p < 0.001$) provided additional support for the reliability of our measure for radical product innovation.

Independent and moderating variables. R&D investment as percentage of turnover is among the most common measures for R&D (e.g., Aghion, Bloom, Blundel, Griffith, Howitt, 2005; Cruz-Cázares *et al*., 2013; Coombs and Bierly, 2006). Accordingly, in line with considerable previous research (e.g., Berchicci, 2013; DeCarolis and Deeds, 1999; Díaz-Díaz, Aguiar-Díaz, De Saá-Pérez, 2008) we measured *R&D* as the average investment in it over the past three years in terms of percentage of turnover. As stated earlier, organizations where there was zero investment in R&D were removed from the observations.

To measure *management innovation* (α = 0.85) we applied an existing scale (Vaccaro *et al*., 2012a) which is based on the encompassing definition of it from Birkinshaw *et al.* (2008). The first two items on this scale relate to new management

practices, items three and four relate to new management processes, and items five and six relate to new structures (Vaccaro *et al*., 2012a).

Control variables. *Environmental dynamism* (α = 0.78) influences the need for radical product innovations (e.g., Crossan and Apaydin, 2010) and is an important external variable to match with a firm's internal rate of change (e.g., Floyd and Lane, 2000; Volberda, 1996). Accordingly, we included environmental dynamism by applying the construct of Jansen *et al.* (2006). Since it influences a firm's necessity, willingness and available resources to innovate (e.g., Cyert and March, 1963; Laursen, 2012), *firm performance* (α = 0.83) was also a control variable measured with a scale developed by Wiklund and Shepherd (2005). We also correlated a firm's performance with its average return on equity and its average sales growth, both over the past three years. These correlations were respectively 0.29 ($p < 0.001$) and 0.24 ($p < 0.001$), and this provided additional support for our measure of firm performance. Investment in R&D may be strongly related to firm size (Cohen and Klepper, 1996); larger firms have greater economies of scale in R&D (Ahuja *et al*., 2008) and they may have higher levels of management innovation (Mol and Birkinshaw, 2009). Accordingly, we included *firm size*, measured by the logarithm of full-time employees. Older organizations might have more accumulative experience which can affect innovation, and they may be less flexible, but have more resources to innovate (Jansen *et al*., 2006). Therefore, *firm age* was included, measured by the number of years since the firm was founded. *CEO tenure* influences a firm's propensity to change and experiment (Wu, Levitas, Priem, 1996), and therefore this was also included. The *size of top management team* can influence its heterogeneity (Siegel and Hambrick, 2005), so we also included this, measuring it by the number of managers in the senior management team. The introduction of different types of innovation differs between industrial and more service-oriented firms (Damanpour *et al*., 2009). We included *industrial firms* and service firms in the analyses, with the first being used as a dummy variable.

3.4 Analyses and results

Table 3.2 presents means and standard deviations of the constructs and correlations among them. Table 3.3 presents several regression analyses based on ordinary least squared analyses. Model I presents the effect of our control variables on radical product innovations. The second model incorporates the effect of R&D to Model I. Model III adds the moderating effect of management innovation to Model II. Following prior research (e.g., Damanpour *et al*., 2009; Malhotra and Majchrzak, 2014), we calculated the Akaike information criterion (AIC) to examine whether the model with or without the moderating effect of management innovation has a better fit with the data to explain radical product innovations, while not overfitting our data (Akaike, 1974). This measure reflects the relative goodness-of-fit and the complexity of models (Akaike, 1974). The AICs of Models II and III are -21.5 and -29.5 respectively. These values indicate that the model with the moderating effect explains a higher degree of variance on radical product innovations and is accordingly preferable to the model without this moderating effect (Akaike, 1974; Arnold, 2010).

Analyses of our data support the first hypothesis: R&D has an inverted U-shaped effect on radical product innovations. R&D has a positive effect ($\beta = 0.27$, $p < 0.001$) on radical product innovations, while this effect is negative for higher levels of R&D ($\beta = -0.13$, $p < 0.05$). To plot this effect, scores on R&D are clustered into three groups: low (lowest 25 percent of scores), high (highest 25 percent of scores), and intermediate (remaining observations). Figure 3.1A depicts the effect of R&D on radical product innovations. As can be seen in this Figure, the slope of the effect of R&D on radical product innovations decreases as the level of R&D rises, thereby supporting hypothesis 1.

Table 3.2: Means, standard deviations, and correlations. [3]

	Mean	St. dev.	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
(1) Radical product innovations	4.06	1.16	1.00									
(2) R&D	4.22	4.88	0.26***	1.00								
(3) Management innovation	3.45	1.14	0.36***	0.07*	1.00							
(4) Environmental dynamism	4.28	1.20	0.38***	0.09*	0.19***	1.00						
(5) Firm performance	4.74	0.95	0.23***	0.11**	0.10**	0.03	1.00					
(6) Firm size [4]	1.76	0.51	-0.01	-0.09*	0.08*	-0.06 †	0.02	1.00				
(7) Firm age	30.90	27.93	-0.06 †	-0.06	-0.08*	-0.11**	-0.06 †	0.16***	1.00			
(8) CEO tenure	13.32	10.44	0.04	-0.04	-0.05	0.04	0.01	-0.04	0.13***	1.00		
(9) Size top management team	5.86	5.20	0.04	0.03	0.13***	-0.03	0.07*	0.20***	0.06 †	0.05	1.00	
(10) Industrial firms	0.41	0.49	-0.05	-0.11**	-0.11**	-0.08*	0.01	0.07*	0.25***	0.09**	-0.02	1.00

In this table, a firm's scores on R&D and management innovation are not yet mean-centered.

***: $p < 0.001$
**: $p < 0.01$
*: $p < 0.05$
†: $p < 0.10$

[3] n = 730

[4] Firm size is measured by the logarithm of the number of full-time employees.

Table 3.3: Results of hierarchical regression analyses: Effect of R&D on radical product innovations.

Model	I	II	III
Independent variable:			
R&D		0.28***	0.27***
		(0.01)	(0.01)
R&D squared		-0.12*	-0.13*
		(0.00)	(0.00)
Management innovation		0.27***	0.22***
		(0.03)	(0.04)
Moderating effects:			
R&D x Management innovation			-0.18***
			(0.01)
R&D squared x Management innovation			0.16**
			(0.00)
Control variables:			
Environmental dynamism	0.37***	0.30***	0.30***
	(0.03)	(0.03)	(0.03)
Firm performance	0.22***	0.18***	0.18***
	(0.04)	(0.04)	(0.04)
Firm size	-0.01	-0.01	-0.02
	(0.08)	(0.07)	(0.07)
Firm age	-0.01	0.00	0.00
	(0.00)	(0.00)	(0.00)
CEO tenure	0.02	0.03	0.03
	(0.00)	(0.00)	(0.00)
Size of top management team	0.04	-0.02	-0.02
	(0.01)	(0.01)	(0.01)
Industrial firms	-0.02	0.04	0.04
	(0.08)	(0.08)	(0.08)
F	27.05***	29.84***	26.19***
R^2	0.19	0.29	0.31
Adjusted R^2	0.18	0.28	0.29

Standardized coefficients are described. Values between parentheses are standard errors.
***: $p < 0.001$
**: $p < 0.01$
*: $p < 0.05$
†: $p < 0.10$

Our findings also support hypothesis 2: management innovation flattens the positive effect of lower levels of R&D on radical product innovations ($ß$ = -0.18, p < 0.001) and dampens the negative effect of higher levels of R&D on radical product innovations ($ß$ = 0.16, p < 0.01). To plot this moderating effect, we categorize scores on management innovation into two groups: low (average score minus 1 standard deviation as the upper limit), and high (average score plus 1 standard deviation as the minimum value) – see also Figure 3.1B. As can be seen in this figure, analyses of our data indicate that R&D has an inverted U-shaped effect on radical product innovations in firms with low levels of management innovation. However, this relationship has characteristics of a J-shape for firms with higher levels of management innovation. Overall, our findings indicate that management innovation flattens the inverted U-shaped effect of R&D on radical product innovations in such a way that it weakens the positive effect of lower levels of R&D and offsets the negative effect of higher levels of radical product innovations on radical product innovations. Together, these findings indicate that management innovation is a key contextual variable to explain a firm's effectiveness at turning R&D into radical product innovations.

Interestingly, Figure 3.1B also shows that the average scores on radical product innovations are consistently higher for firms with higher levels of management innovation compared to firms with lower levels of management innovation, regardless of the level of R&D. As can also be seen in Model III of Table 3.3, management innovation also has a direct positive effect on radical product innovations ($ß$ = 0.22, p < 0.001). In the next section we will discuss this in more detail.

Figure 3.1A: Effect of R&D on radical product innovations.

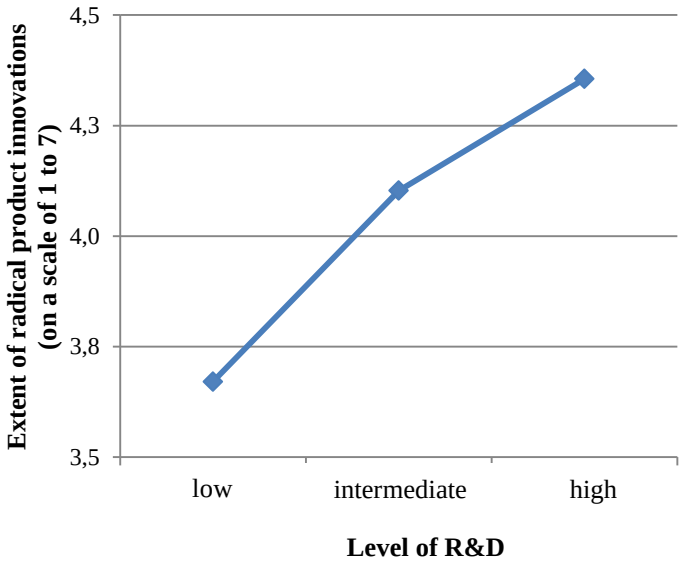
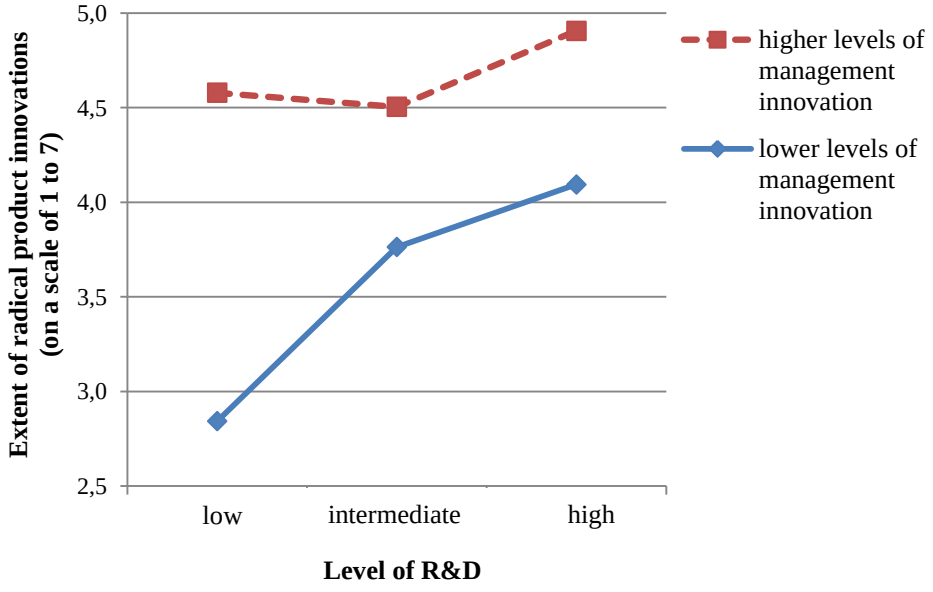


Figure 3.1B: Interaction effect of R&D and management innovation on radical product innovations.



3.5 Discussion and conclusion

Research on technological innovation is extensive compared to that on management innovation, but there is little systematic evidence on how the inverted U-shaped relationship between R&D and radical product innovations is contingent upon management innovation. We contribute in two ways to advancing understanding of how management innovation moderates the effect of R&D on radical product innovations.

First, we provide new insights how the inverted U-shaped relationship between R&D and radical product innovations is contingent upon management innovation. We provide theoretical arguments on how management innovation flattens this inverted U-shaped effect; at lower levels of management innovation, the relationship between R&D and radical product innovations has an inverted U-shaped effect, while the effect is J-shaped for firms with higher levels of management innovation. In so doing, we address the plea from management scientists (e.g., Camison and Villar-López, 2014; Damanpour, 2014; Volberda *et al*., 2013) for more research to be conducted on the relationship between technological innovation and management innovation.

This theoretical contribution adds new insights to prior research focusing on the effect of R&D on firm outcomes (e.g., Acs and Audretsch, 1988; DeCarolis and Deeds, 1999; Lin *et al*., 2006). Cruz-Cázares *et al.* (2013, p. 1239) have stated that linking R&D directly to firm performance without taking into account product innovations "would generate misleading results" because of differences in firms' effectiveness at turning R&D into product innovations. Our theoretical arguments help to explain the mixed effects of R&D on firm outcomes (Artz *et al.*, 2010; Erden *et al*., 2014; Zhou and Wu, 2010) in that we highlight the importance of including management innovation as a contingent variable when explaining variations in firms' effectiveness in turning different levels of R&D into radical product innovations. Our theoretical arguments also suggest that the inverted U-shaped effect of R&D on radical product innovations (e.g., Acs and Audretsch, 1988; Graves and Langowitz, 1993) relate ceteris paribus to firms with lower levels of management innovation.

This paper also complements prior research focusing on a linear positive (e.g., Damanpour *et al*., 2009) or negative (e.g., Roberts and Amit, 2003) effect of management innovation on overall firm performance, either independently or when

management innovation is combined with technological innovation. Our finding that the inverted U-shaped relationship between R&D and radical product innovations becomes more J-shaped as the level of management innovation increases emphasizes the relevance of examining the combined effect of R&D and management innovation with various levels of both. In particular, this J-shaped effect for firms with higher levels of management innovation implies that management innovation can be both detrimental at lower levels of R&D, and beneficial at higher levels of R&D, in terms of a firm's effectiveness at turning R&D into radical product innovations. Firms with an 'either/or' focus on R&D and management innovation are likely to experience suboptimal returns in terms of radical product innovations compared to those firms which focus on both.

Second, alongside our theoretical contribution we make an empirical contribution by using a large-scale survey across multiple industries in the Netherlands to examine how management innovation moderates the inverted U-shaped effect between R&D and radical product innovations. Our empirical findings provide support for our proposed relationships. As such, with the notable exception of Acs and Audretsch (1988) who found R&D to have an inverted U-shaped effect on radical product innovations among various U.S. manufacturing and service- oriented industries, this paper goes beyond the empirical context of specific R&D-intensive industries (see also Table 3.1) with its finding that the inverted U-shaped effect also applies to firms across a broad range of industries in the Netherlands.

Our large-scale survey also helps to address the lack of large-scale empirical research on management innovation (e.g., Černe *et al*., 2013; Mol and Birkinshaw, 2009; Walker *et al.*, 2011). In particular, we address the statement by Damanpour and Aravind (2012, p.445) that measuring only management innovation or technological innovation "may not accurately reflect" its consequences. Additionally, Damanpour (2014, p.1279) has highlighted the need to include "more fine-grained measurement of management innovation" than is possible with dichotomous scales. By using a seven-point scale of management innovation adapted from Vaccaro *et al.* (2012a) and based on a definition by Birkinshaw et al. (2008) we go further than scholars (e.g., Hervas-Oliver and Sempere-Ripoll, 2015; Mol and Birkinshaw, 2009) who measured technological innovation and management innovation simply as dummy variables.

Our findings also reveal that firms with high levels of management innovation on average score more highly on radical product innovations than firms with low

levels of management innovation, regardless of the level of R&D (see also Figure 3.1B). These findings suggest empirical support for prior research (e.g., Mol and Birkinshaw, 2006; Sirmon *et al.*, 2011; Teece, 2007, 2010; Volberda and Van Den Bosch, 2005) in which it has been argued that the role of management in turning technological knowledge into successful firm outcomes is generally more important for competitive advantage than technological knowledge itself. For instance, Hansen *et al.* (2004, p.1280) have stated that "what a firm *does* with its resources is at least as important as *which* resources it possesses." Building on the resource-based view in general or on the dynamic managerial capability view more specifically, scholars (e.g., Damanpour *et al.*, 2009; Sirmon *et al.*, 2011; Teece, 2007) have argued that the structuring, bundling, and leveraging of new and existing technological knowledge are key managerial tasks that are crucial for organizational survival and prosperity. Without questioning the significance of R&D for organizational survival (e.g., Franko, 1989), our findings underline with empirical evidence the vital role of managers and management innovation in particular in increasing the returns from R&D in the form of more radical product innovations.

Regarding the managerial implications of our study, our findings indicate that management innovation can be both detrimental and beneficial in terms of the effect that R&D has on radical product innovations. On the one hand, our findings indicate that when managers of firms with high levels of management innovation start to invest in R&D, they – paradoxically - initially face a decline in the amount of radical product innovations compared to firms with lower levels of management innovation. On the other hand, high levels of management innovation are needed to offset the negative effect of high levels of R&D on radical product innovations. Innovation effectiveness is expected to become a key indicator of leading firms (Cruz-Cázares *et al.*, 2013; Griffin *et al.*, 2013), and a one-sided focus on either R&D *or* management innovation is not sufficient to unlock the potential for radical product innovations.

In spite of these contributions, our study also has several limitations that indicate useful directions for future research. First, we have focused on radical product innovation in terms of how much of it is taking place, while others (e.g., Benner and Tushman, 2002; Danneels, 2002) have focused on the degree of newness involved. In addition to radical product innovation, firms need a sufficient amount of incremental product and service innovation to survive (Levinthal and March, 1993). Future research should examine how R&D and management innovation are related to the

degree of newness of product innovations and to the amount of exploitative product and service innovation.

Second, we have not included the role of time in our model. Complementary effects may reveal themselves over time (Damanpour *et al*., 2009) and organizational change can be differentiated into episodic change or continuous change (e.g., Weick and Quinn, 1999). Future research should examine with longitudinal case studies how management innovation leverages the effect of R&D on radical product innovations over time.

Third, our findings indicate that management innovation has a positive effect on radical product innovation. Management innovation provides more room for employees to come up with and develop ideas (Hamel, 2011; Vaccaro *et al*., 2012b), it renews the focus of attention on activities of organizational members (Van de Ven, 1986), and it requires employees to be more flexible which stimulates innovative behavior (Černe *et al.,* 2013; Prajogo and Sohal, 2001). Future research should examine in more detail how management innovation has a direct effect on radical product innovation.

All in all, our paper contributes to a richer understanding of the relationship between technological innovation and management innovation. Management innovation is an important contingency variable for explaining firms' effectiveness in transforming R&D into radical product innovation.

3.6 Appendix: Measures and items at firm level

Radical product innovations (adapted from Jansen *et al*., 2006)

Our organization accepts demands that go beyond existing products and services.
We invent new products and services.
We experiment with new products and services in our local market.
We commercialize products and services that are completely new to our organization.
We frequently utilize new opportunities in new markets.
Our organization regularly uses new distribution channels.

Management innovation (adapted from Vaccaro *et al*., 2012a)

Rules and procedures within our organization are regularly renewed.
We regularly make changes to our employees' tasks and functions.
Our organization regularly implements new management systems.
The policy with regard to compensation has been changed in the last three years.
The intra- and inter-departmental communication structure within our organization is regularly restructured.
We continuously alter certain elements of the organizational structure.

Environmental dynamism (adapted from Jansen *et al*., 2006)

Environmental changes in our local market are intense.
Our clients regularly ask for new products and services.
In our local market, changes are taking place continuously.
In a year, nothing has changed in our market (reversed item).
In our market, the volumes of products and services to be delivered change fast and often.

All items are measured on a seven-item scale ranging from "strongly disagree" (1) to "strongly agree"(7).

Study II

Firm performance (adapted from Wiklund and Shephard, 2005)

Respondents were asked to estimate their performance over the last year compared to competitors. The answers range from "much worse than our competitors" (1) to "much better than our competitors" (7). The items are:

Revenue
Profit
Return on assets
Growth of market share

CHAPTER 4. Study III: How do new management practices contribute to a firm's innovation performance? The role of organizational size *

* This study will be submitted to an international scientific journal. Earlier versions of this study were presented at the *Strategic Management Society Special Conference* 2013, Geneva/Lausanne, Switzerland; at the *European Academy of Management Annual Conference* 2013, Istanbul, Turkey; and at the *Thematic Conference* of the *European Academy of Management* 2015, Montpellier, France. This study has been awarded with the *Best Paper Award* at the *European Academy of Management* thematic conference "Management Innovation: New Borders for a New Concept", Montpellier, 2015.

CHAPTER 4. Study III: How do new management practices contribute to a firm's innovation performance? The role of organizational size

Abstract *This article contributes to the relatively scarce amount of research on new management practices, i.e. management innovation, by examining how it contributes to a firm's innovation performance resulting out of its existing knowledge base: exploitative product and service innovations. Additionally, we investigate how this relationship is influenced by an important contextual variable: organizational size. We develop a conceptual framework and hypotheses, and test these by survey research. Our findings indicate that new management practices have an increasingly positive effect on a firm's exploitative innovation performance. However, the larger the firm, the more this relationship moves from a positive linear relationship to one that is more J-shaped. These findings increase our understanding how new management practices contribute to a firm's exploitative innovation performance and highlight that organizational size is an important contextual variable in this relationship.*

Keywords: new management practices, management innovation, exploitative innovation performance, organizational size

4.1 Introduction to study III

Innovation is widely acknowledged to be vital for a firm's competitive advantage (e.g., Damanpour, 1991; Hamel, 2000; Schumpeter, 1942) and managers have a crucial role to realize competitive advantages out of a firm's knowledge base (e.g., Hansen, Perry and Reese, 2004; Sirmon, Hitt, Ireland and Gilbert, 2011). Despite its importance for a firm's competitive advantage, research on management innovation, i.e. new-to-the-firm management practices, processes, structures and techniques, is still relatively scarce (e.g., Birkinshaw, Hamel, Mol, 2008; Damanpour and Aravind, 2012; Volberda, Van Den Bosch, Heij, 2013). The majority of existing work on new management practices has focused on specific examples of it (Battista and Iona, 2009; Walker, Damanpour, Devece, 2011), such as the introduction of new human resource management practices (e.g., Ichniowski, Shaw, Prennushi, 1997; Laursen and Foss, 2003) or self-managed teams (e.g., Hamel, 2011; Vaccaro, Van Den Bosch, Volberda, 2012b). Another stream of research (e.g., Damanpour, Walker,

Avellaneda, 2009; Mol and Birkinshaw, 2009; Vaccaro, Jansen, Van Den Bosch, Volberda, 2012a) takes an encompassing definition of new management practices, i.e. management innovation, like the seminal contribution of Birkinshaw *et al.* (2008).

Scholars (e.g., Camisón and Villar-López, 2014; Walker *et al.*, 2011; Whittington, Pettigrew, Peck, Fenton, Conyon, 1999) within the domain of new management practices have paid prevalent attention to their effect on firm performance. Directly linking a firm's knowledge base to firm performance without including the role of innovation performance tends to assume an equal efficiency of turning knowledge into product innovations (Cruz-Cázares, Bayona-Sáez, García-Marco, 2013) or tends to focus on cost savings due to process improvements, while additional revenues due to product innovations are expected to contribute stronger to firm performance than those cost savings (Damanpour, 2014). Questions on how an encompassing approach of new management practices as provided by Birkinshaw *et al.* (2008), hereafter referred to as new management practices, contribute to a firm's innovation performance are largely unanswered. This study focuses on two gaps concerning this largely unanswered question.

First, new management practices are generally aimed to increase the effectiveness and efficiency of organizational processes and outcomes (e.g., Benner and Tushman, 2002; Walker *et al*., 2011; Wischnevsky, Damanpour, Méndez, 2011) and to serve customers better (Linderman, Schroeder, Zaheer, Liedtke, Choo, 2004; Parast, 2011; Benner and Tushman, 2003). This focus on effectiveness and efficiency is associated with exploitative product and service innovations (Benner and Tushman, 2002; Garcia and Calantone, 2002; Jansen, Van Den Bosch, Volberda, 2006). Management practices are pivotal to leverage existing knowledge (e.g., Hansen *et al*., 2004; Sirmon *et al*., 2011), but it is less well documented how new management practices contribute to a firm's innovation performance resulting out of its existing knowledge base: here labelled as a firm's exploitative innovation performance. This construct is conceptualized in this paper as realized exploitative product and service innovations (Benner and Tushman, 2003) and it represents the majority of a firm's innovation performance (e.g., Galunic and Rodan, 1998; Garcia and Calantone, 2002; Laursen, 2012).

Second, organizational characteristics influence the effect of new management practices on a firm's outcomes (Baldridge and Burnham, 1975; Damanpour, 2014). Of the list of organizational characteristics, organizational size has

received prevalent attention to be an important contextual variable to explain variations in leveraging the effect of knowledge on a firm's outcomes (Van Wijk, Jansen, Lyles, 2008). Compared to smaller firms, larger ones have a more complex organizational context (Daft and Becker, 1980; Ettlie and Rubenstein, 1987; Vaccaro *et al*., 2012a). Management scientists have considered organizational size as an antecedent of new management practices (Kimberly and Evanisko, 1981; Mol and Birkinshaw, 2009), or as a moderator of the relationship between transformational and transactional leadership and new management practices (Vaccaro *et al*., 2012a). Prior research has fallen short in explaining how the relationship between new management practices and a firm's exploitative innovation performance is influenced by organizational size as a proxy for organizational complexity. This brings us to the following central question of this paper; *How do new management practices contribute to a firm's exploitative innovation performance and how does organizational size moderate this relationship?*

We contribute to the innovation literature and in particular related to new management practices in two main ways. First, in contrast to a focus on a specific example of new management practices, we advance our understanding how new management practices - as a generic construct - contribute to a firm's exploitative innovation performance. By doing so, we go beyond the work of scholars (e.g., Mol and Birkinshaw, 2009; Walker *et al*., 2011) who have examined the effect of it on firm performance and researchers (e.g., Benner and Tushman, 2002; Parast, 2011) who have examined the effect of specific examples of new management practices on a firm's exploitative innovation performance, such as the introduction of ISO-certificates.

Second, we further advance our understanding of the relationship between new management practices and a firm's exploitative innovation performance by investigating the moderating effect of an important contextual variable: organizational size as a proxy for organizational complexity. By doing so, we complement scholars (e.g., Benner and Tushman, 2002, 2003; Whittington *et al.*, 1999) who have not focused on the moderating role of organizational size in the relationship between new management practices and a firm's outcomes, and those who have considered organizational size as an antecedent of new management practices (Kimberly and Evanisko, 1981; Mol and Birkinshaw, 2009).

In the next section we will review existing literature to examine how new management practices are related to a firm's exploitative innovation performance, and we include the moderating role of organizational size in this relationship. This results in two hypotheses. After the methods, analysis and results sections we discuss important implications and limitations of our study and we provide suggestions for future research.

4.2 Literature review and hypotheses

New management practices refer to the introduction of new management practices, processes, structures, and techniques with the intention to further a firm's goals (Battisti and Iona, 2009; Birkinshaw *et al.*, 2008; Volberda *et al.*, 2013). It embraces "a broad range of managerial and organizational tools […] that form the architecture of the company" (Battisti and Iona, 2009, p. 1326), such as new incentive pay plans, job flexibility, decentralization of decision making, and new operational management practices (Battisti and Iona, 2009; Ichniowski *et al.*, 1997; Laursen and Foss, 2003). Essentially, it involves changes how managers perform their job aimed to address problems a firm is facing (Hamel, 2006). In line with other scholars (e.g., Birkinshaw *et al.*, 2008; Damanpour *et al.*, 2009; Vaccaro *et al.*, 2012a) on new management practices, this paper considers new as new-to-the-firm and focuses on the rational perspective on new management practices.

A firm's exploitative innovation performance can be defined as "products that provide new features, benefits, or improvements to the *existing* technology in the *existing* market" (Garcia and Calantone, 2002, p. 123). It involves "refinement and extension of existing competences, technologies, and paradigms" (March, 1991, p. 85) in which a firm builds further on its existing knowledge and increases its efficiency (Benner and Tushman, 2002; Danneels, 2002; Jansen *et al.*, 2006).

Much knowledge and experience are dispersed throughout an organization (Černe, Jaklič, Škerlavaj, 2013; Crossan, Lane, White, 1999) and structuring, bundling and leveraging of this knowledge and experience are key managerial tasks (Sirmon *et al.*, 2011; Teece, 2007). New management practices are usually introduced to address problems a firm is facing (Currie, 1999; Hamel, 2006) and to increase coordination within a firm aimed to increase the efficiency and effectiveness of organizational processes and outcomes (e.g., Daft, 1982; Mol and Birkinshaw, 2009; Wischnevsky *et al.*, 2011).

The introduction of more new management practices involves a more comprehensive renewal of the way work is accomplished in a firm (e.g., Damanpour, 2014; Fenton and Pettigrew, 2003; Siggelkow, 2001). Different new management practices represent different, but partly overlapping approaches in which each of them contribute in their own way to improve organizational processes and a firm's outcomes (Currie, 1999; De Cock and Hipkin, 1997; Roberts, 2004). These different new management practices are associated with multiple functional areas, such as human resource management, production and marketing (e.g., Currie, 1999; Laursen and Foss, 2003; Rivkin and Siggelkow, 2006), to think "in an integrated way about product design and process design" (Freeman, 1988, p. 335). For instance, the introduction of self-managed teams involves, amongst others, new team-based work structures, decentralization of decision making, new incentive pay systems, new communication plans, job flexibility and new monitoring systems (Ichniowski *et al*., 1997; Roberts, 2004; Vaccaro *et al*., 2012b).

According to Milgrom and Roberts' (1995, p. 181) notion of complementarity "doing *more* of one thing *increases* the returns to doing *more* of another". The introduction of a new management practice has relatively limited benefits (Laursen and Foss, 2003; Roberts, 2004) and may require the introduction of other ones to make it work (e.g., Battisti and Iona, 2009; Siggelkow, 2001). New management practices need to be clustered to fit together rather than trying to maximize the impact of each of them individually in order to increase the joint impact of them on a firm's outcomes (Bloom, Sadun, Van Reenen, 2010; Ichniowski *et al*., 1997; Pettigrew and Whittington, 2003).

New management practices and a firm's exploitative innovation performance

Different new management practices contribute in their own way to increase the utilization of a firm's knowledge base (Currie, 1999; Daft, 1982; Mol and Birkinshaw, 2009). For instance, they increase intra-firm interactions and interdependencies to streamline the transfer among activities and organizational units (e.g., Adams, Bessant, Phelps, 2006; Benner and Tushman, 2002; Vaccaro *et al*., 2012b) or they enable new combinations of existing knowledge (e.g., Bloom *et al*., 2010; Gebauer, 2011; Laursen and Foss, 2003). A higher degree of utilization of a firm's existing knowledge triggers the search for innovative solutions within or nearby its knowledge base which promotes exploitative innovation performance (Benner and

Tushman, 2002, 2003; Danneels, 2002). Building on Milgrom and Roberts' (1995) notion of complementarity, the introduction of more new management practices increases the returns of the introduction of each new management practice (e.g., Battisti and Iona, 2009; Bloom *et al*., 2010; Laursen and Foss, 2003) on utilizing a firm's existing knowledge. Accordingly, we argue that the introduction of more new management practices contributes at an accelerating rate to a firm's exploitative innovation performance by increasing the utilization its knowledge base at an increasing rate. For instance, it can be expected that the combined introduction of new HRM-practices with new operational management practices and new monitoring practices increase the effect of each new management practice on a firm's exploitative innovation performance. Therefore, we expect that;

> *Hypothesis 1: The introduction of more new management practices has an increasingly positive effect on a firm's exploitative innovation performance.*

New management practices and a firm's exploitative innovation performance: the moderating role of organizational size.

Management scientists (e.g., Gruber and Niles, 1974; Kimberly and Evanisko, 1981; Mol and Birkinshaw, 2009) have argued that the introduction of new management practices depends on a firm's size. Organizational size is considered to capture the bureaucratic complexity and scope of different activities of a firm (Baldrigde and Burnham, 1975; Damanpour and Schneider, 2006; Roberts, 2004). Larger firms have more hierarchical layers, more administrative positions and specialization, and a higher ratio of administrators compared to other organizational members (Baldrigde and Burnham, 1975; Blau, 1970; Hamel, 2011). However, prior research has shown mixed results of the effect of organizational size on knowledge utilization and on innovation in general: positive, non-significant and negative relationships are reported (Damanpour, 1996; Lavie, Stettner, Tushman, 2010; Van Wijk *et al*., 2008). Although meta-analyses (Camisón-Zornoza *et al*., 2004; Damanpour, 1992) have suggested a positive relationship between innovation and size, it is highly difficult to make one statement of the relationship between size and all types of innovation together (Nooteboom, 1989). We argue that organizational size as a proxy for organizational complexity is an important contextual variable to explain variations in the relationship between new management practices and a firm's exploitative innovation performance.

Larger firms are more able to introduce new management practices and have a higher necessity to do so (Kimberly and Evanisko, 1981; Mol and Birkinshaw, 2009). As a small firm grows, management delegates decision making and operational activities further down into the organization and to organizational members with particular knowledge concerning the decision, and specialization of activities comes in place (Ettlie, Bridges, O'Keefe, 1984; Nooteboom, 1994). Increasing size thus enables more variety in and advanced differentiation and specialization of organizational members, equipment and tasks (Damanpour, 1996; Moch and Morse, 1977).

On the one hand, this increases the complexity and degree of differentiation of larger firms compared to smaller ones (Daft and Becker, 1980; Kimberly and Evanisko, 1981; Mol and Birkinshaw, 2009), because of an increased number and complexity of hierarchical layers (Child, 1972; Sterman, Repenning, Kofmann, 1997) and more difficult coordination and communication (Stock, Greis, Fischer, 2002). On the other hand, the more skilled and professional employees with a larger stock of capabilities and knowledge provide larger firms an increased number of and more complex and diversified resources, capabilities, knowledge and experience (Damanpour, 1992; Kimberly and Evanisko, 1981).

New management practices and a firm's exploitative innovation performance: the moderating role of organizational size

Larger firms have compared to smaller ones an increased number of and more intense, more complex and more diverse managerial challenges (Baldrigde and Burnham, 1975; Gruber and Niles, 1974; Mol and Birkinshaw, 2009). For instance, larger firms have larger and more complex hierarchical layers (Damanpour and Schneider, 2006; Hamel, 2011; Nooteboom, 1994), more intense planning, coordination and communication challenges, their variety of operations is a larger problem (Gruber and Niles, 1974; Stock *et al*., 2002), and they generally have more competitors (Volberda *et al*., 2011). Accordingly, the introduction of many new management practices in a small firm involves 'overshooting' the managerial challenges it faces (Naveh, Marcus, Moon, 2006). Such 'overshooting' reduces the impact of each new management practice (Naveh *et al*., 2006) on a small firm's exploitative innovation performance, because excessive introduction of them moves a small firm towards more uncontrollability and chaos. This reduces the impact of new management practices to build further on a small firm's existing knowledge base (e.g.,

Davis, Eisenhardt, Bingham, 2009; Kanter, 1988; Volberda, 1996; Whittington and Pettigrew, 2003).

A large firm has compared to a small one reduced chances that the introduction of more new management practices increases its degree of uncontrollability and chaos in which it increasingly deviates from its existing knowledge base. A larger firm needs more new management practices to address its additional managerial challenges (Kimberly and Evanisko, 1981; Mol and Birkinshaw, 2009) which reduces or even may put aside the opportunities for 'overshooting' its managerial challenges with many new management practices. It also has a stronger tendency to and stronger forces to move more along its existing knowledge base (Hannan and Freeman, 1984; Nooteboom, 1994). Thus, we posit that the introduction of more new management practices involves less 'overshooting' of managerial challenges as firms increase in size which enable a large firm to benefit more than a small firm from complementary effects among them to utilize its existing knowledge aimed to increase exploitative innovation performance.

Furthermore, the more variety in and more advanced differentiation and specialization of the higher amount of knowledge (Damanpour, 1996; Moch and Morse, 1977; Voss and Voss, 2013) provide a larger firm, compared to a smaller one, with more opportunities to come up with new combinations of existing knowledge and to strengthen existing combinations between them (Galunic and Rodan, 1998; Grant, 1996; Penrose, 1959). This provides more opportunities for each new management practice to increase the utilization of a firm's knowledge base (Ahuja, Lampert, Tandon, 2008; Damanpour, 1992) which strengthens complementary effects among the introduction of more new management practices on a firm's exploitative innovation performance. Therefore, we derive the following hypothesis;

> *Hypothesis 2: An increase in organizational size moderates the increasingly positive relationship between more new management practices and a firm's exploitative innovation performance in such a way that it strengthens this relationship.*

4.3 Methods

Data collection

To empirically test our proposed relationships, we drew a random sample of ten thousand Dutch companies from REACH database. This database contains information of companies registered at the Dutch Chamber of Commerce. The sample covered a broad range of industries and was restricted to firms with at least 25 employees. A member of the senior management team of each those companies was invited to participate in the survey. As an incentive to participate and to further ensure that respondents provide reliable answers, respondents received a personalized analysis of their firm's position on multiple variables vis-à-vis industry and national averages. Data was collected by using a mixed mode (web-based and post) survey. After several reminders, we received 839 completed observations from a broad range of industries which is a response-rate of 8.4%. Industrial oriented firms such as active in the construction and steel industry represent 41% of our observations. Trade oriented firms such as wholesale and retailers and logistical companies represent 30% of our observations. The remaining percentage (29%) involves service oriented firms such as professional service and financial services firms. The average company is 31 years old and has 155 employees. The average respondent is 49 years old with an average tenure of 13 years at the organization. Data on organizational size was obtained from the REACH database.

Several tests were conducted to assess non-response bias. Based on independent sample T-tests, there were no significant differences ($p > 0.10$) between early and late respondents regarding our main constructs. Additionally, we found no significant difference ($p > 0.05$) between the average size of responding organizations and the average number of it in the REACH database (average logarithm of organizational size: 1.80; standard deviation: 0.90). These findings provide no indications for non-response bias.

We conducted multiple tests to assess common-method bias. By assuring respondents confidentiality and by asking every manager to return the questionnaire directly to the research team, we reduced the chances of common-method bias that can arise when respondents give their answers on the basis of social desirability, for example (Vaccaro *et al.*, 2012a). To further reduce the chances of common-method bias, we compared scores out of the perceptual scales with archival data if possible.

Moreover, a Harman's single factor test with our full model (independent, dependent and moderating variables) indicated that all items loaded on a single factor explain less than half of the variance (33%), suggesting that common-method bias is not a serious problem in this study (Podsakoff and Organ, 1986; Schilke, 2014).

To assess single-response bias, a second member of the senior management team was also asked to complete the survey. Seven percent of first-respondents also had a second-respondent. The inter-rater agreement scores (r_{wg}) based on intra-class correlation for the measures of new management practices and exploitative innovation performance indicated with values of respectively 0.48 ($p < 0.01$) and 0.49 ($p < 0.01$) a 'moderate' agreement between first and second respondent according to the scale of Landis and Koch (1977). Pearson correlation coefficient indicated consistent findings between the scores of the first and second respondent on new management practices ($r_{1,2} = 0.35$, $p < 0.01$) and on exploitative innovation performance ($r_{1,2} = 0.32$, $p < 0.05$) (Jones, Johnson, Butler, Main, 1983).

We assessed the construct validity of our main latent variables (new management practices and exploitative innovation performance) through exploratory factor analyses based on principal component analysis with varimax rotation. Two factors were identified with eigenvalues over Kaiser's criterion of 1 in which each item clearly loaded on its intended factor. Items had communalities larger than 0.3, dominant loadings were with at least 0.62 larger than the acceptable threshold of 0.5, and cross-loadings were not more than 0.20 which is within the acceptable limit of 0.3 (Briggs and Cheek, 1988; Field, 2009). This provides support for convergent and discriminant validity of our main latent measures (Briggs and Cheek, 1988).

Using AMOS 21, values out of a confirmatory factor analysis (CFA) (each item restricted to load on its proposed construct) based on maximum likelihood procedures (Hair *et al*., 2006) indicated that our model fits well with the data (χ^2 /df = 3.45 < 5; goodness-of-fit index (GFI) = 0.98 ≥ 0.90; comparative fit index (CFI) = 0.97 ≥ 0.90; root-mean-square error of approximation (RMSEA) = 0.05 < 0.08) (Bentler and Bonett, 1980). All factor loadings were above the 0.40 level as recommended by Ford, MacCallum and Tait (1986) and their loadings on the proposed indicators were significant ($p < 0.01$) which indicates convergent validity of our main latent measures (Anderson and Gerbing, 1988). A one-factor CFA-model provided a less acceptable fit of our model (χ^2 /df = 24.4; GFI = 0.82; CFI = 0.70; RMSEA = 0.17), suggesting discriminant validity of our main latent measures (Bagozzi and

Phillips, 1982). The Cronbach's α of our main constructs exceeded with at least 0.73 the threshold of 0.7, thereby indicating adequate reliability of our measures (Field, 2009).

To accurately measure linear and non-linear effects, we mean-centered a firm's score on new management practices and organizational size before squaring those scores (Aiken and West, 1991; Zhou and Wu, 2010). The highest VIF was 2.48 which is well below the rule of thumb of 10 (Neter, Wasserman, Kutner, 1990). Therefore, there are no indications of potential multicollinearity.

Measurement

Variables were operationalized by using existing scales. With the exception of organizational size we applied multi-item seven point perceptual scales, because managerial behaviour is often better captures by perceptual measures rather than with archival measures (Tsoukas and Chia, 2002).

Dependent variable. The scale to measure *exploitative innovation performance* ($\alpha = 0.73$), operationalized here as exploitative product and service innovation, was adapted from Jansen, Tempelaar, Van Den Bosch, and Volberda (2009). This scale measures the frequency of realized exploitative product and service innovations. For example, an item of this scale is "We regularly implement small adaptations to existing products and services". The Appendix provides an overview of the main constructs. Following Jansen *et al.* (2009) we calculated the correlation between exploitative innovation performance and percentage of turnover, over the past three years, of extensively improved products and services. This correlation was significant ($r = 0.20$, $p < 0.001$) which strengthens the reliability of our measure for exploitative innovation performance.

Independent and moderating variable. To measure the amount of *new management practices* ($\alpha = 0.82$), i.e. management innovation, we applied the scale of Vaccaro *et al.* (2012a) which is based on an encompassing definition of it provided by Birkinshaw *et al.* (2008). An example of an item is: "Rules and procedures within our organization are regularly renewed". Item one and two of this scale relate to management practices, items three and four relate to management processes, and items five and six relate to structure (Vaccaro *et al.*, 2012a). An advantage of this more encompassing scale is that it is not bounded to a specific example of a new

management practice (Vaccaro *et al*., 2012a). Following Zhou and Wu (2010) we calculated the linear and quadratic term of the amount of a firm´s new management practices to measure an increasingly positive effect.

Among the most frequently used measure for *organizational size* is the number of employees (Camisón-Zornoza *et al*., 2004). In line with other scholars (e.g., Kimberly and Evanisko, 1981; Vaccaro *et al*., 2012a), we measured this construct by the logarithm of number of employees in full-time equivalent. In line with Schilke (2014) and Zhou and Wu (2010) we also included higher order effects by controlling for the moderating role of higher levels of organizational size. Controlling for higher order effects reduces the chances for type I and II errors when examining moderating effects (Agustin and Singh, 2005; Ganzach, 1997).

Control variables. Older organizations are associated with cultural inertia (Voss and Voss, 2013) and firm size is often accompanied by firm age (e.g., Voss and Voss, 2013). Therefore, *firm age* was included, measured by the number of years since its founding. Data on a firm's age was obtained from the REACH Database. The size of a top management team can influence a firm's innovation performance by influencing its search patterns for knowledge (Heyden, Van Doorn, Reimer, Van Den Bosch, Volberda, 2013; Siegel and Hambrick, 2005). Thus, the *size of top management team*, measured by the number of managers in the senior management team, was also included. Environmental dynamism influences a firm's exploitative innovation performance (e.g., Benner and Tushman, 2003; Crossan and Apaydin, 2010; Jansen *et al*., 2006), for instance by the degree to which a firm can continue to build further on its knowledge base and existing processes (e.g., Posen and Levinthal, 2012; Volberda, 1996). Accordingly, we included *environmental dynamism* (α = 0.78) by applying the scale of it from Jansen *et al.* (2006). An important topic in this study is on the role organizational size as a proxy for a firm's organizational complexity. However, environmental complexity is also considered to be an important contextual variable in the setting of new management practices and a firm's outcomes, for instance because of the number of external aspects that need to be taken into account to align various organizational activities with in order to successfully realize different types of innovation (Davis *et al*., 2009; Grant, 2008; Siggelkow and Rivkin, 2005). *Environmental complexity* (α = 0.68) is another control variable measured by adapting the scale of Fuentes-Fuentes, Albacete-Saéz and Lloréns-Montes (2004) which is based on Miller's (1988) conceptualization of the construct. Organizational size is

stronger associated with innovation in certain industries than in others (Damanpour, 1992; Camisón-Zornoza *et al*., 2004). Accordingly, we included industry effects as a control variable by including *industrial oriented firms* and *trade oriented firms* in the analyses in which service oriented firms represent the non-specified industry dummy.

4.4 Analyses and results

Table 4.1 presents means and standard deviations of the constructs and correlations among them. The second Table in this study presents several regression analyses based on ordinary least squared analyses. Model I includes the effect of control variables on a firm's exploitative innovation performance. Model II adds the effect of new management practices to the first model. Model III expands the second model by including organizational size as a moderating variable. The F change statistic concerning Model II and III is significant ($F_{(4,\ 824)} = 2.08$, $p < 0.10$), suggesting that the 0.01 increase in R-square is statistically significant (Weinberg and Abramowitz, 2002): the interaction effects between new management practices and organizational size contribute to explain a firm's exploitative innovation performance.

Building on the work of Kimberly and Evanisko (1981) and Mol and Birkinshaw (2009), we conducted mediation analyses (Baron and Kenny, 1986) to examine whether the amount of new management practices could be a mediator in a relationship between organizational size and a firm's exploitative innovation performance. Model II points out that organizational size ($\beta = 0.00$, $p > 0.10$) and higher levels of it ($\beta = 0.04$, $p > 0.10$) do not have a significant effect on exploitative innovation performance. An additional regression analysis ($F= 13.75$ ($p <0.001$); $R^2 = 0.12$; $\Delta R^2 = 0.11$) similar to Model II, but without new management practices, indicate that organizational size ($\beta = 0.00$, $p > 0.10$) and higher levels of it ($\beta = 0.04$, $p > 0.10$) also do not have a significant effect on exploitative innovation performance. These findings suggest that the amount of new management practices do not mediate a relationship between organizational size and exploitative innovation performance.

Table 4.1: Means, standard deviations, and correlations.[6]

	Mean	St. dev.	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
(1) Innovation performance	5.21	0.95	1.00								
(2) New management practices	3.49	1.15	0.24***	1.00							
(3) Organizational size [5]	1.77	0.51	0.01	0.07†	1.00						
(4) Firm age	30.90	27.93	-0.04	-0.08*	0.16***	1.00					
(5) Size top management team	5.86	5.20	0.06†	0.12***	0.20***	0.06†	1.00				
(6) Environmental dynamism	4.28	1.20	0.22***	0.19***	-0.06†	-0.11**	-0.03	1.00			
(7) Environmental complexity	4.30	1.10	0.34***	0.29***	0.02	-0.02	0.05	0.41***	1.00		
(8) Industrial oriented firms	0.41	0.49	-0.06†	-0.11***	0.07*	0.25***	-0.02	-0.08*	-0.11**	1.00	
(9) Trade oriented firms	0.30	0.46	0.05	0.03	-0.06†	0.03	-0.03	0.00	0.08*	-0.55***	1.00

***: $p < 0.001$
**: $p < 0.01$
*: $p < 0.05$
†: $p < 0.10$

New management practices and organizational size are not yet mean-centered in this table.

[5] Organizational size is measured by the logarithm of the number of full-time employees.
[6] n = 839

Table 4.2: Results of hierarchical regression analyses: Effect of new management practices and organizational size on a firm's exploitative innovation performance.

Model	I		II		III	
Dependent variable	Exploitative innovation performance					
Independent variables:						
New management practices			0.14	***	0.14	***
			(0.03)		(0.03)	
New management practices squared			0.10	**	0.08	*
			(0.02)		(0.02)	
Organizational size			0.00		-0.06	
			(0.07)		(0.08)	
Organizational size squared			0.04		-0.02	
			(0.06)		(0.09)	
Moderating effects:						
New management practices x Organizational size					0.00	
					(0.06)	
New management practices x (Organizational size)^2					-0.02	
					(0.06)	
(New management practices)^2 x Organizational size					0.10	*
					(0.04)	
(New management practices)^2 x (Organizational size)^2					0.11	*
					(0.05)	
Control variables:						
Firm age	-0.03		-0.02		-0.02	
	(0.00)		(0.00)		(0.00)	
Size top management team	0.04		0.01		0.02	
	(0.01)		(0.01)		(0.01)	
Environmental dynamism	0.10	**	0.08	*	0.07	†
	(0.03)		(0.03)		(0.03)	
Environmental complexity	0.28	***	0.25	***	0.26	***
	(0.03)		(0.03)		(0.03)	
Industrial oriented firms	0.01		0.03		0.03	
	(0.08)		(0.08)		(0.08)	
Trade oriented firms	0.04		0.05		0.06	
	(0.08)		(0.08)		(0.08)	
F	18.00	***	13.97	***	10.62	***
R^2	0.11		0.14		0.15	
Adjusted R^2	0.11		0.13		0.14	

n = 839; standardized coefficients are described.

Values between parentheses are standard errors.

***: $p < 0.001$; **: $p < 0.01$; *: $p < 0.05$; †: $p < 0.10$

Our first hypothesis is supported by our data; the amount of new management practices has an increasingly positive relationship with a firm's exploitative innovation performance. Our results indicate that new management practices have a positive relationship with exploitative innovation performance (β = 0.14, $p < 0.001$) and the effect of higher levels of new management practices on a firm's exploitative innovation performance is also significant and positive (β = 0.08, $p < 0.05$).

To plot the effect of new management practices on a firm's exploitative innovation performance, we differentiated the scores on new management practices into three groups: low level (lower score than average minus one standard deviation as upper limit), high level (higher score than average plus one standard deviation as under limit) and intermediate (remaining observations). For each level of new management practices we calculated the mean scores on a firm's exploitative innovation performance. As can be seen in Figure 4.1A, new management practices have an increasingly positive relationship with a firm's exploitative innovation performance which supports hypothesis 1.

However, our findings do not support hypothesis 2; an increase in organizational size does not moderate the increasingly positive relationship between more new management practices and a firm's exploitative innovation performance in such a way that it strengthens this relationship. Analyses of our data indicate that an increase in organizational size does not significantly strengthen the relationship between new management practices and a firm's exploitative innovation performance (β = 0.00, $p > 0.10$). However, organizational size significantly strengthens the positive relationship between higher levels of new management practices and a firm's exploitative innovation performance (β = 0.10, $p < 0.05$). Interestingly to note is that higher levels of organizational size also significantly strengthens (β = 0.11, $p < 0.05$) this relationship (see also Model III in Table 4.2).

To plot the moderating effect of organizational size on the relationship between new management practices and a firm's exploitative innovation performance, we distinguished between small organizations (less than average minus one standard deviation as upper limit) and large organizations (more than average plus one standard deviation as under limit). We calculated the average score on a firm's exploitative innovation performance for each combination of the level of new management practices and organizational size. As can be seen in Figure 4.1B, smaller firms have a

Figure 4.1A: Effect of new management practices on exploitative innovation performance.

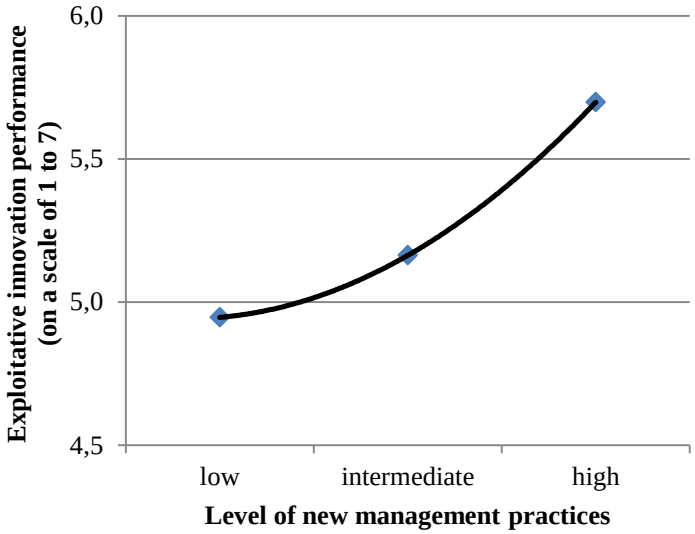
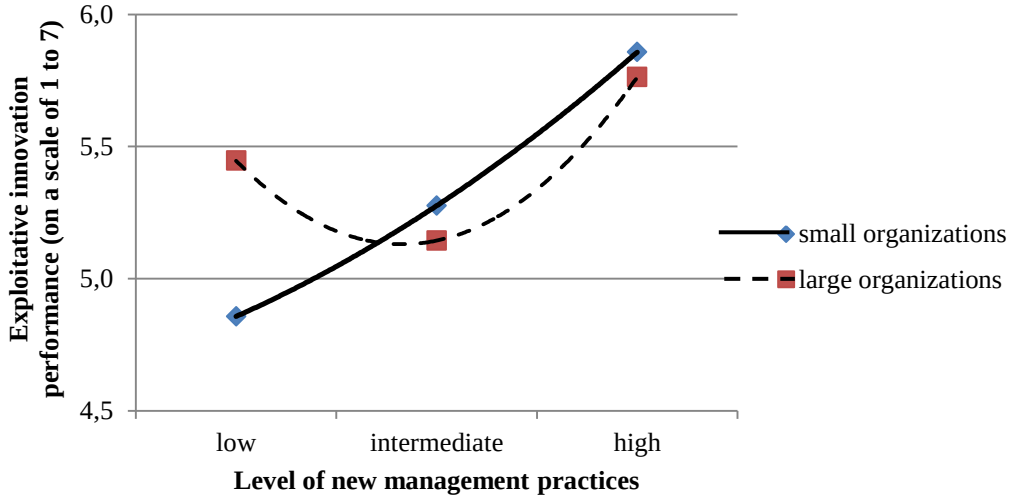


Figure 4.1B: Interaction effect between new management practices and organizational size on exploitative innovation performance.



seemingly linear relationship between new management practices and a firm's exploitative innovation performance (see solid line in Figure 4.1B), while this relationship has characteristics of a J-shaped relationship in the case of large firms (see dotted line in Figure 4.1B). These findings highlight that organizational size is an important contextual factor in the relationship between new management practices and a firm's exploitative innovation performance.

4.5 Discussion and conclusion

Managers have a crucial role to turn knowledge into a competitive advantage (e.g., Roberts, 2004; Sirmon *et al*., 2011), but questions on how new management practices - as a generic construct -contribute to a firm's exploitative innovation performance are largely unanswered. We advance our understanding how new management practices contribute to a firm's exploitative innovation performance in two main ways.

First, we contribute to the innovation literature and in particular on new management practices by advancing our understanding how new management practices contribute to a firm's exploitative innovation performance. Our findings indicate that new management practices have an increasingly positive effect on a firm's exploitative innovation performance. The introduction of more new management practices contributes at an accelerating rate to a firm's exploitative innovation performance by increasing the utilization of its knowledge base at an increasing rate.

Volberda *et al.* (2013, p. 12) have stated that "[f]uture research should examine whether management innovation should be considered and measured as a generic construct or based on specific types of management innovation". An encompassing definition of new management practices enables an examination of complementary effects among new management practices on a firm's exploitative innovation performance. The implications of a non-linear effect of new management practices on a firm's exploitative innovation performance are twofold. On the one hand, we complement scholars (e.g., Benner and Tushman, 2002; Mol and Birkinshaw, 2009; Walker *et al*., 2011) who have focused on a linear relationship between new management practices and firm performance, or between a specific example of a new management practice and a firm's exploitative innovation performance. An examination of linear effects in the context of the introduction of

more new management practices "may be misleading", because of complementary relationships among them (Bloom *et al.*, 2010, p. 129). On the other hand, by examining its effect on a firm's exploitative innovation performance, we complement management scientists who have examined complementary effects among new management practices on firm performance (e.g., Roberts, 2004; Whittington *et al*., 1999), on radical product and service innovations (Laursen and Foss, 2003), or on the introduction of more new management practices (e.g., Battisti and Iona, 2009; Bloom *et al*., 2010). This implies that complementary effects among new management practices are beneficial for multiple types of a firm's performance indicators.

Second, we advance our understanding how the relationship between new management practices and a firm's exploitative innovation performance is influenced by organizational size as a proxy for organizational complexity. Our findings indicate that the relationship between new management practices and a firm's exploitative innovation performance is positive in small firms (see solid line in Figure 4.1B), while this relationship has characteristics of a J-shaped relationship in the case of large firms (see dotted line in Figure 4.1B). These findings suggest that one needs to consider the extent of the new practices introduced when comparing the accelerating positive effect of new management practices on the exploitative innovative innovation performance on firms of varying sizes. As can be seen in Figure 4.1B, the main difference between small and large firms with respect to the slope of the effect of new management practices on a firm's exploitative innovation performance is at low levels of new management practices.

A potential explanation why an increase in organizational size decreases the positive effect of lower levels of new management practices on a firm's exploitative innovation performance may be that larger firms have compared to small ones an increased threat that they more 'undershoot' their additional managerial challenges with the introduction of lower levels of new management practices. The introduction of lower levels of new management practices without the introduction of their complementary new management practices may decrease the returns out of them (Ichniowski *et al*., 1997; Pettigrew and Whittington, 2003; Whittington *et al*., 1999) as firms increase in size, because of their lower levels of flexibility (Nooteboom, 1994), more dispersed goals and resource allocation (Baldrigde and Burnham, 1975) and strong interaction effects (e.g., Birkinshaw *et al*., 2008; Bloom *et al*., 2010) within a larger and more complex set of management practices (e.g., Hamel, 2011; Mol and

Birkinshaw, 2009; Sterman *et al*., 1997). Such an initial decrease has also been referred to as "partial implementation" (Whittington *et al*., 1999, p. 597) or as "playing an incomplete game" (Siggelkow, 2001, p. 842). Because of those strong interaction effects, lower levels of new management practices may also reduce "the smooth internal workings of the configuration" (Whittington and Pettigrew, 2003, p. 127) of existing management practices and operational processes (e.g., Ennen and Richter, 2010; Pettigrew and Whittington, 2003; Siggelkow, 2001) for realizing exploitative innovation performance (Benner and Tushman, 2002) as firms increase in size. For instance, in settings characterized by less flexibility, more dispersed goals and resource allocation, and a larger set and more complex nature of management practices related to larger firms, the introduction of new total quality management practices related to production without those related to other parts of the organization like in HRM, purchasing, monitoring, logistics and customer service activities is likely to decrease the value of the new ones in production and to reduce the value of existing configurations of management practices.

Additionally, with the introduction of low levels of new management practices, a small firm may benefit relatively more than a large firm from increasing the efficiency of use of its existing knowledge base to improve its exploitative innovation performance. Small firms are compared to large ones more associated with higher levels of flexibility and creativity which decreases their tendency to build further on their existing knowledge base (Hannan and Freeman, 1984; Nooteboom, 1994). New management practices are associated with increasing the effectiveness and efficiency of organizational processes and outcomes (e.g., Benner and Tushman, 2002; Mol and Birkinshaw, 2009; Walker *et al.*, 2011). However, future research should examine this phenomenon into more detail.

With our finding concerning this non-linear moderating effect of organizational size on the relationship between new management practices and a firm's exploitative innovation performance we contribute to address the plea of Volberda, Van Den Bosch, and Mihalache (2014, p. 1259) to conduct more research on "contextual variation of management innovation". To our best knowledge we are among the first to explicitly highlight that one needs to consider the extent of the new practices introduced when comparing the accelerating positive effect of new management practices on the exploitative innovative innovation performance on firms of varying sizes.

Management scientists have considered organizational size as an antecedent of new management practices (Kimberly and Evanisko, 1981; Mol and Birkinshaw, 2009), have argued that new management practices apply less to small firms (Benner and Tushman, 2003; Gruber and Niles, 1974), or have not explicitly focused on the role of organizational size in the relationship between new management practices and firm outcomes (e.g., Massini and Pettigrew, 2003; Whittington *et al*., 1999). Our findings suggest that organizational size is a contextual factor in the relationship between new management practices and exploitative innovation performance. Moreover, we highlight that the introduction of new management practices is also beneficial for small firms to increase their exploitative innovation performance. Another implication of this paper is that the focus of prior research on either a positive linear relationship (e.g., Benner and Tushman, 2003; Mol and Birkinshaw, 2009; Walker *et al*., 2011) or a J-shaped relationship between new management practices and a firm's outcomes (e.g., Massini and Pettigrew, 2003; Roberts, 2004; Whittington *et al*., 1999) seem to apply more to small firms and large firms respectively when exploitative innovation performance denotes a firm's outcomes.

Based on findings in this paper, managers should realize many new management practices to increase or maintain their firm's exploitative innovation performance. However, they should also be aware that organizational size in an important contextual variable in this relationship. In particular managers of a large firm whose starting point is lower levels of new management practices should bear in mind that they need to introduce many new management practices to avoid being stuck at lower levels of their firm's exploitative innovation performance (see also dotted line in Figure 4.1B).

Limitations and suggestions for future research

In spite of these contributions, this paper has various limitations that deserve directions for future research. First, we have examined the relationship between new management practices and a firm's exploitative innovation performance, i.e. exploitative product and service innovations. Besides exploitative innovation, firms have to be sufficiently involved in exploratory innovation as well in order to survive on the long run (Levinthal and March, 1993; March, 1991). Future research should further examine how new management practices are related to the amount of exploratory product and service innovations.

Second, we have focused on low versus high levels of new management practices. Besides levels, the degree of interdependencies among new management practices is important for their joint impact on a firm's outcomes (e.g., Rivkin and Siggelkow, 2003; Whittington *et al*., 1999; Whittington and Pettigrew, 2003), as has been touched upon in the potential explanation for the moderating role of organizational size in that relationship. Future research should examine into more detail how interdependencies among different new management practices and between new and existing management practices contribute to a firm's exploitative innovation performance.

Third, we have focused on organizational size as a proxy for organizational complexity. However, small firms can collaborate with each other to imitate advantages of larger firms (Nooteboom, 1994). Further research should extend our research model by taking into account to what extent collaborations among small firms influence the moderating effect of organizational size on the relationship between new management practices and exploitative innovation performance.

Fourth, we have not explicitly examined the role of risks and time in our model. Besides a cross-sectional survey, time may also influence our model from a theoretical perspective. The simultaneous introduction of multiple new management practices is important to overcome 'piecemeal changes' and to increase the value of each new management practice. However, it is also very challenging to do so (e.g., Hamel, 2006; Miller and Friesen, 1982; Whittington and Pettigrew, 2003) and it takes time before the benefits of new management practices pay off, if they pay off (Damanpour *et al.,* 2009; Roberts, 2004; Whittington and Pettigrew, 2003). Future research should examine with longitudinal case studies how time and risks influence our model.

Overall, we contribute to a richer understanding how new management practices contribute to a firm's exploitative innovation performance. New management practices have an increasingly positive effect on a firm's exploitative innovation performance. However, the larger the firm, the more this relationship moves from a positive linear relationship to one that is more J-shaped. These findings shed a new light on how new management practices contribute to a firm's exploitative innovation performance and highlight that organizational size is an important contextual variable in this relationship.

4.6 Appendix: Measures and items at firm level

Exploitative innovation performance, i.e. exploitative product and service innovations (adapted from Jansen *et al*., 2009)

We regularly implement small adaptations to existing products and services.
We improve our provision's efficiency of products and services.
We increase economies of scale in existing markets.
Our organization expands services for existing clients.

New management practices, i.e. management innovation
(adapted from Vaccaro *et al*., 2012a)

Rules and procedures within our organization are regularly renewed.
We regularly make changes to our employees' tasks and functions.
Our organization regularly implements new management systems.
The policy with regard to compensation has been changed in the last three years.
The intra- and inter-departmental communication structure within our organization is regularly restructured.
We continuously alter certain elements of the organizational structure (*item removed after factor analyses*).

CHAPTER 5. Study IV: How does co-creation with customers influence exploitative and exploratory innovation? The moderating role of connectedness within an organization *

* This study will be submitted to an international scientific journal. An abridged version (6-page Best Paper) of this study is published as: Heij, C.V., Volberda, H.W., & Van Den Bosch, F.A.J. (2015). How does co-creation with customers influence innovation performance? The role of connectedness. In J. Humphreys (Ed.), *Best Paper Proceedings of the Seventy-fifth Annual Meeting of the Academy of Management*.

CHAPTER 5. Study IV: How does co-creation with customers influence exploitative and exploratory innovation? The moderating role of connectedness within an organization

Abstract *Co-creation with customers is considered to be an important source of competitive advantage. However, prior research has provided mixed results to what extent it increases innovation performance and mainly included the role of formal coordination mechanisms within an organization in it. To address these gaps in the co-creation literature, we examine how co-creation with customers, conceptualized as relationship learning, influences exploitative and exploratory innovation and how these effects depend on an important informal coordination mechanism among members within an organization: connectedness. Based on a survey among Dutch healthcare organizations providing care services, our findings indicate that relationship learning with customers has an inverted U-shaped effect on exploitative innovation, while its effect on exploratory innovation is positive. Connectedness flattens the negative effect of higher levels of relationship learning with customers on exploitative innovation. These findings contribute to an increased understanding how co-creation with customers contribute to an organization's innovation performance.*

Keywords: co-creation; relationship learning; customers; users; exploitative innovation; exploratory innovation.

5.1 Introduction to study IV

Increased pace of change and more intense competition in many of today's markets force organizations to co-create with external partners to realize product and service innovations (e.g., Chesbrough, 2003; Vanhaverbeke, Van de Vrande, Chesbrough, 2008) and to put a stronger emphasis on the customer perspective (e.g., Prahalad and Ramaswamy, 2004; Teece, 2010; Vargo and Lusch, 2008). The majority of prior research on co-creation has focused on interactions between organizations or with universities to increase a focal organization's innovation performance (Chatterji and Fabrizio, 2014). Co-creation with customers has recently received increased attention as a source of competitive advantage (e.g., Griffin *et al.*, 2013; Prahalad and Ramaswamy, 2004), but scholars have provided mixed arguments and findings how co-creation with customers influences organizational performance (e.g., Atuahene-Gima, Slater, Olson, 2005; Cadogan, Kuivalainen, Sundqvist, 2009; Hamel and

Prahalad, 1994; Rindfleish and Moorman, 2001). Co-creation can take place in various ways (e.g., O'Hern and Rindfleisch, 2010; Payne, Storbacka, Frow, 2008) of which relationship learning, i.e. information sharing, joint sense-making, and relation-specific memory (e.g., Selnes and Sallis, 2003; Wang and Hsu, 2014), has recently received considerable attention in the literature to be an important source of competitive advantage (Jean, Sinkovics, Kim, 2010). This study focuses on two gaps in the co-creation literature.

First, the literature is remarkably scarce on how relationship learning with customers contributes to exploitative and exploratory product and service innovations by applying perspectives of both the degree of relational embeddedness and of heterogeneity of the knowledge bases between them. Those scholars having examined the effect of relationship learning on innovation outcomes have mainly focused on co-creation with external partners in general (e.g., Fang, Fang, Chou, Yang, Tsai, 2011; Foss, Lyngsie, Zahra, 2013; Laursen and Salter, 2006; Wang and Hsu, 2014) and/or have not differentiated between exploitative and exploratory innovations (e.g., Chen, Lin, Chang, 2009; Foss, Laursen, Pedersen, 2011; Kang and Kang, 2010). Co-creation with different types of external partners provides access to different kinds of knowledge (Foss *et al.*, 2013; Tsai, 2009) and has a different impact on product and service innovations (Kang and Kang, 2010; Millson, 2015). Moreover, several management scientists (e.g., Danneels, 2003; Holmqvist, 2003; Uzzie, 1997) have contributed to explain conflicting arguments of the role of co-creation on organization performance by pointing out that relational embeddedness, i.e. tight couplings, and heterogeneity of knowledge bases are both beneficial and detrimental for organizational performance. However, prior research (e.g., Chatterji and Fabrizio, 2014; Chen *et al.*, 2009; Wang and Hsu, 2014) having examined the effect of relationship learning with customers on an organization's innovation performance has mainly applied the perspective of the beneficial effect of having access to the customer's knowledge base.

Second, prior research has largely unanswered the question how the effect of relationship learning with customers on innovation outcomes, i.e. exploitative and exploratory innovations, is influenced by the level of connectedness among members within an organization. Several researchers (e.g., Foss *et al.*, 2011, 2013; Herington, Johnson, Scott, 2006; Takeiski, 2001) have scrutinized how formal coordination mechanisms like decentralization and cross-functional interaction leverage the impact

of co-creation on an organization's outcomes. By doing so, they largely leave aside the important role of informal coordination mechanisms to realize exploitative and exploratory innovations (Chen, Li, Lin, 2013; Jansen, Van Den Bosch, Volberda, 2006; Lechner and Kreutzer, 2010). Jansen *et al.* (2006, p. 1670) stated that "informal coordination mechanisms (i.e., connectedness) are more important than formal coordination mechanisms (centralization and formalization) in predicting both types [i.e., exploitative and exploratory] of innovation". Connectedness involves informal direct relationships among organizational members (Beekun and Glick, 2001; Jaworksi and Kohli, 1993) and its role on exploitative and exploratory innovation has been studied at various levels of analysis within an organization (e.g. Jansen *et al*., 2006; Jansen, Tempelaar, Van Den Bosch, Volberda, 2009; Lechner and Kreutzer, 2010). This brings us to the following central research question: *How does relationship learning with customers contribute to exploitative and exploratory innovation and how does connectedness within an organization moderate this relationship?*

By addressing this research question, we contribute to existing co-creation literature in two main ways. First, we advance our understanding how relationship learning with customers influences exploitative and exploratory innovation by applying perspectives of both the degree of relational embeddedness and of heterogeneity of the knowledge bases between them.

Second, we provide new insights how connectedness as an informal coordination mechanism within an organization moderates the effect of relationship learning with customers on exploitative and exploratory innovation. By doing so, we reduce the lack of research in the co-creation literature on the role of internal coordination mechanisms (Chen *et al*., 2013; Foss *et al*., 2011; Gittell and Weiss, 2004) and in particular on the role of connectedness as an informal coordination mechanism (e.g., Chen *et al*., 2013; Lechner and Kreutzer, 2010) in it.

In the next section we will review existing literature to examine how relationship learning with customers influences exploitative and exploratory innovation, and how connectedness moderates these relationships. This results in four hypotheses. After the methodological and empirical section we discuss the major implications and limitations of our study and we provide suggestions for future research.

5.2 Literature review and hypotheses

Relationship learning can be defined as "a joint activity between a supplier and a customer in which the two parties share information, which is then jointly interpreted and integrated into a shared relationship-domain-specific memory that changes the range or likelihood of potential relationship-domain-specific behaviour" (Selnes and Sallis, 2003, p. 80). A relation-specific memory is also known as knowledge integration between an organization and its customers (Fang *et al.*, 2011; Selnes and Sallis, 2003). The resulting knowledge resides outside the borders of the involved partners, but within the relationship and it enables the involved partners to learn more about which activities should be conducted and how to do so (Selnes and Sallis, 2003; Wang and Hsu, 2014). For instance, relationship learning with clients in the healthcare industry takes place, amongst others, at meetings between organizational members of a healthcare provider and client boards, or during conversations with clients when organizational members provide care services. Accordingly, relationship learning goes beyond the focus of prior research (e.g., Christensen and Bower, 1996; Hamel and Prahalad, 1994) on listening to customers which "result in only incremental product improvements […] if managers passively accept customer input and do not subject it to further evaluation" (Sethi, Smit and Park, 2001, p. 78).

Following prior research (e.g., Foss *et al.*, 2011; Von Hippel, 2005, 2009) we focus on end users as customers. End users directly benefit from a product or service innovation, but an organization indirectly benefits from it: it needs to sell the new product or service to make a profit (Von Hippel, 2009). Adequate levels of both exploitative and exploratory product and service innovations are pivotal for an organization's survival on the short run and on the longer run (e.g., Benner and Tushman, 2002; Levinthal and March, 1993). Earlier studies have often considered a trade-off between exploitative and exploratory innovation as a given, but more recent work has described how organizations can combine these two basic types of innovation simultaneously, either within or beyond the boundaries of an individual organization (e.g., Jansen *et al.*, 2006; Raisch, Birkinshaw, Probst, Tushman, 2009).

Exploitative product and service innovations build further on an organization's existing knowledge base and focus more on its current customers (Benner and Tushman, 2002; Danneels, 2003; Voss and Voss, 2013). It involves a

refinement and extension of an organization's existing knowledge base and a more efficient use of it to improve existing designs, to expand its offering (Benner and Tushman, 2002; Jansen *et al.*, 2006) and to "retain and increase purchases from current customers" (Voss and Voss, 2013, p. 1460). For instance, the Dutch healthcare organization DLW has expanded its number of locations in surrounding villages which provide similar care services and build further on the knowledge base and experience of the established location. In the remainder of this study we refer to customers as current customers, unless otherwise specified.

Exploratory product and service innovations are more radical innovations reflecting a shift to a new technological trajectory and focussing more on new customers (Benner and Tushman, 2002; Danneels, 2003; Voss and Voss, 2013). It requires new knowledge, the development of new designs and new markets (Benner and Tushman, 2002; Danneels, 2004; Jansen *et al.*, 2006) and it is more associated with experimentation, risk taking, variation, and flexibility (Benner and Tushman, 2002; March, 1991). For instance, DLW has introduced new care services to serve people with more intensive care needs and it has introduced new day and welfare activities to attract people living in the vicinity of the care location.

Exploitation, exploration and retention of knowledge are considered to be pivotal in the context of co-creation (Bierly, Damanpour, Santoro, 2009; Lichtenthaler and Lichtenthaler, 2009). An organization and its customers have different, heterogeneous knowledge bases (Danneels, 2003; Vargo and Lusch, 2008; Von Hippel, 1998). An organization has more knowledge on how to realize a specific solution and talks about specifications and features, while customers have more knowledge about their context, needs, preferences or about what they consider as important product characteristics (Chatterji and Fabrizio, 2014; Griffin *et al.*, 2013; Von Hippel, 2009). A stronger overlap between their knowledge bases increases an organization's ability to identify, select, and integrate customer knowledge in its knowledge base (Cohen and Levinthal, 1990; Jean, Sinkovics, Kim, 2012; Koput, 1997). However, a lower degree of heterogeneity between their knowledge bases involves lower benefits, because the obtained knowledge out of it is more redundant and contains fewer valuable new or additional insights to the focal organization (Gilsing, Nooteboom, Vanhaverbeke, Duysters, Van den Oord, 2008; Holmqvist, 2003; Salge, Farchi, Barrett, Dopson, 2013).

Besides these contradictory forces related to the perspective of the degree of heterogeneity of the knowledge bases between an organization and its customers, various scholars (e.g., Andriopoulos and Lewis, 2009; Danneels, 2003; Uzzie, 1997) have argued for the beneficial and detrimental sides of relational embeddedness with customers. This has also been referred to as the 'paradox of embeddedness' (e.g., Meuleman, Lockett, Manigart, Wright, 2010; Uzzie, 1997). Stronger ties between an organization and its customers involve more motivation, trust, and experience to exchange more complex and rich knowledge and to do so in a more efficient way (Bonner and Walker, 2004; Lengnick-Hall, Claymonb, Inks, 2000; Meuleman *et al*., 2010). These stronger ties are needed to address customer needs aimed to "foster client satisfaction and loyalty" (Andriopoulos and Lewis, 2009, p. 701), but they also narrow an organization's market view and inhibit experimentation (Andriopoulos and Lewis, 2009; Danneels, 2003; Uzzie, 1997).

Relationship learning with customers and exploitative innovation

Relationship learning with customers provides an organization additional knowledge on the application of its products and services by its customers (Foss *et al*., 2013; Visnjic and Van Looy, 2013) and on their needs, preferences and context in its existing markets (e.g., Bonner and Walker, 2004; Pine, Peppers, Rogers, 1995). Such additional knowledge increases exploitative innovation (Foss *et al.*, 2013) by refining products and services to better align them with their application and customer needs, preferences and context (Bonner and Walker, 2004; Danneels, 2003; Wilkinson and Young, 2002).

Additionally, relationship learning provides an organization with learning effects and economies of scale in their relationship with customers (Kalwani and Narayandas, 1995; Meuleman *et al.*, 2010; Ritter, Wilkinson, Johnston, 2004) which are instrumental to realize exploitative innovations (Benner and Tushman, 2002; Jansen *et al*., 2006). Such tighter couplings increase the efficiency of knowledge exchange between them in which an organization is better able to detect and select customer knowledge (Holmqvist, 2003; Uzzie, 1997) required to realize exploitative innovation (Bonner and Walker, 2004; Ulaga and Eggert, 2006). Knowledge exchange is also needed to better plan and coordinate their relationship (Dyer and Singh, 1998; Meuleman *et al.*, 2010; Selnes and Sallis, 2003) to increase an organization's own operational efficiency (e.g., Anderson and Narus, 1990; Voss, Sirdeshmukh, Voss,

2008) which is a hallmark of exploitative innovation (e.g., Benner and Tushman, 2002; Jansen *et al*., 2006; Voss and Voss, 2013).

However, we argue that a positive effect of relationship learning with customers on exploitative innovation holds op to a certain point. At higher levels of relationship learning, an organization and its customers are better able to integrate their knowledge and experiences. However, there are not many benefits of learning together, because of more symmetry in their knowledge and experience bases (e.g., Bierly *et al.*, 2009; Cohen and Levinthal, 1990; Holmqvist, 2003). Once the most "fruitful" combinations between their knowledge bases are found, then there remain few fruitful combinations left (Laursen, 2012, p. 1200; Rosenkopf and Nerkar, 2001; Salge *et al*., 2013) to reveal additional customer knowledge for an organization to realize exploitative innovation (Chatterji and Fabrizio, 2014; Tsai, 2009).

Furthermore, the increased complexity of the relationship at higher levels of relationship learning (Vargo and Lusch, 2008; Wilkinson and Young, 2002) makes it increasingly difficult and may exceed the limits for an organization to filter, integrate and capitalize knowledge out of it (Hodgkinson, Hughes, Hughes, 2012; Koput, 1997). This reduces an organization's ability to adequately fulfil customer needs and to realize exploitative innovations based on customer knowledge (e.g., Cadogan *et al*., 2009; Jones and Sasser, 1995; Laursen, 2012). Based on these arguments, we expect that;

> *Hypothesis 1: Relationship learning with customers has a curvilinear (inverted U-shaped) effect on exploitative innovation.*

Relationship learning with customers and exploratory innovation

Relationship learning provides an organization access to new and different customer knowledge and experiences (Foss *et al.*, 2011; Holmqvist, 2003; Jean *et al*., 2012) and new knowledge is created (Bierly *et al.*, 2009; Foss *et al.*, 2013; Wilkinson and Young, 2002). This involves new knowledge fundamental to develop and to select new products and services aimed to address unmet customer needs (O'Hern and Rindfleisch, 2010) and new knowledge needed to overcome problems in the realization of it (Bierly *et al.*, 2009; Foss *et al.*, 2013; Von Hippel, 2009). Access to more new knowledge (Bierly *et al.*, 2009; Chesbrough, 2010b) and new knowledge which challenges an organization's existing beliefs and core assumptions drives the

realization of exploratory product and service innovations (e.g., Benner and Tushman, 2002; Forsman, 2009; Holmqvist, 2003) and enables an organization to sell those new solutions to other customers, including non-customers (Chesbrough, 2010b; Voss and Voss, 2013).

Furthermore, relationship learning enables an organization to use its customers as a linking pin with non-customers where it does not have direct connections with or knowledge about (e.g., Adler and Kwon, 2002; Howells, 2006; Gulati, Nohria, Zaheer, 2000). This enables an organization to realize new products and services and to sell them to new customers, i.e. exploratory innovations, in two ways. On the one hand, such indirect connections with non-customers provides an organization access to new knowledge from them, about them and why they are not yet a customer. Access to such new knowledge and a richer understanding of it enable an organization to develop new products and services out of it, i.e. exploratory innovations, and to realize a more effective marketing and sales strategy in order to attract those non-customers (Castleberry and Shepherd, 1993; Chatterji and Fabrizio, 2014; Gilsing *et al*., 2008). On the other hand, an organization's customers also contribute to a wider dissemination of knowledge about its offering, including about new product and services, to non-customers (Chistopher, Payne, Ballantyne, 1991; Hienerth and Lettl, 2011), for instance by referring and recommending it to them (Chatterji and Fabrizio, 2014; Hallowell, 1996), e.g. word-of-mouth processes to attract new customers (e.g., Villanueva, Yoo, Hanssens, 2008).

However, we argue that beyond a certain point of relationship learning with customers, its positive effect on exploratory innovation decreases. Higher levels of symmetry between the knowledge bases of an organization and its customers at higher levels of relationship learning involve none or a limited degree of new knowledge which decreases an organization's opportunities to realize exploratory innovation out of it (Bonner and Walker, 2004; Dubois and Gadde, 2002; Holmqvist, 2003).

Furthermore, strong and complex linkages with customers and bounded cognitive abilities associated with higher levels of relationship learning narrow an organization's focus on new knowledge from and about non-customers, and to identify and address external opportunities and threats beyond or at the periphery of its existing offering and customers (e.g., Andriopoulos and Lewis, 2009; Laursen and Salter, 2006; Zhou and Li, 2012). Those strong linkages also inhibit experimentation and increases caution to conduct exploratory activities that may decrease the value of the

relationship with their customers (e.g., Danneels, 2003; Voss *et al*., 2008). Consequently, higher levels of relationship learning decreases an organization's focus on new customers and to realize new products and services based on knowledge from non-customers, i.e. exploratory innovations (Andriopoulos and Lewis, 2009; Danneels, 2003; Laursen, 2012). Based on these arguments, we expect that;

> *Hypothesis 2: Relationship learning with customers has a curvilinear (inverted U-shaped) effect on exploratory innovation.*

Relationship learning with customers and product and service innovations: the moderating role of organizational connectedness as an informal coordination mechanism

Besides relationships with customers, an organization itself also consists of a network of relationships (Herington *et al*., 2006; Ritter *et al.,* 2004). Connectedness as an informal coordination mechanism consists of the degree of direct personal connections among organizational members within an organization (Jansen, Van Den Bosch, Volberda, 2005; Jaworksi and Kohli, 1993; Tsai, 2002). Compared to formal coordination mechanisms, informal ones include a more personal and voluntary way of coordination (Tsai, 2002) with unplanned and spontaneous activities (Beekun and Glick, 2001), such as informal 'hall talk' (Jaworksi and Kohli, 1993). Connectedness facilitates knowledge exchange among organizational members with different knowledge bases and experiences (Hansen, 2002; Jaworski and Kohli, 1993; Tsai, 2002). It increases trust and reduces the chances of conflicts among them (Ettlie and Reza, 1992; Jaworki and Kohli, 1993; Tsai, 2002) in which they may put aside their one own interests to perform better as an organization as a whole (Auh and Menguc, 2005).

Customers may also share knowledge with competitors (Takeishi, 2001; Foss *et al.*, 2013) and internal coordination mechanisms are needed to leverage the effect of external knowledge on an organization's innovation performance (Bierly *et al.*, 2009; Takeishi, 2001; Teece and Pisano, 1994). Or as Foss *et al.* (2013, p. 1456) have pointed out: "several conditions are necessary for external knowledge to be brought successfully into the firm and deployed in the pursuit of strategic opportunities. Such success requires […] the establishment of an organizational setup that allows the right knowledge to reach the right organizational members". We argue that connectedness

may be an important contextual variable to explain variations regarding the effect of co-creation with customers on an organization's innovation performance.

Knowledge is not distributed symmetrically across organizational members and coordination mechanisms are needed to alter that (Tsai, 2002). The role of connectedness as a bridge or a channel to distribute knowledge can be considered as twofold (Cecere and Ozman, 2014; Ritter *et al.*, 2004). First, it connects organizational members with each other to access one another's knowledge and experience and to increase the understanding of each other's requirements and preferences (e.g., Gronroos, 1990; Hargadon, 2002). Second, it connects customer knowledge with organizational members who do not have direct contact with customers, such as support personnel (Conduit and Mavondo, 2001; Gronroos, 1990; Ritter *et al.*, 2004).

Low levels of connectedness involve a high degree of 'compartmentalization' (Sanchez and Mahoney, 1996) in which organizational members have a limited degree of direct personal connections among them. This creates learning inefficiencies because of the loss, breakdown, and delay of knowledge flows among them (Sanchez and Mahoney, 1996). However, lower levels of connectedness involve a higher ability to identify new external knowledge (e.g., Hill and Rothaermel, 2003; Jansen *et al.*, 2005; Orton and Weick, 1990). Higher levels of connectedness involve an intensive degree of direct personal connections among organizational members (e.g., Jansen *et al.*, 2006; Jaworki and Kohli, 1993) which increases the dissemination of knowledge throughout an organization (Tsai, 2002; Jansen *et al.*, 2006, 2009), but it reduces their focus on external knowledge (Jansen *et al*., 2005; Orton and Weick, 1990). Building on the not invented here syndrome (Katz and Allen, 1982), such a reduced focus on external knowledge, due to internal resistance or rejection of it by organizational members, applies in particular at higher levels of relationship learning (Laursen and Salter, 2006; Salge *et al*., 2013).

Relationship learning with customers and exploitative innovation: the moderating role of connectedness

We propose that the inverted U-shaped effect of relationship learning with customers on exploitative innovation is steeper in organizations with high levels of connectedness compared to those with low levels of it.

At higher levels of connectedness, more dissemination of knowledge out of relationship learning across an organization (e.g., De Luca and Atuahene-Gima, 2007; Jaworski and Kohli, 1993) increases access of organizational members to additional knowledge on customer needs and on their positive and negative experiences with its existing products and services (Bonner and Walker, 2004; Sanchez and Mahoney, 1996; Ulaga and Eggert, 2006). Such increased access of organizational members to additional customer knowledge enables an organization at an increased rate – compared to an organization with low levels of connectedness - to refine operations and products and services, i.e. exploitative innovation, by further increasing positive customer experiences and by correcting errors in its existing offering (Berthon, Hulbert, Pitt, 2004; Christensen and Bower, 1996; Rapp, Beitelspacher, Schillewaert, Baker, 2012).

Additionally, an organization with high levels of connectedness has, compared to an organization with low levels of it, ceteris paribus more internal coordination (Dubois and Gadde, 2002; Jansen *et al.*, 2006; Tsai, 2002). Increased internal alignment and fewer overlapping activities (De Luca, Verona, Vicari, 2010; Dubois and Gadde, 2002; Hambrick, 1995) enable an organization to obtain a larger amount of more specific knowledge out of relationship learning and to reduce internal barriers in the realization of exploitative innovation out of it (e.g., Atuahene-Gima, 2005; Chen *et al*., 2013; Zaltman, Duncan, Holbek, 1973). It also increases an organization's utilization of additional knowledge out of relationship learning to realize exploitative innovation by integrating it in a more efficient way into its knowledge base and with fewer conflicts among organizational members (e.g., Gittell and Weiss, 2004; Jansen *et al.*, 2005; Molina-Morales and Martínez-Fernández, 2009).

However, reduced chances of conflicts and tight connections among organizational members associated with high levels of connectedness (e.g., Ettlie and Reza, 1992; Jansen *et al.*, 2005, 2009; Jaworki and Kohli, 1993) increase their focus on maintaining internal relationships and agreement among them (Sethi, Smith, Park, 2002). A strong internal focus provides limited opportunities for an organization to identify and disseminate knowledge out of in particular higher levels of relationship learning (e.g., Berthon *et al*., 2004; Janis, 1982; Miller, 1992), because internal knowledge flows largely occupy connections among organizational members (Sethi *et al.*, 2001) and because of their bounded cognitive abilities (Katila and Ahuja, 2002; Laursen, 2012). Thus, we posit that at high levels of connectedness, a stronger internal

focus provides organizational members less access to customer knowledge and involves less utilization of it to realize exploitative innovation out of in particular higher levels of relationship learning compared to an organization with low levels of connectedness.

Furthermore, organizational members with different knowledge bases, diverse knowledge sources (Auh and Menguc, 2005; Jansen *et al.*, 2006; Lubatkin, Simsek, Ling, Veiga, 2006) and multiple understandings of the external environment (Jaworski and Kohli, 1993; Orton and Weick, 1990) are tightly connected to each other at high levels of connectedness (Tsai, 2002). Accordingly, organizational members in an organization with high levels of connectedness have, compared to an organization with low levels of it, access to a more abundant amount, but different or even irrelevant and conflicting knowledge from each other and about customers (Orlikowski, 1992; Sethi *et al.*, 2001, 2002). This involves more difficult or even conflicting types and patterns to select and integrate knowledge out of in particular higher levels of relationship learning with customers into an organization's knowledge base (Gittell and Weiss, 2004; Grant, 1996; Salge *et al.*, 2013) which reduces the rate in which higher levels of relationship learning with customers result in exploitative innovations. Based on these arguments, we derive the following hypothesis;

> *Hypothesis 3: An increase in connectedness moderates the inverted U-shaped effect of relationship learning with customers on exploitative innovation in such a way that this relationship will be steeper for organizations with high levels of connectedness than for those with low levels of connectedness.*

Relationship learning with customers and exploratory innovation: the moderating role of connectedness

Connectedness removes internal barriers of knowledge flows which increases the dissemination and utilization of new external knowledge and diverse knowledge from organizational members within an organization (e.g., De Luca and Atuahene-Gima, 2007; Olson, Walker, Ruekert, 1995). This strengthens the access of organizational members to new knowledge out of relationship learning (Atuahene-Gima and Evangelista, 2000; Conduit and Mavondo, 2001) and increases their understanding of it (Cohen and Levinthal, 1990; Jansen *et al.*, 2005; Jaworski and Kohli, 1993), thereby increasing the rate – compared to an organization with low levels of connectedness – in which an organization can turn new knowledge out of

relationship learning into exploratory innovations (e.g., Benner and Tushman, 2002; Gilsing *et al*., 2008; Katila and Ahuja, 2002).

Furthermore, connectedness increases involvement of more organizational members across an organization aimed to realize exploratory innovations which increases their risk taking, creativity and experimentation, because of decreased comfort zones surrounding them (Damanpour, 1991; Menguc and Auh, 2010). Involvement of organizational members across an organization brings multiple knowledge bases together (Olson *et al.*, 1995) which enables the identification of new opportunities (Hambrick, 1998; Lubatkin *et al.*, 2006) and which is required to realize in particular exploratory innovations (e.g., Atuahene-Gima, 2003; Menguc and Auh, 2010). This provides a more adequate organizational context to turn knowledge out of relationship learning with customers into exploratory innovations (Ballantyne and Varey, 2006; Han, Kim, Srivastava, 1998).

However, connectedness may also augment the proposed negative effect of high levels of relationship learning with customers on exploratory innovation. An organization with high levels of connectedness has compared to an organization with low levels of it an increased "collective blindness" (Nahapiet and Ghoshal, 1998, p. 245) for new external knowledge (Jansen *et al.*, 2005; Laursen and Salter, 2006; Miller, 1992), because of amongst others an increased concurrence among organizational members (e.g., Ettlie and Reza, 1992; Sethi *et al.*, 2002). In such settings, an organization focuses less on new knowledge residing outside the boundaries of its existing knowledge, it has a more selective perception of new knowledge and alternatives, and decreased dissemination of new knowledge among organizational members (e.g., Hill and Rothaermel, 2003; Janis, 1982; Jansen *et al.*, 2006). This reduces access of organizational members to new knowledge and knowledge challenging an organization's existing knowledge base and it reduces the utilization of that new knowledge which is in particular detrimental to turn knowledge out of higher levels of relationship learning with customers into exploratory innovations (Laursen and Salter, 2006; Miller, 1992; Sethi *et al.*, 2001).

Additionally, high levels of connectedness among organizational members increase the complexity to realize exploratory innovations in order to solve customer problems (Sethi *et al.*, 2001). Such tight internal couplings also reduce the flexibility of an organization itself (Orton and Weick, 1990; Tushman and Romanelli 1985; Volberda, 1998) which decreases its ability to realize exploratory product and service

innovations and to sell them to non-customers (Hill and Rothaermel, 2003; Miller, 1992; Volberda, 1998). In particular at high levels of relationship learning an organization has difficulties to alter or break ties with customers (Andriopoulos and Lewis, 2009; Danneels, 2003; Uzzie, 1997). Building on Pfeffer and Salancik's (1978, p. 69) statement that when "everything is connected to everything else, it is difficult to change anything", we argue that connectedness strengthens the proposed negative effect of higher levels of relationship learning with customers on exploratory innovation, because it increases the complexity and decreases an organization's ability to do so. Based on these arguments, we derive the following hypothesis;

> *Hypothesis 4: An increase in connectedness moderates the inverted U-shaped effect of relationship learning with customers on exploratory innovation in such a way that this relationship will be steeper for organizations with high levels of connectedness than for those with low levels of connectedness.*

5.3 Methods

Empirical context

Not in every industry customers want to develop a relationship with their supplier organization (Baker, 2002; Greer and Lei, 2012). Co-creation has mainly been examined in manufacturing industries (Mention, 2011) and in inter-organizational settings (Chatterji and Fabrizio, 2014). The amount of research on co-creation and on product and service innovations is relatively limited in more service oriented industries, though the number of innovation studies in this setting has increased sharply over the last decade (Chesbrough, 2010b; Lusch and Nambisan, 2015). Various scholars (e.g., Christensen, Bohmer, Kenagy, 2000; Davey, Brennan, Meenan, McAdam, 2010) have focused on the vital importance of innovations in the healthcare industry, or on the role of clients to provide care services (e.g., Herzlinger, 2006; Laschinger, Gilbert, Smith, Leslie, 2010). Innovations in this industry include for instance the introduction of new types of care services, a family communication system, 'screen care', and the introduction of new activities for clients and people living in the municipality where the healthcare organization is vested.

In many countries, including in The Netherlands, managerial actions and new policies have been initiated to increase co-creation within the healthcare industry aimed amongst others to better address customer's unique needs, preferences and

service experiences, to increase accessibility, and to become more cost-effective (e.g., Cramm, Rutten-Van Molken, Nieboer, 2012; Minkman, 2011; Schrijvers *et al.*, 2005). In the healthcare industry in general or with a particular focus on activities to threat a medical condition, i.e. cure, co-creation of a healthcare provider with multiple external partners has been examined, such as with suppliers (e.g., Davey *et al.*, 2010), with other healthcare providers (e.g., Gittell and Weiss, 2004), and with clients (e.g., Elg, Engström, Wittel, Poksinska, 2012; McColl-Kennedy, Vargo, Dagger, Sweeney, Van Kasteren, 2012). Healthcare activities aimed to treat a medical condition, i.e. cure, represent together with activities to nurse a medical condition, i.e. care, two fundamental types of healthcare activities (Mintzberg, 2002). In contrast to prior research, Study IV focuses on the relationship learning that takes place between Dutch healthcare organizations providing care services and their clients as end-users, and uses large-scale survey research to examine how this learning helps in realizing exploitative and exploratory product and service innovations and how connectedness moderates these effects.

Healthcare organizations have become more facilitators of providing care (Beddome, Clark, Whyte, 2007) in which clients themselves are also more involved (e.g., Laschinger *et al.*, 2010; Ursum, Rijken, Heijmans, Cardol, Schellevis, 2011). Knowledge about client's clinical and family situation, values and preferences is not easy to codify and is more readily to be exchanged through relationship between organizational members and clients and among organizational members (Gittell and Weiss, 2004). Organizational members of Dutch healthcare providers include for instance nurses with different expertise, volunteers, and administrative staff. The Dutch healthcare industry providing care services serves over 2 million clients, employs around 430,000 employees (Deuning, 2009; Hamers, 2011) and had a total turnover of around €14 billion in the year 2010 (ActiZ, 2012). It can be further disentangled into multiple types of care services of which basic and intensive residential care, and home care account with a total turnover of around €13.7 billion (2010) for the lion's share of the industry (ActiZ, 2012).

Data collection

In collaboration with a leading Dutch association of healthcare organizations providing care services that represents the majority of the Dutch industry, we invited managers of 600 Dutch locations providing care services to participate in the survey.

After several reminders by e-mail and by phone, we received 356 completed observations constituting a response-rate of 59%. Although the size of this sample may be considered to be not very large, it exceeds sample sizes in multiple other strategy and co-creation studies (e.g., Salge *et al.*, 2013; Schilke, 2014; Wang and Hsu, 2014). The organizations that participated in the survey have on average 342 employees and are 52 years old. 53% of them provide basic residential care, 57% provides intensive residential care, and 52% provides home care services. Eighty percent of our respondents hold a senior management position at the organization of interest. The remaining percentage involves other managerial positions, like innovation manager or quality manager. Respondents work on average 10 years at the organization and 24 years in the healthcare industry.

We randomly rotated the items of our main constructs in the survey to reduce the chances of fixed order effects. To assess non-response bias, we compared the scores between early (first 25%) and late (last 25%) respondents with an independent sample T-test (cf. Jansen *et al.*, 2006; Schilke, 2014). Results of this T-test indicated no significant differences ($p > 0.05$) between them concerning the constructs in our research model which does not provide serious indications for non-response bias.

We took multiple steps to handle potential problems related to common-method bias. First, we asked multiple industry experts and managers of healthcare organizations providing care services to test the clarity of the items in our questionnaire for our target audience. This resulted in various adjustments in the phrasing of the items. Second, we ensured confidentiality by asking each respondent to return their answers directly to the researchers and we agreed to reveal no individual and contact details of them. Third, a Harman's single factor test with our full model (independent, dependent and moderating variables) pointed out that all items loaded on a single factor explain less than half of the variance (32.5%) which indicates that common-method bias is not a serious problem in this study (Podsakoff and Organ, 1986; Schilke, 2014). Fourth, we conducted a common latent factor analysis by adding a latent factor to our confirmatory factor analysis (Podsakoff *et al.*, 2003). This analysis (χ^2 /df = 2.09) indicated that the common variance is less than fifty percent (39.7%), providing additional confidence that common-method bias is not a pervasive problem in this paper.

Using AMOS 21, we assessed the construct validity of our full model (independent, dependent, and moderating variables) through confirmatory factor

analysis (CFA) (each item restricted to load on its proposed construct) based on maximum likelihood procedures (Hair *et al*., 2006). After having removed several items due to a high covariance with other items of the same scale (see Appendix for more details), CFA measures provided satisfactory results for an adequate fit of the data with our model (χ^2 /df = 2.30; goodness-of-fit index (GFI) = 0.90; comparative fit index (CFI) = 0.94; root-mean-square error of approximation (RMSEA) = 0.058) (Bentler and Bonett, 1980; Schilke, 2014). Item loadings on the proposed indicators were significant ($p < 0.01$), suggesting that convergent validity of our scales (Anderson and Gerbing, 1988). A one-factor CFA-model provided a less acceptable fit of our model (χ^2 /df = 9.05; GFI = 0.61; CFI = 0.59; RMSEA = 0.145) which indicate discriminant validity of our model (Bagozzi and Phillips, 1982). The Cronbach's α of our main constructs exceeded at least 0.85 the threshold of 0.7 which indicate adequate reliability of our measures (Field, 2009).

Measurement

We used existing scales from the literature to measure our constructs.

Dependent variables. Exploitative innovation (α = 0.85) and *exploratory innovation* (α = 0.89) were adapted from Jansen *et al.* (2006). An example of an item to measure exploitation innovation is: "We regularly implement small adaptations to existing services". An example of an item to measure exploratory innovation is: "We regularly introduce new services". The appendix provides an overview of the items.

Independent variable and moderating variable. Relationship learning (α = 0.88) was adapted from Selnes and Sallis (2003). An example of an item is: "We have a lot of face-to-face communication in this relationship". In the description we stated that the items relate to the organization's interactions with its clients. We also adapted several items to further clarify that we referred to the relationship with their clients (see also the appendix). The scale to measure the degree of *connectedness* (α = 0.82) among organizational members within an organization was adapted from Jansen *et al.* (2009). For instance, an item to measure this construct is: "In our organization, there is ample opportunity for informal "hall talk" among employees."

Control variables. Scholars have provided conflicting arguments of the role of size on innovation in the context of co-creation (Faems, Van Looy, Debackere, 2005) and size is a strong indicator to measure the stock of resources (Cao, Gedajlovic, Zhang, 2009).

Additionally, smaller organizations may have more informal coordination mechanisms (Gruber and Niles, 1974) and they are usually willing to take more risk (Andriopoulos and Lewis, 2009). Hence, we included an *organizational size* as a control variable, measured by the natural logarithm of full-time employees. Tenure of a manager influences the propensity to change and experiment (Wu, Levitas, Priem, 1996). Accordingly, we included the number of years that a manager is active at the organization, i.e. *managerial tenure*, and in the care industry, i.e. *tenure in industry*. Human capital is considered to be an important driver of innovation, for instance because of knowledge, skills and capabilities of employees to realize product and service innovations (e.g., Dakhli and De Clercq, 2004). Accordingly, we included *human capital* ($\alpha = 0.88$) by applying the construct of Youndt, Subramaniam and Snell (2004). Besides informal coordination mechanisms, e.g. connectedness, formal coordination mechanisms influence an organization's ability to exchange and disseminate internal and external knowledge to realize product and service innovations (e.g., Foss *et al.,* 2011, 2013; Lechner and Kreutzer, 2010). Cross-functional interaction has received prevalent attention (e.g., Atuahene-Gima and Evangelista, 2000; Burgers, Jansen, Van Den Bosch, Volberda, 2009) to influence the realization of product and service innovations. Accordingly, we included *cross-functional interfaces* ($\alpha = 0.75$), adapted from Burgers *et al.* (2009), as a control variable. *Environmental dynamism* ($\alpha = 0.76$) influences the necessity to realize exploratory and exploitative innovation (e.g., Volberda, 1998). Hence, we added this construct as a control variable by applying the construct of Jansen *et al.* (2006). Finally, we controlled for the *types of care services* which a care organization provides as dummy variables: basic residential care, intensive residential care, home care, infant care and child care. The non-specified industry dummy refers to other care services.

5.4 Analyses and results

In line with multiple prior studies containing nonlinear and moderating effects (e.g., Mihalache, Jansen, Van Den Bosch, Volberda, 2014; Ritter and Walter, 2012; Wales, Parida, Patel, 2013) we test our hypotheses with hierarchical regression analyses based on ordinary least squares analysis. We mean-centered a respondent's score on relationship learning and connectedness before calculating their interaction effect and the quadratic effect of relationship learning to deal with potential issues relating to multicollinearity (Aiken and West, 1991). The highest VIF in our models

was 2.80 which is well below the rule of thumb of 10 (Neter, Wasserman, Kutner, 1990). This provides no serious indications of potential multicollinearity.

Table 5.1 presents means and standard deviations of the constructs and correlations among them. Table 5.2 presents several regression analyses. Model I and IV include the effect of control variables on exploitative and exploratory innovation respectively. Model II and V add the effect of relationship learning with customers and connectedness to model I and IV. Model III and VI also include the moderating effect of connectedness on the effect of relationship learning with customers on exploitative innovation and on exploratory innovation respectively. The F change statistic concerning Model II and III is significant ($F_{(2, 339)} = 2.53$, $p < 0.10$), suggesting that the 0.01 increase in the R-square between Model II and III is statistically significant (Weinberg and Abramowitz, 2002): the interaction effects between relationship learning with customers and connectedness contribute to explain exploitative innovation. The F change statistic of model VI compared to Model V is not significant ($F_{(2, 339)} = 2.22$, $p > 0.10$), suggesting that the 0.009 increase in R-square is not statistically significant (Weinberg and Abramowitz, 2002): the interaction effects between relationship learning with customers and connectedness do not substantially contribute to explain exploratory innovation.

As can be seen in Modell III in Table 5.2, our findings support our first hypothesis: relationship learning with customers has an inverted U-shaped effect on exploitative innovation. Relationship learning with customers has a positive effect ($\beta = 0.11$, $p < 0.10$) and higher levels of it have a negative effect ($\beta = -0.12$, $p < 0.05$) on exploitative innovation. Following prior research (e.g., Zott and Amit, 2008) we consider a ten percent level of significance as a threshold to support a hypothesis. Interestingly to note is that the positive effect of relationship learning with customers on exploitative innovation ($\beta = 0.14$, $p < 0.05$) and the negative effect at higher levels of it ($\beta = -0.17$, $p < 0.001$) are stronger without including the moderating role of connectedness (see also Model II). This provides an indication that connectedness influences the effect of relationship learning with customers on exploitative innovation, as will we will elaborate later on in this section.

Table 5.1: Means, standard deviations, and correlations.

	Mean	St. dev.	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
(1) Exploitative innovation	5.38	0.85	1.00														
(2) Exploratory innovation	4.15	1.20	0.47	1.00													
(3) Relationship learning	4.80	0.87	0.43	0.35	1.00												
(4) Connected-ness	5.21	1.05	0.34	0.15	0.42	1.00											
(5) Organiza-tional size	1.95	0.61	-0.04	0.03	0.02	-0.16	1.00										
(6) Managerial tenure	10.35	8.71	0.04	0.02	0.10	0.10	-0.16	1.00									
(7) Tenure in industry	24.2	11.42	0.09	0.01	0.11	0.20	-0.10	0.43	1.00								
(8) Human capital	4.79	0.88	0.29	0.35	0.23	0.20	-0.02	0.19	0.02	1.00							
(9) Cross-func-tional interactions	4.54	1.11	0.41	0.30	0.46	0.29	0.10	-0.01	0.04	0.19	1.00						
(10) Environmen-tal dynamism	5.16	0.99	0.17	0.32	0.16	0.00	0.06	0.10	0.00	0.19	0.14	1.00					
(11) Intensive residential care	0.59	0.49	0.09	0.04	0.12	0.06	0.13	-0.19	-0.04	-0.14	0.12	-0.06	1.00				
(12) Basic residential care	0.53	0.50	0.12	-0.04	0.19	0.17	0.11	-0.06	0.10	-0.15	0.12	-0.09	0.39	1.00			
(13) Home care	0.51	0.50	-0.07	-0.01	-0.10	-0.08	0.23	0.02	-0.15	0.10	-0.05	0.06	-0.13	0.04	1.00		
(14) Infant care	0.05	0.21	-0.01	-0.01	-0.10	-0.11	0.12	0.04	-0.10	0.21	0.01	-0.07	-0.16	-0.13	-0.10	1.00	
(15) Child care	0.05	0.22	-0.07	-0.02	-0.06	-0.07	0.19	0.01	-0.08	0.05	-0.06	0.13	-0.12	-0.09	0.15	0.19	1.00

n = 356; All correlations above |0.10| are significant at $p < 0.05$.

Scores on relationship learning with customers and connectedness are not yet mean-centred in table 5.1.

Table 5.2: Results of hierarchical regression analyses: Effect of relationship learning with customers and connectedness on exploitative innovation and on exploratory innovation.

Model	I		II		III		IV		V		VI	
Dependent variable:	Exploitative innovation						Exploratory innovation					
Independent variables:												
Relationship learning			0.14	*	0.11	†			0.19	**	0.17	**
			(0.06)		(0.06)				(0.08)		(0.09)	
(Relationship learning)²			-0.17	***	-0.12	*			-0.07		0.00	
			(0.03)		(0.04)				(0.05)		(0.06)	
Connectedness			0.12	*	0.07				-0.03		-0.08	
			(0.04)		(0.05)				(0.06)		(0.07)	
Moderating effects:												
Relationship learning x connectedness					0.02						-0.06	
					(0.05)						(0.07)	
(Relationship learning)² x connectedness					0.15	*					0.09	
					(0.02)						(0.03)	
Control variables:												
Organizational size	-0.07		-0.06		-0.07		0.02		0.00		0.00	
	(0.07)		(0.07)		(0.07)		(0.10)		(0.10)		(0.10)	
Managerial tenure	-0.06		-0.03		-0.03		-0.07		-0.06		-0.07	
	(0.01)		(0.01)		(0.01)		(0.01)		(0.01)		(0.01)	
Tenure in industry	0.06		0.04		0.05		0.03		0.02		0.04	
	(0.00)		(0.00)		(0.00)		(0.01)		(0.01)		(0.01)	
Human capital	0.24	***	0.19	***	0.20	***	0.29	***	0.26	***	0.27	***
	(0.05)		(0.05)		(0.05)		(0.07)		(0.07)		(0.07)	

Study IV

Cross-functional interactions	0.32	***	0.23	***	0.23	***	0.20	***	0.13	*	0.13	*
	(0.04)		(0.04)		(0.04)		(0.05)		(0.06)		(0.06)	
Environmental dynamism	0.11	*	0.12	*	0.12	**	0.24	***	0.23	***	0.25	***
	(0.04)		(0.04)		(0.04)		(0.06)		(0.06)		(0.06)	
Intensive residential care	0.05		0.04		0.04		0.07		0.06		0.06	
	(0.09)		(0.09)		(0.09)		(0.13)		(0.13)		(0.13)	
Basic residential care	0.12	*	0.06		0.08		-0.04		-0.07		-0.06	
	(0.09)		(0.09)		(0.09)		(0.12)		(0.13)		(0.13)	
Home care	-0.07		-0.03		-0.04		-0.03		0.00		-0.01	
	(0.09)		(0.08)		(0.08)		(0.12)		(0.12)		(0.12)	
Infant care	-0.01		0.03		0.05		-0.04		-0.02		0.00	
	(0.21)		(0.20)		(0.20)		(0.29)		(0.29)		(0.29)	
Child care	-0.02		-0.04		-0.04		-0.03		-0.04		-0.05	
	(0.19)		(0.18)		(0.18)		(0.26)		(0.27)		(0.27)	
F	10.31	***	11.86	***	10.79	***	10.09	***	9.54	***	8.69	***
R^2	0.24		0.33		0.34		0.24		0.28		0.29	
Adjusted R^2	0.22		0.30		0.31		0.22		0.25		0.26	

Standardized coefficients are described. Values between parentheses are standard errors.

***: $p < 0.001$; **: $p < 0.01$; *: $p < 0.05$; † : $p < 0.10$

Our findings partly support the second hypothesis: relationship learning with customers does not have an inverted U-shaped, but a positive effect on exploratory innovation. Model VI shows that relationship learning with customers has a positive effect on exploratory innovation ($\beta = 0.17$, $p < 0.01$), but the effect of higher levels of it is not significant ($\beta = 0.00$, $p > 0.10$). Figure 5.1 depicts the effect of relationship learning with customers on exploitative innovation and on exploratory innovation. This Figure illustrates that relationship learning with customers has an inverted U-shaped effect on exploitative innovation (see solid line), while its effect on exploratory innovation is positive (see dotted line). In the next section we will provide a potential explanation for this surprising result.

Our findings do not support that connectedness steepens the inverted U-shaped effect of relationship learning with customers on exploitative innovation (hypothesis 3). As can be seen in Model III, analyses of our data point out that connectedness does not significantly influence the effect of relationship learning with customers on exploitative innovation ($\beta = 0.02$, $p > 0.10$). However, connectedness does flatten the effect of higher levels of relationship learning with customers on exploitative innovation ($\beta = 0.15$, $p < 0.05$). These findings indicate that connectedness flattens the negative effect of higher levels of relationship learning with customers on exploitative innovation.

To plot the moderating role of connectedness on the effect of relationship learning with customers on exploitative innovation, we calculated the score on exploitative innovation at various levels of relationship learning with customers for healthcare organizations with low levels of connectedness, i.e. one standard deviation below average, and those with high levels of it, i.e. one standard deviation above average (see also Figure 5.2). As can be seen in this Figure, the shape of the effect of relationship learning with customers on exploitative innovation is flatter in healthcare organizations with high levels of connectedness (see dotted line) than in those with low levels of it (see solid line). In particular at high levels of relationship learning with customers the slope of this effect differs between care organizations with low and high levels of connectedness, see also Figure 5.2. Overall, findings presented in Table 5.2 and in Figure 5.2 indicate that connectedness mitigates the negative effect of higher levels of relationship learning with customers on exploitative innovation.

Figure 5.1: Effect of relationship learning with customers on exploitative innovation and exploratory innovation.

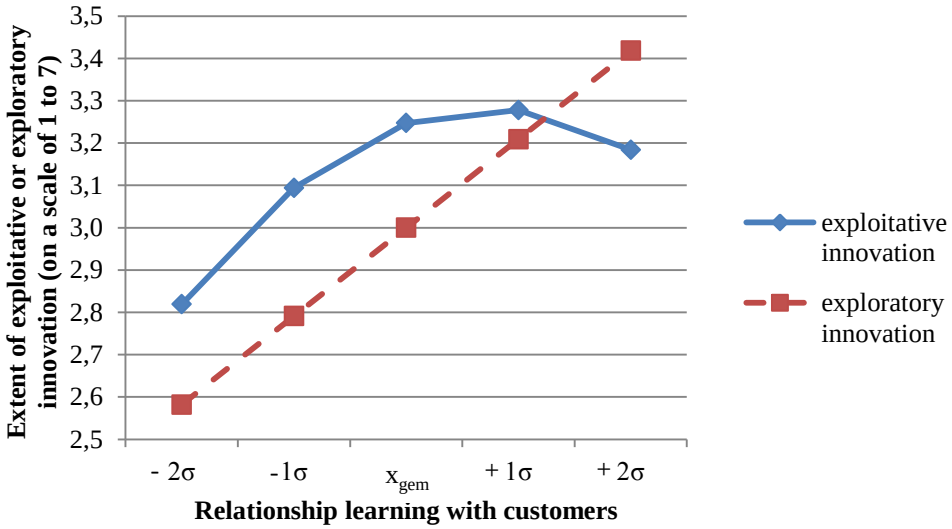
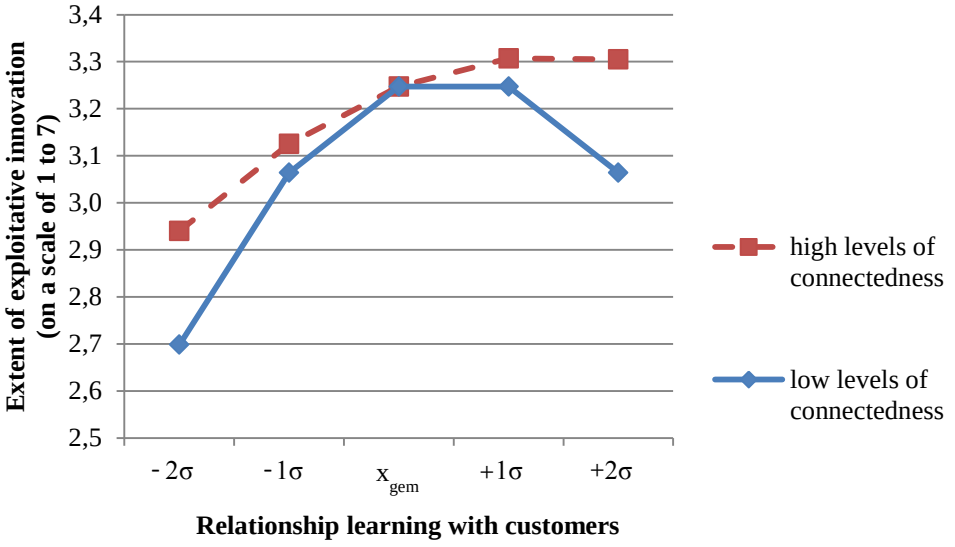


Figure 5.2: Interaction effect between relationship learning with customers and connectedness on exploitative innovation.



Furthermore, our findings do not support hypothesis 4. Analyses of our data indicate that connectedness does not significantly influence the effect of relationship learning with customers on exploratory innovation (β = -0.06, $p > 0.10$), nor does it significantly influence the effect of higher levels of relationship learning with customers on exploratory innovation ($\beta = 0.09$, $p > 0.10$).

5.5 Discussion and conclusion

Co-creation with customers has been increasingly considered to be a source of competitive advantage (e.g., Harker and Egan, 2006; Prahalad and Ramaswamy, 2004). Yet, prior research has provided mixed results to what extent it increases exploitative and exploratory innovation and has largely unanswered the question how this relationship is influenced by connectedness as an informal coordination mechanism within an organization. We contribute to the co-creation literature in at least two main ways.

First, we advance our understanding how relationship learning with customers contribute to exploitative and exploratory innovation by applying perspectives of both the degree of relational embeddedness and of the degree of heterogeneity of the knowledge bases between them. Analyses of our data point out that relationship learning with customers has an inverted U-shaped effect on exploitative innovation, while its effect on exploratory innovation is positive.

A potential explanation why higher levels of relationship learning remain a source of exploratory innovation can be related to access to a larger pool of customer knowledge over time. Besides issues related to the overlap between knowledge bases of an organization and an external partner and to the allocation of attention to high levels of external knowledge, Koput (1997) has identified a third issue when an organization taps extensively into external knowledge bases: the issue of timing. New knowledge resulting out of relationship learning may arrive at an organization with an inappropriate timing to fully utilize it (Koput, 1997), but relationship learning acts as an external knowledge reservoir for knowledge retention and to keep it up-to-date (Bierly *et al.*, 2009; Lichtenthaler and Lichtenthaler, 2009). Utilization of such a knowledge reservoir is in particular effective to realize exploratory innovations at higher levels of relationship learning with customers, because close collaborations and experience in collaborating with them are needed to access a larger piece of the pie of

customer knowledge, including tacit knowledge, and experience residing beyond an organization's existing knowledge domains (e.g., Laursen and Salter, 2006; Salge *et al.*, 2013; Von Hippel, 2009). Additionally, over time, an organization and its customers obtain new knowledge themselves or customers have new needs in which an organization can tap out of a larger reservoir of customer knowledge to realize exploratory innovations compared to exploitative innovation which is more bounded to its existing knowledge domain (Chatterji and Fabrizio, 2014; Cohen and Levinthal, 1990; Tsai, 2009). Nonetheless, future research should further examine this interesting phenomenon into more detail.

Our findings suggest that applying beneficial and more detrimental perspectives associated with both the degree of relational embeddedness and of heterogeneity between the knowledge bases of an organization and its customers, and differentiating innovation performance into exploitative and exploratory innovation contribute to explain mixed results of prior research about to what extent an organization should co-create with its customers to increase its innovation performance. By doing so, we contribute to address the plea of scholars (Griffin *et al.*, 2013; Tsai, 2009) to conduct additional research on how knowledge from customers contributes to an organization's innovation performance, which still lacks a uniform understanding due to mixed results of prior research (Chatterji and Fabrizio, 2014).

Second, we advance our understanding on how connectedness as an informal coordination mechanism within an organization explains mixed findings of prior research of to what extent an organization should co-create with its customers to increase its innovation performance. Our findings do not support that an increase in connectedness steepens the inverted U-shaped effect of relationship learning with customers on exploitative innovation, but do suggest that it flattens the negative effect of higher levels of relationship learning with customers on exploitative innovation.

A potential explanation for this finding may be that high levels of connectedness are required to coordinate the increased amount and complexity of knowledge exchange with customers associated with higher levels of relationship learning with customers (e.g., Gittell and Weiss, 2004; Lengnick-Hall *et al.*, 2000). Organizational settings with such increased coordination may increase the number of exploitative innovations by spurring the dissemination of customer knowledge among organizational members (Reinholt, Pedersen, Foss, 2011; Tsai, 2002). This increases its capacity to understand, integrate and capitalize knowledge out of in particular

higher levels of relationship learning (Hansen, 2002; Holmqvist, 2003; Selnes and Sallis, 2003). A high degree of similarity between coordination mechanisms within an organization and with external partners is expected to result in higher efficiency and better quality for customers compared to an imbalance between them (Gittell and Weiss, 2004). Nonetheless, future research should examine this into more detail.

A potential explanation why connectedness does not significantly influence the effect of relationship learning with customers on exploratory innovation may be that it acts as a 'double-edged sword' in those settings in which its beneficial and detrimental effects counterbalance each other. Earlier on in this study, we have provided arguments how the increased dissemination of customer knowledge and involvement of more organizational members associated with increased connectedness were expected to strengthen the effect of lower levels of relationship learning with customers on exploratory innovation. Alternatively, reduced boundaries of knowledge exchange among organizational members associated with higher levels of connectedness (Jaworki and Kohli, 1993; Tsai, 2002) increase the diffusion of strong and existing norms and expectations, and increases the focus of an organization as a whole on its dominant mainstream, exploitative activities, knowledge and mind-sets (e.g., Benner and Tushman, 2003; Hill and Rothaermel, 2003; Jansen *et al.*, 2009). Such organizational settings act as a less adequate safeguard to protect the initiation and realization of exploratory innovations out of relationship learning by individuals and subunits from the dominant mainstream, exploitative activities and mind sets (Benner and Tushman, 2003; Burgers *et al*., 2009; Jansen *et al*., 2009). Additionally, higher levels of connectedness among organizational members involve a more limited sense of ownership and freedom for individual members which reduce their creativity to develop exploratory innovations (Amabile, Conti, Coon, Lazenby, Herron, 1996; Benner and Tushman, 2002; Burgers *et al.*, 2009). However, future research should examine this interesting phenomenon into more detail. Since our findings indicate that relationship learning with customers has a positive effect on exploratory innovation, this paper does not further discuss the moderating role of connectedness of the effect of higher levels of relationship learning with customers on exploratory innovation.

Our findings imply that connectedness within an organization has a different role on the effect of relationship learning with customers on exploitative innovation compared to its effect on exploratory innovation: it mainly supports the transformation of higher levels of relationship learning with customers on exploitative innovation.

Accordingly, our findings highlight the relevance to include the moderating role of informal coordination mechanisms (connectedness) among members within an organization when examining the effect of co-creation with customers on an organization's exploitative innovation performance. With our findings, we address the suggestion of scholars (e.g., Chatterji and Fabrizio, 2014; Foss *et al.*, 2013; Griffin *et al.*, 2013) to conduct research on the conditions under which relationship learning with customers increases an organization's innovation performance in which in particular the role of informal coordination mechanisms within an organization are under examined.

Our findings also have implications for managers about how they can apply relationship learning with customers to influence their organization's innovation performance. First, managers of many organizations search for knowledge either too little or too much (Laursen, 2012). They should bear in mind that the effect of relationship learning with customers on exploitative innovation is different from its effect on exploratory innovation. More relationship learning with customers is not always 'better' to realize more exploitative innovations. Second, Ritter *et al.* (2004, p. 176) stated that "an important strategic issue confronting management is the interfacing of intra- and interfirm relationships". Our findings concerning the moderating role of connectedness within an organization suggest that managers can apply organizational connectedness as a tool to (1) offset the negative effect of higher levels of relationship learning with customers on exploitative innovation and (2) to realize exploratory innovation out of higher levels of relationship learning with customers without that it comes at the expenses of exploitative innovation.

Limitations and directions for future research

In spite of these contributions, our paper also has some limitations that indicate directions for future research. First, we have controlled for cross-functional interfaces as a formal coordination mechanism, but future research should examine how formal and informal coordination mechanisms are related to each other to influence the effect of relationship learning with customers on exploitative and on exploratory innovation. Formal and informal coordination mechanisms and their effects on innovation performance are predominantly examined in isolation from each other, and there is limited systematic evidence on how they are related to each other to

influence an organization's innovation performance (Foss *et al.*, 2011; Lechner and Kreutzer, 2010).

Second, future research should further examine the role of time in our model with longitudinal case studies, both theoretical and empirical. Just like ample other empirical studies on co-creation (e.g., Bierly *et al.*, 2009; Foss *et al.*, 2013) we have used a cross-sectional research design (Eggert, Ulaga, Schultz, 2006). Inter-firm learning processes are multistage, continuous and iterative (Cegarra-Navarro, 2007; Foss *et al.*, 2013), relationships develop over time (Andriopoulos and Lewis, 2009; Harker and Egan, 2006) and it may take more time before the effect of higher levels of relationship learning with customers results in exploratory innovations compared to its effect on exploitative innovations (Benner and Tushman, 2002; Greer and Lei, 2012).

Third, we encourage future research to replicate our model in other industries. We collected data from Dutch healthcare organizations providing care services, but the opportunities for co-creation with customers to increase an organization's innovation performance may differ per industry (e.g., Greer and Lei, 2012; Harker and Egan, 2006).

Overall, we advance our understanding how co-creation, operationalized as relationship learning, with customers contribute to exploitative and exploratory innovation and how these effects are influenced by connectedness as an informal coordination mechanisms within an organization. Our findings indicate that the effect of relationship learning with customers on exploitative and exploratory innovation is respectively inverted U-shaped and positive. Additionally, connectedness among members within an organization flattens the negative effect of higher levels of relationship learning with customers on exploitative innovation. These findings contribute to an increased understanding how co-creation with its customers contribute to an organization's innovation performance.

5.6 Appendix: Measures and items

Construct:	Items:
Relationship learning with customers (adapted from Selnes and Sallis, 2003)	To what extent do the following statements apply to the interaction between your organization and your clients?
	Our organization and our clients exchange information … - … on successful and unsuccessful experiences with services exchanged in the relationship. - … related to changes in needs, preferences, and behaviour of clients.[1] - … related to changes in our market, like mergers, acquisitions, or partnering. - … related to changes in the technology of our focal care services.[1] - … as soon as possible of any unexpected problems. - … on changes related to changes in our strategy and policy.[1] - … that is sensitive for both parties.
	- It is common to establish joint teams with clients to solve operational problems in the relationship. - It is common to establish joint teams with clients to analyse and discuss strategic issues. - The atmosphere in our relationship with clients stimulates productive discussion encompassing a variety of opinions.[1] - Our employees and managers have a lot of face-to-face communication with our clients.
	Our organization and our clients frequently … - … adjust our common understanding of customer needs, preferences, and behaviour. - … adjust our common understanding of trends in technology related to our business.[1] - … evaluate and, if needed, adjust routines in order-delivery processes. - … evaluate and, if needed, update the formal contracts in our relationship.[1] - … meet face-to-face in order to refresh the personal network in this relationship. - … evaluate and, if needed, update information about the relationship stored in our electronic databases.[1]
Exploitative innovation (adapted from Jansen *et al.*, 2006)	We regularly implement small adaptations to our existing services. We improve our provision's efficiency of our services. We increase economies of scale in existing care markets.[1] Our organization expands services for existing clients. We introduce improved, but existing care services for our market. We frequently refine existing market approaches in the care market.[1]

Exploratory innovation (adapted from Jansen *et al.*, 2006)	Our organization regularly accepts demands that go beyond our existing care services.[1] We regularly invent new care services. We often experiment with new kinds of services in the care market. We introduce services the care market that are completely new to us. We frequently utilize new opportunities in new care markets.[1] Our organization regularly uses new market approaches in the care market.
Connectedness within an organization (adapted from Jansen *et al.*, 2009)	In our organization, there is ample opportunity for informal "hall talk" among employees. In our organization, employees from different departments feel comfortable contacting each other when the need arises. Managers discourage employees discussing work-related matters with those who are not immediate superiors (reversed item).[1] Our employees are quite accessible to each other. In our organization, it is easy to talk with virtually anyone you need to, regardless of rank or position.

All items are measured on a seven-item scale, ranging from "strongly disagree" (1) to "strongly agree" (7);

[1]: item removed after factor analyses.

CHAPTER 6. Study V: To replicate or to renew your business model? The performance effect in dynamic environments*

* This study will be submitted to an international scientific journal. An abridged version (6-page Best Paper) of this study is published as: Heij, C.V., Volberda, H.W., & Van Den Bosch, F.A.J. (2014). How does business model innovation influence firm performance: The moderating effect of environmental dynamism. In J. Humphreys (Ed.), *Best Paper Proceedings of the 74th Annual Meeting of the Academy of Management* (pp. 1502-1507). This study has been awarded with the *Best Paper Award* in the business model innovation track of the innovation special interest group at the *European Academy of Management Annual Conference* 2014, Valencia, Spain.

CHAPTER 6. Study V: To replicate or to renew your business model? The performance effect in dynamic environments

Abstract *Despite the rise in research on business models, there is little systematic evidence of how environmental dynamism influences the performance effects of two types of business model innovation, namely business model replication and business model renewal. In this paper, we introduce a conceptual distinction between these two types of business model innovation. Furthermore, we conceptualize how both types are related to firm performance, and how environmental dynamism moderates those relationships. From the results of a large-scale cross-industry survey we find that environmental dynamism weakens the positive effect of business model replication on firm performance. Business model renewal contributes more strongly to firm performance in environments characterized by intermediate and high levels of dynamism compared to relatively stable settings with low levels of dynamism. These findings indicate that environmental dynamism is a key contextual variable in the relationship between business model innovation and firm performance.*

Keywords: business model innovation, business model renewal, business model replication, environmental dynamism, firm performance.

6.1 Introduction to study V

A central focus of the literature on business models is to increase our understanding of how they can act as a source of competitive advantage. The business models of companies such as Kodak (e.g., McGrath, 2013), Ryanair (e.g., Casadesus-Masanell and Ricart, 2010) and Virgin (e.g., Giesen *et al.*, 2007) have been scrutinized to explain firm success or failure. Every organization has a business model (Casadesus-Masanell and Ricart, 2010; Teece, 2010) – either explicit or implicit – but in today's rapidly changing business environments, business model innovation has become even more important (Amit and Zott, 2001; Schneider and Spieth, 2013). Business model innovation has become a crucial factor in explaining differences in firm performance (e.g., Giesen *et al.*, 2010; Yoon and Deeken, 2013; Zott, Amit, Massa, 2011). Although a business model is closely related to strategy and often grounded, at least in part, in strategic management literature (e.g., Teece, 2010; Zott *et al.*, 2011), we consider these to be different concepts, in line with many previous studies (e.g., Casadesus-Masanell and Ricart, 2010; Klang, Wallnöfer, Hacklin, 2014;

Smith, Binns, Tushman, 2010). For instance, a business model reflects the outcome of a firm's strategic choices and how the firm executes its strategy (Casadesus-Masanell and Ricart, 2010; Richardson, 2008); it focuses specifically on the creation and appropriation of customer value (Baden-Fuller and Haefliger, 2013; Zott *et al*., 2011); and a strategic perspective can be applied to a business model itself (e.g., Lambert and Davidson, 2013; Morris, Schindehutte, Allen, 2005; Teece, 2010). Despite the increase in research on business models (e.g., Zott *et al.*, 2011), several important questions on business model innovation remain largely unanswered.

First, prior research has not clearly differentiated between two types of business model innovation, i.e. replication and renewal. Research on business model *innovation* can be categorized into two main streams, focusing either on *replication*, i.e., *leveraging an existing business model* (e.g., Szulanski and Jensen, 2008; Winter and Szulanski, 2001), or on *renewal*, i.e., *introducing a new business model* that is very different from the previous one (e.g., Johnson, Christensen, Kagerman, 2008; Nunes and Breene, 2011). Business model replication, in particular, is an area that is under-researched (Aspara *et al*., 2010; Winter and Szulanski, 2001).

Second, although environmental conditions are important moderators of the relationship between a business model and firm performance (Zott and Amit, 2007), and many scholars (e.g., Sabatier, Mangematin, Rouselle, 2010; Voelpel *et al.*, 2005) have argued that business model innovation becomes increasingly important in more dynamic environments, there has been surprisingly little research to address the question of how environmental dynamism influences the relationship between both business model replication and renewal and firm performance. The alignment between a firm's business model and its external environment is crucial for a firm to survive or prosper, and business model innovation is vital in realizing that alignment (e.g., Giesen *et al.*, 2010; Voelpel *et al*., 2005). This emphasizes how essential it is to take into account changes in a firm's external environment – i.e., environmental dynamism – when examining the relationship between business model innovation and firm performance. Environmental dynamism "remains a fertile and important line of inquiry for organizational theorists and strategy scholars" (Posen and Levinthal, 2012, p. 600).

Third, as Markides (2013) and Schneider and Spieth (2013) have also emphasized, there has been relatively little empirical research, and in particular few cross-industry surveys, on the relationship between two basic types of business model

innovation, i.e. replication and renewal, and firm performance – including what contingency effects environmental dynamism has on that relationship. Most research on business models is either descriptive (Morris *et al.*, 2005), conceptual (Lambert and Davidson, 2013), based on case studies (Baden-Fuller and Morgan, 2010; Lambert and Davidson, 2013) or focused on a specific firm, market or industry context (Baden-Fuller and Mangematin, 2013; Casadesus-Masanell and Zhu, 2013; Schneider and Spieth, 2013) in an attempt to explain how a particular business model contributes to competitive advantage. This brings us to the following research question: *How does environmental dynamism moderate the relationship between different types of business model innovation – i.e., replication and renewal – and firm performance?*

By addressing this question, we are contributing to the emerging business model innovation literature in at least three important ways. First, we make a theoretical contribution by distinguishing and conceptualizing two types of business model innovation: replication and renewal. To this end, we conceptualize and pinpoint the attributes of these two different types, and show how they are related to firm performance.

Second, we make another theoretical contribution by advancing understanding of how environmental dynamism influences the performance effects of replication and renewal forms of business model innovation.

Third, we make an empirical contribution by developing scales for business model innovation through both replication and renewal, and we use a large-scale survey of firms across multiple industries to assess the generic performance effects of these two types of business model innovation with different levels of environmental dynamism. By so doing we help to address a significant gap in empirical research in this area (Markides, 2013; Schneider and Spieth, 2013; Zott and Amit, 2007).

In the next section, we review the literature on business models, particularly that on business model innovation, and derive two hypotheses. After sections on data and methods and on analyses and results, we discuss the implications and limitations of our study and suggest avenues for future research.

6.2 Theoretical background

Business models and business model innovation

Business models have been conceptualized as an architecture, a description, a statement, or a template (Baden-Fuller and Mangematin, 2013; Zott *et al.*, 2011). However, the concept of a business model is difficult to grasp (Baden-Fuller and Morgan, 2010): various scholars and practitioners have focused on different aspects of a business model (Björkdahl and Holmén, 2013; Morris *et al*., 2005) or on different levels of abstraction (Massa and Tucci, 2014), and some have stretched the concept beyond its boundaries (Margretta, 2002). Hence, there is still no real consensus as to what it stands for (e.g., Baden-Fuller and Haefliger, 2013; Casadesus-Masanell and Zhu, 2013).

Despite there being no commonly agreed understanding of the term, a business model is normally conceptualized as revolving around the notion of value creation and value capture (Casadesus-Masanell and Ricart, 2010; Chesbrough, 2007; Spieth, Schneckenberg, Ricart, 2014). Creating sufficient value for customers is a precondition for a firm to capture an adequate amount of that value for itself in order to increase its chances of survival (Chesbrough, 2007; McGrath, 2010).

Over the last couple of years there has been greater emphasis on understanding which components are fundamental to a business model and how they contribute to competitive advantage and performance (Morris, Shirokova, Shatalov, 2013). Components that are often mentioned include a firm's value offering, economic model, partner network, internal infrastructure, and target market (e.g., Cortimiglia, Ghezzi, Frank, 2015; Morris *et al.*, 2005). Decomposition of a business model also reveals interdependencies, including complementary effects, among its underlying components (Demil and Lecocq, 2010; Massa and Tucci, 2014). One needs to understand those components and their interdependencies, including complementary effects, in order to examine the various activities of a firm in an integrated, and more holistic, way, assess their effectiveness and create a new model (Casadesus-Masanell and Ricart, 2010; Schneider and Spieth, 2013; Zott and Amit, 2010).

Although it is beyond the context of this paper to provide an extensive review of business model definitions and conceptualizations, in line with the holistic approach we consider a business model to comprise a number of different components, and

believe that those components and their interdependencies can be used to create and capture value, thereby contributing to the firm's competitive advantage (Morris *et al.*, 2005, 2013). This type of holistic approach reduces the risk that when performance effects are examined, only certain components of a business model will be considered (Lambert and Davidson, 2013), or that interdependencies between components may be overlooked.

Innovation of a business model occurs not only when its components change, but also when those components are combined in different ways (Amit and Zott, 2012; Björkdahl and Holmén, 2013; Zott and Amit, 2010). This enables a firm to stay active in its existing markets or to move to other markets (e.g., Markides and Oyon, 2010; Winter and Szulanski, 2001). Business model innovation can be classified into two basic types: innovation *within* the framework of the existing model (i.e., replication), and innovation that goes *beyond* the framework of the existing model (i.e. renewal) (Aspara *et al.*, 2010; Osiyevskyy and Dewald, 2015).

Business model replication

To conceptualize business model replication we build on related concepts, including business model development (Cortimiglia *et al*., 2015; Schneider and Spieth, 2013), self-imitation (Aspara *et al.*, 2010), and business model evolution (Demil and Lecocq, 2010). Business model replication (see also Table 6.1) can be defined as the "re-creation of a successful model" (Szulanski and Jensen, 2008, p. 1738), in which a firm leverages business model components and their interdependencies by developing and/or upscaling them within the framework of an existing model to create and capture more value from it, either in a different geographical context or over time (e.g., Baden-Fuller and Winter, 2007; Jonsson and Foss, 2011; Schneider and Spieth, 2013).

The focus of replication is on improving existing methods of value creation and appropriation through incremental changes to an existing business model (e.g., Baden-Fuller and Winter, 2007; Casadesus-Masanell and Ricart, 2011). Replication involves the re-construction of a system of activities and processes that are often imperfectly understood, causally ambiguous, complex and interdependent (Szulanski and Jensen, 2008; Winter and Szulanski, 2001). It requires firms to achieve a balance between precise replication, learning and change (Baden-Fuller and Winter, 2007; Winter *et al.*, 2012).

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Business model replication has been increasingly recognized as an important source of competitive advantage (Lambert and Davidson, 2013; Szulanski and Jensen, 2008), and its purpose is to maintain or improve a firm's competitive position (Dunford, Palmer, Benveniste, 2010; Winter and Szulanski, 2001). Although business model replication is a relatively safe route to short-term success (Szulanski and Jensen, 2008; Voelpel *et al.*, 2005), it lacks variety, and this threatens a firm's survival in the longer run (Andries, Debackere, Van Looy, 2013).

Three key characteristics from business model replication are identified (see also Table 6.1). First, business model replication is about the leverage of a firm's existing business model components (Baden-Fuller and Winter, 2007; Szulanski and Jensen, 2008). Second, internal fit between business model components is needed to create or to reinforce consistency among business model components (Demil and Lecocq, 2010); business model components "need to be cospecialized to each other, and work together well as a system" (Teece, 2010, p. 180) so that firms can benefit from the complementary effects of different sources of competitive advantage (Winter and Szulanski, 2001). With the third key characteristic, market focus, a firm can replicate its business model either in other parts of the country or in other markets which are similar (Baden-Fuller and Winter, 2007; Dunford *et al.*, 2010) – as Ikea has done, for example (Jonsson and Foss, 2011). In addition to this geographical dimension, replication can also take place over time (Baden-Fuller and Volberda, 2003; Winter and Szulanski, 2001). An enriched knowledge of markets, products, services, and operations, acquired over time, enables a firm to refine its business model (Baden-Fuller and Volberda, 2003; Baden-Fuller and Winter, 2007; Mason and Leek, 2008), as has been the case with Ryanair, for example (Casadesus-Masanell and Ricart, 2010).

Business model replication and firm performance

Experience of using a particular business model (Demil and Lecocq, 2010; Teece, 2010) enables a firm to improve that model by remedying mistakes and getting rid of inefficiencies (Schneider and Spieth, 2013; Szulanski and Jensen, 2008) or by removing particular components or changing the priority given to them (Demil and Lecocq, 2013). Business model replication can increase a firm's profit in two ways. On the one hand, it provides cost advantages because it allows the firm to operate more efficiently (Szulanski and Jensen, 2008; Zott and Amit, 2007) and exploit

Table 6.1: Conceptualization of business model replication and business model renewal.

	Business model replication:	**Business model renewal:**
Purpose	Maintain, improve or expand competitive position ('leverage success'). *e.g., Dunford et al. (2010); Jonsson and Foss (2011); Winter and Szulanski (2001)*	New and/or more sustainable competitive position ('create new success'). *e.g., Giesen et al. (2010); Markides and Oyon (2010); Nunes and Breene (2011)*
Focus	Improvement of existing ways of value creation and appropriation by incremental change in existing business model. *e.g., Baden-Fuller and Winter (2007); Casadesus-Masanell and Ricart (2011); Demil and Lecocq (2010); Zott and Amit (2007)*	New ways of value creation and appropriation by radical renewal of business model. *e.g., Amit and Zott (2001); Eyring et al. (2011); Zott and Amit (2007)*
Risks	● limited in the short term ● high in the longer term *e.g., Andries et al. (2013); Szulanski and Jensen (2008); Voelpel et al. (2005)*	● (very) high for first movers in industry ● high for followers *e.g., Casadesus-Masanell and Zhu (2013); Chesbrough, Minin, Piccaluga (2013); Gambardella and McGahan (2010)*
Definition chosen in this paper	Leveraging business model components and their interdependencies by development and/or upscaling them within the framework of an existing business model in order to create and capture more value from it, either in a different geographical context or over time.	Introduction of new business model components and new complementary effects which go beyond the framework of an existing business model to create and capture new value.
Key characteristics:		
1: Business model components	Refinement of existing business model components. *e.g., Casadesus-Masanell and Ricart (2011)*	Obtain new business model components. *e.g., Morris et al. (2005)*
2: Complementarities among business model components	Strengthen complementarities among existing business model components. *e.g., Demil and Lecocq (2010)*	Create new complementarities among business model components. *e.g., Johnson et al. (2008); Morris et al. (2005)*
3: Market focus	Incrementally refined way of remaining active in existing markets, or entering similar, but geographically different, markets. *e.g., Winter and Szulanski (2001)*	Aggressive move in existing markets or entering new markets. *e.g., Markides and Oyon (2010)*

economies of scale (Baden-Fuller and Winter, 2007; Contractor, 2007), and firms with more experience of business model replication can replicate at lower costs (Contractor, 2007). Replication can also increase revenue, because it allows a firm to capture more value from its existing business model (Jonsson and Foss, 2011; Szulanski and Jensen, 2008) by increasing its competitive advantage or by overcoming previous limitations (Schneider and Spieth, 2013; Voelpel *et al.*, 2005).

Furthermore, business model replication establishes closer interactions and reinforcing effects between the various components of a business model (Demil and Lecocq, 2010; Teece, 2010). This makes it harder for competitors to identify the precise components of a firm's business model or the sources of its success, making it more difficult for the business model to be imitated by outsiders (Teece, 2010). Business model replication is not only a path-dependent process of learning (e.g., Johanson and Vahlne, 1990; McGrath, 2010), making imitation of components more difficult for competitors (Barney, 1991; Winter and Szulanski, 2001), but unique combinations of components also differentiate a firm's business model from those of its competitors (Demil and Lecocq, 2010). A business model that is more differentiated and more difficult to imitate increases a firm's competitive advantage (Barney, 1991), and thereby firm performance.

Business model renewal

To conceptualize business model renewal we build on related concepts, including 'reinvention' (e.g., Johnson *et al*., 2008), and some scholars (e.g., Giesen *et al.*, 2007; Schneider and Spieth, 2013) just call it business model innovation. Business model renewal (see also Table 6.1) can be defined as the introduction of new business model components and new complementary effects which go beyond the framework of an existing business model in order to create and capture new value (e.g., Morris *et al.*, 2005; Schneider and Spieth, 2013).

Business model renewal involves a more radical appraisal of a firm's current business model; the aim is to introduce new ways of creating and appropriating value (e.g., Amit and Zott, 2001; Eyring, Johnson, Nair, 2011) in order to arrive at a new or more sustainable competitive position for the firm (Giesen *et al*., 2010; Markides and Oyon, 2010). It increases a firm's chances of survival in the longer run (Andries *et al.*, 2013), but firms that introduce a new-to-the-industry business model face high risks,

because they have no proof of whether that new model will be viable (Casadesus-Masanell and Zhu, 2013; Sminia, 2003).

Business model renewal is a risky process: it requires experimentation which often results in failure (McGrath, 2010), and few companies understand their business model well enough, including its interdependencies, strengths, weaknesses, and underlying assumptions (Johnson *et al.*, 2008). Renewal also involves more challenges and barriers than replication due to organizational inertia, political forces (Cavalcante *et al.*, 2011; Chesbrough, 2010a; Doz and Kosonen, 2010), or fear of cannibalization, for example (Voelpel *et al.*, 2005).

Three key characteristics from business model renewal are identified (see also Table 6.1). First, in the case of business model renewal, a firm obtains new business model components (Morris *et al.*, 2005) that go beyond the framework of its existing model (Schneider and Spieth, 2013) either by developing them itself ('making'), acquiring them ('buying') or by accessing external components (e.g., making alliances). Second, it involves creating new complementary effects among business model components (e.g., Johnson *et al.*, 2008; Morris *et al.*, 2005) through a fundamental revision of a model (Cavalcante, Kesting and Ulhøi, 2011), or the development of a new model 'from scratch' (e.g., Govindarajan and Trimble, 2011). The introduction of new components also provides opportunities for new complementary effects either between the newly acquired components or between existing components. Third, business model renewal enables a firm to enter new markets (e.g., Eyring *et al.*, 2011; Halme, Lindeman, Linna, 2012; Johnson *et al.*, 2008) or to make an aggressive move within its existing markets (e.g., Casadesus-Masanell and Tarziján, 2012; Markides and Oyon, 2010). For instance, Virgin expanded from retail and music into new industries such as airlines and financial services (Giesen *et al.*, 2007), and Singapore Airlines took on the competition within its own industry by introducing a low-cost carrier airline, Silkair (Markides and Charitou, 2004).

Business model renewal and firm performance

Firms need to develop new business models, because, over time, the growth potential of their existing models reaches its limits (Dierickx and Cool, 1989; Zook, 2007) or those models become obsolete due to environmental changes (Cavalcante *et al.*, 2011; Hamel and Välikangas, 2003). Business model renewal enables companies

to make radical improvements in value for customers (Zott and Amit, 2007) as new business model components are introduced (Morris *et al.*, 2005). This allows an organization to protect or regain its market position and profitability in existing markets, because by renewing its business model it can redefine industry profitability (Johnson *et al.*, 2008), reshaping the rules of the game in its existing industry (e.g., Voelpel *et al.*, 2005).

By introducing new components or new complementary effects (Markides and Oyon, 2010), business model renewal enables a firm to target customer niches which are under-served by the industry (Aspara *et al.*, 2010), and sometimes it can even create new markets (Zott and Amit, 2007) or industries (Teece, 2010). This is expected to have a positive effect on firm performance (Kim and Mauborgne, 2005).

Business model innovation and environmental dynamism

A firm's environment is "a source of critical contingencies" (Dess, Ireland, Hitt, 1990, p. 15), and, according to Morris *et al.* (2013, p. 61), the "interface between business model design and the external environmental is especially critical". Various scholars (e.g., Baden-Fuller and Morgan, 2010; Schneider and Spieth, 2013) have stated that business model innovation is needed to meet or adapt to changing environmental conditions, and many have acknowledged that the external environment has a marked influence on innovation and performance (Jansen, Van Den Bosch, Volberda, 2006). Therefore, we argue that environmental dynamism is a key contextual variable in the relationship between business model innovation and firm performance.

Although environmental dynamism can be disentangled into velocity, complexity, ambiguity and unpredictability (Davis, Eisenhardt, Bingham, 2009), management scientists have often defined it in terms of the frequency and intensity of changes in a firm's external environment (e.g., Dess and Beard, 1984; Volberda, 1998). Dynamic environments are characterized by, among other things, fluctuations in demand or supply of raw materials, changes in customer preferences or technologies (Volberda, 1998), regulatory or governmental changes, or different competitive structures in a market (Wirtz, Schilke, Ullrich, 2010). Environmental dynamism makes a firm's competitive advantages more short-lived (Demil and Lecocq, 2010) and it can require a firm to adapt or fundamentally revise its business

model (Morris *et al.*, 2005) to meet the conditions of the new environment (Zahra, 1996).

6.3 Development of hypotheses

Business model replication and firm performance: the moderating role of environmental dynamism

Replicating a business model provides a frame of reference for diagnosing and solving problems (Winter and Szulanski, 2001), and for a firm that is already familiar with business model replication, the first reaction to external changes is most likely to be to work harder to protect or improve its existing business (Voelpel *et al.*, 2005). However, replication in dynamic environments involves building on a business model that has worked under other environmental conditions (Voelpel *et al.*, 2005); this approach is likely to result in a poor fit between the refined business model and the new environment (Giesen *et al.*, 2010; Szulanski and Jensen, 2008; Volberda *et al.*, 2012) which decreases a firm's performance (Szulanski and Jensen, 2008; Voelpel *et al.*, 2005). Optimization, an important characteristic of business model replication, is adequate "only as long as there's no fundamental change in what has to be optimized" (Hamel and Välikangas, 2003, p. 11). In a dynamic environment, replication allows an organization to become better at doing similar things. At the same time, however, the value of business model replication decreases (Dierickx and Cool, 1989; Sorensen and Stuart, 2000); environmental dynamism affects a firm's key success factors (Jensen and Szulanski, 2007), and can weaken a business model (McGrath, 2010) or make it ineffective (Jensen and Szulanski, 2007).

Additionally, business model replication intensifies interdependencies between business model components (Demil and Lecocq, 2010; Teece, 2010), but strong internal consistency of this kind weakens a firm's ability to adapt to changing environmental conditions (Morris *et al.*, 2005). Business model replication is complex (Szulanski and Jensen, 2008; Teece, 2010), and replication in a new environment is even more causally ambiguous and complex (Jensen and Szulanski, 2007). Firms with high interdependencies between business model components may fall into a 'complementarities trap' (Massini and Pettigrew, 2003, p. 170) in which they preserve what used to fit best (Pettigrew and Whittington, 2003; Whittington and Pettigrew, 2003). Without the appropriate context, high interdependencies can easily become a weakness for the firm (Whittington and Pettigrew, 2003), with business model

components losing their complementary effects on firm performance in dynamic environments. Therefore, we argue that in more dynamic environments, refining the current business model components results in a lack of fit with the external environment, and strong interdependencies among business model components weaken a firm's ability to adapt to changing environmental conditions, and the components consequently lose their complementary effect on firm performance. On the basis of these effects, we argue that:

> *Hypothesis 1: Environmental dynamism moderates the relationship between business model replication and firm performance in such a way that it weakens this relationship.*

Business model renewal and firm performance: the moderating role of environmental dynamism

In today's dynamic environment, a business model has a limited life expectancy (McGrath, 2013) because of changing customer needs, the introduction of new and better models by competitors and/or new entrants (Cavalcante *et al.*, 2011; Hamel and Välikangas, 2003), or the shifting or shrinking of the profit pool of an industry's entire value chain (Zook, 2007). Adapting to a new environment requires a firm to bring in new business model components (Morris *et al.*, 2005). In dynamic environments, business model renewal is needed to respond to threats to the existing business model (Cavalcante *et al.*, 2011; Giesen *et al.*, 2010) and to adapt to changing environmental circumstances (Casadesus-Masanell and Ricart, 2010; Schneider and Spieth, 2013) in order to create a fit with the new environment (Giesen *et al.*, 2010) and ensure the survival of the firm (Hamel and Välikangas, 2003; Voelpel *et al.*, 2005). Leaving it too late before reinventing the business model results in a decline in firm performance (Nunes and Breene, 2011), and if a firm undertakes little or no business model renewal, then it will not be able to replace its existing business model. Such inability to adapt to fundamental environmental changes threatens the existence of a firm (Wirtz *et al.*, 2010). Thus, in more dynamic environments, business model renewal has a stronger effect on firm performance than in less dynamic environments, because the firm is then better able to respond to more threats to the existing business model and to create a fit with the new environment in order to survive.

Furthermore, business model renewal enables a firm to react to shifting sources of value (Pohle and Chapman, 2006), and to respond to opportunities as they

arise (Cavalcante *et al.*, 2011; Schneider and Spieth, 2013) – for example, by entering emerging markets (Johnson *et al.*, 2008). A dynamic environment provides a firm with more opportunities to move away from intense competition in its existing markets. In particular, business model renewal is needed because environmental dynamism is regarded as a source of opportunities that can be captured (Giesen *et al.*, 2010; Schneider and Spieth, 2013). Instead of 'doing more of the same', firms should place greater emphasis on how they can become 'different' (Hamel and Prahalad, 1994; Volberda, 2003) to competitors. Thus, in more dynamic environments, business model renewal can be expected to have a stronger effect on firm performance than in less dynamic environments, because in more dynamic environments renewal gives a firm more opportunities to create more value for customers and for itself in new markets.

However, we posit that, beyond a certain point, environmental dynamism weakens the positive effect of business model renewal on firm performance. In highly dynamic environments it enables a firm to respond to threats or to chase opportunities, but the ensuing rewards are reduced (Moss, Payne, Moore, 2014; Posen and Levinthal, 2012; Schilke, 2014). External opportunities need to be of a sufficient scale that justifies investment in business model renewal (Johnson *et al.*, 2008), but there are likely to be fewer such opportunities in a highly dynamic environment. For example, customer needs change more rapidly, and this erodes the profit to be made by a firm from renewing its business model (Posen and Levinthal, 2012; Zook and Allen, 2011). Threats that emerge in highly dynamic environments – arising from actions by competitors or new entrants, for example – may also reduce the value of business model renewal (McGrath, 2013; Volberda *et al.*, 2001), as any new business model may become obsolete more quickly (Voelpel, Leibold, Tekie, 2004).

Furthermore, very dynamic environments are characterized by a relatively high number of opportunities and threats, and a great deal of fluctuation. These conditions, together with the fact that many of the environmental changes taking place are unfamiliar to firms, outside their radar or are not yet existing altogether, make it intensely challenging for them to determine which new business models to develop and to predict which ones are likely to outperform others (e.g., McGrath, 2010; Posen and Levinthal, 2012; Schilke, 2014). Once a new model that is thought likely to outperform alternatives has been implemented, an environment that is highly dynamic may have already changed to such an extent that the model is no longer an optimal fit (Mitchell and Coles, 2003; Mullis and Komisar, 2009; Schilke, 2014). This then

decreases its effectiveness and leads to sub-optimal performance outcomes (Cavalcante *et al.*, 2011; Posen and Levinthal, 2012; Teece, 2010).

At intermediate levels of environmental dynamism, we expect that business model renewal will enable a firm to respond better to the increased threats or opportunities than would be the case for environments with low levels of dynamism. The potential to seize the attendant financial rewards is expected to be greater than in environments with high levels of dynamism. Based on this reasoning, we derive the following hypothesis:

> *Hypothesis 2: The relationship between business model renewal and firm performance is stronger with an intermediate level of environmental dynamism than when the level of environmental dynamism is either low or high.*

6.4 Data and methods

Sample and data collection

In 2012, we randomly selected around ten thousand Dutch companies from the database of the Dutch Chamber of Commerce. The sample covered a wide range of industries and was restricted to firms with at least 20 employees. A member of the senior management team from each of those companies was invited to participate in the survey. After the initial mailing, we sent a reminder and then made follow-up calls. From these ten thousand, 502 firms completed the survey, which is not an uncommon response rate (5%) in surveys which target senior managers (e.g., Burgers, Jansen, Van Den Bosch, Volberda, 2009; Koch and McGrath, 1996), and the sample size is in line with or exceeds the sample sizes of many other strategy and management studies (e.g., Schilke, 2014; Zott and Amit, 2008).

The participating companies are from a broad range of industries. Professional services firms count for 22% of our observations, financial services 4%, logistic firms 5%, construction firms 3%, and firms active in the food industry 5%. The remaining percentage (57%) involves firms active in the more manufacturing-oriented industries, such as the chemical and steel industries. The average age of organizations in our sample is 55 years and the average size is around 130 employees, which is not

uncommon for surveys among established firms (e.g., Burgers *et al*., 2009; Schilke, 2014).

To avoid single-response bias, a second member of the senior management team was also asked to complete the survey: 3% of first respondents had second respondents. The inter-rater agreement scores (r_{wg}) between first and second respondents based on intra-class correlation for our main measures range between 0.48 and 0.71 indicate a 'moderate' to 'substantial' agreement between them (Landis and Koch, 1977). To deal with potential problems relating to single-source data, we also collected archival data on our dependent variable.

To check for non-response bias, we randomly selected around 100 organizations from our observations and collected data from the Company.info database on their profitability in the year 2012. A t-test indicates no significant difference ($p > 0.05$) between the average profitability of this selection of companies and that of Dutch companies published in the database. This finding provides no serious indications of non-response bias.

We took several steps to assess common method bias. By assuring respondents of confidentiality and asking every manager to return the questionnaire to the research team, we reduced the chances of common method bias that can arise when respondents give their answers on the basis of social desirability, for example (Vaccaro, Jansen, Van Den Bosch, Volberda, 2012). We also refined the items used in the scales by conducting interviews with academics, consultants, and practitioners to improve the grammar and wording of the survey. To further reduce the chances of common method bias, we also collected data from a database on firm performance. Moreover, a Harman's single factor test with our full model (independent, dependent and moderating variables) indicates that all items loaded on a single factor explain less than half of the variance (22%), indicating that common-method bias is not a serious problem in this study (Podsakoff and Organ, 1986; Schilke, 2014). In addition, we conducted a common latent factor analysis by adding a latent factor to our confirmatory factor analysis (Podsakoff *et al.,* 2003). This analysis (χ^2 /df = 2.06) indicates that the common variance is less than fifty percent (30.3%), which adds to our confidence that common method bias is not a pervasive problem in this paper.

Measures

Our main constructs are based on perceptual scales, because executives' perceptions of the external environment determine what they do with their firm's business model (Demil and Lecocq, 2010; Greve, 2003; Smith *et al.*, 2010). This is in line with other measures of business model innovation (e.g., Aspara *et al.*, 2010; Zott and Amit, 2007) and of firm performance (e.g., Berthon, Hulbert, Pitt, 2004; Volberda *et al*., 2012). We adapted existing measures where possible. We aggregated item scores for each construct to get an overall score with equal weights for each item (cf. Zott and Amit, 2008).

Dependent variable. Firm performance (α = 0.91) is measured using the scale developed by Volberda *et al.* (2012), which is in turn adapted from Jaworski and Kohli (1993). These items measure how well a firm performs, compared to its competitors. Performance relative to competitors is not only a vital indicator to managers of their firm's success (Greve, 2003), but is also in line with the objective of business model innovation: to close the performance gap between the firm and its competitors or to increase the firm's performance relative to its competitors (Mitchell and Coles, 2003). One example of an item is: "In comparison with our competitors we perform very well". Appendix A provides a list of items of the constructs in this paper. A firm's score on a construct represents the average scores of the underlying items.

To further assess the reliability of this measure, we randomly selected around 100 organizations from our observations and collected archival data from the Company.info database on their profit margins over 2012 (earnings before interest and taxes as a % of turnover) and increase in return on equity between 2011 and 2012 (in %). These performance data relate to the same year as the year in which the survey was conducted. Of the companies included in these observations, 35 organizations have publicly released the required data on Company.info. The correlations between our measure for firm performance and profit margin in 2012 (r = 0.43, $p < 0.05$) and return on equity (r = 0.35, $p < 0.05$) are significant, which strengthens the reliability of our measure for firm performance.

Independent and moderating variables. To our knowledge, there are no adequate scales available for measuring business model replication and business model renewal as conceptualized in this paper. Aspara *et al.* (2010) and Zott and Amit (2007) have provided scales for measuring particular aspects of business model

replication and business model renewal, but their focus respectively on geographical business model innovation and on improved versus new transactions does not correspond to our generic definition and conceptualization of business model replication and business model renewal. It is difficult to operationalize a business model (Markides, 2013), but taking the three key characteristics of business model innovation – namely, key components, complementary effects between components, and market focus (see also Table 6.1) – we have adapted items from multiple existing scales (e.g., Burgers *et al*., 2009; Collins and Smith, 2006; Jansen *et al*., 2006) to measure business model replication and business model renewal. For both replication and renewal, each of these characteristics is covered by three items in the scale. Building on prior research (e.g., Burgers *et al.*, 2009), items on business model replication and business model renewal relate to the past three years of a firm and to the average situation of a firm's business units.

Refinement of business model components is related to the leveraging of existing knowledge and activities (Baden-Fuller and Winter, 2007; Jensen and Szulanski, 2007; Mason and Leek, 2008), as addressed in the first three items of the measure for business model replication (see also the Appendix). Strengthening existing complementarities is related to having greater experience of knowledge transfer (Dunford *et al.*, 2010), and refinement is often associated with intra-organizational learning (Holmqvist, 2003), which is captured by items 4, 5 and 6 of the business model replication measure. In terms of the third key characteristic of business model innovation, market focus, business model replication involves an incrementally refined way of remaining active in existing markets or entering markets that are similar though geographically different (e.g., Aspara *et al.*, 2010). Items 7, 8, and 9 of the measure for business model replication capture this last key characteristic.

Developing or acquiring new business model components is related to exploration (Benner and Tushman, 2002; March, 1991), as addressed in the first three items of the measure for business model renewal (see also the Appendix). Business model renewal is related to new connections between components (Zott and Amit, 2010), and this is captured by items 4, 5 and 6 of our measure. In line with the third key characteristic of business model innovation, renewal is related to an aggressive move in existing markets or to entering new markets (e.g., Markides and Oyon, 2010), and is captured by items 7, 8 and 9.

Study V

We assessed the construct validity of our measures for business model replication and business model renewal in several ways. First, we conducted an exploratory factor analysis with the eighteen items for the two basic types of business model innovation. To do so, we followed the suggestions of Field (2009) to use direct oblimin as a method of oblique rotation, because prior research (e.g., Aspara, Lamberg, Laukia, Tikkanen, 2013; Govindarajan and Trimble, 2011; Johnson *et al*., 2008) has indicated that key characteristics within each type of business model innovation may be related, and that there may potentially be relationships also between the two broad concepts themselves. Kaiser-Meyer-Olkin (KMO) measures verify our sampling adequacy with a KMO of 0.85 ('great', according to Field, 2009), and KMO values for individual items are at least 0.76. Bartlett's test of sphericity (χ^2 (153) = 2578.36; $p < 0.001$) indicate that the correlations between the items are sufficiently large to be clustered to form constructs (Field, 2009).

The results of the exploratory factor analysis reveal a four-factor solution with eigenvalues over Kaiser's criterion of 1 in which each basic type of business model innovation is associated with two factors. Only items with communalities larger than 0.3, dominant loadings larger than 0.5, and-cross loadings lower than 0.3 are included in further analyses (Briggs and Cheek, 1988). The first factor of business model replication comprises the first item of its scale and three items of the key characteristic 'complementarities among business model components'. The second factor of business model replication involves items relating to the key characteristic 'market focus', together with the second item of its scale.

The first factor of business model renewal can be associated with obtaining or establishing new activities and businesses to enter new industries, because it consists of the second, fourth, fifth, and eighth item of its scale. The second factor of business model renewal consists of the third and seventh item of its scale which focus more on new market opportunities. However, the correlation of the items constituting the second factor of business model renewal with the other factor of renewal exceed with |0.44| and |0.41| respectively the acceptable limit of |0.40|, indicating that the two factors of business model renewal are interrelated with each other (Field, 2009). Overall, these findings demonstrate discriminant validity between business model replication and business model renewal.

Second, another way in which we assessed the construct validity was to compare the two basic types of business model innovation to related measures.

Product and service innovations are different from business model innovation, though strongly related to it (Björkdahl and Holmén, 2013; Johnson *et al*., 2008; McGrath, 2010). We asked respondents to provide us with figures for the percentage of total revenues over the last three years that come from new or improved solutions, as represented by products and services that have been (1) extensively improved or are (2) completely new to the firm. Our measure of business replication correlates more strongly with turnover that comes from extensively improved products and services (r = 0.18; $p < 0.001$) than business model renewal (r = 0.03; $p > 0.10$). The first correlation is also stronger than the correlation between our measure of business replication and revenues originating from completely new products and services (r = 0.09; $p < 0.05$). The revenues from completely new products and services correlate more strongly (r = 0.20; $p < 0.001$) with our measure of business model renewal than with business model replication (r = 0.09; $p < 0.05$). The correlation between our measure for completely new products and services and business model renewal (r = 0.20; $p < 0.001$) is also stronger than the correlation between the measure for business model renewal and revenues from extensively improved products and services (r = 0.03; $p > 0.10$). These findings provide additional support for the convergent and discriminant validity of our measures for both types of business model innovation (Jansen, Tempelaar, Van Den Bosch, Volberda, 2009).

In line with Zhou and Wu (2010), we controlled for higher-order effects of both basic types of business model innovation which may override their first-order performance effects. Controlling for these higher-order effects reduces the chances of type I and type II errors when examining moderating effects (Agustin and Singh, 2005; Ganzach, 1997).

Environmental dynamism (α = 0.84) was measured using the scale developed by Jansen *et al.* (2006). An example item is "Environmental changes in our market are intense". Following Schilke (2014), we include environmental dynamism and its squared term in the analyses in order to examine its non-linear moderating effect on the relationship between business model renewal and firm performance.

We assess the construct validity of our full model (items of independent, dependent and moderating variables) with exploratory and confirmatory factor analyses. An exploratory factor analysis based on principal component analysis with varimax rotation indicates a five-factor solution with eigenvalues over Kaiser's criterion of 1, with each item loading clearly on its intended factor. Only business

model replication is represented by two factors. One factor of business model replication comprises the items of the key characteristic 'market focus' complemented with the second item of its scale. The second factor of business model replication involves items of the key characteristic 'complementarities among business model components' and the first item. Only items with communalities higher than 0.3, dominant loadings larger than 0.5, and cross-loadings below 0.3 are included in further analyses (Briggs and Cheek, 1988). Items associated with the first factor of business model replication do not meet the criteria for confirmatory factor analysis, leaving us with each factor representing one main construct.

Using AMOS 21, we applied a confirmatory factor analysis (each item is restricted to loading on its proposed construct) based on maximum likelihood procedures in order to validate our main measures from the exploratory factor analysis (Hair *et al*., 2006). Only items with factor loadings above 0.40 were included (Ford, MacCallum, Tait, 1986): items have standardized loadings of at least 0.52. Values indicate a satisfactory fit of our data with the model (χ^2 /df = 2.23; goodness-of-fit index (GFI) = 0.96; comparative fit index (CFI) = 0.97; root-mean-square error of approximation (RMSEA) = 0.05) (Bentler and Bonett, 1980; Schilke, 2014). Item loadings on the proposed indicators were significant ($p < 0.01$), and a one-factor CFA-model provided a less acceptable fit of our model (χ^2 /df = 19.10; GFI = 0.66; CFI = 0.44; RMSEA = 0.19). Overall, the findings from our exploratory and confirmatory factor analyses indicated the discriminant and convergent validity of our main measures (Bagozzi and Phillips, 1982; Briggs and Cheek, 1988).

Like our other measures, our reliability analyses based on Cronbach's alpha analyses for the *business model replication* (α = 0.73) and *business model renewal* (α = 0.71) scales meet a common threshold value of 0.7 (Field, 2009).

Control variables. Our first control variable is *firm age*, and in line with other scholars (e.g., Jansen *et al.*, 2006; Lockett, Wiklund, Davidsson, Girma, 2011; Zott and Amit, 2007) we measure this by the number of years since the firm was founded. In particular, young and small firms find it difficult to survive to the point where a new business model pays off (Sabatier *et al.*, 2010), but older organizations are likely to have acquired more experience and may have more resources to innovate (Jansen *et al.*, 2006). Our second control variable is *firm size*. In line with other scholars (e.g., Jansen *et al.*, 2006; Lockett *et al.*, 2011; Zott and Amit, 2007) we measure this by the logarithm of the number of full-time employees. Due to a greater degree of

organizational inertia (Hannan and Freeman, 1984), larger firms are more inclined to focus on existing competencies, and are more at risk of cannibalizing their own offerings since revenues from new products often come at the expense of existing products (Pauwels, Silva-Rosso, Srinivasan, Hanssens, 2004). In addition, large firms have grown to that size because they have done something successful (Hamel and Välikangas, 2003), and success with certain activities triggers further investment in those activities (e.g., Lavie, Stettner, Tushman, 2010). Therefore, by controlling for firm size we also take a firm's previous success into account. Absorptive capacity enables a firm to detect developments and to develop viable business models (e.g., Nunes and Breene, 2011; Ofek and Wathieu, 2010; Volberda, Foss, Lyles, 2010). A firm's *absorptive capacity* (α = 0.88) is measured by adapting items from Jansen, Van Den Bosch, Volberda (2005). A greater degree of competitiveness increases the both the need and the motivation for a firm be innovative in terms of its business model so that it can maintain or improve its performance (e.g., Baden-Fuller and Morgan, 2010, Casadesus-Masanell and Zhu, 2013; Voelpel *et al*., 2005). Accordingly, *environmental competitiveness* (α = 0.87) is included as a control variable by applying measures developed by Jansen *et al.* (2006). Controlling for potential industry effects is important in the relationship between diversification and its performance effects (Dess *et al.*, 1990). We added the following industry dummies in which the remaining manufacturing-oriented industries are the non-specified dummy: *financial services*, *professional services*, *information technology*, *logistics*, *food*, and *construction*.

6.5 Analyses and results

Table 6.2 presents the means and standard deviations of the constructs and the correlations between them. Table 6.3 shows the results of several regressions based on ordinary least squares analyses. Model I presents the effect of control variables on firm performance. The second model adds the effect of business model replication, business model renewal, and environmental dynamism to Model I. Model III adds the first-order moderating effect of environmental dynamism to Model II. Model IV brings the second-order moderating effect of environmental dynamism to the analysis. Following prior research (e.g., Damanpour, Walker, Avellaneda, 2009; Malhotra and Majchrzak, 2014; Schmittlein, Kim, Morrison, 1990), we calculate the Akaike information criterion (AIC) which reflects the relative 'goodness-of-fit' and the complexity of models in order to identify and select the model with the relative highest degree of variance on firm performance (Akaike, 1974; Posada and Buckley, 2004).

Table 6.2: Means, standard deviations, and correlations.

	Mean	St. dev.	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
(1) Firm performance	5.19	1.21	1.00													
(2) Business model replication	4.71	0.97	0.32	1.00												
(3) Business model renewal	3.83	1.33	0.26	0.27	1.00											
(4) Environmental dynamism	4.90	1.28	0.14	0.25	0.30	1.00										
(5) Firm age	55.39	46.67	-0.04	-0.07	-0.06	0.05	1.00									
(6) Firm size	2.10	0.77	0.04	0.00	0.16	0.10	0.26	1.00								
(7) Absorptive capacity	4.86	0.72	0.40	0.68	0.33	0.33	-0.02	0.06	1.00							
(8) Environmental competitiveness	5.10	1.34	-0.04	0.13	0.11	0.33	0.02	0.08	0.12	1.00						
(9) Financial services	0.04	0.18	-0.02	-0.05	0.00	0.04	0.02	0.11	0.04	0.01	1.00					
(10) Professional services	0.22	0.41	0.01	0.02	0.09	0.09	-0.12	0.05	0.04	-0.07	-0.10	1.00				
(11) Information technology industry	0.04	0.18	0.01	0.11	0.05	0.17	-0.07	0.00	-0.08	0.04	-0.04	-0.10	1.00			
(12) Logistics	0.05	0.21	-0.10	-0.09	-0.01	-0.12	0.01	0.05	-0.04	0.06	-0.04	-0.12	-0.04	1.00		
(13) Food	0.05	0.23	0.03	0.03	0.03	0.07	0.07	0.04	0.02	0.10	-0.04	-0.13	-0.05	-0.05	1.00	
(14) Construction	0.03	0.23	-0.04	-0.08	-0.12	0.03	0.06	-0.09	-0.11	0.11	-0.05	-0.13	-0.05	-0.05	-0.06	1.00

n = 502; All correlations above |0.08| are significant at $p < 0.05$.

Table 6.3: Results of hierarchical regression analyses: Effect of business model replication, business model renewal and environmental dynamism on firm performance.

Model:	I		II		III		IV	
Independent variables:								
Business model replication			0.08		0.08		0.09	†
			(0.07)		(0.07)		(0.07)	
(Business model replication)^2			0.11	*	0.13	**	0.14	**
			(0.04)		(0.04)		(0.04)	
Business model renewal			0.15	**	0.15	**	0.23	***
			(0.04)		(0.04)		(0.05)	
(Business model renewal)^2			-0.03		-0.04		-0.04	
			(0.02)		(0.03)		(0.03)	
Environmental dynamism			-0.01		-0.01		0.04	
			(0.04)		(0.04)		(0.05)	
(Environmental dynamism)^2							0.02	
							(0.03)	
Moderating effect:								
Business model replication x Environmental dynamism					-0.08	†	-0.09	*
					(0.04)		(0.04)	
Business model renewal x Environmental dynamism					0.02		-0.04	
					(0.03)		(0.04)	
Business model renewal x (Environmental dynamism)^2							-0.16	**
							(0.02)	
Control variables:								
Firm age	-0.03		-0.04		-0.03		-0.04	
	(0.00)		(0.00)		(0.00)		(0.00)	
Firm size	0.04		0.03		0.03		0.04	
	(0.07)		(0.08)		(0.08)		(0.08)	
Absorptive capacity	0.41	***	0.32	***	0.33	***	0.31	***
	(0.07)		(0.10)		(0.10)		(0.10)	
Environmental competitiveness	-0.08	*	-0.09	*	-0.09	*	-0.08	†
	(0.04)		(0.04)		(0.04)		(0.04)	
Financial services	-0.08	*	-0.08	*	-0.08	*	-0.08	*
	(0.27)		(0.27)		(0.26)		(0.26)	
Professional services	-0.04		-0.07	†	-0.07	†	-0.07	
	(0.12)		(0.13)		(0.13)		(0.13)	
Information technology industry	-0.01		-0.03		-0.03		-0.03	
	(0.24)		(0.24)		(0.24)		(0.24)	
Logistics	-0.10	*	-0.11	*	-0.11	*	-0.11	**
	(0.22)		(0.22)		(0.22)		(0.22)	
Food	0.00		-0.01		-0.01		-0.02	
	(0.22)		(0.22)		(0.22)		(0.22)	
Construction	-0.01		0.01		0.01		0.01	
	(0.20)		(0.20)		(0.20)		(0.19)	
F	11.66	***	8.96	***	8.12	***	7.76	***
R^2	0.18		0.22		0.22		0.23	
Adjusted R^2	0.17		0.19		0.19		0.20	

Standardized coefficients are described. Values between parentheses are standard errors.
***: $p < 0.001$; **: $p < 0.01$; *: $p < 0.05$; †: $p < 0.10$

Models I, II, III and IV had an AIC of respectively 94.8, 84.4, 85.0 and 80.9. These values indicate that Model IV has relatively the best fit to the data with respect to explaining firm performance, but does not overfit our data (Akaike, 1974; Arnold, 2010).

To deal with potential multicollinearity between the direct effects of each basic type of business model innovation and environmental dynamism and their interaction effects, we mean-center those scales before multiplying the relevant scales (Schilke, 2014; Zhou and Wu, 2010). The highest variance inflation factor (VIF) is 2.48, which is well below the rule of thumb of 10 (Neter, Wasserman, Kutner, 1990). Therefore, there are no indications of potential multicollinearity.

Although they are not explicit hypotheses in this paper, Model IV indicates that both basic types of business model innovation have a positive effect on firm performance. Business model renewal has a positive effect on firm performance (β = 0.23, $p < 0.001$). Analyses of our data indicate that business model replication has an increasingly positive effect on firm performance, because both at relatively low levels ($\beta = 0.09$, $p < 0.10$) and at higher levels ($\beta = 0.14$, $p < 0.01$), it has a positive effect on firm performance. Following prior research on business models (e.g., Zott and Amit, 2007) we consider a ten percent level of significance to be a threshold value.

Concerning the moderating effect of environmental dynamism, our data supports hypothesis 1: environmental dynamism weakens the relationship between business model replication and firm performance ($\beta = -0.09$, $p < 0.05$). To plot this moderating effect, we cluster the scores for both business model replication and environmental dynamism into two groups: low (average score minus one standard deviation as upper limit), and high (average score plus one standard deviation as minimum value). Figure 6.1 depicts the moderating effect of environmental dynamism on the relationship between business model replication and firm performance. As can be seen in this figure, the slope of the effect of business model replication on firm performance is steeper in less dynamic environments than for more dynamic environments, thereby supporting hypothesis 1.

Figure 6.1: The moderating effect of environmental dynamism on the performance effects of business model replication.

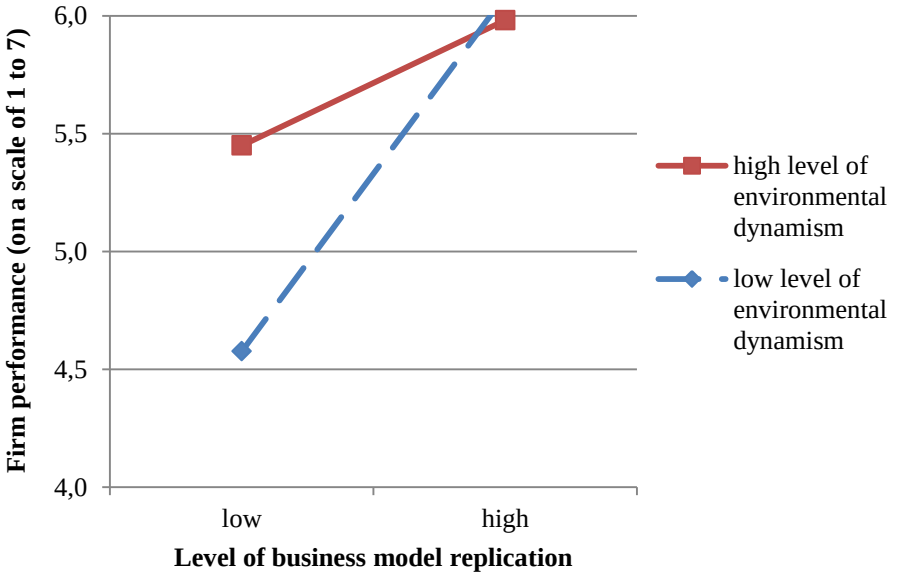
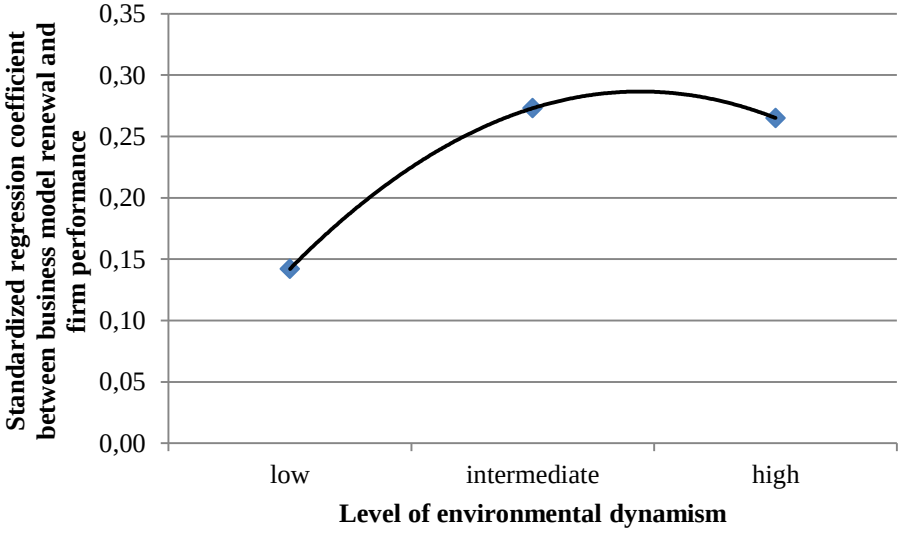


Figure 6.2: The relationship between business model renewal and firm performance as a function of environmental dynamism.



Furthermore, analysis of our data indicates that environmental dynamism does not influence the relationship between business model renewal and firm performance (β = -0.04, p > 0.10), but higher levels of dynamism does significantly weaken this relationship (β = -0.16, p < 0.01). These findings indicate that the relationship between environmental dynamism and firm performance becomes weaker as the level of environmental dynamism increases.

We follow the procedure used by Schilke (2014) and Jaccard (2003) to further test the nature of this non-linear relationship. To plot this non-linear moderating effect of environmental dynamism on the relationship between business model renewal and firm performance, we calculate the association between business model renewal and firm performance at various levels of environmental dynamism: low (average score minus one standard deviation as upper limit), high (average score plus one standard deviation as minimum value), and intermediate (remaining observations) – see also Figure 6.2. To create this graph, we calculate the standardized effect of business model renewal on firm performance at each level of environmental dynamism. This standardized effect represents the vertical axe of Figure 6.2.

As can be seen in this Figure, the effect of business model renewal on firm performance is less strong and not significant (β = 0.14, p > 0.10) in environments characterized by low levels of dynamism compared to those where the levels are high or intermediate. In environments with high levels of dynamism, business model renewal has a positive effect on firm performance (β = 0.265, p < 0.05). It has a particularly strong effect on firm performance (β = 0.273, p < 0.001) in environments characterized by intermediate levels of dynamism. However, the effect of business model renewal on firm performance (b = 0.25) in environments characterized by intermediate levels of dynamism does not exceed the upper boundary of a 90% confidence interval [0.09; 0.43] of its effect on firm performance in environments characterized by high levels of dynamism.

Overall, the findings presented in Figure 6.2, together with the significant moderating effect of higher levels of environmental dynamism, provide partial support for hypothesis 2: the relationship between environmental dynamism and firm performance is stronger in environments characterized by intermediate levels of environmental dynamism than in those with low levels of dynamism, but not significantly stronger than those with high levels.

6.6 Discussion and conclusion

Despite the growing interest in business models as a topic for research (e.g., Zott *et al.*, 2011), we still know relatively little about precisely what part environmental dynamism plays in the relationship between the two types of business model innovation that we have conceptualized and provided with key attributes: replication and renewal. Our study contributes both theoretically and empirically to the business model innovation literature by providing new insights regarding the contingent role of environmental dynamism in the performance effects of replication and renewal.

First, we help to advance the business model innovation literature by conceptualizing and describing attributes of replication and renewal (see also Table 6.1), and by conceptualizing how each contributes to firm performance. With this paper we address earlier concerns that "we need to distinguish different types of business model innovation" (Schneider and Spieth, 2013, p. 23) and that "the emergence of at least a few fundamental, basic research streams on the business model concept may increase both the separation and attachment of the publications under the label 'business model'" (Klang *et al*., 2014, p. 474–475). By distinguishing two types of business model innovation, and conceptualizing and identifying their characteristics, we help to address the lack of clarity over what business model innovation is all about (e.g., Casadesus-Masanell and Zhu, 2013; Lambert and Davidson, 2013; Spieth *et al*., 2014).

Second, the arguments we present help to develop understanding of how environmental dynamism acts as a contingent variable in the relationship between business model replication and firm performance and between business model renewal and firm performance. We provide arguments as to how environmental dynamism can be used to explain differences in performance between business model replication and business model renewal. We explain how environmental dynamism weakens the relationship between business model replication and firm performance, and how it has an inverted U-shaped moderating effect on the relationship between business model renewal and firm performance. This paper therefore complements prior research in which it has been argued that environmental conditions are important moderators of the relationship between a business model and firm performance (Zott and Amit, 2007) and that business model innovation becomes increasingly important in more

dynamic environments (e.g., Giesen *et al*., 2010; Sabatier *et al.,* 2010; Voelpel *et al.*, 2005). Our theoretical arguments indicate that it is important to make a distinction between business model replication and business model renewal so as to understand how business model innovation influences firm performance at different levels of environmental dynamism.

Third, our large-scale survey among firms across multiple industries provides empirical support for the idea that business model replication and business model renewal are two different types of business model innovation, each of which contribute to firm performance. These findings complement prior research (e.g., Aspara *et al.*, 2010; Szulanski and Jensen, 2008) which has focused on the positive effect of the less encompassing view of business model replication – for example, geographical replication - on firm performance. Our findings also support the findings of existing descriptive, conceptual and case-based studies (e.g., Casadesus-Masanell and Ricart, 2011; Nunes and Breene, 2011) that business model renewal has a positive effect on firm performance. Our work addresses the pleas of Morris *et al.* (2013, p. 46) for "measurement of business models and their underlying characteristics" and of Schneider and Spieth (2013, p. 23-24) for "a deeper and more reliable understanding of how business model innovation impacts on firms' results in terms of financial performance".

Moreover, this paper provides empirical support that environmental dynamism has an important contingent effect on the relationship between two types of business model innovation, i.e. replication and renewal, and firm performance. Our findings indicate that environmental dynamism weakens the positive relationship between business model replication and firm performance, while business model renewal has a stronger effect in environments characterized by intermediate and high levels of dynamism compared to relatively stable settings with low levels of environmental dynamism.

One interesting question is why business model renewal should apparently have no stronger effect in settings with intermediate levels of dynamism than in those with high levels of dynamism. One possible explanation could be that, in the more dynamic settings, the lower rewards and the fit of business model renewal to the external environment are counterbalanced by higher returns that stem from focusing more strongly on the firm's activities in a new industry, changing the competitive game within an industry, or gaining second-mover advantage.

The frequency and intensity of changes in environments characterized by high levels of dynamism reduce the profitability of existing business models by reshaping and redistributing industry profitability and by changing the rules of the competitive game (Casadesus-Masanell and Ricart, 2010, 2011; Voelpel *et al.*, 2005). In settings of this kind where firms may perceive their performance dipping towards below the level they aspire to or becoming problematic, they are more likely to devote effort to developing new business models with a higher risk profile and to introduce ones that offer greater potential to maintain or to restore performance (Cyert and March, 1963; Greve, 2003; McGrath, 2010; Osiyevskyy and Dewald, 2014). This could include adopting a new business model that enables a firm to access, or even create, a new industry with more attractive market conditions (e.g., Kim and Mauborgne, 2005; Kumar, Scheer, Kotler, 2000; Teece, 2010). It could also involve introducing a new-to-the-industry business model to redefine the rules of the game (Casadesus-Masanell and Zhu, 2013) and capture first-mover advantage (Lieberman and Montgomery, 1988). For instance, DSM has renewed its business model to enable it to move from the chemical industry into life sciences, so that it can tap into the more attractive growth and opportunities which this new industry offers. Being willing to consider business model renewal that involves a higher level of risk may also speed up a firm's capacity to respond to changing conditions; it may be able to revisit its recent stock of potential new business models rejected earlier as being not worth the risk (Greve, 2003).

The frequency and intensity of changes in environments characterized by high levels of dynamism may also reduce the required investments to realize business model renewal compared to settings with relatively lower levels of dynamism (Adner and Snow, 2010; Greve, 2003) which can counterbalance the reduced value of business model renewal as proposed at hypothesis 2. In these settings, imitating another company's new business model (e.g., Baden-Fuller and Morgan, 2010; Volberda *et al*., 2001) or combining models from various other companies (Mullins and Komisar, 2009) can help a firm to reduce the gap between its performance and those who are leading the way in terms of business models (Alamdari and Fagan, 2005; Porter, 1996) and can provide a firm with second-mover advantages (Aspara *et al*., 2010). Second-mover advantages associated with imitating the new business models of other companies include lower develop costs, faster alignment with the external environment, and an improved version of a business model compared to the one of the business model pioneer (e.g., Greve, 2003; Lieberman and Montgomery,

1988). For instance, to avoid bankruptcy at the beginning of the 1990s, Ryanair departed from its previous, fairly standard, airline business model to become instead "the Southwest of Europe" (Casadesus-Masanel and Ricart, 2010, p. 203), adopting the 'no-frills' business model of Southwest Airlines (e.g., Casadesus-Masanel and Ricart, 2010; Morris *et al*., 2005). It would be valuable for future research to look in more detail at this phenomenon.

Our study, however, complements existing descriptive, conceptual, and case-based studies (e.g., Baden-Fuller and Morgan, 2010; Lambert and Davidson, 2013; Morris *et al*., 2005) on business model innovation in that it emphasizes the importance of differentiating between two types of business model innovation, replication and renewal, in the context of different levels of environmental dynamism. Although some scholars (e.g., Giesen *et al.*, 2010; Sabatier *et al.*, 2010; Voelpel *et al.*, 2005) have implicitly assumed that environmental dynamism triggers business model renewal or strengthens the relationship between business model renewal and firm performance in a linear way, our findings reveal that dynamism in fact has a non-linear moderating effect on this relationship. Furthermore, this paper clearly fills the research gap indicated by Zott and Amit (2007, p. 194-195) who argued that "there has been no systematic large-scale empirical analysis of the performance implications of business model design themes under various environmental regimes".

Our findings have several managerial implications. Although many industries face non-linear shifts at certain moments in time, shifts which can pose a threat to established firms (Govindarajan and Trimble, 2011; Hamel and Välikangas, 2003), most firms seem to focus on applying their existing business model and start creating new business models too late (Govindarajan and Trimble, 2011; Yoon and Deeken, 2013). As a result, they do not manage to capitalize on the value of business model innovation (Amit and Zott, 2012). Our findings indicate that to increase firm performance, management – and in particular those at the top – should take into account how environmental dynamism will influence the performance effects of business model replication and renewal.

Despite making important contributions, this paper also has various limitations that indicate useful directions for future research. First, in subsequent research it would be useful to examine how leadership influences the value of two types of business model innovation. Leadership is vital to initiate and realize business model innovation (e.g., Bock, Opsahl, George, Gann, 2012; Mitchell and Coles, 2004;

Smith *et al.*, 2010), and different styles of leadership such as transformational and transactional leadership may lead to different types of business model innovation or influence their performance effects.

Second, although we are among the first to use a cross-industry survey to examine how environmental dynamism influences the performance effects of business model replication and renewal, future research should take a more longitudinal perspective to assess in more detail the performance implications of these two types of business model innovation over time. For instance, the risks associated with replication and renewal may impact firm performance at different moments in time (e.g., Andries *et al.*, 2013). The degree of environmental dynamism can also be assessed retrospectively and based on changes that are expected to take place in the future, i.e. prospectively (e.g., Brown, 1985; Jacobs, Johnston, Kotchetova, 2001).

Third, although we have included multiple control variables, our research model should be extended in future to include other contingency factors. For instance, first- and second-mover advantages (e.g., Lieberman and Montgomery, 1988) may influence the value of business model innovation, as has been mentioned in our potential explanation of the results of the second hypothesis. Other environmental characteristics such as the degree of complexity and unpredictability (Davis *et al.*, 2009) may also influence the value of business model innovation.

Fourth, future research should examine into more detail how, and under what conditions, business model replication and business model renewal have a complementary effect on firm performance. As can be seen in Table 6.2, business model replication and renewal are also strongly correlated with each other ($r = 0.27$; $p < 0.001$). Some scholars (e.g., Casadesus-Masanell and Tarziján, 2012; Markides, 2013; Markides and Oyon, 2010) have looked at how multiple business models within a firm complement each other. In his conceptual paper, Markides (2013) suggests that a firm can conduct both business model replication and business model renewal, either within a given time frame or across multiple business models relating to different business units. Aspara *et al.* (2013) argue that complete renewal of the business model happens less frequently in any given time frame; in their Nokia case study they found that a firm can combine business model replication and business model renewal by "[r]etaining some elements and renewing others" (Aspara *et al.*, 2013: 462). Additionally, we develop measures for business model replication and business model

renewal, but these two models could be developed further and tested with different datasets.

In conclusion, this paper contributes theoretically and empirically to the business model innovation literature by advancing our understanding of how environmental dynamism acts as a contingent variable in the relationship between business model replication and renewal and firm performance. Environmental dynamism weakens the positive performance effect of business model replication. Business model renewal contributes more strongly to firm performance in environments characterized by intermediate and high levels of dynamism than in relatively stable settings with little environmental dynamism. These findings add to our understanding of how business model innovation influences firm performance and provide further evidence of how environmental dynamism is a key contextual variable in the relationship between business model innovation and firm performance.

6.7 Appendix: Measures and items at firm level

Key characteristics	**Business model replication** (items adapted from Aspara *et al*., 2010; Belderbos, Carree, and Lokshin, 2004; Collins and Smith, 2006; Jansen *et al.*, 2005, 2006; Jaworski and Kohli, 1993)	**Business model renewal** (items adapted from Aspara *et al*., 2010; Burgers *et al.*, 2009; Collins and Smith, 2006; Covin and Slevin, 1989; Jansen *et al*., 2006)
1: Business model components	We continuously look for opportunities to leverage our existing knowledge.	We are very active with initiatives to create entirely new value for certain customers.[1]
	Our organization often improves production and operational processes.[1]	We have acquired many companies in very different industries.[1]
	We often improve existing distribution channels.[1]	Our organization regularly uses new distribution channels.[1]
2: Complementarities among business model components	At the end of the day, our employees feel that they have learned from each other by exchanging and combining ideas.	Our organization has created various new lines of products and services.
	Employees at this company are proficient at combining and exchanging ideas to solve problems or create opportunities.	Our organization has established or sponsored various new ventures.
	If needed, employees from different departments can easily contact each other.[1]	Employees here are capable of sharing their expertise to bring new projects or initiatives to fruition.[1]
3: Market focus	Our organization actively reproduces its own successful business model in a certain market area in other geographical market areas.[1]	We frequently utilize new opportunities in new markets.
	We increase economies of scale in existing markets. [1]	Our organization has entered many new industries.
	Our organization deepens existing customer relationships.[1]	Our organization usually has a very competitive, 'undo the competitors' posture.[1]

Study V

Firm performance (adapted from Jaworski and Kohli, 1993; Volberda *et al.*, 2012)
Our organization is very profitable.[2]
In comparison with similar organizations, we are doing very well.
Our competitors can be jealous of our performance.

Environmental dynamism (adapted from Jansen *et al*., 2006)
Environmental changes in our local market are intense.
Our clients regularly ask for new products and services.
In our local market, changes are taking place continuously.
In a year, nothing has changed in our market (reversed item).
In our market, the volumes of products and services to be delivered change fast and often.[1]

All items are measured on a seven-item scale, ranging from "strongly disagree" (1) to "strongly agree" (7).

[1]: item removed after factor analyses; [2]: item removed after Cronbach's alpha analysis

CHAPTER 7. General discussion and conclusion: management innovation, co-creation, and business model innovation as significant drivers of firms' (innovation) performance

Innovation is generally considered to be pivotal for organizational survival (e.g., Andriopoulos and Lewis, 2009; Chandy and Tellis, 1998; Schumpeter, 1934). It can be differentiated into different types such as technological innovation, management innovation, co-creation and business model innovation, and technological innovation in particular has received considerable attention in academic research (e.g., Crossan and Apaydin, 2010; Damanpour, 2014). Examining the role of non-technological types of innovation in turning technological knowledge into product and service innovations and subsequently into a commercial success can provide important new insights into how organizations can increase their chances of organizational survival or prosperity. This dissertation examines how and under which conditions three major non-technological types of innovation, i.e. management innovation, co-creation with customers, and business model innovation, contribute to firm performance: either innovation performance, or overall firm performance.

Study I in this dissertation identifies common and emerging research areas, and it sets research priorities for management innovation which serve as a springboard for the next two studies. Studies II, III and IV provide new insights into how management innovation and co-creation with customers contribute to exploitative and exploratory product and service innovations. The moderating role of organizational size and organizational connectedness on these effects is also scrutinized in Studies III and IV respectively. Study V advances our understanding of two basic types of business model innovation, i.e. replication and renewal, and how their performance effects are contingent upon the level of environmental dynamism. Hypotheses are tested using data from multiple large-scale surveys and are complemented with archival data.

The following section summarizes the main findings and contributions of the five studies in this dissertation on how and under which contextual factors management innovation, co-creation with customers, and business model innovation contribute to firm performance. After the summary of the main more general findings and contributions, we highlight a number of implications and limitations and we discuss directions for future research.

7.1 Main findings and contributions

This section highlights the focus, key findings and major contributions of each of the five studies presented in this dissertation (see also Table 7.1.6 at the end of this section for an overall summary). For each study, we also include a table listing its main findings.

7.1.1 Study I

The first study presented in this dissertation provided a review of progress in management innovation research, highlighting the important shift towards more research on various types of non-technological innovation that took place over the last couple of years, with an emphasis on management innovation. Several definitions of management innovation were discussed (e.g., Birkinshaw *et al*., 2008; Hamel, 2006; Mol and Birkinshaw, 2009) and classic types of management innovation such as the moving assembly line (Chandler, 1977) and the multidivisional structure (Chandler, 1962) and more recent types such as total quality management programmes (e.g., Zbaracki, 1998) and self-managed teams (e.g., Hamel, 2011; Vaccaro *et al*., 2012b) were presented. After having discussed the concept of management innovation, and how it differs from very closely related concepts of administrative innovation and organizational innovation, this study identified common areas of research in terms of the antecedents (managerial, intra- and interorganizational), dimensions, outcomes, and contextual factors relating to management innovation (see also Table 7.1.1). For instance, several scholars have investigated managerial antecedents of management innovation such as transformational leadership (Vaccaro *et al*., 2012a) and top management team diversity (Heyden, 2012).

The first study highlighted the relationship between technological and management innovation, indicating that these two types of innovation have different effects on performance. This is an emerging area of research which warrants further attention, and we have accordingly presented a series of priorities for future research (see Table 7.1.1). For example, one priority is to advance our understanding of how management innovation and technological innovation are related by applying a complementary perspective (Milgrom and Roberts, 1995). As such, based on a review on common and emerging areas and research priorities concerning management innovation, this study has laid a foundation for stimulating further scholarly discussion

of important innovation research topics, including the crucial role of management innovation.

Table 7.1.1: Main contributions of Study I.

Main contributions:
● Providing an integrative framework of management innovation: - Managerial antecedents (e.g., Birkinshaw, 2010; Vaccaro et al., 2012a) - Intra-organizational antecedents (e.g., Harder, 2011; Mol and Birkinshaw, 2009) - Inter-organizational antecedents (e.g., Damanpour and Aravind, 2012; Wright *et al.*, 2012) - Outcomes of management innovation (e.g., Mol and Birkinshaw, 2009; Walker *et al*., 2011) - Contextual factors (e.g., Grant, 2008; Vaccaro *et al*., 2012a)
● Identifing emerging research themes in management innovation: - Debate 1: the relationship between management innovation and technological innovation (e.g., Damanpour *et al*., 2009; Mol and Birkinshaw, 2012) - Debate 2: the performance effects of management innovation versus technological innovation (e.g., Teece, 2010; Volberda *et al.,* 2010)
● Setting up research priorities for management innovation research: - Conceptualize and define management innovation in complementary ways - Investigate complementarities between management innovation and technological innovation and the impact on performance - Examine the usefulness of pluralism in research methods as a means to increase the contributions of management innovation research - Examine how management innovation is related to exploratory innovation - Examine the extent to which management innovations are generic or specific

7.1.2 Study II

Study II examined how management innovation moderates the inverted U-shaped effect of R&D on radical product innovations. The results of a large-scale survey of Dutch firms across a broad range of industries support the hypothesis that R&D has an inverted U-shaped effect on radical product innovations. Analyses of our data also indicate that this effect applies ceteris paribus to firms with lower levels of management innovation. In firms with high levels of management innovation, the effect of R&D on radical product innovations becomes J-shaped (see also Table 7.1.2). These findings indicate that management innovation should be considered a key moderator in explaining firms' effectiveness at transforming R&D into successful radical product innovations.

Our research provided a response to management scientists (e.g., Camison and Villar-López, 2014; Damanpour, 2014; Volberda *et al*., 2013) who have called for

more research on the relationship between technological innovation and management innovation. In particular, this study helped to explain why R&D can have mixed effects on firm outcomes (Artz *et al.*, 2010; Erden *et al*., 2014; Zhou and Wu, 2010) as it highlighted the importance of including management innovation as a contextual variable when looking at variations in a firm's effectiveness at transforming different levels of R&D into radical product innovations. Cruz-Cázares, Bayona-Sáez, and García-Marco (2013, p. 1239) have stated that directly linking R&D to firm performance without taking account of product innovations "would generate misleading results" because of differences in a firm's effectiveness at turning R&D into product innovations. With the notable exception of Acs and Audretsch (1988), most scholars who have examined the inverted U-shaped effect of R&D, i.e. new technological knowledge, on a firm's innovation performance have typically done so in specific industries that are R&D-intensive. Our arguments and findings highlight that the inverted U-shaped effect of R&D on radical product innovations (e.g., Acs and Audretsch, 1988; Graves and Langowitz, 1993) also applies to firms across a broad range of industries in the Netherlands and, all other things being equal, can also relate to firms with lower levels of management innovation.

Table 7.1.2: Main findings of Study II.

Hypotheses:		**Results:**
1	R&D has a curvilinear (inverted U-shaped) effect on radical product innovations.	Supported
2	Management innovation moderates the inverted U-shaped relationship between R&D and radical product innovations in such a way that the inverted U-shaped effect will be flatter, i.e. moves towards a J-shaped effect, in firms with high levels of management innovation than in firms with low levels of management innovation.	Supported
Contributions:		
● Our research with firms across multiple industries in the Netherlands confirms the findings from previous research that there is a U-shaped relationship between R&D and product innovation, but suggests that this applies particularly to firms with a lower level of management innovation.		
● Management innovation seems to be detrimental for a firm's effectiveness at turning lower levels of R&D into radical product innovations.		
● R&D and management innovation can have complementary effects on radical product innovations, but only when high levels of both types are present.		

This study also complemented prior research focusing on whether the combined effect of management innovation and technological innovation on firm performance is either positive (e.g., Damanpour *et al*., 2009) or negative (e.g., Roberts and Amit, 2003). The finding that increased levels of management innovation have the effect of transforming the inverted U-shaped relationship between R&D and radical product innovation into more a J-shape highlights the relevance of examining the combined effect of R&D and management innovation at various levels of both. In particular, this J-shaped effect for firms with higher levels of management innovation implies that management innovation can be both detrimental at lower levels of R&D, and beneficial at higher levels of R&D, in terms of a firm's effectiveness at turning R&D into radical product innovations.

7.1.3 Study III

The third study focused on how new management practices, i.e. management innovation, contribute to a firm's exploitative innovation performance. Additionally, we included the moderating role in this relationship of a particular organizational characteristic which has been acknowledged to be an important contextual variable in leveraging knowledge on a firm's outcomes: organizational size (Van Wijk, Jansen, Lyles, 2008). Our findings indicate that new management practices have an accelerating positive effect on a firm's exploitative innovation performance. However, the larger the firm, the more this relationship moves from a positive linear relationship to one that is more J-shaped (see also Table 7.1.3). These findings increase our understanding of how new management practices contribute to a firm's exploitative innovation performance and highlight organizational size as an important contextual variable in this relationship.

This study complements scholars (e.g., Benner and Tushman, 2002; Mol and Birkinshaw, 2009; Walker, Damanpour, Devece, 2011) who have focused on a linear relationship between new management practices and firm performance or between a specific example of a new management practice and a firm's performance in exploitative innovation. Looking at a range of new management practices in line with the encompassing definition of it by Birkinshaw *et al*. (2008), rather than focusing on a specific example, allows one to examine complementary effects between them and what impact they have collectively on the exploitative innovation performance of a firm. For instance, it can be expected that introducing new human resource

management practices alongside new operational and new monitoring management practices will increase the effect of each of these new practices on a firm's exploitative innovation performance. Additionally, by examining the effect of new management practices on a firm's exploitative innovation performance, we added to the insights of researchers who have examined complementary effects among new management practices on firm performance (e.g., Roberts, 2004; Whittington *et al*., 1999).

Table 7.1.3: Main findings of Study III.

Hypotheses:		**Results:**
1	The introduction of more new management practices has an increasingly positive effect on a firm's exploitative innovation performance.	Supported
2	An increase in organizational size moderates the increasingly positive relationship between new management practices and a firm's exploitative innovation performance in such a way that it strengthens this relationship.	- No significant moderating effect at lower levels of new management practices - Supported at higher levels of new management practices
Contributions:		
● Suggest that new management practices have an accelerating positive effect on a firm's exploitative innovation performance.		
● Complementary effects among new management practices seem to be beneficial not only for overall firm performance, but also for a firm's exploitative innovation performance.		
● Suggests that one needs to consider the extent of the new practices introduced when comparing the accelerating positive effect of new management practices on the exploitative innovative innovation performance on firms of varying sizes.		

Concerning the moderating role of organizational size, to our best knowledge we are among the first to explicitly highlight that one needs to consider the extent of the new practices introduced when comparing the accelerating positive effect of new management practices on the exploitative innovative innovation performance on firms of varying sizes. Management scientists have considered organizational size as an antecedent of new management practices (Kimberly and Evanisko, 1981; Mol and Birkinshaw, 2009), or have not explicitly focused on the role of organizational size in the relationship between new management practices and firm outcomes (e.g., Massini and Pettigrew, 2003; Whittington *et al*., 1999). Study III suggested that organizational size is an important contextual variable in explaining whether new management practices have a linear positive effect on a firm's exploitative innovation performance – as suggested by Benner and Tushman (2002), and Parast (2011), for instance – or

whether they have a J-shaped effect on performance outcomes (e.g., Massini and Pettigrew, 2003; Whittington *et al*., 1999).

7.1.4 Study IV

Study IV focused on the effect of relationship learning with customers on exploitative and exploratory product and service innovation and it examined how these relationships are contingent upon connectedness among organizational members as an informal coordination mechanism within an organization. Findings based on a large-scale survey of Dutch health care providers indicate that relationship learning with customers has an inverted U-shaped effect on exploitative innovation, while its effect on exploratory innovation is positive (see also Table 7.1.4). Organizational connectedness flattens the negative effect of higher levels of relationship learning with customers on exploitative innovation. These findings help to increase our understanding of how co-creation with customers influences an organization's innovation performance.

Accordingly, this study helped to provide greater clarity of how knowledge from customers influences an organization's innovation performance (e.g., Chatterji and Fabrizio, 2014; Griffin *et al.*, 2013). Our findings suggest that differentiating a firm's innovation performance of relationship learning with customers into exploitative and exploratory innovation and applying the theoretical perspectives (e.g., Danneels, 2003; Holmqvist, 2003; Uzzie, 1997) of both relational embeddedness and heterogeneity of knowledge bases helps to explain the mixed results of previous research regarding extent to which an organization should co-create with its customers in order to increase its innovation performance.

This study also addressed the lack of research on the moderating role of organizational connectedness as an informal coordination mechanism which influences how relationship learning with customers can help to bring about exploitative and exploratory product and service innovations (e.g., Chen *et al*., 2013; Foss *et al*., 2013). We highlight the relevance to include the moderating role of connectedness among organizational members as an informal coordination mechanism within an organization when examining the effect of co-creation with external partners on an organization's exploitative innovation performance; Connectedness among organizational members supports the transformation of higher levels of relationship learning with customers into exploitative innovation.

Table 7.1.4: Main findings of Study IV.

Hypotheses:		**Results:**
1	Relationship learning with customers has a curvilinear (inverted U-shaped) effect on exploitative innovation.	Supported
2	Relationship learning with customers has a curvilinear (inverted U-shaped effect) on exploratory innovation.	- Support for a positive effect of lower levels of relationship learning on exploratory innovation
		- No significant effect of higher levels of relationship learning on exploratory innovation
3	An increase in connectedness moderates the inverted U-shaped effect of relationship learning with customers on exploitative innovation in such a way that this relationship will be steeper for organizations with high levels of connectedness than for those with low levels of connectedness.	- No significant moderating effect of connectedness at lower levels of relationship learning
		- Connectedness flattens the negative effect of higher levels of relationship learning on exploitative innovation
4	An increase in connectedness moderates the inverted U-shaped effect of relationship learning with customers on exploratory innovation in such a way that this relationship will be steeper for organizations with high levels of connectedness than for those with low levels of connectedness.	Not supported: no significant moderating effect
Contributions:		
● Differentiating innovation performance into exploitative and exploratory innovation helps to explain the mixed results of earlier research about the extent to which an organization should co-create with its customers in order to increase its innovation performance.		
● Applying the theoretical perspectives of relational embeddedness *and* of the heterogeneity of knowledge bases seems to provide valuable new insights into how knowledge from customers influences an organization's innovation performance.		
● Highlighting the relevance to include the moderating role of connectedness among organizational members as an informal coordination mechanism within an organization when examining the effect of co-creation with external partners on an organization's exploitative innovation performance.		

7.1.5 Study V

Study V investigated how firms can turn business model innovation into a source of competitive advantage, and how environmental dynamism influences those performance effects. This study helped to clarify what a business model and in particular business model innovation stands for (e.g., Casadesus-Masanell and Zhu,

2013; Spieth *et al.*, 2014) by differentiating between two basic types of business model innovation, i.e. replication and renewal, and by conceptualizing and describing the key characteristics of each type.

Additionally, the results of a large-scale survey indicate that environmental dynamism weakens the positive relationship between business model replication and firm performance, while the effect of business model renewal is stronger in environments that are characterized by intermediate and high levels of dynamism than in settings that are relatively stable, i.e. that have low levels of dynamism (see also Table 7.1.5). These findings indicate that it is important to take the level of environmental dynamism into account when examining the performance effects of business model replication and business model renewal. Additionally, our findings seem to contrast with the implicit assumptions of scholars (e.g., Giesen *et al.*, 2010; Sabatier *et al.*, 2010; Voelpel *et al.*, 2005) that environmental dynamism triggers business model renewal and that it strengthens the relationship between business model renewal and firm performance in a linear way.

Table 7.1.6 summarizes the research question, key findings, and theoretical contributions of each individual study in this dissertation.

Table 7.1.5: Main findings of Study V.

Hypotheses:		**Results:**
1	Environmental dynamism moderates the relationship between business model replication and firm performance in such a way that it weakens this relationship.	Supported
2	The relationship between business model renewal and firm performance is stronger with an intermediate level of environmental dynamism than when the level of environmental dynamism is either low or high.	- Support for business model renewal having a stronger positive effect on firm performance in environments with intermediate levels of dynamism than in settings with low levels of dynamism
		- No support for there being differences in the effect of business model renewal on firm performance in environments with intermediate levels of dynamism compared to those with high levels of dynamism
Contributions:		
● Helps to provide greater clarity on what business model innovation stands for by conceptualizing and setting out key characteristics of two basic types: business model replication and business model renewal.		
● Indicate the importance to take the level of environmental dynamism into account when examining the performance effects of business model replication and business model renewal.		
● Seems to contrast with the implicit assumption of scholars that environmental dynamism strengthens the relationship between business model renewal and firm performance in a linear way.		

Table 7.1.6: Summary of research questions, key findings, and theoretical contributions.

	Research question:	Key findings:	Theoretical contributions:
Study I	*What are common and emerging research domains and the research priorities in the field of management innovation?*	● Identifies common areas of research in terms of antecedents (managerial, intra- and interorganizational), dimensions, outcomes, and contextual factors related to management innovation.	● Lays the foundation for further scholarly discussion on important innovation research topics, including the crucial role of management innovation.
		● Highlights emerging but under-researched themes: the relationship between technological innovation and management innovation, and their effects on performance.	
		● Sets out an agenda for future research and research priorities for management innovation research.	
Study II	*How does management innovation moderate the relationship between R&D and radical product innovations?*	● R&D has an inverted U-shaped effect on radical product innovations.	● Our research with firms across multiple industries in the Netherlands confirms the findings from previous research that there is a U-shaped relationship between R&D and product innovation, but suggests that this applies particularly to firms with a lower level of management innovation.
		● At lower levels of management innovation, the relationship between R&D and radical product innovations has an inverted U-shaped effect, while	● Management innovation seems to be detrimental for a firm's effectiveness at turning lower levels of R&D into radical product innovations.

(Table continues on the next page.)

		for firms with higher levels of management innovation the effect is J-shaped.	● R&D and management innovation can have complementary effects on radical product innovations, but only when high levels of both types are present.
Study III	*How do new management practices, i.e. management innovation, contribute to a firm's exploitative innovation performance and how does organizational size moderate this relationship?*	● New management practices have an increasingly positive effect on a firm's exploitative innovation performance.	● Suggest that new management practices have an accelerating positive effect on a firm's exploitative innovation performance.
			● Complementary effects among new management practices seem to be beneficial not only for overall firm performance, but also for a firm's exploitative innovation performance.
		● The larger the firm, the more the relationship between new management practices and exploitative innovation performance moves from a positive linear relationship towards a more J-shaped relationship.	● Suggests that one needs to consider the extent of the new practices introduced when comparing the accelerating positive effect of new management practices on the exploitative innovative innovation performance on firms of varying sizes.
Study IV	*How does relationship learning with customers contribute to exploitative and exploratory innovation and how does connectedness within an organization moderate this relationship?*	● Relationship learning with customers has an inverted U-shaped effect on exploitative innovation, while its effect on exploratory innovation is positive.	● Differentiating innovation performance into exploitative and exploratory innovation helps to explain the mixed results of earlier research about the extent to which an organization should co-create with its customers in order to increase its innovation performance.
			● Applying the theoretical perspectives of relational embeddedness *and* of the heterogeneity of knowledge bases seems to provide valuable new insights into how knowledge from customers influences an

			organization's innovation performance.
		● Organizational connectedness flattens the negative effect of higher levels of relationship learning with customers on exploitative innovation.	● Highlighting the relevance to include the moderating role of connectedness among organizational members as an informal coordination mechanism within an organization when examining the effect of co-creation with external partners on an organization's exploitative innovation performance.
Study V	*How does environmental dynamism moderate the relationship between different types of business model innovation, i.e. replication and renewal, and firm performance?*	● Conceptualization, and setting out key characteristics of two types of business model innovation: replication and renewal.	● Helps to provide greater clarity on what business model innovation stands for.
		● Environmental dynamism weakens the positive relationship between business model replication and firm performance, while the positive effect of business model renewal is stronger in environments with intermediate and high levels of dynamism than in relatively stable settings, i.e. with low levels of environmental dynamism.	● Indicate the importance to take the level of environmental dynamism into account when examining the performance effects of business model replication and business model renewal.
			● Seems to contrast with the implicit assumption of scholars that environmental dynamism strengthens the relationship between business model renewal and firm performance in a linear way.

7.2 Overarching theoretical contributions to the innovation literature

The overall aim of this dissertation is to advance our understanding of how and under which conditions management innovation, co-creation with customers, and business model innovation, contribute to firm performance. This dissertation provides multiple contributions to achieve its overall aim which are grouped into the following three overarching areas:

1) Performance effects;
2) The moderating role of internal and external factors;
3) Methodological and empirical contributions.

Overall, this dissertation addresses the call from scholars (e.g., Baden-Fuller and Haefliger, 2013; Damanpour, 2014; Volberda *et al*., 2014) to conduct more research on non-technological types of innovation, including on their relationship with technological innovation. For instance, Damanpour (2014, p. 1279) has stated that "research focus[ing] on technology-based product and process innovations should be expanded to a broader focus that embodies both technological and non-technological innovations."

7.2.1 Performance effects.

Drawing on the innovation process in which technological knowledge needs to be transformed into product and service innovations which are subsequently fundamental in influencing firm performance (e.g., Baregheh *et al*., 2009; Pavitt, 2005), we differentiate between two kinds of firm performance: (1) innovation performance, i.e. product and service innovations, and (2) overall firm performance. We address a number of largely unanswered questions as to how several types of non-technological innovation contribute to these two kinds of firm performance.

By applying the dominant rational perspective on management innovation (Birkinshaw *et al*., 2008; Volberda *et al*., 2014), and the relational view in the study on co-creation (Dyer and Singh, 1998), this dissertation sheds a new light on how management innovation and co-creation with customers contribute to product and service innovations. Additionally, it lays a foundation for further advancing our understanding of how two basic types of business model innovation – replication and renewal – increase the value of technological innovation and existing technological

knowledge. Our contributions concerning the performance effects of management innovation, co-creation with customers, and business model innovation can be clustered into three groups, as presented in Table 7.2.1.

Table 7.2.1: Contributions concerning performance effects.

● Relationship between technological and non-technological types of innovation: how management innovation and co-creation with customers contribute to firms' innovation performance.
● Conceptualization of two basic types of business model innovation and their performance effects.
● Moving beyond linear effects to provide a more fine-grained understanding on the performance effects of various types of innovation.

Relationship between technological and non-technological types of innovation: how management innovation and co-creation with customers contribute to firms' innovation performance

Management innovation, and in particular its relationship with technological innovation, are emerging, yet under-researched domains (e.g., Damanpour, 2014; Mol and Birkinshaw, 2006; Volberda *et al*., 2013, 2014). As highlighted in the introduction (paragraph 1.2) of this dissertation, technological innovation has been referred to as the introduction of new technological knowledge, and of technological process and product/service innovations in which new technological knowledge is embodied (e.g., Bergek, Jacobsson, Carlsson, Lindmark, Rickne, 2008; Geels, 2005). Various scholars (e.g., Hollen, Van Den Bosch, Volberda, 2013; Markus and Robey, 1988; Mothe and Thi, 2010; Orlikowski, 1992) have speculated that there may be different relationships between technological innovation and management innovation: (perspective 1) technological innovation can enable management innovation (e.g., Evan, 1966; Hecker and Ganter, 2013); (perspective 2) management innovation can enable technological innovation (e.g., Camisón and Villar-López, 2014; Mothe and Thi, 2010); and (perspective 3) both types of innovation can have a combined, complementary effect on firm performance (e.g., Damanpour, Szabat, Evan, 1989; Damanpour *et al*., 2009). This dissertation contributes to the second and third of these perspectives on the relationship between management innovation and technological innovation in that it advances our understanding of how management innovation *interacts* with R&D, and how it *enables* the introduction of product and service innovations.

Study I highlights the relationship between management innovation and technological innovation and their relative performance effects as emerging domains. It also points out the need for additional research on the relationship between these two types of innovation by applying a complementary perspective. Study II provides new insights on the relationship between technological innovation and management innovation by taking into account both new technological knowledge (R&D) and radical product innovations. This study advances our understanding of how radical product innovations are enabled by complementary effects between differing levels of R&D and management innovation.

This dissertation differentiates between two prominent types of product and service innovation: exploitative and exploratory. Adequate levels of both types are fundamental for organizational survival (e.g., Benner and Tushman, 2002; Levinthal and March, 1993). In contrast to Study II, where the focus of attention is on more radical, exploratory product and service innovations, Study III provides new insights into how management innovation enables a firm's exploitative innovation performance. Accordingly, both Studies II and III advance our understanding of how management innovation enables exploratory and exploitative product and service innovations.

In a similar vein to Studies II and III, Study IV examines how non-technological innovation enables exploitative and exploratory product and service innovations. This study shifts the focus beyond the level of an organization in order to provide more understanding of how and to what extent an organization can create synergies between its knowledge base and those of its customers in order to improve its level of exploitative and exploratory product and service innovations. Firms differ in the degree to which they can realize product and service innovations using their knowledge base (Cruz-Cázares *et al.*, 2013; Laursen, 2012), and differentiating between organizations/actors that generate or hold certain knowledge and those that utilize that knowledge helps to explain the mixed findings of prior research about what drives successful innovative firms (Bierly, Damanpour, Santoro, 2009; Damanpour and Wischnevsky, 2006). By applying an "outside-in" perspective on co-creation where an organization benefits from existing knowledge from customers which is new-to-the-firm (Bierly *et al.*, 2009; Enkel, Gassmann, and Chesbrough, 2009, p. 312), Study IV adds to current insights (e.g., Chatterji and Fabrizio, 2014; Laursen and Salter, 2006) on the importance of making a distinction between customers who

generate or hold knowledge and organizations that turn customer knowledge into product and service innovations.

Conceptualization of two basic types of business model innovation and their performance effects

Business models are known to increase the value of new technological knowledge and of product and service innovations (e.g., Chesbrough and Roosenbloom, 2002; Johnson *et al*., 2008; Venkatraman and Henderson, 2008). Several scholars (e.g., Itami and Nishino, 2010; Markides and Oyon, 2010; Teece, 2010) have also suggested that business models can commercialize the value of management innovation and co-creation or that these two types of non-technological innovation are required to realize business model innovation.

Product and service innovations often require business model innovation to commercialize their value (Johnson *et al*., 2008). However, to understand more about how business model innovation increases the value of technologies, products and services and of certain non-technological types of innovation, we first need to deal with the lack of clarity on what business model innovation stands for (e.g., Casadesus-Masanell and Zhu, 2013; Spieth *et al*., 2014) and to gain additional insights into how it influences firm performance (Schneider and Spieth, 2013). Study V addresses this lacuna in academic research by conceptualizing and providing key attributes of two basic types of business model innovation: replication and renewal. It also conceptualizes how these two basic types contribute to firm performance.

Moving beyond linear effects to provide a more fine-grained understanding on the performance effects of various types of innovation

This dissertation goes beyond an examination of linear effects which is a common feature of much of the previous research on management innovation (e.g., Mol and Birkinshaw, 2009; Walker *et al*., 2011), co-creation (e.g., Chatterji and Fabrizio, 2014; Selnes and Sallis, 2003; Wang and Hsu, 2014) and on business models (Aspara *et al*., 2010; Osiyevskyy and Dewald, 2015). In this dissertation, nonlinear effects is used to mean either the effect of an independent variable on one or more dependent variables, to moderating effects, or to both.

By investigating nonlinear effects, we have shown that assertions in prior research (e.g., Chatterji and Fabrizio, 2014; Walker *et al*., 2011) concerning linear

effects apply at certain levels of management innovation and relationship learning with customers. For instance, Study II advances our understanding of how management innovation offsets the negative effect of higher levels of R&D on radical product innovations. Study IV provides new insights into how relationship learning with customers has a different effect on exploitative product and service innovations than it has on exploratory product and service innovations. By doing so, we address the promising opportunity for new research on the non-linear effects of knowledge utilization, as suggested by Van Wijk *et al*. (2008).

7.2.2 The moderating role of internal and external factors.

The value of knowledge and innovation is very much dependent on their context (Damanpour, 1991; Galunic and Rodan, 1998; Rosenbusch, Brinckmann, Bausch, 2011). Besides enhancing our understanding of how management innovation, co-creation with customers, and business model innovation contribute to firm performance, this dissertation also provides new insights how a number of different contextual factors influence those effects. The contributions it makes in relation to the moderating factors involved here can be clustered into two groups, as shown in Table 7.2.2. By examining formal and informal coordination mechanisms, and internal and external contextual variables, these various studies advance our understanding of why firms with fairly similar levels of new technological knowledge, management innovation, co-creation with customers or business model innovation can differ in terms of performance – either innovation performance or overall firm performance.

Table 7.2.2: Contributions concerning the moderating role of internal and external factors.

● The contextual role of internal coordination mechanisms, both formal and informal – management innovation and organizational connectedness – in realizing product and service innovations from R&D and co-creation with customers.
● The role of internal and external contextual factors, i.e. organizational size and environmental dynamism, in the relationship between various types of non-technological innovation and firm performance.

Formal and informal coordination mechanisms

Study II investigates the moderating role of management innovation on the inverted U-shaped effect of R&D investment on radical product innovations. Rather than focusing on management innovation as a formal coordination mechanism, Study IV addresses the gap in the literature regarding how organizational connectedness, which serves as an informal coordination mechanism among members within an organization, moderates the effect of relationship learning with customers on exploitative and exploratory product and service innovations. These two studies highlight the importance of formal and informal coordination mechanisms within an organization in realizing either exploratory or exploitative product and service innovations. In particular, Studies II and IV show how management innovation and organizational connectedness offset the negative effect of respectively higher levels of R&D on radical product innovations and of higher levels of relationship learning with customers on exploitative product and service innovations.

Internal and external contextual factors

Study III examines the moderating role of organizational size (used as a proxy for organizational complexity) on the effect on new management practices on exploitative product and service innovations. Study V includes the moderating role of environmental dynamism on the performance effects of two basic types of business model innovation. Both organizational size and environmental dynamism are often considered to be important contextual variables which influence the value of knowledge and innovation (e.g., Damanpour, 1991; Hamel and Välikangas, 2003; Jansen *et al*., 2006). Studies III and V emphasize the importance of including internal and external contextual factors such as organizational size and environmental dynamism in order when looking to understand more about how management innovation, business model replication and business model renewal contribute to firm performance.

By including various contextual variables as applicable to particular studies, this dissertation helps to clarify the different performance effects of management innovation, co-creation with customers, or business model innovation that have been put forward by prior research. For instance, Study III reveals that organizational size is an important contextual variable in explaining whether new management practices have a linear positive effect on a firm's exploitative innovation performance – as

suggested by Benner and Tushman (2002), and Parast (2011), for instance – or whether they have a J-shaped effect on performance outcomes (e.g., Massini and Pettigrew, 2003; Whittington *et al*., 1999). With its finding that organizational connectedness flattens the negative effect of higher levels of relationship learning with customers on exploitative product and service innovations, Study IV helps to clarify whether co-creation is beneficial (e.g., Chatterji and Fabrizio, 2014; Foss *et al*., 2011), detrimental (e.g., Christensen and Bower, 1996; Hamel and Prahalad, 1994), or has an inverted U-shaped effect (e.g., Atuahene-Gima, Slater, Olson, 2005; Laursen and Salter, 2006) on an organization's performance. As such, this dissertation responds to calls for more research that takes account of "contextual variation" in non-technological innovation (Markides, 2013; Volberda *et al*., 2014, p. 1259).

7.2.3 Methodological and empirical contributions.

Large-scale survey research on management innovation (e.g., Damanpour, 2014; Damanpour and Aravind, 2012; Hervas-Oliver and Sempere-Ripoll, 2014), co-creation with customers (Chatterji and Fabrizio, 2014; Wang and Hsu, 2014), and in particular on business model innovation (Lambert and Davidson, 2013; Schneider and Spieth, 2013; Zott and Amit, 2007) is relatively scarce. Because they involve large-scale survey research, four of the five studies in this dissertation provide various methodological and empirical contributions (see also Table 7.2.3).

Table 7.2.3: Methodological and empirical contributions.

● A more fine-grained understanding of the role of management innovation – as a generic construct – on firm performance.
● Development of scales for measuring business model replication and business model renewal.
● Large-scale survey research across multiple industries to assess the performance effects of R&D and business model innovation in a more generic way.
● Large-scale survey research among Dutch health care providers to examine the effect of co-creation with customers on innovation performance.

Studies II and III adopted a seven-point scale of management innovation from Vaccaro *et al.* (2012a), which is based on an encompassing definition provided by Birkinshaw *et al.* (2008). Accordingly, this dissertation goes beyond the conceptualizations provided by management scientists (e.g., Hervas-Oliver and Sempere-Ripoll, 2014; Mol and Birkinshaw, 2009) who measured management

innovation as dummy variables or in terms of specific examples such as ISO certifications (e.g., Benner and Tushman, 2002; Kim, Kumar, Kumar, 2012). Empirical studies have often measured certain types of innovation using dichotomous measures (Damanpour, 2014). Accordingly, this dissertation provides a more fine-grained understanding on the role of management innovation - as a generic construct - on firm performance.

Most of the research on business models is descriptive (Morris *et al*., 2005), conceptual (Lambert and Davidson, 2013), or based on case studies (Baden-Fuller and Morgan, 2010; Lambert and Davidson, 2013). Accordingly, there are very few adequate scales for measuring business model replication and business model renewal. Although a business model is a broad concept (e.g., Lambert and Davidson, 2013; Zott *et al*., 2011) which is difficult to grasp (Baden-Fuller and Morgan, 2010) and operationalize (Markides, 2013), Study V develops scales for measuring business model replication and business model renewal which are based on our conceptualizations and the key characteristics we have identified.

In contrast to the single-firm, -market or -industry nature of the majority of business model studies (e.g. Lambert and Davidson, 2013; Schneider and Spieth, 2013), Study V conducts a large-scale survey among Dutch firm across multiple industries in order to assess the performance effects of two basic types of business model innovation, including the moderating role of environmental dynamism, in a more generic way. In a similar vein, Study II goes the beyond the dominant focus of prior research (e.g., Erden *et al.,* 2014; Katila and Ahuja, 2002) where the inverted U-shaped relationships between prominent indicators of new technological knowledge and firm performance has typically been examined in specific R&D-intensive industries (see also Table 3.1 in Study II). With the notable exception of Acs and Audretsch (1988), who found that R&D has an inverted U-shaped effect on radical product innovations among various U.S. manufacturing and service-oriented industries, our findings provide empirical support for the notion that an inverted U-shaped effect of R&D on radical product innovations applies to firms in a broad range of industries in the Netherlands.

There are more opportunities for interaction with customers when the service element of a firm's offering increases (Harker and Egan, 2006), but co-creation has been examined mainly in manufacturing industries (Mention, 2011) and in inter-organizational settings (Chatterji and Fabrizio, 2014). Various scholars (e.g.,

Christensen, Bohmer, Kenagy, 2000; Davey, Brennan, Meenan, McAdam, 2010) have focused on the vital importance of innovations in the healthcare industry, and on the role of clients in it (e.g., Herzlinger, 2006; Laschinger, Gilbert, Smith, Leslie, 2010). There are two fundamental types of healthcare activity: those that aim to treat a particular medical condition, i.e. provide a cure, or those designed to nurse a more chronic condition, i.e. provide care (Mintzberg, 2002). In contrast to prior research, Study IV focuses on the relationship learning that takes place between Dutch healthcare organizations providing care services and their clients as end-users, and uses large-scale survey research to examine how this learning helps in realizing exploitative and exploratory product and service innovations and how connectedness moderates these effects.

Although our four empirical studies draw on three different datasets, they are part of a broader overall project to quantify various types of innovation, namely the *Erasmus Competition and Innovation Monitor*. This monitor – of which the author is a principal associate – provides a systematic measure of the level of non-technological types of innovation such as management innovation, co-creation and business model innovation. The Erasmus Competition and Innovation Monitor, together with other initiatives such as the Community Innovation Survey (CIS), the INNFORM survey (e.g., Whittington *et al*., 1999), and surveys by Professor Nicholas Bloom, Professor John Van Reenen and colleagues to quantify management practices (e.g., Bloom and Van Reenen, 2007; Bloom, Sadun, Van Reenen, 2010) represents increased efforts to systematically measure types of non-technological innovation. By doing so, it addresses that "the absence of high-quality firm-level data" hampers the development of new insights on the role of non-technological types of innovation like management innovation and business model innovation (Bloom *et al*., 2010, p. 109; Lambert and Davidson, 2013; Volberda *et al.*, 2014).

7.3 Managerial implications

In addition to theoretical implications, the studies in this dissertation contain a number of important managerial implications. Overall, they highlight the importance for management of innovating beyond the technological domain in order to improve firm performance. This underlines the importance of extending the debate on innovation to cover more than merely technological innovation (e.g., Birkinshaw *et al.*, 2014; Griffin *et al.*, 2013; Teece, 2010; Volberda and Van Den Bosch, 2005). In particular, this dissertation provides new insights for management into how, and under which internal and external contextual factors management innovation, co-creation with customers, and business model innovation influence firm performance. Table 7.3.1 summarizes the main managerial implications of this dissertation.

Table 7.3.1: Main managerial implications.

● In order to improve firm performance, management should avoid investing too heavily in technological innovation alone (Studies I and II).
● To increase the innovation performance of their firm, management should undertake high levels of management innovation in order to realize complementary effects to be gained with either high levels of R&D or among new management practices (Studies I, II and III).
● To spur firm performance, management should take into account both beneficial and more detrimental perspectives on the performance effects of co-creation with customers and of business model innovation (Studies IV and V).
● Management should take into account particular characteristics of their organizational context, e.g. organizational size and organizational connectedness, when deciding whether and how management innovation and co-creation with customers can help to drive the firm's innovation performance (Studies I, III and IV).

Studies I and II underline that directing all one's efforts to technological innovation is unlikely to be the optimal strategy for management who are looking to increase their firm's performance. Complementary sources of competitive advantage such as management innovation and co-creation are fundamental to fuel firms' performance. Study I highlights the dominant focus of research on the technological side of innovation and it emphasizes the importance of research in management innovation and the progress that has been made in this area. This study also highlights the relative performance effects of technological innovation and management innovation, suggesting that the non-technological type of innovation is an important

source of competitive advantage. Study II informs management that investments in R&D - and in particular higher levels of it - are not always a guarantee for more radical product innovations, suggesting that management should not solely rely on R&D to improve the innovation performance of their firms.

Studies II and III indicate that management innovation has an important role on a firm's innovation performance. Study II shows that management innovation weakens the positive effect of lower levels of R&D on radical product innovations, while it offsets the negative effect of higher levels of R&D on radical product innovations. Study III demonstrates that management innovation has an increasingly positive effect on exploitative innovation performance. The findings from these studies suggest that high levels of management innovation should be undertaken by management so that the complementary effects that come from either having high levels of both R&D and management innovation or complementary effects among new management practices can be harnessed as a means of increasing the firm's innovation performance.

Studies IV and V highlight the importance for management of taking into account both beneficial and more detrimental perspectives on the performance effects of co-creation with customers and of business model innovation. Study IV builds further on the beneficial and detrimental characteristics of both the degree of relational embeddedness and the heterogeneity between the knowledge base of an organization and those of its customers (e.g., Danneels, 2003; Holmqvist, 2003; Uzzie, 1997). According to the perspective of relational embeddedness, stronger ties between an organization and its customers involve more motivation, trust, and experience to exchange more complex and rich knowledge and to do so in a more efficient way, but they also narrow an organization's market view and inhibit experimentation (e.g., Andriopoulos and Lewis, 2009; Danneels, 2003; Uzzie, 1997). A higher degree of heterogeneity between their knowledge bases involves more valuable new or additional knowledge to the focal organization, but reduces its ability to identify, select, and integrate that customer knowledge in its knowledge base (e.g., Cohen and Levinthal, 1990; Holmqvist, 2003; Salge, Farchi, Barrett, Dopson, 2013). Findings presented in study IV seem to suggest that the detrimental effect of a stronger relational embeddedness and of a lower degree of heterogeneity between the knowledge base of an organization and those of its customers - associated with higher

levels of relationship learning - applies particularly to exploitative innovation, rather than to exploratory innovation.

Study V informs management of positive and negative aspects of the value of business model innovation and the degree of fit between business model innovation and the external environment as the level of environmental dynamism increases. For instance, this study has provided arguments to suggest that business model renewal enables a firm to respond better to the increased threats or opportunities as the level of environmental dynamism increases, while the potential to seize the attendant financial rewards is expected to be reduced as the environment becomes more dynamic.

Study IV also informs management that organizational connectedness offsets the negative effect of higher levels of relationship learning with customers on exploitative product and service innovations. Studies I and III highlight the importance of organizational context in the relationship between management innovation and firm performance. For example, Study III informs management that the larger the firm, the more the relationship between management innovation and exploitative innovation moves from being a positive linear relationship to one which is more J-shaped. Accordingly, Studies I, III and IV point out the importance for management of taking into account characteristics of the organizational context such as organizational size and the level of connectedness among organizational members when deciding whether and how management innovation and co-creation with customers can help to drive the firm's innovation performance.

7.4 Limitations and directions for future research

In spite of its multiple contributions, this dissertation could be developed and complemented by future research in various ways. In this section we first point out the limitations of the individual studies, and what they suggest in terms of directions for future research, before discussing the broader overall limitations of the dissertation and further directions for future research.

7.4.1: Limitations and directions for future research of each study.

Table 7.4.1 summarizes the research priorities set in the first conceptual study, and for each of the four empirical studies lists the limitations and directions for future

Table 7.4.1: Limitations and directions for future research of each study.

Study:	Limitations and directions for future research with a more theoretical focus:	Limitations and directions for future research with a more methodological and empirical focus:
I	● Conceptualize and define management innovation in complementary ways.	● Future research could examine the usefulness of pluralism in research methods as a means to increase the contributions of management innovation research.
	● Investigate complementarities between management innovation and technological innovation and the impact on performance.	
	● Examine how management innovation is related to exploratory innovation.	
	● Examine the extent to which management innovations are generic or specific.	
II	● This study focused on radical product innovation in terms as *how much* of it is taking place instead of the *degree of newness* of it. Future research could examine how R&D and management innovation are related to the *degree of newness of product innovations* and to the *amount of exploitative product and service innovations*.	● Our model in this study did not include the *role of time*. Future research could examine with *longitudinal case studies* how management innovation leverages the effect of R&D on radical product innovations over time.
	● This study focused on the *contextual role* of management innovation instead of its *direct performance effect*. Future research could examine into more detail how management innovation has a *direct effect* on radical product innovations.	
III	● This study examined the relationship between new management practices and a *firm's exploitative innovation performance* without taking into account the level of a *firm's exploratory innovation performance*. Future research could further examine how new management practices are related to *the amount of exploratory product and service innovations*.	● This study did not explicitly examine the *role of risks and time* in our model. Future research could examine *with longitudinal case studies how time and risks* influence our model.
	● This study focused on low versus high *levels* of new management practices without a focus on the *degree of interdependencies* among them. Future research could examine into more detail *how interdependencies* among	

	different new management practices and between new and existing management practices contribute to a firm's exploitative innovation performance.	
	● This study has not included how small firms can *collaborate with each other* to imitate advantages of larger firms. Future research could extend our research model by taking into account to what extent *collaborations among small firms* influence how organizational size moderates the relationship.	
IV	● Although this study controlled for cross-functional interfaces as a formal coordination mechanism, it did not examine how it influences the value of organizational connectedness. Future research could examine how *formal and informal coordination mechanisms are related to each other* to influence the effect of relationship learning with customers on exploitative and on exploratory innovation.	● This study applied a *cross-sectional research design*. Future research could further examine *the role of time in our model with longitudinal case studies*.
		● We collected data from Dutch health care organizations providing care services. Future research could replicate our model *in other industries*.
V	● We did not focus on the role of *characteristics of leadership*. Subsequent research could examine how various types of leadership influence the value of two types of business model innovation: replication and renewal.	● This study applied a *cross-industry survey*. Future research could take a *more longitudinal perspective* to assess in more detail the performance implications of these two types of business model innovation over time.
	● Future research could extend our research model with *other contextual factors*, like first- and second-mover advantage.	● Future research could further develop our scales for business model replication and business model renewal and test them with different datasets.
	● This study did not focus on how business model replication and business model renewal *are related to each other*. Future research could examine into more detail *how*, and under *what conditions*, these *two types of business model innovation* have a *complementary effect on firm performance*.	

research. These are segmented into two relative broad categories: those with a more theoretical focus and those with a more methodological and empirical focus.

The limitations and directions for future research with a more methodological or empirical focus often relate to the data collection being cross-sectional in nature. The limitations and directions for future research with a more theoretical focus listed in Table 7.4.1 can be further segmented into several groups. First, multiple ones refer to a complementary perspective on a certain type of innovation, such as interdependencies between new management practices besides the amount of it (Study III), or the degree of newness of exploratory product and service innovations in addition to the amount of it (Study II). Second, various limitations and directions for future research refer to an examination of the relationship with management innovation and another performance indicator, such as exploratory innovation (Studies I and III). Third, several other ones emphasize the need to extend the research model with other constructs, such as leadership (Study V) or formal coordination mechanisms (Study IV).

7.4.2: Overall limitations and directions for future research.

Besides the limitations and direction for future research of the individual studies (listed in Table 7.4.1), several more overall limitations and directions for future research concerning this dissertation are identified (see also Table 7.4.2).

First, this dissertation examines the role of management innovation, co-creation with customers, and business model innovation on firm performance in isolation from one another. However, several scholars (e.g., Chesbrough, 2007; Giesen *et al*., 2010; Markides and Oyon, 2010; Teece, 2010) have made suggestions as to how those three types of non-technological innovation may be related to each other. For instance, business models can commercialize the value of management innovation and co-creation, and these two types of non-technological innovation are required to realize business model innovation (e.g., Itami and Nishino, 2010; Markides and Oyon, 2010; Teece, 2010; Zott, Amit, Massa, 2011). Future research could examine and empirically test how, and under which conditions, management innovation, co-creation with customers, and business model innovation can have complementary effects with each other to leverage the impact of technological innovation on firm performance.

Table 7.4.2: Overall limitations and directions for future research.

● The effects of management innovation, co-creation with customers, and business model innovation on firm performance are examined merely *in isolation* from one another. Future research could examine and empirically test how, and under what conditions, these three types of non-technological innovation can have *complementary effects* that help to leverage the impact of technological innovation on firm performance.
● The underlying logic in this dissertation is based primarily on a *selected group of theoretical perspectives*: the *rational perspective* on management innovation, and the *relational perspective* on co-creation. Future research could examine the relationships investigated in this dissertation with *other theoretical perspectives* as suggested by Birkinshaw *et al*. (2008), such as the institutional perspective, in particular in substantially regulated industries as the health care.
● The *mechanisms* between types of non-technological innovation and (innovation) performance merit further attention. Future research could apply mediation analyses to empirically test those mechanisms as *intervening mechanisms*.
● The *cross-sectional* nature of our data collection in a broad range of industries or among health care providers in the Netherlands raises questions about the generalizability of our findings beyond the sample. Future research could apply *longitudinal case studies* or *panel data in multiple countries* to further assess the effects examined in this dissertation at *various stages over time* and to assess the *generalizability* of our findings to other research settings.

Second, the underlying logic of the empirical studies in this dissertation is primarily based on the rational perspective on management innovation in Studies II and III (Birkinshaw *et al*., 2008; Volberda *et al*., 2014). Study IV complements this perspective with the relational perspective (Dyer and Singh, 1998). However, multiple theoretical perspectives can be applied in management innovation studies (Birkinshaw *et al*., 2008; Volberda *et al*., 2014), in studies on co-creation (e.g., Dyer and Singh, 1998; Laursen, 2012) and to business models in order to come up with alternative explanations of the phenomena and their effects (Amit and Zott, 2001; Casadesus-Masanell and Ricart, 2010). In addition to a rational perspective, institutional, fashion, and cultural perspectives have been applied in management innovation studies (Birkinshaw *et al*., 2008). For instance, according to Naveh, Marcus, Moon (2004, p. 1843), by applying both a rational and an institutional perspective, firms can "implement a new management practice because of real needs and a high fit between what the practice suggests and their needs (technical efficiency)", but, they argue, firms also do this "because of customer pressure and the fear of falling behind the competition (external pressure)". In a similar vein, an institutional perspective on business model innovation highlights, for instance, the importance of legitimizing the

new model and diffusing it across an industry (Casadesus-Masanell and Zhu, 2013; George and Bock, 2011). In the health care industry, managerial actions and new policies have been initiated to encourage the introduction and dissemination of best practices relating to co-creation (e.g., Minkman, 2011; Schrijvers *et al.*, 2005). Future research could examine the relationships investigated in this dissertation with other theoretical perspectives as suggested by Birkinshaw *et al*. (2008), such as the institutional perspective, in particular in substantially regulated industries as the health care.

Third, the mechanisms between types of non-technological innovation and (innovation) performance merit further attention. For instance, following prior research (e.g., Ahuja and Katila, 2001; Gilsing *et al*., 2008; Holmqvist, 2003; Jean, Sinkovics, Kim, 2012) in Study IV we also implicitly apply the absorptive capacity perspective when examining the effect of relationship learning with customers on innovation performance. In Study II, we propose that a shift towards either an administrative bureaucracy or an organic organizational model (Daft, 1982; Damanpour *et al*., 1989; Spencer, 1994) helps to explain the contextual role of management innovation on the effect of either lower or higher levels of R&D on radical product innovations. Although these mechanisms are derived from prior research, it would be worthwhile applying mediation analyses (Byrne, 2001) in order to empirically test those mechanisms as intervening mechanisms.

Fourth, although we used a large-scale survey, complemented by archival data, our research is cross-sectional in nature. Additionally, the surveys in this dissertation were conducted with Dutch organizations either from a broad range of industries (Studies II, III, and V) or from a specific industry (Study IV). This raises issues as to whether our findings are generalizable beyond our sample. As a next step, longitudinal case studies or panel data in multiple countries may provide a useful way of assessing further the effects examined in this dissertation at various stages over time and the generalizability of our findings to other research settings.

7.5 Conclusion

Examining the role of various types of non-technological innovation in turning technological knowledge into product and service innovations and subsequently into commercial success can provide important new insights into how organizations can derive more value from their technological knowledge. The overall aim of this dissertation is to advance our understanding of how, and under which conditions, management innovation, co-creation with customers, and business model innovation contribute to firm performance, either innovation performance or overall firm performance. The five studies presented in this dissertation meet this aim, in that they highlight the managerial, intra-organizational, and inter-organizational antecedents of management innovation and they reveal more about how management innovation, co-creation with customers and two basic types of business model innovation, i.e. replication and renewal, contribute to firm performance. Additionally, this dissertation provides new insights how the performance effects of these types of non-technological innovation are influenced by various contextual factors like organizational size and environmental dynamism. We also outline several areas for future research concerning how various types of non-technological innovation can act as additional sources of competitive advantage. All in all, this dissertation provides new insights into how, and under which conditions three major types of non-technological innovation – management innovation, co-creation with customers, and business model innovation – may act as important additional sources of competitive advantage.

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SUMMARIES

Summary in English

Innovation is generally considered to be a cornerstone of organizational survival in many of today's dynamic and competitive markets. However, the technological domain of innovation has received prevalent attention. This dissertation goes beyond the dominant focus on technological innovation in innovation studies by examining how and under which conditions several types of non-technological innovation contribute to firm performance. To do this, it focuses on three types of innovation that recently have received increased attention to be important sources of competitive advantage: management innovation, co-creation with customers, and business model innovation. The studies presented in this dissertation advance our understanding of how, and under which conditions, management innovation and co-creation with customers contribute to exploitative and exploratory product and service innovations. They also provide new insights into how and under which levels of environmental dynamism two basic types of business model innovation, i.e. replication and renewal, contribute to firm performance.

Study I identifies common and emerging areas of research, and sets a series of research priorities for management innovation. Study II finds that investments in research and development (R&D) have an inverted U-shaped effect on radical product innovations, in particular for firms with lower levels of management innovation. However, in firms with high levels of management innovation, this relationship becomes J-shaped. Study III shows that new management practices, i.e. management innovation, have an increasingly positive effect on a firm's exploitative innovation performance. However, the larger the firm, the more this relationship moves from a positive linear relationship to one that is more J-shaped. Study IV finds that co-creation with customers, conceptualized as relationship learning, has an inverted U-shaped effect on exploitative innovation, while the effect of this learning on exploratory innovation is positive. Additionally, the informal coordination mechanism connectedness among organizational members flattens the negative effect of higher levels of relationship learning with customers on exploitative innovation. Finally, Study V advances our understanding by differentiating between and conceptualizing two basic types of business model innovation, replication and renewal, and by describing their key characteristics. Additionally, it shows that environmental

dynamism weakens the positive effect of business model replication on firm performance, while business model renewal contributes more strongly to firm performance in environments characterized by intermediate and high levels of dynamism than in relatively stable settings, i.e. with low levels of dynamism.

All in all, these five studies advance our understanding of how, and under which conditions, management innovation, co-creation with customers, and business model innovation contribute to firm performance and it provides multiple avenues for future research that should further reveal the importance of innovating beyond the technological domain.

Summary in Dutch (Nederlandstalige samenvatting)

Innovatie is cruciaal voor organisaties om te kunnen overleven. Het gros van de innovatiestudies zijn echter gericht op technologie als verklarende variabele. Deze dissertatie gaat verder dan de dominante focus op technologische innovatie door te onderzoeken hoe en onder welke omstandigheden verschillende niet-technologische typen innovaties bijdragen aan bedrijfsprestaties. De focus ligt op drie niet-technologische typen innovatie die recentelijk naar voren zijn gekomen als aanvullende bronnen van concurrentievoordeel: managementinnovatie (innovatieve manieren van managen en organiseren), co-creatie met klanten, en businessmodel-innovatie (innovatie in de manier hoe een organisatie waarde creëert èn zich toe-eigent). De studies in deze dissertatie presenteren nieuwe inzichten hoe en onder welke omstandigheden managementinnovatie en co-creatie met klanten bijdragen aan exploitatieve (meer incrementele vernieuwing) en exploratieve product- en dienstinnovaties (meer radicale vernieuwing). Tevens presenteert het nieuwe inzichten hoe en onder welke niveaus van omgevingsdynamiek verschillende manieren van businessmodel-innovatie bijdragen aan bedrijfsprestaties.

De eerste studie in deze dissertatie presenteert een overzicht van antecedenten en effecten van managementinnovatie, alsmede onderzoeksprioriteiten met betrekking tot managementinnovatie. De tweede studie toont aan dat investeringen in onderzoek en ontwikkeling (R&D) een niet-lineair (omgekeerd U-vormig) effect hebben op radicale product innovaties, in het bijzonder voor bedrijven met lagere niveaus van managementinnovatie. Bedrijven met een hoge mate van zowel R&D als managementinnovatie genieten door complementaire effecten ertussen van een hogere mate van radicale product innovaties. Studie III toont aan dat nieuwe managementpraktijken (managementinnovatie) een toenemend positief effect hebben op de hoeveelheid exploitatie product- en dienstinnovaties. Echter, bedrijven met grotere aantallen medewerkers hebben te maken met een dip in hun exploitatie product- en dienstinnovaties bij lagere niveaus van nieuwe managementpraktijken alvorens hogere niveaus van nieuwe managementpraktijken bijdragen aan meer exploitatie product- en dienstinnovaties. Studie IV toont aan dat co-creatie met klanten een omgekeerd U-vormig heeft op exploitatieve product- en dienstinnovaties, terwijl dat effect op exploratieve product- en dienstinnovaties positief is. Bovendien vlakt verbondenheid tussen medewerkers binnen een organisatie het negatieve effect af van hogere niveaus van co-creatie met klanten op exploitatieve product- en

dienstinnovaties. Ten slotte presenteert studie V nieuwe inzichten door het maken van een onderscheid tussen en het conceptualiseren van twee basistypen businessmodel-innovatie, replicatie en vernieuwing, en het beschrijven van kenmerken behorende bij elk van de twee. Daarnaast toont de studie aan dat omgevingsdynamiek het positieve effect van businessmodel-replicatie op bedrijfsprestaties verzwakt, terwijl vernieuwing van een businessmodel sterker bijdraagt aan bedrijfsprestaties in middelmatig en zeer dynamische omgevingen in vergelijking met omgevingen met relatief weinig omgevingsdynamiek.

Onderzoek naar de rol van niet-technologische typen van innovatie in hoe technologische kennis omgezet kan worden in product- en dienstinnovaties en in een commercieel succes kan belangrijke inzichten bieden hoe organisaties de waarde van technologische kennis kunnen vergroten. Het doel van deze dissertatie is om nieuwe inzichten te presenteren hoe en onder welke omstandigheden drie niet-technologische typen innovatie, management innovatie, co-creatie met klanten, en businessmodel-innovatie, bijdragen aan bedrijfsprestaties. De vijf studies in deze dissertatie bereiken dit doel door het inzichtelijk maken van antecedenten (management, intra- en interorganisatorisch) van managementinnovatie en door het vergroten van de kennis hoe managementinnovatie, co-creatie met klanten en twee typen businessmodel-innovatie bijdragen aan de bedrijfsprestaties. Deze dissertatie biedt eveneens nieuwe inzichten hoe deze effecten worden beïnvloed door verschillende omgevingsfactoren zoals de mate van omgevingsdynamiek en het aantal medewerkers van een organisatie. Tevens worden meerdere mogelijkheden belicht voor toekomstig onderzoek omtrent het belang van innovatie buiten de kaders van alleen technologie.

ABOUT THE AUTHOR

Cornelis Vincent 'Kevin' Heij was born on 18 December 1985 in Krimpen aan den IJssel. After finishing his studies in Technology Management at the Technological University Rijswijk and Business Administration at the Erasmus University, he became project manager at the research institute INSCOPE – Research for Innovation, combining this with PhD research at the Rotterdam School of Management, Erasmus University. His research interests include ambidexterity, business model innovation, competitive strategies, contingency theories, and complementary effects between technological and non-technological types of innovation. These types of non-technological innovation are also known as 'social innovation' in the Netherlands.

His work has been presented at many annual conferences such as the *Strategic Management Society* (Prague, 2012; Madrid, 2014) *Academy of Management* (Philadelphia, 2014; Vancouver, 2015), *European Academy of Management* (Rotterdam, 2012; Istanbul, 2013; Valencia, 2014; Warsaw, 2015), and the *European Group for Organization Studies* (Helsinki, 2012; Montreal, 2013; Rotterdam, 2014). He has also presented at more themed conferences such as the special conferences of the *Strategic Management Society* (Geneva/Lausanne, 2013; Copenhagen, 2014; St. Gallen, 2015) and the *European Academy of Management* (Rotterdam, 2011; Montpellier, 2015). He has also organized national and international conferences and was co-chair of the business model innovation track of the 2015 annual meeting of the *European Academy of Management.* The courses he has taken include the summer seminar on "Evolutionary Perspective on Strategic Management" at the *Wharton School, University of Pennsylvania* in 2012.

In addition to two scientific publications and two publications in *The Academy of Management Proceedings* (2014 and 2015), he has acted as guest editor for special issues on management innovation and on social innovation for the *European Management Review* and *M&O: Tijdschrift voor Management en Organisatie* respectively. His recent publications include several books on business model innovation, *Re-inventing business: how firms innovate their business model*

(Van Gorcum, 2013, ISBN: 978 90 232 5146 0), and *The new business model of financial advice: from provision to value creation* (Mediawerf, 2014, ISBN:978 94 90463 33 5), annual reports on innovation in specific industries and on Dutch firms, i.e. *Erasmus Competition and Innovation Monitor*, and he has also written articles for journals that target a broader audience, such as *Economisch Statistische Berichten, FD Outlook, Het Verzekerings-Archief*, and *Tijdschrift voor HRM*. Together with his supervisors, he has received multiple awards for his work. His book *Re-inventing business: how firms innovate their business model* received the *ERIM 2014 Award for the Best Book in the Domain of Research in Management*. The study *Management innovation: Management as fertile ground for innovation* was awarded the *European Management Review* best paper award in 2013. The study *To replicate or to renew your business model? The performance effect in dynamic environments* received the best paper award in the innovation track of the EURAM 2014 Annual Conference. The study *How do new management practices contribute to a firm's innovation performance? The role of organizational size* has been awarded with the *Best Paper Award* at the *European Academy of Management* thematic conference "Management Innovation: New Borders for a New Concept" (Montpellier, 2015).

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INNOVATING BEYOND TECHNOLOGY

STUDIES ON HOW MANAGEMENT INNOVATION, CO-CREATION AND BUSINESS MODEL INNOVATION CONTRIBUTE TO FIRMS' (INNOVATION) PERFORMANCE

Innovation is generally considered to be a cornerstone of organizational survival in many of today's dynamic and competitive markets. This dissertation goes beyond the dominant focus on technological innovation in innovation studies by examining how and under which conditions several major non-technological types of innovation contribute to firm performance.

The five studies presented in this dissertation reveal more about how management innovation, co-creation with customers and two basic types of business model innovation, i.e. replication and renewal, contribute to firm performance, either innovation performance or overall firm performance. Our findings indicate that management innovation contributes to a firm's exploitative innovation performance at an accelerating rate, and that it transforms an inverted U-shaped relationship between R&D and radical product innovations into a relationship that is J-shaped. Co-creation with customers has an inverted U-shaped effect on exploitative innovation, while its effect on exploratory innovation is positive.

Additionally, we provide new insights how those performance effects are influenced by contextual factors like organizational size and environmental dynamism. For instance, our results suggest that environmental dynamism weakens the positive effect of business model replication on firm performance, while business model renewal contributes more strongly to firm performance in environments characterized by intermediate and high levels of dynamism than in relatively settings with low levels of dynamism.

Overall, this dissertation provides new insights into how, and under which conditions, management innovation, co-creation with customers and business model innovation may act as important additional sources of competitive advantage.

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Erasmus Research Institute of Management - ERiM
Rotterdam School of Management (RSM)
Erasmus School of Economics (ESE)
Erasmus University Rotterdam (EUR)
P.O. Box 1738, 3000 DR Rotterdam,
The Netherlands

Tel. +31 10 408 11 82
Fax +31 10 408 96 40
E-mail info@erim.eur.nl
Internet www.erim.eur.nl