BUSINESS MODEL DESIGN AND TECHNOLOGICAL INNOVATION
–
MULTI-METHOD ESSAYS ON DRIVERS, WORKING MECHANISMS, AND CONSEQUENCES

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Nicolas Frederik Höflinger

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GENERAL INTRODUCTION

"*Business opportunities are like buses,*
there's always another one coming"

Sir Richard Branson, *Founder of Virgin Group*

In search for competitiveness, performance, and excellence, answers are given in the very past by Joseph Schumpeter (1934), Peter Drucker (1954), Tom Peters and Robert Waterman (1982) to the steady entrepreneurial question of what makes companies successful. In the present, a new concept shapes the academic discussion in the field of management: the idea of business modelling. The focus of this concept centers on the idea of how managers can best prepare their company's business logic in concert with its technological potential to reach their strategic destinations earlier than competitors and grasp the benefits of market leadership.

This dissertation project is nested in the business model literature with strong influences from the fields of strategy as well as technology and innovation management. It contributes to these research streams mainly by identifying relevant drivers, working mechanisms, and outcomes of linking the concepts of business model design and technological innovation.

Going back to the 1970s, battered through a heavy boom and bust cycle during the dot-com crisis and degenerated to an inflated buzzword in the late 1990s (Ghaziani & Ventresca, 2005), the business model concept is recently experiencing a true renaissance. It is subject to a steep rise of publications (Zott, Amit, & Massa, 2011) and special issues in distinguished academic outlets (e.g. Long Range Planning (2010), R&D Management (2014, 2015 forthcoming), International Journal of Technology Management (2015 forthcoming), International Journal of Entrepreneurship and Innovation Management, Global Strategy Journal (2015 forthcoming), among others) eager to finally form the theoretically well-grounded concept it takes to become one of the elementary tools of managers today and in the future.

Practice is far ahead when it comes to using and working with the concept (see for example the work by Osterwalder and Pigneur (2010)), while research is hampered by its unclear definitions, working mechanisms, antecedents, consequences and relationships with other adjacent concepts such as strategy or technological innovation (George & Bock, 2011; Zott et al., 2011). The relationship between business model design and technological innovation is a special one, with a huge problem of complexity on the one hand and evenly great potential benefits for value creation and capture on the other (Baden-Fuller & Haefliger, 2013). As indicated before, the overarching aim and scope of this dissertation thesis is to unlock the drivers, outcomes, as well as the working mechanisms that researchers momentarily face at the intersection of business model design and technological innovation.

The academic objective of management research can be characterized as describing, explaining, and creating real socio-technological phenomena (Peters, Brühl, & Stelling, 2005). Theory, as a central supporting function in reaching these goals, can be depicted as a system of laws to enable the explanation of a larger aggregation of facts (Albert, 1964). In order to do so, it is important to initially decide on a relevant research question, followed by the development of specific hypotheses to explain the inherent subject matter (Schnell, Hill, & Esser, 2011). At the same time, it is necessary to assemble these singular hypotheses into a holistic theoretical framework, which aligns the chain of scientific thought about complex systems of reality and consequently fulfills a primarily heuristic function (Kirsch, 1971).

The scope of this dissertation project allows to thoroughly analyze and advance an emerging concept such as the business model with its naturally inherent uncertainties of a theoretically nascent field of research (Edmondson & McManus, 2007), such as measurement issues and the resulting lack of high quality quantitative empirical evidence (Snihur & Zott, 2014). In order to set the stage for theoretical advancements and to begin the process of framework development, the basic terminologies and their relationships have to be clarified.

Chesbrough (2007) proposes that "*[t]oday, innovation must include business models, rather than just technology and R&D*" (p. 12). The role of a business model thus is to create "*a heuristic logic that connects technical potential with the realization of economic value*" (Chesbrough & Rosenbloom, 2002, p. 529) if the innovation is to be a successful one. Ultimately, "*figuring out how to capture value from innovation is a key element of business model design*" (Teece, 2010, p. 183). Following these statements, technology and the business model are seemingly interconnected and their relationship supposedly influences the success of an innovation and maybe even other organizational performance outcomes. As Baden-Fuller & Häfliger (2013) put it, there is a fundamental link between technology and the business model, which is highly complex but also potentially very powerful, and thus needs to be decoded in order to be able to better comprehend it. How can we unpick the relationship between technology and innovation to make it graspable and to clearly resolve its interdependencies?

To start with, let's look at the basic definition of 'innovation', which is "an iterative process *initiated by the perception of a new market and/or new service opportunity for a technology-based invention, which leads to development, production, and marketing tasks striving for the commercial success of the invention*" (Freeman, 1991, p. 303). According to Garcia and Calantone (2002), this definition best captures the two essential distinctions of an innovation: namely an iterative process with different degrees of newness that combines the technological development of an invention with its market introduction. In accordance, a business model represents a firm-centric, yet boundary spanning, activity system that simultaneously considers the content (e.g. what products and services are offered by a firm) and the process (e.g. how these products and services are brought to market) of doing business (Zott et al., 2011, p. 1037). It aims at the 'market-introduction' aspect inherent in a technological invention. Although related, the boundary-spanning perspective separates the business model clearly from the general definition of marketing, which "*is the process of planning and*

executing the conception, pricing, promotion and distribution of ideas, goods and services to create exchange and satisfy individual and organizational objectives" (American Marketing Association, 1985; Grönroos, 1990).

If the business model's role is to capture value from an innovation by successfully introducing it to market, the question arises of whether or not the existing business model of a focal firm is sufficient to do so or if a novel business model is better suited to accomplish this task. Chesbrough and Rosenbloom (2002) were among the first to discuss this issue. The authors state that while there are situations, where an already familiar business model can successfully be employed with a novel technology, oftentimes the existing model is not sufficiently suited to the given circumstances. Empirical evidence points towards the growing need for innovators to overcome organizational and societal change with increasing innovativeness (Gemünden, Salomo, & Hölzle, 2007). Additionally, it seems to be the fit between the technology and the choice of the business model that determines future profits (Baden-Fuller & Haefliger, 2013). New business models may be needed. In order to reach the best fit and thus maximum value captured from an innovation, every technology effort needs to take the development of a new business model into account (Teece, 2010). Business model innovation can play an important role in value appropriation (Amit & Zott, 2012), especially when handling novel technologies (Björkdahl, 2009).

Based on these considerations regarding the interdependency between technology and the business model, there are two basic dimensions regarding the degree of novelty: novelty of the business model and novelty of the technology. Both can be specified in their values as either '*familiar to the firm*' or '*new to the firm*'. 'New to the firm' is the minimum requirement to be considered an innovation by the OECD as opposed to 'new to the market' and 'new to the world' (OECD/Eurostat, 2005). In order to simplify things, this dissertation assumes that the value 'new to the firm' does by definition include innovations that are 'new to the market' and

also ‘new to the world’. The OECD put the focus clearly on the degree of an innovation’s novelty as opposed to its continuity or its effects on the focal firm or the market, as would be the case with a ‘radical vs. incremental’ categorization (see also Garcia and Calantone (2002)).

Based on these two dimensions it is possible to span a 2x2 matrix of four distinct combinations between technology and the business model (see Figure 1). Each quadrant offers a unique combination of business model and technology that implies specific opportunities for decoding the inherent interrelationships and their impact on organizational performance as well as the identification of other potentially influencing factors. Admittedly, there may be core and supporting technologies, but the focus here is on individually marketable innovations and their corresponding business model.

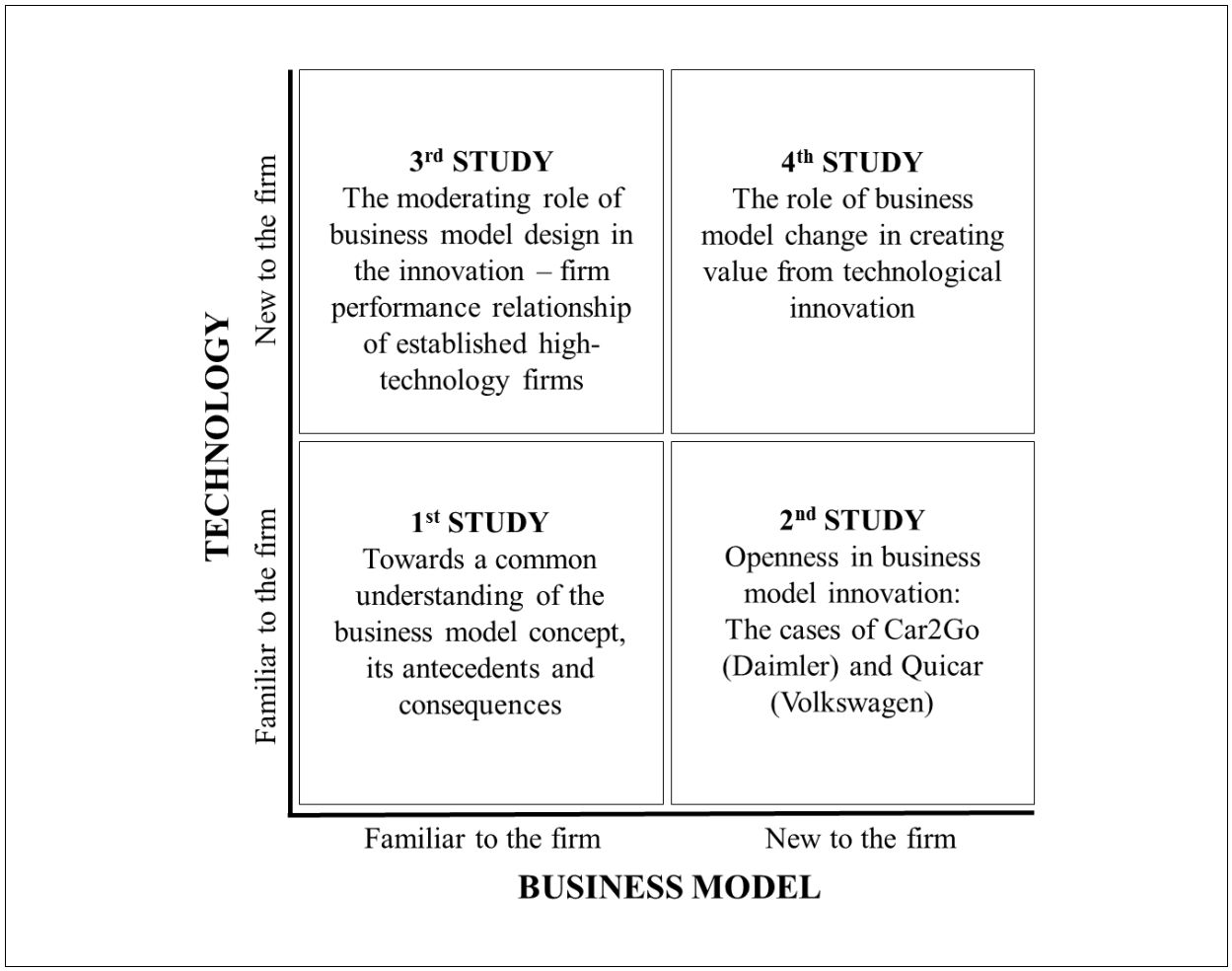

Figure 1: Overarching framework

This framework serves as the basis for answering the overall research question of this dissertation thesis. Each of the four quadrants and the resulting aim and scope is addressed with an individual study based on a specific methodology and dedicated data source in order to best tailor it to the needs of each setting. In order to reach methodological fit and thus internal consistency of the whole research project (Edmondson & McManus, 2007), this dissertation thesis builds on a hybrid methodological approach to increase the sources of insights and discovery into the organizational phenomena arising at the intersection of business model design and new technological developments. The following section gives a brief overview of the aim and scope as well as the methodological approach of each paper. For an overview of the basic methodological characteristics see Table 1.

Table 1: Basic methodological characteristics of the single studies

	1st Study	**2nd Study**	**3rd Study**	**4th Study**
Aim & Scope	Generate a unifying understanding of the business model concept's conceptualizations and delineate a conceptual framework of its antecedents and consequences	Analyze the innovation process of creating a radically new business model from the perspective of established companies and the drivers that determine its success	Examine efficiency-novelty-, complementarities-, and lock-in-centered business model designs in their moderating role of the technological innovation – firm performance relationship	Identify the elements of business model change as complementors to different types of technological innovation and analyze these single as well as systemic effects on focal firm's value creation
Method	• Systematic literature review	• In-depth case study research	• Hierarchical OLS regression • Simple slope Analysis	• Tobit regression • Propensity score matching
Data Sources	• EBSCO Business Source Premier Database	• Face-to-face and telephone interviews • Company publications • Press releases • Corporate websites	• Primary survey data from 209 respondents in 119 firms • Final sample consists of 90 firms with two separate respondents for each firm	• Secondary data from the Mannheim Innovation Panel • Final sample of 2346 firms • Longitudinal subsample of 684 firms
Setting	Highly regarded academic journals published in English language	Automotive industry in Germany: • Daimler AG ("Car2Go") • Volkswagen AG ("Quicar")	Electronics (automation) industry in Germany: • Electric drives • Control systems and switchgear, • Measurement technology	Manufacturing and service firms in Germany: • High-technology manufacturing • Medium-high-technology • Medium-low-technology manufacturing • Low-technology-manufacturing • Knowledge-intensive services • Other services

As the conceptual foundation of this thesis, the first study reviews 14 years' worth of business model research. It follows the idea of capturing the essence of the concept, broadly published in leading management, entrepreneurship, and marketing outlets. Based on a systematic literature review (Short, 2009), it has a clear focus on academic rather than practitioner-oriented research. Located in the first quadrant of the framework, it aims to identify antecedents and consequences of business model design. The study further arrives at a unifying understanding of the business model concept as well as an agenda for future research.

Located in the second quadrant of the framework, the basic idea of the second study is to analyze how established firms develop a novel business model for an existing technology. It takes one of the most basic and long existing technological achievements of modern mankind, the automobile, as an example. More specifically, the aim is to delineate the process of creating viable business models based on such familiar technologies. Important factors for success are derived such as the process's inherent openness towards the external environment and the employment of complementary technological innovation. The methodological approach rests on case study research (Yin, 1994). In order to secure the relevancy of the findings, the study concentrates on two of the largest automotive producers in the world and their different approaches towards carsharing – Daimler AG ('Car2Go') and Volkswagen AG ('Quicar').

The third study of the framework analyses the role of a firms existent business model in form of novelty, efficiency, complementarities, and lock-in centered designs (Amit & Zott, 2001) as moderators for the relationship between technological innovation and firm performance. It builds on a uniquely collected set of quantitative primary survey data from 180 respondents of 90 medium and large established organizations in the German electronics industry that manufacture automation technology such as electric drives, control systems, switchgear as well as measurement and testing technology. It employs information from 119 firms to conduct several analyses securing the robustness of the results.

The fourth study, located in the outer quadrant of the overall framework takes the most dynamic perspective by analyzing the intersection of a new to the firm technological development with an equally novel business model. More specifically, it seeks to shed light into which elements of business model change (e.g. content, structure, or governance) increase value creation from incrementally and radically new products as well as new process developments by established organizations. The elements of business model change are tested individually and by adding all three elements together to further test into the systemic nature of the business model concept. The paper relies on a broad sample of 2346 manufacturing and service firms in Germany, represented in the Mannheim Innovation Panel (MIP). Based on the initially cross-sectional data, probit regression models as well as propensity score matching algorithms are employed to test the proposed relationships. Additional analysis of a longitudinal subsample of 684 firms with an average time lag of three years between the independent and dependent measures supports the robustness of the results. The following four chapters each represent one of the four studies. They are followed by a short conclusion of overarching methodological and theoretical contributions and an outlook on future research.

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STUDY 1: THE BUSINESS MODEL CONCEPT AND ITS ANTECEDENTS AND CONSEQUENCES – TOWARDS A COMMON UNDERSTANDING

ABSTRACT

For some time now, the business model concept has been rapidly gaining importance in management research and practice. In order to take this fascinating development into closer consideration, a systematic review of prior research was necessary in order to arrive at a unifying understanding and to resolve inconsistent interpretations of the concept. A resource-based framework is further derived covering the key antecedents and consequences of the business model based on structuring and integrating prior work. Technological resource potential, firm strategy and organizational contingencies are identified as internal antecedents, while market opportunities, extra-industry conditions and competitive activities are located as external antecedents. As consequences of a business model economic value, social value and organizational learning were acknowledged. Holistic business models that take the external environment into account and focus also on social value creation represent an important alternative to hitherto existing capitalist market approaches. Finally, a detailed research agenda of potential issues relevant for future advancements of business model research is presented.

INTRODUCTION

A business model describes a firm's value delivery to its customers and the conversion of their payments to profit (Teece, 2010). Generally all firms, established multinational corporations and startup companies alike, need at least one business model to approach their markets. The business model concept emerged in the management literature with the rise and fall of the dot.com bubble in 1998-2001 (Ghaziani & Ventresca, 2005; Teece, 2010). Since then, it has gained considerable importance and represents now a powerful concept of management research and practice (Casadesus-Masanell & Ricart, 2010; McGrath, 2010). A web search conducted by Chesbrough and Rosenbloom (2002) in May 2000 for the keyword "business model" using the Google search engine yielded 107,000 hits. In November 2012, the identical keyword in the same search engine provided 31,100,000 results – around 300 times as much.

Google is among the firms that feature an innovative business model, which radically shaped the industry structure and still yields superior performance (Gambardella & McGahan, 2010; Itami & Nishino, 2010). The literature has studied firms from manifold industries that profit essentially from their underlying business model, for example 3Com, Xerox (Chesbrough & Rosenbloom, 2002), INGDirect (Dunford, Palmer, & Benveniste, 2010), Arsenal FC (Demil & Lecocq, 2010), and USAToday (Smith, Binns, & Tushman, 2010). The critical importance in practice has been reflected by a growing attention in the academic literature. Multiple empirical studies and conceptual works have developed manifold definitions of the concept, representing a widely dispersed field of research. As a consequence, only a few understandings have been adopted in further works, among them Amit and Zott (2001), Chesbrough and Rosenbloom (2002) and Teece (2010). This limited degree of cumulative conceptualization of the business model and its constituent elements complicates further research advances. However, two recent articles constitute important steps towards overcoming these limitations.

First, Zott et al. (2011) reveal the fact that the respective literature is separated into three thematic silos: strategy, e-business, as well as technology and innovation management, with little overarching connections between them. To tackle this issue, the scholars carve out a set of emerging commonalities between the three areas. Zott et al. (2011) promote the business model as representing a new unit of analysis, as an integrated approach to explain how firms do business and as accounting for both value capture and value creation. Second, George and Bock (2011) provide highly valuable insights into three universal dimensions of a business model relevant in entrepreneurial and managerial practice. They further contribute to the literature by proposing a business model definition that uses these dimensions to enact a commercial opportunity.

Despite their highly valuable contributions to research, both publications leave out a number of potential insights. Neither of the extant reviews attempts to fully integrate the dispersed field and to provide a detailed framework of the concept and its antecedents as well as consequences. Zott et al. (2011, p. 1038) even specifically call for *"more clarity about the theoretical building blocks of the business model, its antecedents and consequences, and the mechanisms through which it works"*. They neither provide researchers with a detailed research agenda in that field. Hence, they underscore the great need for resolving conceptual ambiguities in the academic discussion.

As such, this literature review contributes to existing scholarly research in a number of ways. First, a systematic evaluation of the business model literature in leading management and entrepreneurship journals is provided. Second, an integrative understanding of the concept and its constituent elements is built by taking a resource-based perspective. Because of its broad applicability, this unifying understanding can serve as a potential bridge between the various streams within business model research. Third, a resource-based conceptual framework of the antecedents and consequences of the concept is developed by integrating and systematizing

prior work. This framework contributes to a better theoretical understanding on how business models can be designed in order to create competitive economic and societal advantages through value creation for a focal firm and its environment. Fourth, a detailed research agenda is presented to facilitate future conceptual and particularly empirical advancements.

METHODS

To capture the current state of business model research, a systematic process is necessary. It includes identifying a relevant body of academic literature, a keyword search and initial check of the relevancy of identified articles as well as a detailed analysis of the final set of papers.

First, for the selection of the literature base, Short (2009) and his suggestions on 'the art of writing a review article' as well as other highly regarded literature reviews (e.g. Short, Ketchen, Shook, & Ireland, 2010) are explicitly followed. These recommendations center on selecting a number of top management outlets and combining them with an assortment of specialty journals relevant to the particular area of research. In favor of a comprehensive understanding of the 'business model' topic, this requires specialized outlets from the areas of entrepreneurship, marketing, and technology and innovation management. Grounded on Short (2009), the considered top management journals are *Academy of Management Journal, Academy of Management Review, Administrative Science Quarterly, Journal of Management, Journal of Management Studies, Organization Science, Strategic Management Journal.* Due to their high impact on management research, *Management Science, Organization Studies, California Management Review, Journal of International Business Studies, Long Range Planning,* and *Industrial & Corporate Change* were added to the management literature base.

The specialty journals are of comparable quality and include the following outlets: *Journal of Business Venturing, Entrepreneurship: Theory & Practice, Journal of Small Business Management, Small Business Economics, Journal of Marketing Research and*

Marketing Science, Journal of Marketing, Research Policy, Journal of Product Innovation Management. The original set consisted of a total of 22 outlets. The relevance of important practitioner-oriented books on business models, for example Afuah & Tucci (2000), Chesbrough (2006), Hamel (2000), Johnson (2010); Osterwalder & Pigneur (2010), Wirtz (2011) are acknowledged, but not explicitly included in the review database due to the initial focus on top-level peer-reviewed journals.

Second, to yield an initial body of articles, the EBSCO Business Source Premier Database was utilized to search the selected journals for articles that contain the term "business model*" in their title, abstract, and/or keywords. The search was conducted in October of 2014 and no limitations concerning the years of publication were applied. As a result, an initial list of 181 articles was identified. In order to secure their relevancy, the articles had to meet a number of criteria in order to be considered for final analysis. 13 of the initial hits were deleted because they were book reviews, editorials, or teaching materials. A check of the articles' abstracts revealed that 35 articles were lacking a focus on the business model concept or adjacent fields and were thus deleted. This process yielded 133 remaining articles. Those were then entirely reviewed. One major criterion was that articles should provide a definition or a focused depiction of business models based on the authors' understanding, so that it supports the derivation of further clarity on the concept itself. Articles that did not fulfill this criterion were eliminated due to the following reasons: they do not mention the term business model in the article even if they state it in the abstract (13 articles), or they only mention the term but do not explicitly develop the concept any further (41 articles). Finally, the ultimate set of literature for further analyses consists of 79 journal articles.

Third, an analytical review scheme to thoroughly examine the existing literature was applied (Ginsberg & Venkatraman, 1985). It consisted of a table that categorized the works and their content according to author(s) and title of the publication, year of publication, journal

name, study type, main findings, theoretical underpinning and the definition of the business model concept. In addition to that, several columns to gather insights about adjacent areas were added, for example about the role of corporate strategy and first approaches to innovating and changing business models. These additional columns serve for the derivation of the conceptual framework but did not find their way in the final overview table. Systematic comparisons of identified aspects within and between articles led to the insights of this study at hand. The following section delineates the characteristics of the existing body of literature on the business model concept.

AN OVERVIEW OF BUSINESS MODEL RESEARCH

Important Characteristics of the Literature

The body of work identified in the literature analysis has been published in 16 out of the initially selected 22 peer reviewed journals. *Long Range Planning* (30 out of 79 articles; 38 percent) accounts for most of them, primarily due to a large special issue on business models published in 2010. The other identified journals are: *California Management Review* (10 articles), *Research Policy* (nine articles), *Entrepreneurship: Theory & Practice* (five articles), *Industrial & Corporate Change*, *Organization Science*, *Strategic Management Journal* (three articles respectively), *Journal of Management Studies*, *Journal of Product Innovation Management*, *Journal of Small Business Management*, *Management Science*, *Small Business Economics* (two articles respectively), *Academy of Management Review*, *Journal of Management*, *Journal of Marketing*, and *Organization Studies* (one article respectively).The identified articles were published over a 14-year time span ranging from one publication in the year 2000 to five publications between January and October of 2014 (see Figure 1).

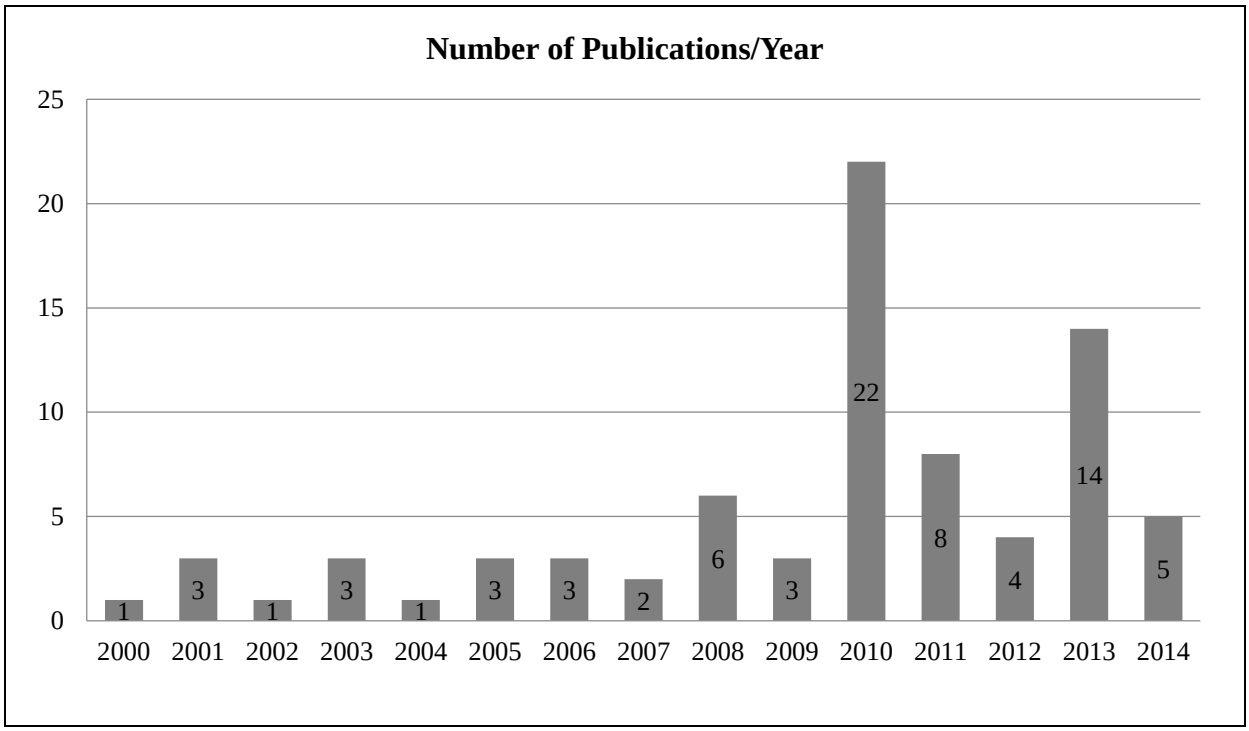

Figure 1: Number of publications per year

Out of the final set of 79 articles (see Table 1), 30 articles are purely conceptual, while 35 articles pursue qualitative empirical research methods. Only the remaining 14 articles present quantitative empirical studies. They examine a variety of industries. Most of the firms are located in the manufacturing industry (40 percent), covering computer and electronics, motor vehicles, semiconductors, chemicals and pharmaceuticals. The information industry (23 percent) represents the second largest group covering e-business, software, telecommunications as well as the motion picture and sound recording industry. Another set of studies has addressed professional, scientific, and technical services (10 percent), such as biotech, life science and consulting. Some studies have examined transportation and warehousing (six percent), finance and insurance (five percent), food services (four percent), oil and gas extraction (three percent), health care (three percent), public administration (three percent), and other industries (three percent).

The aim of the qualitative empirical works is to understand what constitutes a "good" business model. This approach includes considerations of how the business model is designed, advanced, and applied in various contexts. Within the set of qualitative empirical publications, case studies were used as the major type of study. They range from in-depth studies of one firm (Doganova & Eyquem-Renault, 2009; Kuratko & Mathews, 2004), over multiple firms and business models (Sabatier, Mangematin, & Rousselle, 2010; Yunus, Moingeon, & Lehmann-Ortega, 2010), to longitudinal studies (Garnsey, Lorenzoni, & Ferriani, 2008; Kodama, 2009). The quantitative empirical papers have studied the effects of certain business model designs on different performance measures. Three major types of study designs could be identified. The first category uses survey data from top and middle managers (Bonaccorsi, Giannangeli, & Rossi, 2006; Dewald & Bowen, 2010). The second form uses particularly trained MBA students to rate the business models of various firms based on company websites, stock market, and analysts' reports (Zott & Amit, 2007; 2008). The third and last sort is based on the analysis of secondary data, such as existing surveys, analysts' reports and articles in the business press (Alessandri & Bettis, 2003; Bock, Opsahl, George, & Gann, 2012; Goel, Miesing, & Chandra, 2010; Munari & Toschi, 2011).

In general terms, there are only a few attempts to support the business model concept with a coherent theoretical base. One of the earliest and most influential publications in the field provided a first overview of relevant theories (Amit & Zott, 2001). Based on various approaches of how value can be created by the business model (i.e. by offering novelty, complementarities, efficiency, and lock-in), the authors shaped the concept employing resource-based theory (Barney, 1991; Penrose, 1959), creative destruction theory (Schumpeter, 1934), value chain analysis (Porter, 1985), transaction cost economics (Williamson, 1975), dynamic capabilities (Teece, Pisano, & Shuen, 1997), and strategic network theory (Dyer & Singh, 1998). While

these propositions offered scholars a wide variety to choose from, less than half of the identified articles in the literature clearly base their efforts on an existing theory or conceptual foundation.

Out of the works that did, a large majority of authors decided to base their thoughts on Penrose's (1959) and Barney's (1991) resource-based theory (Demil & Lecocq, 2010; Gambardella & McGahan, 2010; Grönlund, Sjödin, & Frishammar, 2010; Mangematin et al., 2003; Möller, Rajala, & Westerlund, 2008). This represents an important finding for the area of business model research. But it is equally important to know about the other theoretical paths that scholars have taken. They cover the application of dynamic capabilities (Athreye, 2005; Jacobides & Winter, 2012; Teece, 2010; Teece et al., 1997; Winter & Szulanski, 2001), dominant logic (Chesbrough, 2010; Chesbrough & Rosenbloom, 2002; Downing, 2005; Prahalad & Bettis, 1986), behavioral theory of the firm (Cyert & March, 1963; Huygens, Baden-Fuller, Van Den Bosch, & Volberda, 2001; Sosna et al., 2010), activity systems theory (Markides & Sosa, 2013; Vygotsky, 1978; Zott & Amit, 2010), evolutionary theory (Garnsey et al., 2008; Nelson & Winter, 1982), contingency theory (Donaldson, 1996; Zott & Amit, 2008) and uncertainty theory (Knight, 1921; Thompson & MacMillan, 2010).

The manifold conditions and objectives faced by firms in their respective industrial setting imply a high complexity of understanding the related business model conceptualization (Casadesus-Masanell & Llanes, 2011) and potentially explain the vast differences in its theoretical underpinning. After 14 years of research, such disparities also show that knowledge about the business model and its potential implications is still beginning to evolve and to build its theoretical base (Edmondson & McManus, 2007). These results call for an integrative approach towards a unifying business model understanding based on a solid theoretical foundation.

Table 1: Overview of the body of literature on business models

Author (Year)	Type of Article	Selected Findings	Business Model Understanding
Mahadevan (2000)	Conceptual	The role in the market, physical attributes of the goods traded, and personal involvement required in buying/selling process guide organizations' choice of an appropriate business model.	A business model is a unique blend of three streams (value stream for the business partners and the buyers, revenue stream, logistical stream) that are critical to the business.
Winter & Szulanski (2001)	Case study of one firm (Bank One)	Key elements of a business model replication strategy theory: broad scope of knowledge transfer and the role of the dynamic capabilities of the central organization. The speed of replication is critical in a competitive setting.	The clever implementation of an insight into consumer needs and typically a complex set of interdependent routines that are discovered, adjusted, and fine-tuned by "doing".
Huygens et al. (2001)	Longitudinal study of the music industry with a time-span of 120 years	Search behavior of rival firms drives co-evolution of industries and firms over time through competitive dynamics among new entrants and incumbent firms and manifests itself in the simultaneous emergence of business models and organizations.	Business models and the manifestation of competitive regimes can be defined by factors such as the nature of customer interaction, asset configuration and knowledge leverage (based on Venkatraman & Henderson, 1998).
Amit & Zott (2001)	Inductive case study of 59 American and European e-businesses that have recently become publicly traded corporations	In e-business, transactions can create new value. Interdependent dimensions of the value creation potential of e-businesses: efficiency, complementarities, lock-in, and novelty. No single entrepreneurship or management theory can fully explain the value creation potential of e-business.	A business model depicts the content, structure, and governance of transactions designed so as to create value through the exploitation of business opportunities.
Chesbrough & Rosenbloom (2002)	Case study of 6 spin-offs that commercialized technology from Xerox's research laboratories	The business model mediates the value creation process. Its ultimate role is to ensure that the technological core of an innovation delivers value to the customer. Heuristic logic is required to discover an appropriate business model.	The business model provides a coherent framework that takes technological characteristics and potentials as inputs, and converts them through customers and markets into economic outputs.
Alessandri & Bettis (2003)	Quantitative analysis of secondary data of 54 large US firms from seven industries (airlines, banking, and computers for example)	Strategies have to be hard to imitate for a superior performance. Managers should integrate four lessons (see “Business Model Understanding”) into their business models to obtain such a superior performance that is robust to drastically changing market conditions.	Lessons for shareholder value creating business models under varying economic conditions (1. innovative strategies different from competitors; 2. competitors have inherent difficulty imitating these innovative strategies; 3. strong cost positions; 4. value propositions robust to economic conditions).
Wirtz & Lihotzky (2003)	Quantitative study of survey data from 122 top-management executives from B2C electronic business companies	Assess the suitability of a set of customer retention strategies (trust building, community, convenience, free service, individualization, contractual agreements, technical integration) in accordance with a given internet business model (content, commerce, context, connection).	The revenue model, the usage intensity and the net benefit for the customer (in form of a value proposition) are important components of an internet business model. Dimensions for differentiating revenue models: directness and transaction dependence of the revenue stream.

Author (Year)	Type of Article	Selected Findings	Business Model Understanding
Mangematin et al. (2003)	In-depth case study of 60 biotech firms in France with data from interviews with managing, research, or financial directors	Highlights the temporary nature of the emergent business model in the biotech sector, in which entrepreneurs rely on growth forecasts to persuade capital investors to invest in a radical innovation project.	Each business model has its own development logic, which is coherent with the needed resources - customer and supplier relations, a set of competencies within the firm, a mode of financing its business, and a certain structure of shareholding (based on Teece et al., 1994).
Morrison et al. (2004)	Case study based on interviews with executives at 35 different MNCs.	Advantages of the Netchising business model include added strategic flexibility, a greater ability to mass-customize, and improved value chain efficiencies.	Netchisers use the Internet for transferring core activities through partnership arrangements. The primary responsibility of the netchiser is to establish and maintain state-of-the-art core competencies (dedicated business assets, systems and knowledge).
Chatterjee (2005)	Conceptual	COAR model (Customer Outcomes, Core Objectives, Activities, Resources) helps develop better strategy and avoid unnecessary risk. A firm needs to track its superior performance in real-time in order to develop clarity about its business model.	COAR model: To earn a profit for shareholders, firms need clarity on how to simultaneously deliver the outcome that the customer values and capture some of this value for the firm's shareholders. Activities and resources are needed to deliver the core objectives.
Downing (2005)	Conceptual	Social dimension of business development: Improve the understanding of interactions between entrepreneurs and stakeholders in learning, business models, vision building, and innovation, and through more general concepts of networking, social capital, and embeddedness.	A set of expectations about how the business will be successful in its environment.
Athreye (2005)	Industry case study based on quantitative and qualitative data	Tight labor market conditions play an important role in inducing investment in process capability and the role of entrepreneurial experimentation in evolving a business model.	Organizational capabilities of a business model for outsourced software: the ability to scale up quickly in response to growth in demand; human resource management capability; software process management capabilities; ability to manage global operations.
Chesbrough et al. (2006)	Case study of two companies in the developing world (ApproTEC and Simputer)	Realizing the business opportunities of the developing world will require appropriate technologies and business models as well as substantial local knowledge and an abundance of patience. The distribution channel is especially importance here.	See Chesbrough & Rosenbloom (2002). Elements of the business model in the developing world: a means of financing, distribution channels, incentives for local dealers, value proposition, business value chain.
Bonaccorsi et al. (2006)	Quantitative analysis of survey data from 146 Italian open source software firms	Hybrid business models (proprietary and open source) are not a transient stage but rather a permanent feature of the new software industry.	The way products and services are sold to customers, cash is generated, and income is produced.
Mustar et al. (2006)	Conceptual (literature review)	The business model, the type of resources and the institutional link are the dimensions that differentiate between research-based spin-offs.	The articulation of the value proposition, the identification of the market segment, the position which is taken in the value chain and the estimated cost structure and profit margin (based on Chesbrough & Rosenbloom, 2002).

Author (Year)	Type of Article	Selected Findings	Business Model Understanding
Zott & Amit (2007)	Quantitative study of survey and secondary data of 190 entrepreneurial firms that derived their revenues over the internet	Novelty-centered business model design matters to the performance of entrepreneurial firms. Organizational design should extend beyond internal design to include a focus on the architecture of the transactions that a focal firm engineers with its partners, suppliers, and customers.	The business model as depicts the content, structure, and governance of transactions designed so as to create value through the exploitation of business opportunities" (based on Amit & Zott, 2001).
Andries & Debackere (2007)	Quantitative analysis of secondary data from 117 technology-based new ventures from the US	New ventures as well as new business units often need to adapt their initial business model due to the presence of uncertainty and ambiguity. Adaptation is crucial for the performance of these businesses and is beneficial in less mature, capital-intensive and high-velocity industries but not in more mature, stable industries.	A business model consists of various components, for example a core strategy, strategic resources, customer interface, value network, and a fit between all the components (from Hamel, 2000).
Möller et al. (2008)	Conceptual	Service innovation shapes value creation. Service providers that incorporate clients' experiences and capabilities into service co-creation will be strong even in the future.	Superior service-driven business models address the capabilities required by different modes of value co-creation. Resources, and especially their manifestation as competences are fundamental in creating and capturing value.
Fiet & Patel (2008)	Conceptual	The success of a venture partially depends on the market conditions for others, which affects how an opportunity can be exploited.	A business model explains how a venture is expected to create a profit (based on Afuah & Tucci, 2000; Chesbrough, 2003; Hedman & Kalling, 2003).
Mason & Leek (2008)	In-depth longitudinal case study of a single business model of an offshore supply network in the aerospace industry	Dynamic business models are useful tools for organizations working out types of knowledge that need to be transferred between firms and inter-firm knowledge transfer mechanisms designed to solve inter-firm problems.	Preconceived organizational and network structures built through the development of interdependent operational and administrative routines that evolve through problem solving activities. Three components of dynamic business models: network structure, inter-firm routines and knowledge forms.
Schindehutte et al. (2008)	Conceptual	A firm's entrepreneurial orientation (a market-driving behavior such as business model innovation) interacts with other strategic orientations (market orientation, technology orientation) in the process determining how they are manifested.	A primary vehicle for the firm's approach to the environment. It consists of six decision areas: how the firm creates value, for whom value is created, the source of internal advantage, the source of external differentiation, the model for making money, and the time and growth aspirations of the firm (based on Morris et al., 2005).
Garnsey et al. (2008)	Longitudinal in-depth case study of Acorn Computers and its spin-off ARM	Techno-organizational speciation (moving a technology into new market domains by adopting a new business model) has lasting consequences when it launches a technology that becomes a dominant standard compatible with multiple applications.	A business model can be thought of as a design that specifies how a firm is connected to others in its ecosystem in order to create and capture value. It can be operationalized in practice and may be wrought as a response to experience or be developed ex-ante.
Zott & Amit (2008)	Quantitative analysis of secondary data of 170 firms that conducted part of their business over the internet	Novel business models can augment the performance realized through superior product market strategies. A firm's product market strategy and its business model are distinct concepts that affect the firm's market value.	The business model depicts the structure, content, and governance of transactions between the focal firm and its exchange partners (based on Amit & Zott, 2001).

Author (Year)	Type of Article	Selected Findings	Business Model Understanding
Kodama (2009)	Longitudinal in-depth case studies of Japan's consumer electronics, semiconductor and mobile phone services	New business models, products and services are created through horizontal and vertical knowledge integration.	Vertical value chain model: integrates by vertically linking business activities within and across firms; Horizontal value chain model: involves firms expanding from existing to new business domains, and building networked SCs to create new value chains.
Doganova & Eyquem-Renault (2009)	Inductive case study of a French entrepreneurial venture, the university spin-off Koala	The business model plays a performative role by contributing to the construction of the techno-economic network of an innovation.	A narrative and calculative device that allows entrepreneurs to explore a market; it is a scale model of a new venture, which aims at demonstrating its feasibility and worth to the partners whose enrolment is needed; by circulating, it gradually builds the network of the venture that it represents.
Björkdahl (2009)	In-depth case studies of three multi-national corporations (decanters, industrial compressors, ball bearing housings)	In order to create and appropriate economic value firms are required to accompany technology cross-fertilization with changes to their business models. The rates of success of, and the unlocking of the value inherent in a new technology, are highly dependent on the business model.	A business model describes the logic and the activities that create and appropriate economic value, and the link between them. Components of a business model: customer value; customer segment; offering; revenue model; sourcing; distribution (based on Chesbrough & Rosenbloom, 2002).
Grönlund et al. (2010)	In-depth case study of one firm in the upstream oil & gas industry	Core capabilities and business models should be considered at the same time for the creation of a NPD process that sustains long term performance and allows the firm to fully benefit from open innovation. There is a need for reconfiguring the business model within NPD.	Two key parts: creating value, and capturing a portion of that value (based on Chesbrough, 2003). It is a focusing device that mediates between development efforts and value creation, and that underscores the way the firm generates profits (based on Chesbrough & Rosenbloom, 2002).
Goel et al. (2010)	Quantitative analysis of secondary stock-market data of firms in the media industry	The media industry must discover new business models to monetize its products and create value.	Business models are needed to capture hitherto untapped revenue streams arising from new technology and to cater to changing customer tastes.
Dewald & Bowen (2010)	Quantitative analysis of survey data from 126 real estate brokers	There is increased likelihood of resistance to a new business model when managers perceive business model innovation as a threat, and increased likelihood of adoption when the innovation is perceived as an opportunity.	A business model targets customers, offers value propositions, and requires skills and competences.
McGrath (2010)	Conceptual	Experimentation is key with new business models, within firms and across industries. It may itself offer another source of competitive differentiation. There is a human dimension to competing on new business models.	Core components of a business model: the basic "unit of business" that refers to what customers pay for (products, services, guarantees, for example); key metrics that reflect the architecture of the business, those operational activities that influence the critical dimensions of performance for a firm.

Author (Year)	Type of Article	Selected Findings	Business Model Understanding
Gambardella & McGahan (2010)	Conceptual	Companies that innovate in their business models to take advantage of new markets have the potential to lead in developing new knowledge-exchange industries.	An organization's approach to generating revenue at a reasonable cost. (based on Brandenburger & Stuart, 1996). It reflects management's hypothesis about what customers want, how they want it, how an enterprise can meet those needs, and get paid for doing so (based on Teece, 2010).
Itami & Nishino (2010)	Conceptual	The business system is the actual core part of a business model. While the profit model earns revenues for the short term, the business system learns information for the longer term: a successful business model must aim for both these outcomes.	A business model is composed of two elements, a business system (the "system of works" to deliver its products or services to its target customers) and a profit model (a pattern of the firm's intention about how it will make a profit in its given business).
Doz & Kosonen (2010)	Conceptual	Over time, efficient firms naturally evolve business models of increasing stability but also rigidity. Three core meta-capabilities are needed: strategic sensitivity, leadership unity and resource fluidity. Strategic agility is a keystone to having the ability to renew business models.	Sets of structured and interdependent operational relationships between a firm and its stakeholders, and among its internal units and departments (objective). Cognitive structures of how to set boundaries to the firm, of how to create value, and how to organize its internal structure and governance (subjective).
Thompson, & MacMillan (2010)	Conceptual	Visionary businesses can play a role in creating new business models that open up new markets, and simultaneously attend to societal wealth improvements.	Principles for designing and executing business models under high uncertainty: establish the scope of the enterprise; attend to the socio-politics of the proposed activity; identify/create an appropriate unit of business; preplan a realistic approach to disengagement; anticipate unintended consequences; follow discovery driven principles.
Casadesus-Masanell & Ricart (2010)	Conceptual	A business model is a reflection of the firm's realized strategy. Virtuous cycles can be crucial elements in the successful operation of business models.	The logic of the firm, the way it operates and how it creates value for its stakeholders (based on Baden-Fuller et al., 2008). Choices made by management about how the organizations must operate concerning policies, assets and governance as well as the consequences of these choices.
Dahan et al. (2010)	Conceptual	The business model is broadened to incorporate cross-sector collaborations between MNEs and NGOs: such partnerships can create and deliver both social and economic value.	A representation of a firm's underlying core logic and strategic choices for creating and capturing value within a value network.
Chesbrough (2010)	Conceptual	Experimentation and effectuation, and the successful leadership of organizational change must be brought to bear in order to overcome the barriers of business model innovation.	Companies commercialize new ideas and technologies through their business models (for the functions of a business model see Chesbrough & Rosenbloom, 2002).
Baden-Fuller & Morgan (2010)	Conceptual	Business models act as various forms of models: to describe and classify businesses (role models, scale models, kinds of businesses, types of businesses); to operate as sites for scientific investigation; to act as recipes for creative managers.	A set of generic level descriptors of how a firm organizes itself to create and distribute value in a profitable manner. Entails a variety of strategic elements: resources, capabilities, products, customers, technologies and markets.

Author (Year)	Type of Article	Selected Findings	Business Model Understanding
Teece (2010)	Conceptual	To be a source of superior performance, a business model must be non-imitable in certain respects, for example being hard to replicate, complicated process steps, strong intellectual property protection.	The design or architecture of the value creation, delivery and capture mechanisms employed. Management's hypothesis about what customers want, how they want it and what they will pay, and how an enterprise can organize to best meet customer needs, and get paid well for doing so.
Zott & Amit (2010)	Conceptual	Parameters for activity system design: design elements (content, structure and governance) for the architecture of an activity system; and design themes (novelty, lock-in, complementarities and efficiency) for the sources of value creation.	A business model depicts a system of interdependent activities that transcends the focal firm and spans its boundaries. Design elements: activity system content; activity system structure; activity system governance.
Sosna et al. (2010)	Longitudinal in-depth case study of a Spanish family-owned dietary products business	Trial-and-error learning is highly important for business model innovation in an uncertain environment. Externalities can affect business model development over time. Entrepreneur's character and previous learning influence business model innovation.	The design of transaction content, structure and governance so as to create value through the exploitation of business opportunities (based on Amit & Zott, 2001).
Demil & Lecocq (2010)	Case study of the English football club Arsenal FC	Business model evolution is a fine tuning process involving voluntary and emergent changes in and between permanently linked core components. "Dynamic consistency" is a firm capability to build and sustain its performance while changing its business model.	Different "building blocks" (resources and competences; organizational structure; propositions for value delivery; the structure of the organization's costs and revenues) to produce a proposition that can generate value for consumers and thus for the organization (based on Lecocq et al., 2006).
Yunus et al. (2010)	Case study of three firms: Grameen Phone, Grameen Veolia, Grameen Danone	Lessons for business model innovation: challenging conventional thinking; finding complementary partners; undertaking continuous experimentation; favoring social profit oriented shareholders; specifying social profit objectives clearly and early.	The business model concept offers a consistent and integrated picture of a company and the way it generates revenues and profit. Three components of a conventional business model: Value proposition; Value constellation; Profit equation.
Wirtz et al. (2010)	In-depth case study with 22 business managers of Web 2.0 related internet companies	Web 2.0 trends and characteristics are changing the rules of the "create and capture value" game, and thus significantly disrupt the effectiveness of established Internet business models.	Reflects the operational and output system of a company, and as such captures the way the firm functions and creates value. It consists of a sourcing domain; value generation domain; value offering domain; distribution domain; revenue domain.
Sabatier et al. (2010)	In-depth case studies of four European biotechnology companies with their six business models	A business model portfolio is the range of different ways firms deliver value to their customers to ensure both their medium term viability and future development. It is a way to articulate and finance the firm's activities in the medium run and to ensure idiosyncrasy to protect its future health.	Components of a business model: Level of promise (lag between investment and revenues, level of risk and expected returns) and degree of interdependency with other organizations; critical resources; Sequence of events to implement the business model; Iconic business model.
Smith et al. (2010)	In-depth case study with interviews and observations of 12 top management teams	Managing complex business models effectively depends on leadership that can make dynamic decisions, build commitment to both overarching visions and agenda specific goals, learn actively at multiple levels, and engage conflict.	The design by which an organization converts given strategic choices (about markets, customers, value propositions) into value, and uses a particular organizational architecture (people, competencies, processes, culture and measurement systems) to create and capture this value.

Author (Year)	Type of Article	Selected Findings	Business Model Understanding
Svejenova et al. (2010)	Longitudinal case study the business model of one individual chef	Business models have both significance and usefulness when extended to the level of the individual. The quest for creative freedom and responses beyond existing practices are the principal drivers of business model change.	Depicts the content, structure, and governance of transactions designed so as to create value through the exploitation of business opportunities (based on Amit & Zott, 2001).
Dunford et al. (2010)	Longitudinal in depth case study of ING Direct (international retail bank) with 71 interviews of executives worldwide	Business models do not emerge "fully formed", they rather continue to evolve from their initial conception and throughout their repeated application. The more rapidly internationalization occurs, the more condensed is this evolution if an internationalization is to be successful.	Defines how the enterprise creates and delivers value to customers and converts payments received to profits (based on Teece, 2010). Comprises a set of assumptions about such factors as the needs and behavior of customers, the behaviors of revenues and costs, and of competitors.
Esslinger (2011)	Conceptual	Both commercial success and sustainable relevance of product designs are possible. Powerful influence of design on the business model and design's role in building sustainability extends well beyond the profits of individual enterprises.	The "sustainability-driven business model" considers: consumers as individuals with a complex set of needs that consumption of products only partially satisfies and as members of a larger community with complex interdependencies.
George & Bock (2011)	Literature review and inductive case study of 151 surveys of practicing senior managers of 130 Indian firms	Present an opportunity-centric perspective of the business model. Interaction of the business model dimensions potentially explains a variety of patterns in business model practice.	For small and medium enterprises that function as a single business unit, a business model is the design of organizational structures to enact a commercial opportunity. Three dimensions noted in the definition: value structure; resource structure; transactive structure.
Zott et al. (2011)	Conceptual (literature review)	Silos of business model literature: E-Business, Strategic Management, Technology and Innovation Management. Emerging themes: the business model as a new unit of analysis; system level approach to business; activity perspective; seeks to explain how value is created, not only captured.	Offer an overview of various business model definitions in the fields of strategic management, e-business and technology and innovation management.
O'Toole & Vogel (2011)	Conceptual	Conscious Capitalism is a viable business model to generate both profit and sustainability, but not all firms are able adopt it, for example small businesses.	The only way to optimize value is creating a win-win business model that benefits the company, its stakeholders, and the environment/society in general.
Day (2011)	Conceptual	Firms have to rethink existing business models, and open up the organization to network partners in order to anticipate and respond to fast moving market signals.	A business model describes how a business creates the value it provides customers and then captures economic profits. It captures where and how the firm is embedded in an extended network of customers, suppliers, and partners.
Hienerth et al. (2011)	Case study of three firms (LEGO, IBM and Coloplast)	Implementing user-centric business models successfully requires a comprehensive approach encompassing an appropriate social software design, a transparent intellectual property policy, proper incentive systems, evolutional learning and nurturing as well as employee empowerment.	Adopt Teece (2010) and add four interlocking dimensions: the customer value proposition, the profit formula, key resources and key processes by Johnson, Christensen and Kagermann (2008).

Author (Year)	Type of Article	Selected Findings	Business Model Understanding
Casadesus-Masanell & Llanes (2011)	Conceptual (econometric model calculations)	The configuration of business models in an industry is the outcome of a search process for higher profits. Illustrate a methodology for the study of endogenous business models; a two-period game where in the first period business models are chosen and in the second period firms interact in the marketplace to attract users.	Adopt Baden-Fuller et al. (2008) and Casadesus-Masanell & Ricart (2010). Add that A firm's real business model includes a broad range of organizational such as products and markets, sources of revenue, incentive systems, hiring policies, information technologies.
Munari & Toschi (2011)	Quantitative study of 247 new ventures (123 academic spin-offs, 124 other)	The type of business model is an important factor in the academic spin-off's ability to access Venture Capital financing.	There are three types of business models: product-, technology-, and service-based business models based on the main modes of activities in which firms operate.
Bock, Opsahl, George, Gann (2012)	Quantitative Study of 107 MNCs based on archival data	Creative culture has a positive and partner reliance a negative effect on strategic flexibility during business model innovation. Further, the relative magnitude of business model innovation effort moderates the effect of reconfiguration on strategic flexibility.	Business models as design of organizational structures (Adopted from Baden-Fuller and Morgan, 2010).
Datta & Gailey (2012)	Case study of a social venture in India	Empowerment elements are embedded in the business models of for-profit social entrepreneurial ventures.	Described as a for-profit social venture: organizations that attempt to have both an economic (profitable/growth) goal and a social impact goal.
Halme, Lindeman & Linna (2012)	Case study of two established manufacturing firms	Define intrapreneurial bricolage as entrepreneurial activity within a large organization characterized by creative bundling of scarce resources, which may be of fundamental importance in MNC innovation for inclusive businesses.	Business model refers to the value that a product or service brings to the customer, how the product/service is delivered to customers, and how the profit is captured.
Jacobides & Winter (2012)	Conceptual	Structure, or more specifically, industry architecture, affects capability development by way of its effect on the feedback that firms receive.	Business models as structural innovations.
Morris, Shirokova & Shatalov (2013)	Quantitative study of 289 Russian food service companies	Seven generic models emerge in an industry, indicating there are multiple ways to succeed, such that firms gravitate toward standard models where some of them perform better.	At its core, a business model should explain how a company generates income or earns money. It consists of operational, economic, and strategic decisions reflected by structures and processes.
Chatterjee (2013)	Conceptual	Define four types of generic business models and then propose a systematic process for firms to consider multiple design configurations to choose the design that has a high probability of success.	Business models are characterized as driven by efficiency or perceived value (often both). Efficiency-Based models rely on human or capital resources to produce commodities. Perceived Value-Based models position their output as a "want" item and command a price premium (price discriminate).
Desyllas & Sako (2013)	Case study analysis of one automobile insurance company	Although business models do not warrant formal intellectual property (IP) protection, their constituent components (e.g. business methods and brands) often do. Formal and strategic IP protection methods play complementary roles for long-term competitiveness.	A business model describes the design of the value creation, delivery and capture mechanisms to be employed by the firm.

Author (Year)	Type of Article	Selected Findings	Business Model Understanding
O'Connor & Rice (2013)	Longitudinal case study of 12 innovation projects in 10 firms	Business model development is a very exploratory process. Market creation for breakthrough innovations may require as much time and investment as their technical development.	A business model defines the market infrastructure needed, the methods of delivering benefits, and relevant parts of the value chain.
Wilson & Post (2013)	Case study of seven social for-profit businesses	A clear intentionality around a social purpose drives venture design and their associated missions and business models to synthesize competing economic and social paradigms.	The design of a business model defines the creation of all types of value (e.g. social, financial) and its effective delivery through the core products or services.
Casadesus-Masanell & Zhu (2013)	Mathematical model in a game-theoretic framework	An entrant needs to strategically choose whether to reveal its innovation by competing through the new business model, or conceal it by adopting a traditional business model.	A business model refers to the logics of the firm and ways to create and capture value for its stakeholders; it focuses primarily on ways to generate revenues and define value propositions for customers, suppliers, and partners.
Al-Aali & Teece (2013)	Conceptual	Propose integrated IP management as aiming at the management of the various forms of intellectual property (patents, trade secrets, trademarks, copyright) together; intellectual property management is in turn integrated with overall business model design and corporate strategy.	A business model defines a product's value positioning for customers and addresses how the firm will generate profits.
Markides & Sosa (2013)	Conceptual	The success of first-mover advantages depends on the business model (i) that the pioneer utilizes to exploit the first-mover advantages associated with early entry: (ii) that late entrants adopt to attack the pioneers; and (iii) that the pioneer uses to respond to these attacks.	A business model is a system of interdependent activities such as the firm's value-chain activities, its choice of customers and its choice of products and services.
Priem, Butler & Li (2013)	Conceptual	Offer an expanded boundary model of strategy research that includes the demand side, business models, and business ecosystems within the strategy research "umbrella."	A business model describes the value proposition for customers, the targeted customer segment, how the offering will be produced and delivered, and expected costs and profit.
Visnjic Kastalli, Van Looy & Neely (2013)	Case study of a manufacturing and service firm	In the process of implementing a service business model (as well as any new business model), transparency is the key ingredient in decision making and effective implementation.	A business model is the way a firm creates and captures value.
Baden-Fuller & Haefliger (2013)	Conceptual	The relationship between the business model and technology is two-way: First, business models mediate the link between technology and firm performance. Second, developing the right technology is a matter of a business model decision regarding openness and user engagement.	A business model is a system that solves the problem of identifying who is (or are) the customer(s), engaging with their needs, delivering satisfaction, and monetizing the value.
Achtenhagen, Melin & Naldi (2013)	Longitudinal case study of 25 firms of various industries and sizes	Identify three critical capabilities to successfully shape, adapt and renew business models: an orientation towards experimenting with and exploiting new business opportunities; a balanced use of resources; as well as achieving coherence between leadership, culture, and employee commitment.	A business model captures the sources of revenues (and costs), with descriptions of the business architecture (for product, service and information flows, including description of the market participants), the value chain position, and relevant industries, as well as the benefits which customers and suppliers can gain from a company's business model.

Author (Year)	Type of Article	Selected Findings	Business Model Understanding
Velu & Stiles (2013)	Longitudinal case study of one financial services firm	Show that balanced procedural rationality and political expediency facilitate and helped resolve the paradoxes involved in running conflicting business models.	A business model summarizes the architecture and logic of a business and defines the organization's value proposition and its approach to value creation and value capture.
Aspara, Lamberg, Laukia & Tikkanen (2013)	Historical case study of one firm in the telecommunication industry	Corporate top managers can make their decisions about changing the composition of their corporation's businesses and the value-creating links between them, based on their recognition of inter-organizational cognitions. Distinguish between a firm's corporate business model and business models of its various units.	A corporate business model is the corporate top managers' perceived logic of how value is created by the corporation, especially regarding the value-creating links between the corporation's portfolio of businesses; The business unit model is the business unit manager's perceived logic of how the unit in question functions and creates value, in connection with both its market environment and within the corporation.
McNamara, Peck & Sasson (2013)	Longitudinal quantitative analysis of the English Football Premier League	Transitioning between business models can involve a (temporary) decline in performance.	A business model outlines how a firm delivers value to customers and converts payment into profit.
Bohnsack, Pinkse & Kolk (2014)	Content analysis of automotive related magazines	Incumbent and entrepreneurial firms approach business model innovation in distinctive ways. Convergence in their business models emerges over time.	A business model contains the value proposition (product/services and segments targeted), the value network (product development, production and [after]sales), and the revenue/cost model (payment and financing).
Mina, Bascavusoglu-Moreau & Hughes (2014)	Quantitative analysis of 788 manufacturing and service firms	Business services are more active open innovators than manufacturers. Open innovation is associated with the adoption of a service business model in manufacturing firms.	A business model describes how firms develop, deliver and appropriate value.
West & Bogers (2014)	Conceptual	There is a tendency to ignore the importance of business models, despite their central role in distinguishing open innovation from earlier research on inter-organizational collaboration in innovation.	Key goals of a business model are value creation and value capture.
Lehoux, Daudelin, Williams-Jones, Denis & Longo (2014)	Longitudinal case study of three academic spin-offs in the health industry	Business models redefine or reframe technology-based value propositions. Industry-level dynamics are likely to constrain business model innovation.	A business model is a "focusing device that mediates between technology development and economic value creation" (adapted from Chesbrough & Rosenbloom, 2002)

An integrative understanding of the business model and its constituent elements

The previous theory-related characteristics are in line with existing literature reviews that discovered a generally dispersed understanding of the business model concept (George & Bock, 2011; Zott et al., 2011). The following analysis explores the general idea behind a business model, its central objectives, and its constituting elements to arrive at a unifying understanding.

The general idea centers on four main understandings of the business model. The first group of studies gathers around the concept as a *coherent entity*, characterizing it as a coherent framework (Chesbrough, Ahern, Finn, & Guerraz, 2006; Chesbrough & Rosenbloom, 2002) and a consistent and integrated picture (Yunus et al., 2010) of various components and levels of analysis. The second comprehension circles around the *logic of the firm* (Casadesus-Masanell & Ricart, 2010; Dahan, Doh, Oetzel, & Yaziji, 2010). The perspectives vary from the logic and the activities of economic value creation (Björkdahl, 2009) to the logic of the company's development and growth (Mangematin et al., 2003). The third appreciation refers to *a hypothesis* about organizational contexts, for example how customers, competitors, revenues, or costs will develop in reality (Doz & Kosonen, 2010; Dunford et al., 2010; Gambardella & McGahan, 2010). The ultimate perception of the business model focuses on *design*, especially the design of the value creation, delivery, and capture processes in place (Sabatier et al., 2010; Smith et al., 2010; Teece, 2010). The designs further clarify how a firm connects with other players in an ecosystem to jointly create value (Amit & Zott, 2001; Garnsey et al., 2008; Svejenova et al., 2010).

Despite these varying views, there is consensus on the main objective of a business model, which is to clarify the value creation and capture approach of a focal firm together with its stakeholders (Amit & Zott, 2001; Teece, 2010; Zott & Amit, 2007; 2008, 2010). Value creation is what ultimately unites the different understandings. It is also deeply rooted in resource-based theory (Barney, 1991; Penrose, 1959; Wernerfelt, 1984) and can result from the acquisition, combination, or exchange of resources (Chen, 1996). In other words, resource-based theory proposes that in order to create economic benefits, firms must be organized to take advantage of valuable, rare and hard to substitute resources (Amit & Schoemaker, 1993; Barney, 1991). Due to its growing scholarly acceptance in the field (Demil & Lecocq, 2010; Gambardella & McGahan, 2010; Mangematin et al., 2003; Möller et al., 2008) and its high suitability for

explaining how firms create and appropriate value (Bowman & Ambrosini, 2000), resource-based theory will be used to provide a solid conceptual foundation for this review and the business model in general.

Next to value creation and capture, two other objectives define the business model's role in management research and practice. A business model links technological resources and economic value (Chesbrough & Rosenbloom, 2002; Doganova & Eyquem-Renault, 2009) and it is the entrepreneurial tool employed to enact commercial opportunities (Amit & Zott, 2001; George & Bock, 2011). Resources need an opportunity to enfold their inherent value creation and growth effects (Penrose, 1959). Technological capabilities and market opportunities often provide the foundation of new businesses (Andries & Debackere, 2007). Chesbrough and Rosenbloom (2002) define a business model to take a technology and convert it to economic value through customers and markets, representing a commercial opportunity (Choi & Shepherd, 2004; Shane, 2000). Amit and Zott (2001) depict transactions designed to create value by exploiting business opportunities and George and Bock (2011) define a business model as "*the design of organizational structures to enact a commercial opportunity"* (p. 99).

While all three definitions center on opportunities, George & Bock (2011) take a practitioners' perspective based on interviews of over 150 managers from different industries in combination with existing theories such as the resource-based view to derive the following three underlying elements of a business model: *value structure*, *resource structure*, and *transactive structure*. With this strong focus on both theory and practice, they offer an ideal basis to resolve the high complexity in grasping the business model concept that can arise from various industries (Casadesus-Masanell & Llanes, 2011). They are further consistent with the definitional elements of Amit and Zott (2001) as well as Chesbrough and Rosenbloom (2002). Systematic analysis supported by resource-based theory has shown that even all of the definitional elements used in other articles can be united under these three structures (Table 2).

The *value structure* of a business model represents "the system of rules, expectations, and mechanisms that determine a firm's value creation and capture" (George & Bock, 2011, p. 99). It fundamentally defines how the firm intends to create value from the business (Baden-Fuller & Morgan, 2010; Morris, Shirokova, & Shatalov, 2013; Thompson & MacMillan, 2010), based on the exploitation of available resources (Wernerfelt, 1984). In this regard, the business model needs to contain a detailed description of the value that is generated based on the offering, which is often called the value proposition (Björkdahl, 2009; Mahadevan, 2000). It indicates what kind of value is provided, and it includes a characterization of the customers, stakeholders and market segments to which it is offered (Schindehutte, Morris, & Kocak, 2008; Smith et al., 2010).

Based on these considerations, the value structure defines how the firm can capture some of the value that it creates (Chatterjee, 2005; Möller et al., 2008). That depends on the profit potential a firm can expect from its business model (Fiet & Patel, 2008; Itami & Nishino, 2010). This potential combines the mechanisms through which a firm plans to generate revenues by realizing the value proposition (Bonaccorsi et al., 2006; Mahadevan, 2000; Wirtz & Lihotzky, 2003). It also includes an estimation of the cost structure (Alessandri & Bettis, 2003; Dunford et al., 2010). Ultimately, the value structure entails a description of the organizational governance, rules, and legal form of the firm necessary to create and especially capture the potential value (Amit & Zott, 2001; Dahan et al., 2010). Such rules or formal contracts can strengthen a company's power in bargaining with other players (Coff, 1999).

The *resource structure* of a business model is characterized as an "architecture of the firm's organization, production technology, and core resources […] employed to serve customers" (George & Bock, 2011, p. 99). Elementary to a resource-based perspective, it potentially comprises all kinds of tangible and intangible resources, for example physical, human and organizational capital (Barney, 1991), depending on the given opportunity. It

describes the value chain that actually executes the value creation and capture determined by the value structure (Itami & Nishino, 2010; Mustar et al., 2006). It further presents the complementary assets that a firm needs to generate products and services (Chatterjee, 2013; Chesbrough & Rosenbloom, 2002; Huygens et al., 2001). These assets may provide important competences and capabilities of the firm (Athreye, 2005; Grönlund et al., 2010; Mangematin et al., 2003; Möller et al., 2008). All of them taken together represent the resource dimension of the business model.

The *transactive structure* of a business model refers to the "organizational configuration that determines key transactions with partners and stakeholders" (George & Bock, 2011, p. 99). It shapes the necessary organizational capital resources (Tomer, 1987), which include relationships between a firm and other firms in its environment (Barney, 1991). There are obvious similarities with Amit and Zott's (2001) notion of a transaction structure, which describes the firm's position in a value network that connects it with customers, suppliers, partners and other stakeholders. Such a network does not only offer the benefits of access to resources through partnerships, but also poses the challenge of creating and preserving value due to rivals' easy access to substitute resources (Amit & Zott, 2001). If managed well, it enables a firm's organizational design to go beyond the internal architecture and to take advantage of the influence of external players (Zott & Amit, 2007). Companies may, for example, exploit the creative potential of their customers by integrating them into their core business processes through information and communication technologies (Hienerth, Keinz, & Lettl, 2011). This structure can also entail a description of how the firm interacts with social, economic, and political contexts (Downing, 2005; Schindehutte et al., 2008). In particular, it can include an identification of competing actors within the network (Chesbrough & Rosenbloom, 2002) and impact on the necessary logistics and distribution channels to deliver value to customers (Chatterjee, 2005; Morrison, Bouquet, & Beck, 2004).

Table 2: Integration of definitional elements of the business model concept based on George and Bock (2011)

Author (s)	Value Structure	Resource Structure	Transactive Structure	Author (s)	Value Structure	Resource Structure	Transactive Structure
George & Bock (2011)	**x**	**x**	**x**	Yunus et al. (2010)	**x**		**x**
Amit & Zott (2001)	**x**	**x**	**x**	Wirtz et al. (2010)	**x**	**x**	**x**
Chesbrough & Rosenbloom (2002)	**x**	**x**	**x**	Sabatier et al. (2010)	**x**		**x**
Mahadevan (2000)	**x**	**x**		Grönlund et al. (2010)	**x**	**x**	
Winter & Szulanski (2001)	**x**			Smith et al. (2010)	**x**	**x**	
Huygens et al. (2001)		**x**	**x**	Svejenova et al. (2010)	**x**	**x**	**x**
Mangematin et al. (2003)		**x**	**x**	Dunford et al. (2010)	**x**		
Alessandri & Bettis (2003)	**x**			Goel et al. (2010)	**x**		
Wirtz & Lihotzky (2003)	**x**			Dewald & Bowen (2010)	**x**	**x**	
Morrison et al. (2004)			**x**	Esslinger (2011)			**x**
Downing (2005)			**x**	Zott et al. (2011)	**x**	**x**	**x**
Chatterjee (2005)	**x**	**x**	**x**	O'Toole & Vogel (2011)	**x**		**x**
Athreye (2005)		**x**		Day (2011)	**x**		**x**
Mustar et al. (2006)	**x**	**x**	**x**	Hienerth et al. (2011)	**x**		**x**
Chesbrough et al. (2006)	**x**	**x**	**x**	Casadesus-Masanell & Llanes (2011)	**x**	**x**	**x**
Bonaccorsi et al. (2006)	**x**		**x**	Munari & Toschi (2011)	**x**	**x**	
Andries & Debackere (2007)	**x**	**x**	**x**	Bock et al. (2012)	**x**	**x**	**x**
Zott & Amit (2007)	**x**	**x**	**x**	Datta & Gailey (2012)	**x**		
Möller et al. (2008)	**x**	**x**		Halme et al. (2012)	**x**		**x**
Fiet & Patel (2008)	**x**			Jacobides & Winter (2012)		**x**	**x**
Schindehutte et al. (2008)	**x**		**x**	Morris et al. (2013)	**x**		
Mason & Leek (2008)			**x**	Chatterjee (2013)	**x**	**x**	
Garnsey et al. (2008)			**x**	Desyllas & Sako (2013)	**x**		**x**
Zott & Amit (2008)	**x**	**x**	**x**	O'Connor & Rice (2013)	**x**		**x**
Doganova & Eyquem-Renault (2009)			**x**	Wilson & Post (2013)	**x**		
Kodama (2009)		**x**	**x**	Casadesus-Masanell & Zhu (2013)	**x**		**x**
Björkdahl (2009)	**x**	**x**	**x**	Al-Aali & Teece (2013)	**x**		**x**
McGrath (2010)	**x**	**x**		Markides & Sosa (2013)	**x**		
Gambardella & McGahan (2010)	**x**	**x**		Priem, Butler & Li (2013)	**x**	**x**	**x**
Itami & Nishino (2010)	**x**	**x**	**x**	Visnjic Kastalli et al. (2013)	**x**		
Doz & Kosonen (2010)	**x**		**x**	Baden-Fuller & Haefliger (2013)	**x**		**x**
Thompson, & MacMillan (2010)	**x**		**x**	Achtenhagen et al. (2013)	**x**		**x**
Casadesus-Masanell & Ricart (2010)	**x**			Velu & Stiles (2013)	**x**		
Dahan et al. (2010)	**x**	**x**	**x**	Aspara et al. (2013)	**x**		
Chesbrough (2010)	**x**	**x**	**x**	McNamara, Peck & Sasson (2013)	**x**		**x**
Baden-Fuller & Morgan (2010)	**x**	**x**		Bohnsack et al. (2014)	**x**		**x**
Teece (2010)	**x**		**x**	Mina et al. (2014)	**x**		**x**
Zott & Amit (2010)	**x**	**x**	**x**	West & Bogers (2014)	**x**		
Sosna et al. (2010)	**x**	**x**	**x**	Lehoux et al. (2014)	**x**		**x**
Demil & Lecocq (2010)	**x**	**x**	**x**				

At its basic core, across multiple industries every business model can consist of a mix of the proposed three organizational structures, with some of them being more prominent than others. Interdependency (Doz & Kosonen, 2010; Mason & Leek, 2008; Winter & Szulanski, 2001), coherence (Dahan et al., 2010), and dominance (George & Bock, 2011) between the structures can potentially explain how business models can be designed to deal with the multitude of products and services within different industries as well as their specific requirements for successful value creation and capture. The following resource-based framework introduces the antecedents that drive new business model creation and change.

CONCEPTUAL FRAMEWORK OF BUSINESS MODEL RESEARCH

Centered on insights from resource-based theory and a thorough review of the business model literature, a conceptual framework of internal and external antecedents as well as major consequences is developed. This includes an overview of relevant determinants and their impact on firms' efforts towards new business model creation and change (Figure 2). The classification between firm-internal and -external emerged from the literature analysis and is in line with the boundary-spanning nature of the business model concept.

Internal Antecedents

Analysis revealed a number of firm-internal and firm-external antecedents to business model design. The most important internal antecedents are technological resource potential, firm strategy, and organizational contingencies. First, *technological resource potential* primarily drives new business model creation and change, as technologies require the right business model configuration in order to generate economic value (Chesbrough, 2010; Grönlund et al., 2010). Technical success from an innovation has to be transformed through a business model first, because it does not automatically lead to economic value creation (Baden-Fuller & Haefliger, 2013; Teece, 2010). Firms that invest in technological potential are more

successful in generating economic value when they accompany these investments with changes to their underlying business model (Björkdahl, 2009).

New business model design may also be driven by novel technologies (Goel et al., 2010). A company's process that introduces a new technology and leads to the reorganization of its business model has been called 'techno-organizational speciation' (Garnsey et al., 2008). Consequently, an innovation's techno-economic network relies on the business model of a firm (Doganova & Eyquem-Renault, 2009; Lehoux, Daudelin, Williams-Jones, Denis, & Longo, 2014). This network can spread across the overall architecture of a sector including its markets as well as upstream and downstream enterprises (Gambardella & McGahan, 2010). It can provide both, a competitive technology and the required resources for driving business model reconfiguration (Calia, Guerrini, & Moura, 2007).

Second, *firm strategy* actively determines a company's business model design. A relatively large subset of prior research has devoted its efforts to resolve the question what strategy means for a business model and the two concepts can be distinguished. Resource-based theory states that strategy involves striking the balance between exploiting given resources and developing new ones (Wernerfelt, 1984). In principle, a business model may be understood to equal a static configuration of organizational elements to enact a specific opportunity. In contrast, strategy is a dynamic set of initiatives to strengthen the business model against its external environment (George & Bock, 2011). It is the plan for how to reach a desired future state, whereas the business model describes that state (Dahan et al., 2010). Consequently, a firm's strategy triggers potential changes to the business model's design. Strategy represents an important antecedent because it enforces firms to choose their business models in a competitive struggle between various conceivable design alternatives (Bonaccorsi et al., 2006; Casadesus-Masanell & Ricart, 2010) and additionally capture, share, and realize the intended strategic tasks (Itami & Nishino, 2010; Mason & Leek, 2008). Business model and strategy are distinct

concepts, with strategy complementing the business model and vice versa (Priem, Butler, & Li, 2013; Zott & Amit, 2008).

Third, the functionality and design of business models may depend on *organizational contingencies*. These include discovery-driven principles and decision-makers' effectual attitude, previous experiences as well as their personal values. Appropriate configurations that fit a given technology, market opportunity, and other conditions are hardly found immediately (Dunford et al., 2010; O'Connor & Rice, 2013). In order to optimally adapt the business model, ongoing experimentation (Athreye, 2005; Sabatier et al., 2010) and continuous adjustment and trial-and-error learning are necessary (Demil & Lecocq, 2010; Sosna et al., 2010). This is especially the case under high-uncertainty conditions (Thompson & MacMillan, 2010). The capability to play with the business model requires the development of new processes for experiments and evaluations of their results (Chesbrough, 2007) and qualifies as an important organizational capital resource (Barney, 1991; Tomer, 1987) to shape the characteristics of a business model. A balanced use of resources as well as a fit between leadership, culture, and commitment of employees supports these experimental tasks (Achtenhagen, Melin, & Naldi, 2013).

The straightforward idea behind this constant refinement is to learn as much as possible at the lowest achievable cost (McGrath, 2010). Because it is valuable, rare and difficult to imitate or substitute (Barney, 1991), the knowledge gained from the experiments reflects an important strategic resource to improve the business model towards superior performance (Amit & Schoemaker, 1993). More specifically, the constant refinement represents a process of reducing uncertainty, which at first enables experimentation followed by learning and the development of a plausible and realistic business model. If a business model does not fit the required needs, this process also facilitates its cost-saving refusal (Thompson & MacMillan, 2010). Possible variations of experiments range from simple thoughts over experiments on

schematic models to managers' tryouts on their real world company (Baden-Fuller & Morgan, 2010).

Moreover, organizations have to develop an effectual attitude towards experimentation with business models in order to identify internal leaders to manage their outcomes and to establish a culture that embraces the new situation (Chesbrough, 2010). A firm's response to early failures, the skill to learn from them, and the endurance to continue testing represent core organizational and individual characteristics that can be critical to how the learning process subsequently develops (Sosna et al., 2010). Experimentation is the key to deepen the understanding about business models even across industries (Huygens et al., 2001; McGrath, 2010).

Decision-makers generate tacit knowledge from previous experiences, which represents a highly valuable human capital resource (Barney, 1991) that also impacts business model design (Audretsch, Lehmann, & Plummer, 2009; Baden-Fuller & Morgan, 2010; Dewald & Bowen, 2010). These experiences can manifest themselves in form of knowledge on the local circumstances of a new market (Chesbrough et al., 2006), exploitation behavior (Farmer, Xin, & Kung-Mcintyre, 2011) or the right understanding of how to address environmental changes and adjust the business model accordingly (Aspara, Lamberg, Laukia, & Tikkanen, 2013; Wirtz, Schilke, & Ullrich, 2010). Evaluating these experiences can help leaders to focus on particularly relevant information channels and endow them with a specific superior performance in creating a new venture (Fiet, 2007; West & Noel, 2009). The business model can additionally be a product of the decision-maker's integration of external knowledge derived from economic, social, and cultural influences (Downing, 2005; Mason & Leek, 2008). In this regard, transparency is the key to effective decision-making and business model implementation (Visnjic, Van Looy, & Neely, 2013). These relationships and conversations with external players, such as venture capitalists, accountants, and governments, may result in

an early detection and enhanced solution of any problems related to new business model creation and change (McGrath, 2010).

Besides knowledge, the personal values, visions, and strategies of the individual decision maker can drive the design of the business model (Downing, 2005). This requires a strong psychological and emotional personality (Sosna et al., 2010) with entrepreneurial energy, business-minded insight and rigid commitment to implementation (Gambardella & McGahan, 2010). A business model's design and subsequently its performance is further influenced by a leadership style that questions the model's feasibility (McGrath, 2010), as well as lively decision-making, commitment to agenda specific objectives, and comprehensive visions (Smith et al., 2010). Leadership unity and collective commitments are especially important for organizational change such as an adoption of the business model, which often involves emotionally demanding decisions (Doz & Kosonen, 2010). Organizational contingencies in their many forms consequently represent an important antecedent towards business model design.

External Antecedents

The key external antecedents of business model design comprise market opportunities, extra-industry conditions, and competitive activities. First, business models' initial design is largely driven by the exploitation of *market opportunities* (Amit & Zott, 2001; Chesbrough & Rosenbloom, 2002; George & Bock, 2011). Those chances limit the way given resources can be exploited (Penrose, 1959). The information about an existent market opportunity may even represent a unique firm resource (Barney, 1991). Identifying these occasions in order to design a feasible business model is oftentimes difficult because today's firms are continuously confronted with changing customer needs (McGrath, 2010). Moreover, market opportunities are not easily anticipated across economic sectors (Gambardella & McGahan, 2010). The customers' requirements are of central importance for companies designing a business that also

leads to benefits for themselves (Möller et al., 2008). So the ability to mobilize available resources and align them with the dynamically changing opportunities is essential for the life expectancy of a firm and its business model (Fiet & Patel, 2008; Liao, Kickul, & Ma, 2009).

Second, concerning *extra-industry conditions*, the effect of the environmental context on the design of a business model finds various examples in the literature. Managerial decisions regarding the deployment of resources and capabilities, relevant for a new or changed business model, depend on the economic, industrial, social, technological, and regulatory environments (Amit & Schoemaker, 1993; Welter & Smallbone, 2011). There are special requirements in the internet sector (Mahadevan, 2000), particularly new developments such as Web 2.0, that can significantly disorder the effectiveness of traditional e-business models (Wirtz et al., 2010). These models clearly differ from the ones small and medium-sized enterprises in the industrial environment would employ (Mangematin et al., 2003), for example in their resource structure where machinery gives way to a fast internet connection and a small group of talented coders. They differ even more strongly from models demanded by the somewhat underdeveloped, high-uncertainty situation of emerging markets (Thompson & MacMillan, 2010; Yunus et al., 2010), where a lack of infrastructure and buying power calls for drastically different value structures.

Generally, the design of the initial business model based on environmental conditions is one key to the survival of fresh ventures or new corporate business units (Andries & Debackere, 2007). Literature has shown that externalities set the boundaries of how firms can create, develop, replicate (Sosna et al., 2010) or change their business models over time (Björkdahl, 2009). A business model also represents the primary vehicle for how a company approaches the external environment (Schindehutte et al., 2008) and its suitability can only be judged against such a certain context (Teece, 2010). The environment enacts its influence through positive or negative emerging changes, which are unintended and cannot always be controlled by management (Demil & Lecocq, 2010). In order to respond to rapidly changing market

signals, firms may even have to open up their business models towards potential partners in their network (Day, 2011).

It is therefore important to match the consequences of environmental change with the different structures of the company's business model (Wirtz et al., 2010). Decision makers should always provide viable solutions against a range of environmental contingencies (Casadesus-Masanell & Ricart, 2010). Even the invention of a new way around a single market constraint may increase a business model's performance (McGrath, 2010). Managing a business model portfolio can lead to more flexibility in reorganizing a firm's activities in coherence with the changing environment (Sabatier et al., 2010).

Third, the successful design of a business model strongly depends on the *competitive activities* of other players in the market. Consensus exists that companies must regularly adjust their business models to resist market pressures and to sustain high performance (Wirtz et al., 2010). A new and successful business model per se may be insufficient for ensuring a superior performance because its main elements are often transparent and easily imitable once the model is implemented (Teece, 2010). Business models themselves do not offer possibilities for formal intellectual property protection (Desyllas & Sako, 2013), but it may be integrated with corporate strategy (Al-Aali & Teece, 2013). They have to be designed in order to hinder imitation by competitors and to enable superior performance (Alessandri & Bettis, 2003). Thus, the employed resources have to be rare, valuable and hard to imitate by competitors and the business model must be organized to take advantage of them (Amit & Schoemaker, 1993; Barney, 1991).

One approach to adapt the business model to changing competitive situations is applicable to firms that understand and anticipate them and track their own performance relative to their competitors (Chatterjee, 2005). This can lead to a firm-level capability called 'dynamic

consistency', which allows for maintaining superior performance while implementing everything from incremental to radical changes to the model when necessary (Demil & Lecocq, 2010). A second approach refers to a number of characteristics that inhibit copying the business model. Such characteristics are for example the pure virtue of being difficult to replicate, complex process steps or established organizational structures that hinder the implementation of a new model (Teece, 2010). New market entrants may also choose to reveal an innovation by adopting a novel business model or conceal it by selecting a traditional model (Casadesus-Masanell & Zhu, 2013). The business models of an incumbent and a new entrant may eventually converge over time (Bohnsack, Pinkse, & Kolk, 2014).

Oftentimes, firms use a replication strategy, which involves testing early versions of new business models in small local markets and subsequently scaling them up to a broader audience. The speed of replication is critical in competitive settings (Winter & Szulanski, 2001). Organizations that run this strategy find their business model exposed to varying competitive surroundings in a short period of time and are required to shape it due to these varying experiences (Dunford et al., 2010). In this case, competition does not necessarily have to be a threat, but it can also serve as a chance to learn and improve the business model. Exploitative learning can even support further international expansion (Prashantham & Young, 2011).

Consequences

The central consequences of business model design in the reviewed literature are the following: creation and capture of economic value, creation of social value as well as organizational learning.

First, the majority of articles in the literature focus on how business models create and capture *economic value* from their available resources. Despite this common focus, the articles differ in the recipient of that value. Business models may create customer value (Chesbrough

& Rosenbloom, 2002; Sabatier et al., 2010), shareholder value (Alessandri & Bettis, 2003; Chatterjee, 2005), and even benefits for all other stakeholders of a company – employees, customers, suppliers and other partners (Sosna et al., 2010; Zott & Amit, 2010). Accordingly, a firm also appropriates a portion of that value for itself (Crook, Ketchen, Combs, & Todd, 2008; Garnsey et al., 2008; West & Bogers, 2014). This is the profit margin of the business (Demil & Lecocq, 2010). Business models may thus also enhance a firm's performance, especially in combination with new technology development (Grönlund et al., 2010), product market positioning (Zott & Amit, 2007; Zott & Amit, 2008), innovation networks (Gronum, Verreynne, & Kastelle, 2012), and the management of complex strategies (Smith et al., 2010). However, superior performance is not necessarily permanent in nature, and sustaining it may call for innovation of the business model (McGrath, 2010) and the resources and competences employed by it (Amit & Schoemaker, 1993; Crook et al., 2008).

Second, business models can also create *social value* (Di Domenico, Haugh, & Tracey, 2010; Meyskens, Robb-Post, Stamp, Carsrud, & Reynolds, 2010). To address the challenges of poverty in the developing world, business models may simultaneously aim at establishing new markets as well as improve local societal wealth (Datta & Gailey, 2012; Thompson & MacMillan, 2010; Yunus et al., 2010). In these settings, partnerships with nongovernmental organizations can be mutually reinforcing and can lead to the creation of both economic and social value (Dahan et al., 2010). In Western economies alike, companies may aim at creating business models that benefit the focal firm, its stakeholders, and the society in general (O'Toole & Vogel, 2011; Wilson & Post, 2013).

Third, designing business models offers huge opportunities for *organizational learning* and as a result knowledge creation as a key resource over other players in a market (Amit & Schoemaker, 1993). Firms can gain valuable information about both their technologies and their markets as a byproduct of organizing the new value delivery to the customer. The business

model may thus contains a ‘learning system’ that provides information for the longer term which then can grow to become important for the health of the firm (Itami & Nishino, 2010).

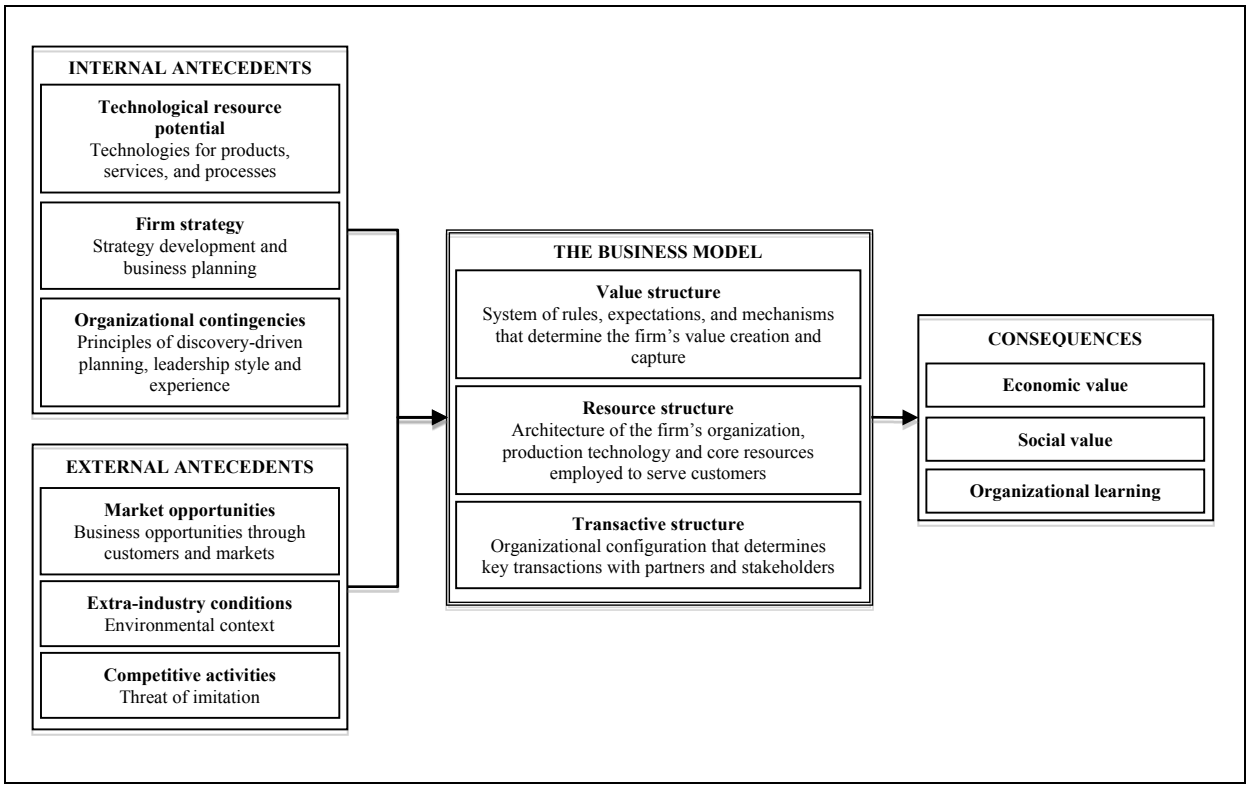

Figure 2: A conceptual framework of the business model’s antecedents and consequences

AGENDA FOR FUTURE RESEARCH

The agenda for future research regards the issues that are considered most important judging from the development of the conceptual framework. It focuses on selected key issues and does not represent a comprehensive list with all potential research opportunities. Rather, it concentrates on those key issues that seem to deserve particular attention in the near future to further advance researchers’ understanding of business models (Table 3).

First, further investigation of the business model concept itself is needed, especially with regard to the interdependencies of the three underlying structures. Prior research has primarily examined the various elements of business models, some of them already pointing towards their necessary coherence (Chesbrough et al., 2006; Yunus et al., 2010) or interdependency (Doz &

Kosonen, 2010; Mason & Leek, 2008). A dominance of the structures occurs when one business model dimension obtains relatively more importance within the firm's configuration of efforts. This significant aspect of a business model's configuration can influence organizational effectiveness and the strategic fit with the external environment (George & Bock, 2011).

Table 3: Selected possibilities for future business model research

Issue	Main Focus	Illustrative Research Questions
The business model	The interplay between the three underlying structures of the business model concept	Are there interdependencies between the business model structures? How do these interactions affect potential consequences?
Technological resource potential	The fit between business model design and technology	How do technologies influence the design of the business model's structures?
Firm strategy	The adoption and innovation of the business model over time	How can business model innovation be successfully accomplished within various industrial contexts and organizational situations?
Organizational contingencies	The influence of leadership style, experience and discovery-driven principles on the business model	How do risk attitudes influence the design of business models? How do various leadership styles affect the performance of a business model? How does the use of discovery driven principles influence the functionality of a business model?
Market opportunities	The fit between an opportunity and business model design	How do certain business model designs lead to a better exploitation of a given opportunity?
Competitive activities	The protection of the business model from imitation	What role do internal structures play for the protection of a business model from imitation? How does technological know-how influence the defence of competitors?
Extra-industry conditions	The influence of the environmental context on the business model	What externalities cause the need for changes to an established business model? How do they influence the performance of a business model?
Consequences	The effect of a focal firm's business model on performance.	How do business models affect firm performance? How do business models affect organizational learning?

For instance, if one function of a business model is to "estimate the cost structure and profit potential of producing the offering, given the value proposition and value chain structure chosen" (Chesbrough & Rosenbloom, 2002, p. 533), dependencies between the value and the resource structure are very likely. Other authors point towards the possibility that the long term sustainability of a business depends on interactions between parts of the value structure and the transactive structure (Mahadevan, 2000). To date, however, there are no comprehensive insights on how the three structures affect one another and how these interactions influence

potential consequences. It is left to scholars to dedicate their future efforts to this important matter.

Second, there is a strong need to gain further clarity on the fit between the business model and its antecedents, especially technology and market opportunities. Not all business models are equal, some scholars identify constituent parts that others do not consider and vice versa. This is for a reason. The importance of each of the three business model structures depends on various antecedents. For instance, for a producer of consumer electronics, the resource structure might be more important than for a reseller of the same products, where the transactive structure might be more central to the business model. In general, a service provider of any kind has a different value structure than a firm that manufactures physical goods. Quantitative studies are required to provide clarity on cause and effect relationships and on interaction effects among the antecedents and the design of the business model. These issues include the empirical analysis of the relationship between technological inputs and economic outputs of the business model.

Another aspect of the considerations concerning the fit of the business model and its antecedents is the role of competition. The idea behind this relationship is to find out how to protect the business model from being imitated (Teece, 2010). If protection is impossible, researchers may find out what role the business model's fit with antecedents, such as the underlying technology or market situation, plays for the success of companies with similar business models, for example franchising or licensing. Different business model designs should therefore be tested under varying industrial, environmental, and competitive conditions.

Concerning organizational contingencies, decision makers' personal characteristics, such as risk attitudes and leadership styles, hold particular promise as determinants of business model design. The role of experience in creating and sustaining business models offers a further

potential area of investigation. Here, insights from other disciplines, such as sociology and psychology, may provide helpful starting points. Many scholars promote the extensive use of discovery-driven principles for the design of sustainable business models (Athreye, 2005; Sabatier et al., 2010). Evaluations of such techniques in comparison with classic planning approaches promise interesting insights, and they may substantially advance the emerging field of business model innovation. In addition, studies that examine the interplay of individual and organizational characteristics deserve further attention. For instance, such investigations could examine which entrepreneurs prefer discovery-driven instead of traditional planning approaches and analyze the resulting performance implications of these combinations.

Third, an emerging theme is concerned with the dynamics of business model change and innovation. In this context, the terms ‘business model innovation’ and ‘strategic innovation’ can be considered largely equivalent “One type of innovation that tends to be disruptive to established competitors is business-model innovation. In earlier work […], I called this type of innovation ‘strategic innovation’, which is a confusing term. ‘Business model innovation’ captures the essence of this type of innovation without ambiguity” (Markides, 2006, p. 19). While this perspective favors a disruptive understanding, Demil and Lecocq (2010) suggest that incremental changes to the business model are more common. Recent attempts of defining business model innovation do not present an agreement on this issue. The definitions vary between “the capacity to create new strategies which modify the rules of the competitive game in an industry” (Yunus et al., 2010, p. 312), a firm’s adoption of “a novel approach to commercializing its underlying assets” (Gambardella & McGahan, 2010, p. 263) or simply “a strategic renewal mechanism” (Sosna et al., 2010, p. 387). A major objective for scholars is gaining definitional clarity on business model innovation and on how it can be successfully accomplished under various environmental conditions, e.g. for manufacturing firms developing service business models (Mina, Bascavusoglu-Moreau, & Hughes, 2014).

Moreover, there is not yet agreement on how the process of new business model design is ideally supposed to happen. Common is a multi-step approach, which begins with the creation of a first business model idea that is subsequently refined (Chatterjee, 2005; Winter & Szulanski, 2001). The process of designing a business model involves making the right choices (Mahadevan, 2000) about assets, policies and governance structures that often are not easily reversible without costly changes (Casadesus-Masanell & Ricart, 2010). In addition to that, running a new business model that may conflict with a firm's older model may lead to complex difficulties (Velu & Stiles, 2013) and to a temporary decline in performance (McNamara, Peck, & Sasson, 2013).

Fourth, with regard to methodological advancements, a stronger focus on quantitative studies is likely needed to further improve the area of business model research. Scholars should aim at a thorough operationalization of the business model that is able to capture the high complexity arising from firms' various objectives (Casadesus-Masanell & Llanes, 2011). The conceptualization by George and Bock (2011), derived mainly from practical relevance, represents a helpful starting point to this endeavor. There are already a number of approaches to measure the business model concept. Andries and Debackere (2007), for example, assess the changes of products and markets to characterize business model adaptation based on secondary data, but they do not consider changes of the actual model components. Bonaccorsi et al. (2006), in the context of e-businesses, operationalize the idea of hybrid business models that measure firms' degree of openness towards open source software. Wirtz and Lihotzky (2003) use a standard internet business model taxonomy to examine the application of customer retention measures dependent on the selected business model type. Finally, Zott and Amit (2007; 2008) develop two latent variables based on perceptual measures derived from specially trained expert raters to assess novelty- and efficiency-centered business model designs.

While all of these measurement approaches are important, they do not fully capture the concept's complex nature and consequently retain scholars from unlocking the full academic value inherent in the field of business model research. With enhanced measures, scholars will be able to better understand the relationships inside and outside the business model concept.

Finally, with regard to consequences, researchers have to convincingly demonstrate that different business model designs actually have an effect on various forms of consequences, such as economic value creation and capture. Researchers may, therefore, analyze the causes of these performance effects. One direction of investigation may point towards the necessary alignment between firm strategy and the business model and whether it leads to desired outcomes. Taken the business model as a new unit of analysis in a setting with multiple consequences, the potential for further investigation concerning these effects is immense. The relevance of business model research fundamentally depends on future studies to find ways to address this issue, next to the few important attempts that have already been undertaken (Zott & Amit, 2007; 2008).

LIMITATIONS

Some limitations apply to this study. First, this study is based on high impact academic journals only and thus excludes insights from more practitioner-oriented books and journals. Second, due to the large spectrum of potentially relevant outlets in the intersection of strategic management, entrepreneurship, and technology and innovation management, there exist a number of journals whose additional inclusion in the analysis is debatable. In order to draw a reasonable line, recent guiding principles in selecting the journals with major relevance for the respective areas were followed (Short, 2009). Third, the study's findings are based on a relatively small number of 79 articles, which is due to the comparably nascent field of research and the demanding criteria regarding journal quality. While these aspects show that the review is not exhaustive, it is still both systematic and comprehensive. Finally, as the conceptual

framework is based on prior research, it should not be understood as a complete framework of all possible determinants and effects of the business model. As a framework, it further abstracts from reality, in which the relationships among variables are more complex with possible feedback loops. This means that potential interactions between antecedents and their resulting influence on the business model, e.g. between market opportunities and the necessary technological potential, could not be analyzed based on existing literature but offer great potential for future research.

CONCLUSION AND OUTLOOK

As shown by the literature review, the business model is a powerful concept for researchers to gain new insights into firms' activities of creating and capturing value. It further serves practitioners to design their businesses in order to succeed in enacting commercial opportunities. It is therefore a valuable extension to established concepts of entrepreneurship and management research, such as corporate strategy, because it depicts the actual structures necessary for a firm to profit from its business. This paper presents an approach that helps to overcome the barriers of the dispersed and multifaceted field of business model research. Definitional clarity and integrity of the business model have been supported by examining its various understandings, complementing them with insights from resource-based theory and combining them with earlier contributions to integrating the dispersed field (George & Bock, 2011; Zott et al., 2011). As such, a conceptualization of the business model as the design of three basic organizational structures, that is, value structure, resource structure, and transactive structure has been selected. This thorough literature review has shown that all conceptualization of the business model and its elements match at least one of these three structures, many of them even all three. The integrative understanding may consequently be used by researchers from various fields as well as practitioners from different industries. Based on a resource-based conceptual framework for the antecedents and consequences of business model design, a

detailed research agenda presents various challenges and opportunities for future work in advancing the field towards new academic insights and important managerial implications. Future research may deepen the knowledge about the nature of business models, the internal fit of their structures, and the external fit with antecedents and consequences. Additional opportunities for outstanding contributions refer to business model innovation and the corresponding role of strategy. Managers and entrepreneurs will be able to better understand how to assess the power of their business model already in use and how to bring about the necessary changes.

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STUDY 2: OPENNESS IN BUSINESS MODEL INNOVATION: THE CASES OF CAR2GO (DAIMLER) AND QUICAR (VOLKSWAGEN)

ABSTRACT

This paper analyzes the business model innovation process of market-driving established corporations, especially in light of an increasing openness towards the firm environment. Case study research is applied to examine the emerging carsharing business models of two leading German car manufacturers: Car2Go (Daimler) and Quicar (Volkswagen Group). The study contributes to research and practice in different ways. First, three stages of the innovation process for radically new business models are identified: vision and prototype, experimentation and customer integration, and implementation and upscaling. Second, this study examines how the business model innovation process profits from different degrees of openness. Third, several antecedents of the process are identified: complementary external and internal technological developments, the external environment of the focal firm as well as a strategic fit between the partners involved in the innovation process and also in the resulting business model. Finally, the interdependencies between the new business model's structures are illustrated.

INTRODUCTION

"A business model is the design of organizational structures to enact a commercial opportunity" (George & Bock, 2011, p. 99). Such opportunities, as characterized in the entrepreneurship and management literature, represent a chance to introduce new products, processes, or services (Gaglio, 2004) that result in the foundation of new businesses (Baron & Ensley, 2006). Business venturing relies on recognizing, discovering, or creating these possibilities (Dyer, Gregersen, & Christensen, 2008). Without them, there is no entrepreneurship (Short, Ketchen, Shook, & Ireland, 2010). Exploiting these chances is particularly challenging when markets cannot be taken as given and must be newly created or radically redefined (Schindehutte, Morris, & Kocak, 2008). Under these conditions, customers cannot give information or clues about how to fulfill their needs, because customers do simply not exist. Firms that rise to such a challenge engage in what is called 'market-driving behavior' (Kumar, 1997), which leads them to create completely new markets and produce radical innovations in products, services, and business models (Schindehutte et al., 2008).

Out of these novelties, crafting fresh business models is among the most important steps to ultimately profit from the other – mostly technological – innovations required for new market creation (Teece, 2010). A business model innovation must enlarge an existing economic pie by attracting new customers into the market. It represents more than just a radical new strategy by a focal firm (Markides, 2006). First efforts have been made to uncover the complex task of new business model creation. They have focused on organizational learning (Sosna, Trevinyo-Rodríguez, & Velamuri, 2010), social businesses (Yunus, Moingeon, & Lehmann-Ortega, 2010), and bottom of the pyramid markets (Thompson & MacMillan, 2010). Recent research calls for further investigation into "*(1) enablers, (2) process and elements, and (3) effects of business model innovation*" (Schneider & Spieth, 2013, p. 21).

The business model concept itself has emerged as an entirely new unit of analysis, covering the focal firm as well as other players in the value network: customers, collaborators, and competitors (Zott, Amit, & Massa, 2011). This inherent openness of business models offers different parties the opportunity to share the innovation work – from invention to commercialization (Chesbrough, 2007). To date, little is known about how these separate players actually assemble to innovate and how the process of such assembly into an innovative business model occurs. Therefore the following question arises: *How does the business model innovation process unfold and how does a firm's openness towards other players in its environment influence this process and the resulting new business model?*

Case study research grounded in an analytical framework derived from prior business model research is employed in an attempt to answer this question. The cases are the emerging carsharing business models of Car2Go (Daimler AG) and Quicar (Volkswagen AG) in Germany. Both represent an outstanding chance to study business model innovation. Global trends such as urbanization, energy and resource transition, as well as changing legal policies in megacities – fueled by the steadily rising cost of car ownership – activate a radical change in mobility needs of customers worldwide (Shaheen & Cohen, 2007). Carsharing is a promising way to exploit such opportunities. Once a niche offering in Europe (Katzev, 2003), things drastically changed when Daimler, followed by other original equipment manufacturers (OEMs), realized the growing opportunities in carsharing and entered this market. These events rang in a new era for the automotive industry (Zhao, 2010) and triggered its most radical business model innovation to date: from selling vehicles to selling mobility.

A number of contributions to business model research emerge from this study. First, three distinct process steps of business model innovation are delineated: vision and prototype, experimentation and customer integration, as well as implementation and upscaling. Each one of them entails key activities and follows a specific goal – important guidelines in the design of

radically new business models. Second, business model research benefits from the discovery of different degrees of openness during a business model's innovation process. Third, this particular analysis determines the function of several antecedents during business model innovation. Internally or externally developed technological innovations are a crucial enabler of the new business models and determine a great share of their future success. Moreover, there exists a positive influence of the external environment including competition and there is an implicit need for a strategic fit between all actors involved in the newly generated model. Finally, a detailed description of the emerging business model of OEM carsharing and the resulting interdependencies between its structures is provided.

CONCEPTUAL BACKGROUND

In order to theoretically ground the empirical analysis, prior literature on business models stemming especially from strategic management, entrepreneurship, as well as technology and innovation management has been systematically analyzed for drivers of business model design (See Study 1 for further details). Based on their relevance for the given research question and empirical setting, the resulting analytical framework conceptually rests on five distinct constructs: business model, firm strategy, market environment, technological innovation, and discovery-driven principles. It especially considers the elements of a business model and its inherent openness towards the external environment. Centered on – but not exclusively limited to – established firms, these underlying constructs characterize the development process of radically new business models introduced in the following section (Table 1).

As the first and central construct of the analytical framework, the *business model* rests on organizational structures designed to exploit a market opportunity (George & Bock, 2011, p. 99). An additional function of a business model is to create value for all stakeholders and to capture part of it for the focal firm (Casadesus-Masanell & Ricart, 2010; Teece, 2010; Zott &

Amit, 2007; 2008, 2010). The business model as a discrete unit of analysis is centered on the firm level, but with wider boundaries (Amit & Zott, 2001, p. 511).

Table 1: Analytical framework, underlying definitions, and operationalization

Construct Definition	Properties	Data sources
Business Model A business model represents "*the design of organizational structures to enact a commercial opportunity*" (George & Bock, 2011, p. 99)	Organizational structures: • Transactive structure to determine key transactions with partners and stakeholders and thus the business model's openness • Resource structure of the static architecture of the firm's organization and core resources leveraged to serve customers • Value structure as the system of rules and mechanisms to determine the focal firm's value creation and capture activities	• Factual information from companies' promotional documents and websites indicating relevant pricing structures and terms of lease • Information from press releases: − establishment of new national or international partnerships − number of cities and countries where offering was made available and differences between cities regarding technologies − amount of registered customers − number of cars in the respective systems • Interviewees' descriptions of their business model, its role for a successful carsharing venture, detailed depictions of the resource/transactive/value structure as well as drivers and challenges of the business models' design
Organizational Environment "*Environments affect organizations through the process of making available or withholding resources, and organizational forms can be ranked in terms of their efficacy in obtaining resources.*" (Aldrich, 1979, p. 61).	The environment has the potential to affect the core components of the business model (Demil & Lecoqu, 2010)	• Factual information from press releases describing novel opportunities through changes in demand for new mobility concepts, competitive activities, and extra-industry conditions such as local city support • Interviewees' descriptions regarding their perception of the actual market situation, positive and negative influential factors, the role of competition, and the required number of customers to reach profitability
Corporate Strategy "*Strategy refers to the determination of the basic long-term goals and objectives of an enterprise, and the adoption of courses of action and the allocation of resources necessary for carrying out these goals*" (Chandler, 1962, p. 13)	Strategy entails designing business models to allow the organization to reach its goals. Business models are reflections of the realized strategy. (Casadesus-Masanell & Ricart, 2010, p. 204)	• Factual information from press releases describing the new business models role in shaping the future of urban mobility and their location in the corporate settings • Interviewees' descriptions of strategic tasks and challenges as well as business model design activities and identification of relevant alternatives to the current models
Technological Innovation Technological innovations can comprise new developments in products, services and processes (Damanpour and Evan, 1984)	A business model mediates between the technological resource potential and firm's economic value creation through customers and markets (Chesbrough & Rosenbloom, 2002)	• Factual information from the press releases, company publications, and corporate websites regarding the role of 'external' technological developments such as mobile internet and 'internal' developments such as telematics and other relevant car technologies. • Interviewees' description of technology importance for business model development
Discovery-Driven Principles "*Discovery-driven planning systematically converts assumptions into knowledge as a strategic venture unfolds*" (McGrath & MacMillan, 1995, p.3)	Firms need to follow discovery-driven principles like experimentation, effectuation and trial-and-error learning for a successful creation of new business models under high-uncertainty conditions (Thompson & MacMillan, 2010).	• Factual information from the press releases characterizing the first attempts of customer integration and subsequent changes to the models such as pricing • Interviewees description of changes to the initial business model idea during its development, on how the firms generated insights into the need for change, as well as the resources made available to them during development

Situated between the traditional firm and network perspectives (Zott, Amit, & Massa, 2011), the business model includes all of the relevant players – partners, customers, and other stakeholders – in the company's value network (Chesbrough & Rosenbloom, 2002). Such an openness towards external parties may improve value creation and capture by using an organization's own key assets in combination with that of other firms (Chesbrough, 2007). Such partnerships can result in business models that expand a product or service innovation's output, reduce R&D expenses, and access markets that were previously out of reach (Chesbrough & Schwartz, 2007; Chesbrough, 2003).

A business model's inherent openness becomes even clearer through its constituent elements: transactive, value, and resource structure (George & Bock, 2011). The transactive structure of a business model refers to the "organizational configuration that determines key transactions with partners and stakeholders" (George & Bock, 2011, p. 99). It thus defines elementary interfaces between the focal firm and external actors in the value network, serving as the basis for a business model's openness towards the environment. The value structure represents "the system of rules, expectations, and mechanisms that determine a firm's value creation and capture" (George & Bock, 2011, p. 99). A business model's resource structure is characterized as a "static architecture of the firm's organization, production technology, and core resources leveraged to serve customers" (George & Bock, 2011, p. 99). These three organizational structures need to be designed in order to create a viable business model.

Second, the *organizational environment* is of major importance for the feasibility of a new business model as well as for its actual design process. Generally, a firm depends on its environment through whether or not it allows the firm to access necessary resources, which has implications on its performance in comparison to other firms (Aldrich, 1979). The adaption of an initial business model due to the presence of challenging environmental conditions is the key to the survival of new ventures or new business units (Andries & Debackere, 2007).

Externalities set the boundaries of how firms can create, develop, or replicate their business model over time (Sosna et al., 2010). The organizational environment has the power to influence all of a business model's elements, ranging from costs and availability of resources over the characteristics of the value chain towards even changing the inherent value of the offered products and services (Demil & Lecocq, 2010). While the resource-based definition of firm environment is rather broad, the term may include other important concepts. Accordingly, business models have to be designed around the realization and exploitation of market opportunities (Amit & Zott, 2001; George & Bock, 2011) and the competitive activities of other players in the market (Alessandri & Bettis, 2003). A new and successful business model itself is not enough to ensure competitive advantage because its main elements are often transparent and easily imitable once it is implemented (Teece, 2010).

Third, *corporate strategy* actively determines a company's business model as it defines the long term vision and potential actions on how to react to potential scenarios, e.g. different market developments or arising technological opportunities. At its basic core, strategy represents a "*determination of the basic long term goals and objectives of an enterprise, and the adoption of courses of action and the allocation of resources necessary for carrying out these goals*" (Chandler, 1962, p. 13). It entails designing and choosing business models in a competitive struggle between various conceivable business model alternatives to ensure an organization's competitiveness (Bonaccorsi, Giannangeli, & Rossi, 2006). In essence, a business model is a reflection of a realized strategy (Casadesus-Masanell & Ricart, 2010).

Fourth, *technological innovations* may influence the business model in its ultimate role of value creation and capture (Grönlund, Sjödin, & Frishammar, 2010). While it can comprise new developments in products, services, and processes (Damanpour & Evan, 1984), technological resource potential serves as input for the business model, which converts it into economic value by tailoring an offer for customers in the most effective way (Chesbrough &

Rosenbloom, 2002). New technology can initiate changes in a firm's business model (Calia, Guerrini, & Moura, 2007) and consequently represents a central driver of innovation.

Fifth and finally, firms need to follow *discovery-driven principles* like experimentation and trial-and-error learning for a successful design of new business models under high-uncertainty conditions (Thompson & MacMillan, 2010). While there are two basic approaches towards new venture creation, often referred to causation ('follow a strict plan') and effectuation ('experiment and learn on the go') (Sarasvathy, 2001), discovery-driven principles clearly belong to the latter. At their basic core, they rely on a systematic conversion of assumptions into new knowledge as a venture evolves (McGrath & MacMillan, 1995). While experimentation is essential for successful business model innovation (Sosna et al., 2010), there are a number of implications for the actual design process: experimentation takes place within and across firms, business model evolution is highly path dependent, and it is hardly possible to know in advance which design will win (McGrath, 2010).

Prior research suggests that business model innovation occurs throughout multiple stages (Sosna et al., 2010; Thompson & MacMillan, 2010; Winter & Szulanski, 2001; Yunus et al., 2010). Initially, companies gather insights into unmet customer needs, followed by multiple steps to gain clarity on how a suitable business model can fulfill these needs (Chatterjee, 2005). However, market-driving firms face a situation in which there are no existing customers at the outset. Existing approaches are not applicable to such a setting. New solutions are needed. Consequently, for the following analysis, I adopt the idea of several stages to analyze the process of creating a market-driving, new business model.

METHOD AND SETTING

Case study research was selected for a number of reasons. First, the process of business model innovation and the potential interdependencies of the resulting structures are highly

complex (Chatterjee, 2005; George & Bock, 2011; Sosna et al., 2010), offering a great opportunity to gain deeper insights. Second, knowledge on business models and their working mechanisms is rather limited (Zott et al., 2011) and highly dependent on the industry (Casadesus-Masanell & Llanes, 2011). The real-life circumstances of the selected cases could better be considered (Yin, 1994) because qualitative research can address the need for local contextualization (Miles & Huberman, 1994). Third, the nascent stage of prior research calls for explorative instead of confirmative data analysis (Edmondson & McManus, 2007).

This study is geared towards prior methodological publications on how to conduct case study research (Eisenhardt, 1989; Yin, 1994) as well as recent qualitative empirical literature analyzing innovative processes and related actions (Ambos & Birkinshaw, 2010; Kurkkio, Frishammar, & Lichtenthaler, 2011; Lehoux, Daudelin, Williams-Jones, Denis, & Longo, 2014). These process-oriented approaches offer an ideal foundation to study dynamic organizational activities over time (Ferlie, Fitzgerald, Wood, & Hawkins, 2005). Multiple cases were selected as the basis for this study, because they lead to comparative data that can generate more generalizable theoretical findings than single cases (Yin, 1994).

Case selection

For this article, I conducted a case study of the carsharing business models of two German automotive OEMs and their internal and external strategic partners: Daimler (‘Car2Go’) and Volkswagen Group (‘Quicar’). The choice of cases was based on the following theoretical considerations (Eisenhardt, 1989), which make the selected automotive firms particularly relevant for studying business model innovation. First, they represent radically new business models that are likely to change the nature of an entire industry. The analysis two of the three largest automotive OEMs in the world (forbes.com, 2012) additionally assures the findings’ relevance. Second, all of the chosen business models were in an early stage of creation and implementation, and thus offer ideal opportunities for scientific analysis of the business model

innovation process. Third, besides the fact that the selected firms are situated in the same country and industry and thus offer high potential for comparability, they were chosen because of their different business model approaches: free-floating versus station-based (See Table 2). Both approaches offer the basic value of carsharing, where in a free-floating model cars can be parked wherever free parking space is available after a trip. In a station-based approach, cars have to be returned to the starting position to end a trip. The two core approaches have several important implications for the resulting business models, as the following analyses will show.

Table 2: Overview of OEM carsharing business models; Sources: company websites and promotional documents

	OEM carsharing business model	
	Car2Go (www.car2go.com)	**Quicar** (www.quicar.de)
Provider	At the end of 2011, the European part of Car2Go entered into a joint venture with the car rental company Europcar: Car2Go Europe responsible for the European operations. Car2Go holds 75% and Europcar 25% of this new venture. Car2Go remains a 100% subsidiary of Daimler for all non-European operations.	To create and implement this concept, three areas of the Volkswagen Group joined forces: Volkswagen Financial Services, Volkswagen Fleet International, and the Volkswagen Brand. Responsibility for the project is taken mostly by Volkswagen Leasing GmbH in Braunschweig, Germany, a 100% subsidiary of Volkswagen Financial Services AG.
Core	Free-floating: Vehicles are located throughout urban areas and can be parked wherever free parking space is available. Position finding via smartphone or internet.	Station-based: Fetching and returning vehicles from fixed stations throughout urban areas. Locations and availability via smartphone or internet.
Cities	Canada: Calgary, Toronto, Vancouver; U.S.: Austin, Miami, Portland, San Diego, Washington D.C.; Netherlands: Amsterdam; Austria: Vienna; Germany: Berlin, Cologne, Dusseldorf, Hamburg, Ulm, Stuttgart.	Germany: Hannover.
Vehicles	Smart fortwo Car2Go Edition (2 Seats), fuel engine or electric drive.	Golf BlueMotion (5 Seats) + Quicar Plus: A Selection of Volkswagen Vehicles, e.g. convertibles, transporters, etc.
Number of vehicles	> 5 700	200
Number of stations	-	50
Pricing (exemplarily, depending on location)	Austin, TX, U.S.: Registration: $35.00 + tax Per minute: $0.35 + tax Per hour maximum: $12.99 + tax Per day maximum: $65.99 + tax Per mile after 150 miles per rental: $0.45 + tax Includes the costs of fuel, parking, service, insurance, maintenance, mileage, etc. with no security deposits, monthly fees, or reservation charges.	Hannover, Germany: Registration: $30.00 incl. tax ($18 for students aged 18 to 30) Driving: First 30 minutes $7.00 incl. tax, then $0.25 incl. tax per minute Parking: $0.12 incl. tax per minute Includes the costs of fuel, service, insurance, maintenance, mileage, etc. with no security deposits, monthly fees, or reservation charges.

The first case is Car2Go, founded in 2008 by Daimler AG in Ulm, Germany, and Austin, Texas, U.S. (20081021_Daimler_19). It was the first carsharing concept launched by an automotive OEM in Germany. Car2Go applies a free-floating approach to carsharing, where cars are freely arranged on any available parking spots throughout a predefined area in a city. Customers can enter a free vehicle wherever they encounter one, start their voyage at point A and leave the car at destination B. The second case is Volkswagen with its project Quicar, which was started in Hannover, Germany in late 2011 (20111102_VW_2). Quicar chose a station-based approach to carsharing, where cars are only available at fixed stations throughout a city. Cars have to be returned to the original station A after each trip.

Data collection

The primary data source comprises in-depth semi-structured interviews (n = 6) with top-level and middle-level managers of the newly created ventures, the OEMs, and their strategic partners to specifically address the research question (See Table 3). Five interviews were conducted face-to-face on site with the managers of the respective ventures. One interview was conducted by telephone due to the schedule and timely availability of one interviewee. A chain sampling approach was thereby employed to identify key informants responsible for the business model innovations (Miles & Huberman, 1994). Such a chain sampling approach "identifies informants of interest from people who know people who know what informants are information rich" (Miles & Huberman, 1994, p. 28). This sampling procedure led to varying hierarchical levels between the respondents, which positively affects a broader perspective on the complex business model design activities and also helps to minimize respondent bias (Eisenhardt & Graebner, 2007).

An interview guideline was generated to predefine the semi-structure of the interviews. It was developed based on prior literature on the business model concept, business model innovation, as well as potential antecedents and consequences (please see Study 1 of this

dissertation for further details). The order of the questions was slightly adapted when needed due to the exploratory nature of the interviews. The interviews were conducted between November 2011 and January 2012 and lasted between 60 and 90 minutes. They were recorded and fully transcribed (Yin, 1994). In order to complement the insights from the interviews and to secure their validity, secondary data was used for Car2Go and Quicar from: (1) corporate websites (*n* = 2; 1+1), press releases (n = 30; 19+11) and promotional documents (*n* = 3; 2+1) until June 2012. This allowed for empirical triangulation of the study's findings.

Table 3: Interview respondents and positions

Case	Position of Interviewee at the time of the interview	Company	Interview Code
Car2Go	Chief Marketing Officer	Car2Go GmbH (Daimler AG)	Interview_C2G_1
	Chief Executive Officer	Car2Go GmbH (Daimler AG)	Interview_C2G_2
	Director Strategy & Business Development; Project Leader Car2Go	EUROPCAR Autovermietung GmbH	Interview_C2G_3
Quicar	Head of Mobility Concepts; Project Leader Quicar	Volkswagen AG	Interview_QC_1
	Head of Brand management; Project Manager Carsharing	Volkswagen AG	Interview_QC_2
	Head of Mobility Concepts	Volkswagen Financial Services GmbH	Interview_QC_3

Data analysis

The first step in the data analysis was to look at each case individually based on the interviews and the secondary data (Yin, 1994). The examination was based on a spreadsheet, into which each interview was transferred according to thematically related questions of the interview guideline (Miles & Huberman, 1994). The main unit of analysis was the business model following Zott et al. (2011), because it is highly appropriate for the given purposes as it covers the focal firms, their partners, collaborators, and competitors. While the business model itself was the main unit of analysis, the activities and goals driving the business model innovation process at the firm level emerged as an embedded unit of analysis (Yin, 1994).

The individual case analysis was geared towards how the companies went about the creation of a new business model. Unique patterns for each case were the result. They were then used to code and thematically reorganize the interview data. The different sets of codes address the antecedents of business model innovation, the process steps, the goals of each step, as well as the value, resource, and transactive structure of the resulting business model. The initial coding scheme was further detailed during the analysis. The second step consisted of cross-case analysis to identify common themes based on the patterns of the individual case analysis (Yin, 1994). This included a comparison of the cases for within-group similarities and intergroup differences in order to go beyond initial impressions and capture new findings from the data (Eisenhardt, 1989). A search for causal relationships between the constructs was part of the assessment (Miles & Huberman, 1994), which was based on recurrent analysis of the interviews, the theoretical framework and the secondary data.

Following Yin (1994) several steps have been undertaken to secure the results' validity and reliability. First, in order to strengthen internal validity, a systematic analytical framework was developed based on prior research (see Table 1). It was extensively discussed with scholars active in the area of business model and automotive related industries. Second, to secure construct validity, the interview data was triangulated with secondary information from multiple sources wherever possible (see Tables 1 + 2 for details on the data sources used). Additionally, an early version of the analytical results was send out to the respondents for validation. Key findings could thus be clearly related to the original research question and the relevant information in the data (Yin, 1994). Third, external validity was improved based on the use of multiple cases (Eisenhardt & Graebner, 2007). Fourth, to increase reliability, case study protocols based on the different data sources were generated to facilitate future replication (Yin, 1994). Ultimately, the most knowledgeable respondents from different backgrounds were selected, e.g. engineers and marketing managers, in order limit potential biases in the data

collection process. In the following, the findings of these analyses will be presented, starting with the strategic motives of the two firms to engage in business model innovation followed by the process steps that they subsequently undertook.

FINDINGS

The cases of Car2Go and Quicar

Free-floating versus station-based carsharing are two very different business model approaches, with effects on their overall design. However, from a financial perspective, the value offered to the customer is qualitatively consistent between the two providers: Consumers only pay for every minute they use a vehicle and the costs for gas/electricity, parking, and insurance are included (company websites). Besides economic value creation, the firms expect additional forms of value from their undertakings with these new business models: organizational learning from business model experiments and the openness towards customers and partners (Interview_QC_1, Interview_C2G_1), positive spillover effects to the OEM brands (Interview_QC_1, Interview_QC_3, Interview_C2G_2, Interview_C2G_2), societal value in form of lower emissions, fewer cars in total, and major noise reductions if the cars are electrically-driven (Interview_QC_2, 20100920_Daimler_14).

Strategic drivers of new business model creation

Until the late 1980s, from the perspective of an OEM, the traditional automotive business consisted of developing, producing, and distributing vehicles in larger batches to their area retailers and sales partners, which then sell the cars one by one to the end customers (Interview_QC_1, Interview_QC_2, Interview_C2G_2). There where various drivers for Daimler and Volkswagen to broaden their original businesses. “The question of where the value chain of an automotive manufacturer starts and where it ends has moved massively in recent years” (Interview_QC_2). Based on this core business, several services evolved for providing

leasing and financing offers to customers, and these additional services already contribute a considerable share of the OEMs' annual profits (Interview_QC_2). Such options have lowered the entry barriers for customers towards owning a car, compared to the relatively high initial investment of buying a car. However, from a customer perspective, the cost and complexity of car ownership remain high (Interview_QC_1, Interview_C2G_1).

The shifting value chain and the high ownership cost are accompanied by a number of recent societal developments. The way people live, where they live, and how they want to be mobile are changing drastically. Large megacities worldwide grow in size, and the city councils continuously seek to reduce the limits of CO2 emissions in these areas (Interview_QC_2). For executives, the question was whether it would still be possible for their customers to enter a city center with Daimler or Volkswagen vehicles (20081021_Daimler_19, Interview_C2G_2, Interview_QC_1). The OEMs were both actively looking for new ways to meet these diverse challenges and to exploit the resultant opportunities outside their core business of automobile production and sales (Interview_QC_3, Interview_C2G_2, 20111102_VW_2).

Exemplarily, at Daimler, the idea of freely arranging a high number of vehicles available for rental in city centers has existed since the early days of the Smart brand in the mid-1990s. Back then, however, the required technologies to realize it did not exist, such as mobile Internet (Interview_C2G_2). In a more recent attempt to analyze various potential mobility-related business concepts in 2007/08, Daimler's Business Innovation division had the required technological developments at hand to create such a revolutionary business model (Interview_C2G_1). They realized that the existing carsharing providers – mainly socially oriented associations with idealistic visions but without profit in mind – were still engaging in a niche market (Interview_C2G_2). The potential market volume had the right dimensions for them to generate a significant and profitable business model (Interview_C2G_1). Especially as an OEM, they were forced to offer the right concepts able to secure their market position in the

future (Interview_C2G_1, 20111128_Daimler_3). This was the first step by a German OEM from an automobile market to a market of (individual) mobility. Volkswagen also faced the task of having to create the market in the first place, with no initially existing demand from local customers (Interview_QC_2).

Business model innovation

Based on the analysis of the two cases in order to answer the initial research question, the business model innovation process of market-driving firms can be classified into three stages. In the first stage, a vision of the new-to-the-world business model and a functioning prototype of the offering are built. The second stage centers on experiments and the integration of newly acquired customers into the innovation process. The third stage focuses on the implementation and upscaling of the refined business model.

First stage: Vision and prototype

The idea of carsharing at Daimler was born from a discussion by a small group of Business Innovation employees about future mobility in urban areas (Interview_C2G_1). Their approach to resolving the question of how they could facilitate 24/7 use of a vehicle without the associated complexity was fairly technology-driven (Interview_C2G_1). Their first activity involved coming up with the idea to employ automated systems and payment per minutes of use to enable the availability of a large amount of self-organized cars within a city. “It was the business model that we had in mind” (Interview_C2G_1). At this point, they defined the model’s core, the free-floating approach (Interview_C2G_2). For the further development, the executives at Car2Go could only rely on their own imagination, driven by two questions: what might attract a customer and what could be commercially successful (Interview_C2G_1). “Back in 2007, there was nothing comparable to our offering, so it was very difficult, much like flying blind” (Interview_C2G_2).

The Car2Go blueprint consisted of propositions about a first value chain, a target customer segment, customers' willingness to pay, suitable pricing, a potential cost structure, and a unique selling point in the face of other means of transportation (Interview_C2G_1). The team also sought to anticipate the required technical components and necessary investments (Interview_C2G_1). The Car2Go blueprint had to be presented to a committee of various executives and innovation specialists of Daimler AG's Business Innovation division (Interview_C2G_1, 20100325_Daimler_16). For the blueprint to be approved, the Car2Go team had to include calculations showing the business model's potential value capture: "At the end of the day, money has to be earned. But the real perspective of the customer and the wish for a maximum solution drove us" (Interview_C2G_2). As a major learning for the early Car2Go team, the right distance between the potential new business area and the organization's core business proved to be crucially important to get approval and funding from the parent company. The new idea must be close enough to make use of existing competences in order to generate an advantageous position compared to an external competitor. At the same time, the new model must be sufficiently far from the organization's core business to avoid revenue cannibalization (Interview_C2G_1).

With the necessary approval, it took a small team of employees approximately six months to develop a viable prototype to be able to test the concept in reality (Interview_C2G_1). To build the prototype at minimum cost and time, they bought the technical components from different suppliers, partly reprogrammed available software and installed the parts in a first set of 100 cars. In October 2008, they launched the prototype in the city of Ulm in Germany, a Daimler development center, to be used only by the location's 700-1,000 employees (Interview_C2G_2, 20090326_Daimler_18, 20081021_Daimler_19). The prototype was explicitly not offered to the public, because of the early state of the software and the system's operation (Interview_C2G_2, 20090713_Daimler_17).

The business model creation procedure for Quicar at Volkswagen shows many similarities but also some differences with that of Daimler. Due to the later start in 2011, the Volkswagen managers were able to analyze existing carsharing providers, for instance other OEMs (e.g. Daimler), startups (e.g. Zipcar), and car rental companies (Interview_QC_3). The final decision to build their own offering was based on these analyses and the finding that while existing players were doing many things right, they were also leaving enough room for improvement (Interview_QC_2). Volkswagens clear objective for the carsharing business model was to make it an economic success (Interview_QC_1, Interview_QC_2).

Based on prior experience and available information from their corporate research divisions, the concept's potential drivers of financial success were identified, especially vehicle utilization (Interview_QC_2). The managers figured that a station-based system would be best suited to reach high degrees of utilization (Interview_QC_3). Consequently, they defined the future business model's core and estimated the number of cars, stations, and customers needed to reach the required utilization rate (Interview_QC_3). Further, a first pricing model was derived by estimating the potential costs of reconfiguring the cars, running the system, paying for promotion, etc. (Interview_QC_1). To further develop the details of the business model blueprint, service design methods were applied (e.g., scenarios) early in the project and tried out with specific potentially relevant test persons (Interview_QC_2).

Regarding the technical developments necessary for a Quicar prototype, Volkswagen followed a different approach to Daimler. It sought to develop all the required technology in-house, both hardware and software (Interview_QC_3, 20110512_VW_4). The executives felt that with this approach, they could get a deeper access to the relevant business model elements, even if it implied a higher complexity (Interview_QC_2). Volkswagen not only had to deal with more in-house production depth, but also with the mindset of their engineers. The goal for them was to develop a technical solution for customer service needs that will actually not be realized

as a technology by the users. “That was a world revolution to my engineers” (Interview_QC_2). Because it is much shorter than a car’s development time, the speed of initiation of the carsharing business model added further complexity (Interview_QC_3).

Despite some differences between the two cases, the overall goal of the first stage of business model innovation for both firms was to initiate a new vision and to prove its basic functionality. Various activities facilitated this endeavor, such as defining the core of the new business model, creating a detailed blueprint, and constructing a full-scale prototype after approval by the parent organization (See Table 4).

Table 4: First stage activities and representative quotes

First Stage: Vision and prototype		
Case	**Key Activities**	**Representative quotes**
Car2Go	**Idea and vision building**	*[The idea of] Car2Go has come about as I was sitting with colleagues and we were considering how mobility in urban will look like in the future. We considered ourselves: what is with people who actually want to drive without having a car (Interview_C2G_2)*
	Definition of the core approach to the customer	*We tried to define the whole thing with the eye of the customer. If I would be the customer, what would I ask for? I would like to buy mobility only when I really need it. (Interview_C2G_1)*
	First **detailed blueprint**	*We considered this [the business model] from the first minute on in 2007 with our initial idea and tried to write it down as detailed as possible (Interview_C2G_2)*
	Approval by top-level management	*[The new business model] must be close enough to your company to take advantage of its core competencies in order to improve your position compared to some external firm trying to build such a model. But [the new business model] has to be so far away that it does not interfere with its core business (Interview_C2G_2)*
	Development of a full-scale prototype	*And then within 6 months we have externally purchased some kind of car sharing components and reprogrammed or redesigned a few pieces of hardware. It looked really quite crazy back then, seven different hardware devices wired wildly together under the dashboard. (Interview_C2G_2)*
Quicar	**Idea and vision building**	*For us, the business model already played a role for the development of the service (Interview_QC_3)*
	Definition of the core approach to the customer	*Since there were no carsharing users, we could not ask them about their needs. You simply can’t query this step (Interview_QC_2)*
	First **detailed blueprint**	*We also rely a lot on our own research context. We have employed our corporate research with things like trend research, research on mobility, etc. Also, we worked together with various agencies to gain more of this service-oriented logic (Interview_QC_2)*
	Approval by top-level management	*In any case, right from the outset, the announcement was the thing [the new business model]must be profitable (Interview_QC_1)*
	Development of a full-scale prototype	*At a certain point, we have also tested the pricing model. You have to tell the customer how much the whole thing will ultimately cost, so he knows about the basic factors of the offering (Interview_QC_1)*

Second stage: Experimentation and customer integration

Five months after the first test of the prototype, in March 2009, it was scaled to 200 cars and opened up to the population of the city of Ulm (Interview_C2G_2, 20100325_Daimler_16). In the same year, Car2Go also took the prototype to Austin, Texas to gain experiences in another potential target market (Interview_C2G_2, 20090326_Daimler_18). The executives say that the findings from the prototype had not led to changes in the offering core – a minute-based, free-floating model. They are convinced that, to be authentic, a business model's core components should not be changed regularly (Interview_C2G_1). But other, more detailed attributes of the business model, for instance, pricing, customer processes, and technological components (Interview_C2G_1, 20090713_Daimler_17, 20100325_Daimler_16, 20111122_Daimler_4) are regularly updated from Car2Go's headquarters in Ulm to make the offering more attractive (Interview_C2G_2, 20110310_Daimler_13). There is one advantage to carsharing being a locally offered service: a company can deploy different variations of the same basic service in different locations. Daimler continues to use Ulm to constantly experiment with new technological features and changes to the business model (20081021_Daimler_19). Continuous learning unburdens Ulm from the pressure to be profitable: "You can't have both, playfully try out new things and at the same time strictly control for costs" (Interview_C2G_2).

By publicly introducing Car2Go, Daimler began to include insights from its newly acquired customers into the further refinement of the business model. Since then, Car2Go's executives have sought to make the company transparent to the outside world (Interview_C2G_1). This includes broad social media activity (e.g., on Twitter and Facebook), which has become Car2Go's most important channel for improvements (Interview_C2G_2). In Ulm, Car2Go invites customers to focus group meetings to informally discuss recent topics, such as whether electric mobility will be the future for Car2Go.

Table 5: Second stage activities and representative quotes

Second Stage: Experimentation and customer integration		
Case	**Key Activities**	**Representative quotes**
Car2Go	**Introduction of the business model to the public**	*We started in October 2008 in Ulm with 50 vehicles and solely the employees which were about 700 people at this location. Because that was very successful, we decided to test it with the overall population of Ulm. That was in March 2009, i.e. 6 months after the launch here with our own employees. Then we went to Austin, but that was still seen as the a pilot (Interview_C2G_1)*
	Acquisition of first set of customers	*Car2Go has contributed decisively, if we were not even at all those who have made sure that we [carsharing] are out of this niche (Interview_C2G_1)*
	Strong customer integration	*We employ a very sophisticated way of asking our customers about their satisfaction, depending on the duration of their membership and usage patterns. This provides an enormous enrichment to our products and services (Interview_C2G_1)*
	Web 2.0 and social media activity	*This whole online lifestyle that just interlocks with this business model (Interview_C2G_2)*
	Open experimentation with the business model	*You can't have both, playfully try out new things and at the same time strictly control for costs (Interview_C2G_1).*
	Changes to the business model details	*And we do not want to change that because we feel that it is really harmonious. In order to be authentic, you can't change your core components all the time (Interview_C2G_2)*
Quicar	**Introduction of the business model to the public**	*We have set up a business case and have said that if we do something like Quicar in Hanover with 200 cars, then we want to at least have an idea of how we can bring such a thing to an economic success at a later point in time (Interview_QC_3)*
	Acquisition of first set of customers	*Our task was at first to create the market. So there is no expressed demand by the customer for this product, there are no customers saying Volkswagen go do something in this area. On the other side, if you have such an offer, you can see very quickly that the customers are willing to engage in it. (Interview_QC_2)*
	Strong customer integration	*Open innovation is indeed great, but if the team in the end says that it prefers its own approach over the customers', then it will not work out. So you need to have the openness in the team to then also implement these 'open innovations' (Interview_QC_1)*
	Web 2.0 and social media activity	*We also have a lead user concept, from which we expect good insights. If, for example, you looks into our Facebook profile, you can see that we have many dedicated users that are really having fun bringing in new stations and ideas (Interview_QC_2)*
	Open experimentation with the business model	*The good thing is that if we do something where we misunderstood our customers and it does not yield the intended effect, we can simply change it back, that's trial-and-error (Interview_QC_3)*
	Changes to the business model details	*We do not plan fundamental changes at the moment. But we think of the many little changes, for example, reduce the complexity for the customer (Interview_QC_1)*

All this input is prioritized and regularly discussed (Interview_C2G_1, Interview_C2G_2). The focus at Car2Go goes beyond the integration of customers towards a firm with open boundaries (Interview_C2G_1). In the first stage of the innovation process, Car2Go defined the core of its business model. In the second stage, this definition of Car2Go's core activities was explicitly substantiated: the core system of Car2Go's rental processes, the

integration of the cars' technology, and Car2Go's brand essence (Interview_C2G_1). To open the boundaries, interfaces are offered to anybody wanting to take over adjacent, noncore activities, for instance the development of a smartphone application. Car2Go wants to create a synergetic ecosystem of users, developers, suppliers, and other mobility providers (Interview_C2G_1).

In its pilot stage in the first relevant local market, the city of Hannover (20111102_VW_2), Volkswagen also did not plan changes to the core of its business model, but strongly engaged in experiments regarding the details, such as pricing and reducing the complexity for customers (Interview_QC_1). To ensure that the pilot project functioned properly, the Quicar team started off with extra capacity, especially regarding costs (Interview_QC_3). During this stage, they sought to optimize their operational processes (Interview_QC_1). The Quicar team also underwent intensive learning about the technological requirements of carsharing, including continuous testing of their newly developed rental software (Interview_QC_3). Regarding hardware, Volkswagen had been in the dark about many components such as telematics. Functional questions had to be resolved, comprising basic issues such as how customers can enter a car without a key – a normal day-to-day task for a car owner but very different for carsharing users (Interview_QC_2).

The Quicar team strongly integrated its customers to improve these elementary aspects. Various sources, including classic market research and customer surveys, are tapped to learn from their users' experiences (Interview_QC_1). Volkswagen put in place a lead user concept (Interview_QC_1) and coupled it with intense social media activity in blogs and networks such as Twitter and Facebook (Interview_QC_2). Quicar used these Web 2.0 tools to build an open innovation platform where people can exchange their experiences and actively engage in discussions with Quicar employees (Interview_QC_2). Supporters are regularly invited to lead user workshops, where insights are verified and further developed into business model or

service improvements (Interview_QC_1). In weekly quality circle meetings, the Quicar team discusses and decides on the most important customer insights, which are then instantly retested during the pilot to check their effects (Interview_QC_1). The team engages in an iterative trial-and-error process: if implemented actions (e.g., relocation of a station) do not yield the intended effect, they are simply undone (Interview_QC_3).

A comparison of the two cases shows that the overall goal of the business model's second innovation stage is to further refine the initial blueprint to reach the efficiency necessary for implementation and upscaling. Crucial activities are the acquisition and integration of a first lead user set and open experimentation with the business model to improve its constituent elements while leaving the core unchanged (See Table 5).

Third stage: Implementation and upscaling

During the third stage, Car2Go engaged in an exclusive strategic partnership with the car rental company Europcar for its European operations (Interview_C2G_1). Car2Go executives say that Europcar helped them to be faster and more effective with their business model's rollout strategy (Interview_C2G_2). The experience of Car2Go's executives is that the more cities are covered by the service, the faster other cities realize that carsharing may also be beneficial for them (Interview_C2G_2, 20081021_Daimler_19). These snowball effects positively influence the new market, speed up future business model implementation, and increase the likelihood of market success (Interview_C2G_2, Interview_C2G_1).

Car2Go faces a number of challenges to its rapid, large-scale international implementation. First, there are certain barriers in every new city. For instance, there was no local team in place, no relationships, a foreign language, and unknown traffic flows in the various districts (Interview_C2G_1). Europcar owns a network of offices in many European cities (Interview_C2G_3, 20111020_Daimler_8). It offered Car2Go the opportunity to access

this existing infrastructure, including the know-how of Europcar's employees (Interview_C2G_1) and to overcome many major barriers more easily. Second, Car2Go had to develop expertise in how to implement the business model, for instance about a district's size, how many vehicles were necessary for this area, how many customers could be reached, etc. Know-how was also necessary in the technical part of the implementation process (Interview_C2G_2). Today, there is a routine procedure following steps such as ordering the vehicles, equipping them with the necessary telematics and software, checking the signal strength in the various locations, and defining a business district (Interview_C2G_2). Car2Go put in place a task force (Interview_C2G_2) that in 2012 implemented the business model in 12 cities (Interview_C2G_1) – a rollout speed of one city per month.

Third, the Car2Go experience shows that a high implementation speed can challenge task coordination in strategic partnerships, e.g. with Europcar. Compromises had to be made in order to secure a well-functioning service, until the operations in a local market had become a routine (Interview_C2G_2). Fourth, potential customers had to be made aware of carsharing's functionality and benefits. People had reservations about the new service, simply because they did not know how to use it (Interview_C2G_2). In Hamburg, for example, the ramp-up phase was fairly slow, because carsharing was completely new to the city. In Vancouver, in contrast, it was already somewhat established and people were quick to realize the benefits of Car2Go's new offering compared to existing providers (Interview_C2G_2). Car2Go perceived some sort of competition from a preexistent provider in a new local market as an advantage. Customers had already internalized the general workings of carsharing and could focus on the new features (Interview_C2G_2). Fifth, Car2Go also learned that people needed to experience a sense of knowing that the new concept was there to stay. Only then did they begin to change their mobility behavior and to use Car2Go.

Since Quicar is still in the pilot stage of its business model development, its executives did not expand the business model to cities other than Hannover at this stage. However, this is their clear strategic objective for the future and the primary reason why they developed the business model (Interview_QC_2). Their goal for the pilot was to determine a blueprint that shows how to lead this offering towards economic success at a later stage (Interview_QC_3). The market situation at the time of the interviews was characterized by emerging competition in the biggest cities with the largest potential for carsharing worldwide (20100325_Daimler_16). First-mover advantages play a major role, such as securing parking space and being first in the customers' perception (Interview_QC_1, Interview_QC_3).

Table 6: Third stage activities and representative quotes

Third Stage: Implementation and upscaling		
Case	**Key Activities**	**Representative quotes**
Car2Go	**Engagement in strategic partnerships**	*At Europcar, among others, has played a role, that we want to expand quickly and want to go to many cities in Europe of which we have no idea, do not have a team in place, do not speak the language, do not know the city, have any relationships, and do not know each district and traffic (Interview_C2G_2)*
	Revision of the value chain	*The partnership has actually influenced the decision which parts of the value chain we want to do ourselves at the end. This has been essential for us (Interview_C2G_2)*
	Protection of the business model's functioning	*Indeed, in practice, we have not even implemented it as originally planned, because we have simply not gotten as far in the cooperation and our demands on [rollout] speed also do not make it possible for us at the moment (Interview_C2G_1)*
	Further openness of the business model	*You have to make your company transparent to the outside world (Interview_C2G_1)*
Quicar	**Engagement in strategic partnerships**	*Everything a car rental company can, we can buy. The car rental companies have outsourced a lot, too. We use some of the same services as established car rental companies. With Quicar, ultimately two areas cooperate, the Volkswagen brand and the Financial Services (Interview_QC_1)*
	Revision of the value chain	*We have partners in software development. We have at in the operative business on site partners for specific tasks like for example handling of vehicles, etc. (Interview_QC_2)*
	Protection of the business model's functioning	*But in the future, strategically, the vehicle aspect [of the business model] is driven by the auto part [Volkswagen Brand] and the whole issue of operational implementation is then taken on a more operational level of the service part [Volkswagen Financial Services] (Interview_QC_1)*
	Further openness of the business model	*I do not think that we will make the overall carsharing business without further collaborations in the future (Interview_QC_2)*

While the third stage findings concentrate on the case of Car2Go, it becomes clear that the overall goal of stage three of business model innovation is to rapidly upscale the refined business model on an international basis to benefit from first-mover advantages in key markets.

Elementary activities to achieve this goal are the engagement in strategic partnerships to overcome the barriers to upscaling of the business model and to further open the boundaries so as to increasingly involve external partners (see Table 6).

The emerging business model of OEM carsharing

The openness of the business model innovation process also becomes apparent in the transactive, value, and resource structure of the emerging business models (see Table 7). The *transactive structure* holds a central position. It depicts the relationships with external players and thus determines the focal firm's core business model activities. In the case of Car2Go and Europcar, a partnership seemed beneficial because of the following effects. First, Europcar and Car2Go mutually complement their service offerings (Interview_C2G_2, 20110722_Daimler_11). Car2Go customers gain access to a large variety of different vehicles, longer rental times, and farer travel distances (Interview_C2G_1, Interview_C2G_3). Europcar solves part of its "problem of the last mile" by offering free rides in Car2Go vehicles to their rental offices (Interview_C2G_2, Interview_C2G_3). Second, Car2Go executives state that Europcar helped them to accelerate the rollout of its business model (Interview_C2G_2). Third, the partnership with Europcar allowed Car2Go executives to rethink their entire value chain towards the decision on which parts to make their core competency and which parts to outsource (Interview_C2G_1).

Compared to Car2Go, Quicar sees two major reasons to avoid engaging in external partnerships at the strategic level. First, carsharing and the entire mobility services business are supposed to become core to the Volkswagen Group, which wants to internally build up the required knowledge and consider potential strategic partnerships in later stages (Interview_QC_2, Interview_QC_3). In comparison, Car2Go was more outwardly oriented from the beginning, and constructed its first prototype mostly from externally supplied technological components (Interview_C2G_1). Second, Quicar found all of the required

competences within Volkswagen Group subsidiaries: the Volkswagen brand, including its car fleet business for corporate clients, and Volkswagen Financial Services AG (Interview_QC_2). Thus, the corporate strategic decisions of both firms seem to influence the structures of their business models and imply strong interdependencies between them.

Table 7: Business model elements and representative quotes

	Representative quotes regarding OEM carsharing business models	
	Car2Go	**Quicar**
Value Structure	*We make it possible to be automobile anywhere in urban areas around the clock* (Interview_C2G_1)	*The goal is to create an available, binding and schedulable offer for the client and not to leave it to chance whether a car is available. Reliability is an important aspect here* (Interview_QC_1)
	Our business model is based on the fact that we provide individual mobility to broad sectors of the population who possess a driver's license and who are over 18 years old and live in densely populated areas of megacities (Interview_C2G_2)	*The only entry requirement is that he is 18 years old and he has a driver's license, no matter for how long* (Interview_QC_2)
	To find a car for short distances and within minutes (Interview_C2G_3)	*But we want to earn money with this service. From the outset. We chose a completely different approach than the others I think* (Interview_QC_3)
Resource Structure	*I think carsharing itself is not so insanely expensive and resource-intensive. But what we do and how we do it definitely is* (Interview_C2G_1)	*But I have to ultimately have a budget to bring about a marketing campaign to explain customers the topic in more detail. Otherwise, we have an organic growth like the classic carsharing providers have the needed 15 years to generate 2000 users. This does not for us nowadays* (Interview_QC_1)
	It is a service business, but it's a service that comes with an asset, namely vehicles. And we just need to build huge fleets (Interview_C2G_2)	*If you do everything yourself, then of course you also need the appropriate resources* (Interview_QC_2)
	Value creation depends, among other things, upon getting the right number of cars in the right cities. The interaction of many factors must be right after all (Interview_C2G_3)	*Well in the end one also needs a certain amount of financial power because one thing is clear: you have to modify the cars, you also need a certain amount of marketing power to explain the customer something new, something unusual. We did not all grow up with sharing cars* (Interview_QC_3)
Transactive Structure	*Europcar ensures that we are simply faster. Europcar has a branch network throughout Europe. That means we have access to certain shops and to a certain infrastructure* (Interview_C2G_1)	*Regarding locations, customer relations, station structure - all needed for carsharing - I do not know where a car rental company could help us. Everything a car rental company can offer, we can buy* (Interview_QC_1)
	The question is always whether it is complementary to my business model. If you ask me, for example, whether a car rental company is a good partner, then my answer is 'yes', because it offers a service that we do not offer at the moment (Interview_C2G_2)	*With Volkswagen Financial Services we have the of the largest automotive financial service provider in the world on board. So actually, a partner that can mostly do anything Europcar or Sixt can offer* (Interview_QC_2)
	Customers that use Car2Go are also potential Europcar customers if they need another car because they might have sold their old one (Interview_C2G_3)	*The cars, the operation, the rental system, the background processes, the billings, we do all that. That's all an objective of the Financial Services AG. As such, the partnership is clear* (Interview_QC_3)

Regarding the business model's extent of openness, both of these carsharing providers aim to at integrate substantially with other mobility players in the market (Interview_QC_2, 20100920_Daimler_14, 20111202_Daimler_2). The goal is to offer their customers one platform for mobility in which they can easily switch between the different offerings (Interview_C2G_1, Interview_QC_2, 20111110_Daimler_6). Both firms assume that carsharing will only enfold its full potential in such an integrated infrastructural system.

The *value structure* is crucial for the two models' value creation and capture capabilities, because it predefines the amount of users that enter the system and their consumption behavior. Car2Go and Quicar both offer individual mobility around the clock without the complexity and costs of car ownership (Interview_C2G_2, Interview_QC_1, 20081021_Daimler_19). To open their offerings to a broad audience, Quicar and Car2Go define the lowest possible entry barriers for their users: to supply a valid drivers' license (Interview_C2G_2, Interview_QC_2). The differences lie in the core of the specific business models. The free-floating approach aims to provide customers with a maximum freedom of use (Interview_C2G_1, 20090326_Daimler_18), while the station-based approach aims to provide maximum reliability (Interview_QC_1, 20110512_VW_4). These two approaches are having very strong influences on structures and the interdependencies between them.

The essential driver for the creation and capture of financial value of all carsharing providers is utilization – the amount of minutes each vehicle is used per day (Interview_C2G_1, Interview_QC_1). This determines how much revenue can be generated. According to the executives at Car2Go and Quicar, the business model design and the usage amount it can generate play a crucial role in reaching the desired utilization rates and creating financial value (Interview_C2G_2, Interview_QC_3, 20111013_VW_1). First, the pricing structure is mainly responsible for attracting customers and can actively influence their behavior regarding the situations and durations of service usage (Interview_QC_1). Quicar's pricing structure reflects

the fact that the average rental time is higher in the station-based model owing to the mandatory two-way trips (Interview_QC_1, 20111013_VW_1). Second, in Car2Go's free-floating approach, average utilization strongly depends on the number of vehicles in a market to ensure the necessary availability for customers to be able to use the service at will (Interview_C2G_2). Third, a specific driver of utilization for the station-based business model is the number of stations, which provide customers with the required availability (Interview_QC_2, 20111102_VW_02, 20110512_VW_4).

Costs, on the other hand, are essential for a business model to be able to capture financial value. The fact that a Quicar vehicle is more expensive than a Car2Go vehicle – owing to the in-house development favored by Volkswagen (20110512_VW_4) – results in higher required utilization rates for Quicar (Interview_C2G_2, Interview_QC_2). The overall financial value capture of both carsharing business models further depends on the number of cities in which the service is offered (Interview_C2G_2, Interview_QC_1). Because of the carsharing business model's high scalability, the system's relatively large research and development investments may be divided between the different locations (Interview_C2G_1).

The *resource structure* proves to be fundamental for the viability of a carsharing business model, because it depicts the configuration of resources that are required for its financial feasibility. One difference between OEM carsharing and other forms of carsharing becomes especially apparent in the resource structure. The OEM business models require more financial resources from open boundaries with associated manufacturers (20100325_Daimler_16). OEM carsharing is a service that comes with an asset – a large amount of cars. To reach profitability, providers must build up fleets of several thousand vehicles worldwide, which result in substantial assets in their balance sheets (Interview_C2G_1). The research and development costs further add to these investments. The resource structure thus seems to influence the viability of the value creation and capture ambitions nested in the value structure. The

executives at Car2Go and Quicar consider the solid financing from their parent groups as a major competitive advantage. Only such funding made their offerings possible in the first place (Interview_C2G_2, Interview_QC_3).

Financial resources are especially important in the various business model innovation stages. In the first stage, venture financing is essential for the necessary research and development efforts to create the system (Interview_C2G_2). Additionally, since there is very little information available on carsharing, the OEMs have to carry out costly market research (Interview_C2G_2, Interview_QC_1). For the introduction of the business model pilot to the first markets, carsharing providers need large budgets to finance the marketing campaigns necessary to introduce their groundbreaking offering to new customers (Interview_QC_1). In the implementation stage, Car2Go's experiences are that a provider needs substantial resources to be able to quickly roll out a carsharing business. If limited financial or human resources hinder implementation speed, the whole business model is at risk (Interview_C2G_2). While in the initial stages of business model development, a small team of people equipped with resources and decision-making power is ideal (Interview_C2G_1, Interview_QC_1); a later international implementation requires a larger number of specifically trained employees for planning and for operational tasks (Interview_C2G_2).

DISCUSSION

This study's findings have a number of important contributions for business model research regarding the increasing openness of the business model innovation process, the importance of fit between strategic partners for this process, the role of complementary technological developments, the need for discovery-driven principles, and the resulting interdependencies between elements of the business model itself.

First, the contribution to existing research on business model innovation (Chatterjee, 2005; Sosna et al., 2010; Winter & Szulanski, 2001) consists of a proposition that the business model innovation process consists of three broad stages (Figure 1) and that there are varying degrees of openness to these stages. Stage one yields important implications for research by providing insights on how established organizations can come up with groundbreaking business models. Previous research has paid attention to the necessity of integrating technology and market approaches during the first steps of an innovation (Berthon, Mac Hulbert, & Pitt, 2004; Gupta, Raj, & Wilemon, 1986). While insights from a market perspective are very valuable in the pilot stage of the innovation process, they can hinder the development of radically new concepts (Gilbert, 2003; Kim & Mauborgne, 1999).

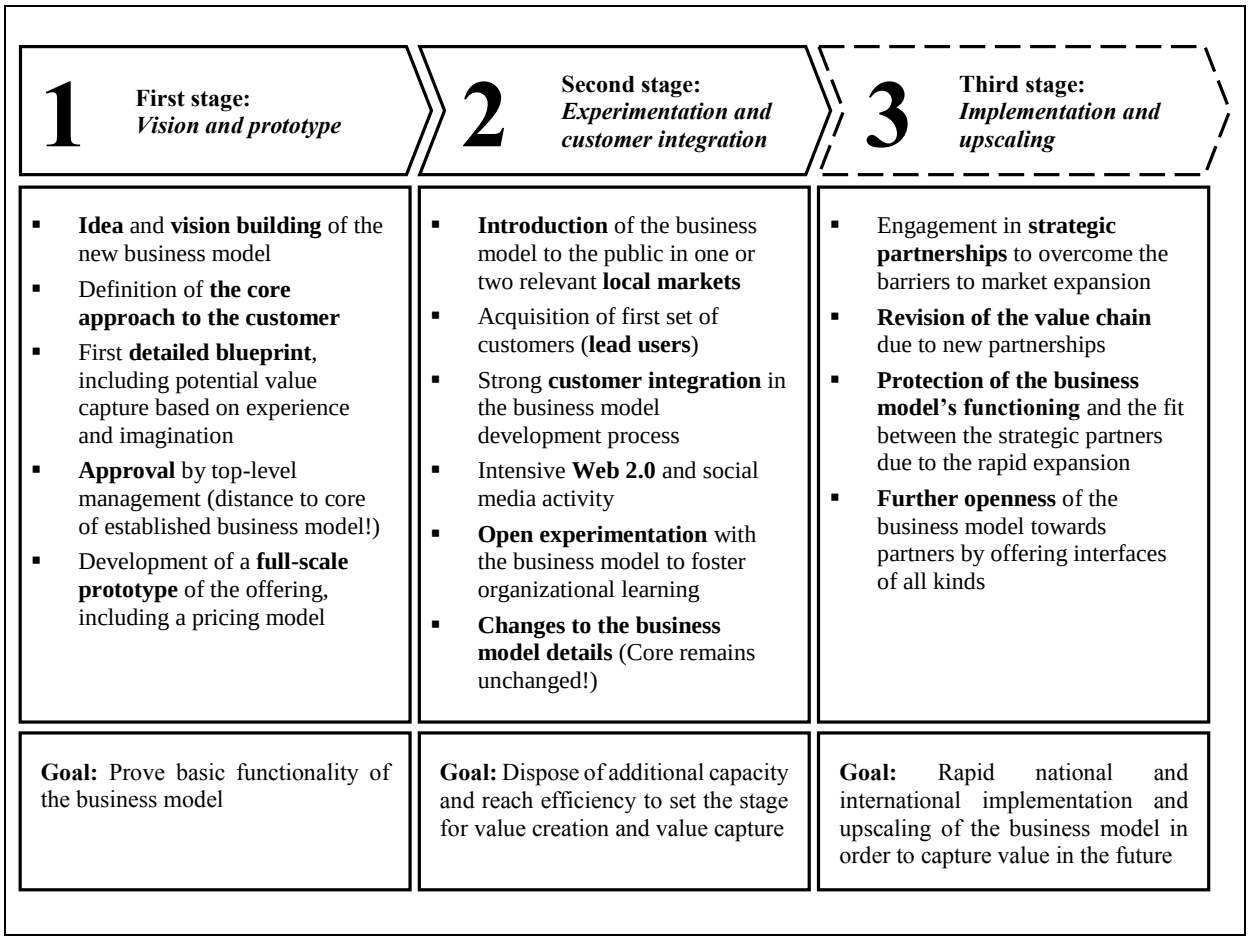

Figure 3: Three stages of business model innovation in a market-driving situation

The findings indicate that, in a newly defined market setting, firms first have to generate a number of customers before they can start to track their needs. Previously, firms can only anticipate what potential preferences future customers might have (Doganova & Eyquem-Renault, 2009) and design a first business model prototype accordingly. As already identified for technological innovations (Hargadon & Douglas, 2001), customers first have to become familiar with a radically new business model innovation such as OEM carsharing before they can judge its value and begin to accept it, too.

The findings regarding stage two provide researchers with insights on how a first blueprint can be turned into an efficient business model by means of openness towards the environment and constant learning. One major contribution of the analysis is that competition does not necessarily have to be a threat, but can also serve as an opportunity to learn from and improve a business model. Organizations that run a rapid upscaling strategy find that their business model is exposed to varying competitive surroundings in a short time period and are required to shape it in response to these varying experiences (Dunford, Palmer, & Benveniste, 2010). The findings further show that existing competitors can increase the own offering's acceptance speed in a local market, owing to the steeper learning curves by customers. Competition may lead to reduced marketing and promotion spending. It may actually increase the likelihood of a firm to achieve strong financial performance (Itami & Nishino, 2010).

The analysis of stage three contributes to the business model literature by depicting the barriers to the rapid international upscaling of a new business model and the role of strategic partnerships and open boundaries to overcome them. Findings also deepen the current understanding of partnerships' role in business model functionality (Amit & Zott, 2001; Chesbrough & Rosenbloom, 2002; Chesbrough, 2007; Yunus et al., 2010; Zott et al., 2011). In particular, discovering the own core activities is one major challenge for the successful

openness of the business model innovation process, because firms have to know their expertise before looking for beneficial partners (Zott & Amit, 2010).

Second, an important implication for research on business model innovation results from the need of a strategic fit between the different actors in the value network during the innovation process due to potential downsides of increasing its openness. When partners have divergent goals, high coordination costs – for instance from contractual negotiations – may arise (Christensen, Olesen, & Kjær, 2005). Tradeoffs have to be made between the benefits of discovery due to joint innovation activities and the resulting coordination costs (Almirall & Casadesus-Masanell, 2010). Service innovation scholars state that a desire to cooperate, commitment to common objectives, and trust are necessary elements for a collective innovation activity (Möller, Rajala, & Westerlund, 2008). While these characteristics seem to be equally important for a joint business model innovation, findings show that the correct enactment of formal contracts as part of a business model's governance aspects (Amit & Zott, 2001; George & Bock, 2011) often fall behind the pressing requirements of a rapid rollout.

Third, this study contributes to the ongoing discussion regarding the relationship between the business model and technological innovation (Baden-Fuller & Haefliger, 2013). While OEM carsharing is all about developing a new business model for an existing technology (the car), complementary technological developments still play a crucial role for the innovation process and the resulting model itself. Shaping a new market requires not only a whole new business model, but also a completely new service, technological components, and processes in order to successfully exploit promising opportunities. Internally or externally developed complementary technological developments – for instance mobile Internet – represented crucial enablers for new business models and the markets that they create.

Fourth, the insights from the cases extend scholars' understanding of one key aspect of business model innovation in the special situations of market-driving firms: discovery-driven principles like experimentation and learning (Baden-Fuller & Morgan, 2010; Chesbrough, 2010; McGrath, 2010; Sosna et al., 2010). Contrary to the literature, which indicates that early-stage business model innovation can be abandoned at little cost (McGrath, 2010; Thompson & MacMillan, 2010), firms may have to invest heavily in market research and the development of the required technological components as well as other assets such as the cars. This contradiction might result from the market-driving approach, instead of the sole development of a new business model complementing an existing product or service. Moreover, to learn from early-stage experimentation, the nascent business model must be unburdened from the obligation to be profitable. This challenge implies that market-driving firms should focus on future business opportunities instead of immediate value capture during business model innovation (Möller et al., 2008). While some additional capacity might be required to experiment during the initial stages, capturing value will only work with a high degree of efficiency and less profound changes to the business model after implementation.

Finally, the findings contribute to research on the business model concept itself by highlighting the interdependencies between its elements. While prior research has quite uniformly pointed towards the existence of such interrelationships (Doz & Kosonen, 2010; Winter & Szulanski, 2001; Zott & Amit, 2010), it does not analyze them in detail nor provides empirical evidence. One structure may become more dominant within a business model's configuration than others (George & Bock, 2011). The transactive structure and thus the decisions for (Car2Go) or against (Quicar) external strategic partnerships strongly determines both business models, leading to different value chains and costs, among others. In addition, the high funding of the parent companies made the OEM carsharing business models possible in the first place, reflecting a high impact on the resource structure. The value structure on the

other hand strongly predefines consumption patterns and thus the key value driver of the business model – utilization – by setting the price and availability of the service. Depending on the core of the business model and whether it yields greater flexibility (Car2Go) or greater reliability (Quicar), the value structure determines the amount of financial resources required to provide cars or parking space, for example, thus influencing the resource structure. Consequently, there are major interdependencies between the three structures, with important implications for the business model's potential value creation and value capture.

LIMITATIONS

A number of limitations apply to this study. First, both cases of the in-depth analysis are situated in the German automotive industry. Single industry settings normally have a positive effect on the external validity of the results, but may limit their generalizability outside the given context (Yin, 1994). Thus, firm specific characteristics might have influenced the results of this study, and the business model innovation process should be validated by other case studies and methodological approaches. Second, due to the reliance on qualitative interview data – among other sources – the findings might be biased by post hoc rationalization. Such recall bias (Zott & Huy, 2007) may lead to important facts that may have been forgotten or misinterpreted by the respondents due to the time lag between the actual events and the time of the interview (Eisenhardt & Graebner, 2007). In order to strengthen the results, data was triangulated with secondary information from multiple sources.

CONCLUSION

This paper provides detailed insights into how established organizations can design new business models by opening up the innovation process. Practitioners profit from this study in that they gain a clear step-by-step process guideline of how to approach radically innovative business models. More specifically, practitioners learn how to integrate their efforts with the

competences external partners for joint economic and even societal value creation. While the selected case studies, Car2Go and Quicar, focus on business model innovations by large corporations and thus management research and practice, the findings also have important implications for small firms as well as the entrepreneurship literature. However, the field of business model innovation needs further qualitative and quantitative research efforts to offer a deeper understanding of the roles of new business model creation in the successful creation of novel markets.

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APPENDIX A

Original interview guideline (in German language)

1. Warum engagiert sich Ihre Firma im Bereich Car-Sharing?
2. Welche mittel- und langfristigen Ziele verfolgen Sie mit Ihrem Engagement? (Profit, Umsatz, Bekanntheitsgrad der Marke, technologische Ziele, gesellschaftliche Ziele?)
3. Wie definieren sie die kritische Masse für Profitabilität im Car-Sharing (was + welcher Wert)?
4. Sprechen wir über den Markt für Car-Sharing im Moment: von welchen wesentlichen marktseitigen Einflussfaktoren können Sie als Anbieter profitieren und welche schränken Sie ein?
5. Wie würden Sie Ihr Geschäftsmodell beschreiben?
6. Wie hängt der Erfolg Ihres Car-Sharing Angebotes von Ihrem gewählten Geschäftsmodell ab?
7. Wie sind Sie bei der Entwicklung Ihrer Car-Sharing Dienstleistung strategisch vorgegangen?
8. Welche Rolle hat hierbei die Entwicklung eines passenden Geschäftsmodells gespielt und wie wurde dabei vorgegangen?
9. Welche Probleme gab es bisher bei der Implementierung Ihres Geschäftsmodells?
10. Führen Sie Ihr ursprünglich konzipiertes Geschäftsmodell unverändert weiter oder planen Sie bereits Anpassungen? Wenn ja, welche?
11. Wie gelangen Sie zu Erkenntnissen über Innovationsbedarf an Ihrem Geschäftsmodell?
12. Wie gehen Sie mit diesen Erkenntnissen um?
13. Welche Rolle spielen technologische Entwicklungen für den Erfolg Ihres Geschäftsmodells und wie stimmen Sie beides aufeinander ab?
14. Welche Rolle spielt die Elektromobilität für Ihr Angebot, heute und in Zukunft?
15. Welche Ressourcen (Budget, Menschen, Zeit, Informationen) sind für Ihr Car-Sharing Angebot besonders wichtig und warum?
16. Wenn Kooperationen bestehen: Welche Partnerschaften mit welchen Zielen/Inhalten gibt es momentan? (eventuell nur die wichtigsten)
17. Wenn ja: Nach welchen Kriterien wählen Sie Ihre Kooperationspartner aus?
18. Wenn ja: Wie stimmen sie Ihre Zusammenarbeit und Ihre Zielvorstellungen mit denen Ihrer Partner organisatorisch aufeinander ab?
19. Wenn ja: Welche Rolle spielen lokale Kooperationen?
20. Wie beurteilen Sie die Rolle der Stadtverwaltung für den Erfolg Ihres Angebotes? Wie spielt dies bei der Auswahl der Städte eine Rolle?
21. Wie liefern Sie Ihren Kunden einen Mehrwert und schaffen Anreize, für Ihren Service zu bezahlen?
22. Wie sichern Sie Ihrer Firma einen Teil des erzeugten Mehrwertes? Wie wurde diese Frage bei der ursprünglichen Entwicklung Ihres Geschäftsmodells berücksichtigt? Kostenstruktur?
23. Wenn ja: Wie ist die Aufgabenverteilung innerhalb der (externen) Wertschöpfungskette zwischen Ihnen und Ihren Partnern (wer macht was?) und wer hat welchen Anteil an der erreichten Wertschöpfung?
24. Wie schützen Sie Ihr Geschäftsmodell vor Konkurrenz?
25. Was sind für sie die entscheidenden (internen/externen?) Elemente für den Erfolg Ihres Car-Sharing Angebotes?
26. Wie bewerten Sie den bisherigen Erfolg Ihres Car-Sharing Ansatzes gemessen an Ihren Zielen?
27. Gibt es formale Lernprozesse (Wissensmanagement)?
28. Welche finanziellen und zeitlichen Kapazitäten stehen für die Weiterentwicklung Ihres Geschäftsmodells zur Verfügung?
29. Mit welchen Problem haben Sie hier zu kämpfen und wie gehen Sie diese an?
30. Wie würden Sie die Einflussnahme des Konzerns auf Ihre Gesellschaft beschreiben?
31. Welche Zielgruppe wollen Sie mit Ihrem Angebot erreichen? Warum genau diese?
32. Wie berücksichtigen Sie Kundenfeedback in Ihrem Angebot?
33. Verwenden Sie feste Schlüssel für die Einnahmenaufteilung oder gibt es andere Anreizsysteme?
34. Wie unterscheidet sich Ihrer Meinung nach Ihr Angebot und Ihr Geschäftsmodell von denen anderer Anbieter (z.B. Autos, Verfügbarkeit, Flexible Parkplatzsuche vs. Fixe Abholungs-/Abgabepunkte)?
35. Welche weiteren Schlüsselfaktoren (Kunden, Verfügbarkeit, Fahrzeuge, Städte, Partner, Infrastruktur, Stellplätze, etc.) sind Ihrer Meinung nach noch wichtig im Wettbewerb?

APPENDIX B

Initial coding scheme for data classification

- Motivation to enter car-sharing
- Challenges of Implementation
- Success Factors
  - Firm internal
  - Firm external
- Market-Driving Behavior
- Openness during business model innovation
  - First Steps
  - Continuous Customer Integration
  - Scale-up of new business
- Discovery-driven principles
  - Experimentation, Trial-And-Error Learning
  - Knowledge Management
- Business model elements
  - Value Structure (Value Proposition)
  - Value Structure (Value creation)
  - Value Structure (Value capture)
  - Resource Structure
  - Transactive Structure (General/Fit)
  - Transactive Structure (Operations)
  - Transactive Structure (Financials/Insurance)
- Technology
  - Technology (External: Mobile Internet, Smartphone)
  - Technology (Telematics/Hardware)
  - Technology (Software)
- Firm Strategy
  - Strategy Development
  - Business Planning
- Market Opportunities
- Competitive Activities, Protections against imitation
- Environment
  - Extra-Industry Conditions (City Support)
  - Extra-Industry Conditions (Modal Split)
  - Extra-Industry Conditions (Society and Other)
- Consequences/Goals
  - Profit, Financial Value Creation and Capture
  - Future Sales
  - Branding
  - Social Value
  - Organizational Learning
- E-Mobility

STUDY 3: THE MODERATING ROLE OF BUSINESS MODEL DESIGN IN THE INNOVATION – FIRM PERFORMANCE RELATIONSHIP OF ESTABLISHED HIGH-TECHNOLOGY FIRMS

ABSTRACT

Based on recently acquired survey data from the electrical automation industry in Germany, this study refers to the question of how business model design moderates the relationship between technological innovation and firm performance. In prior literature, four of the most prominent forms of the current business model configuration are carved out as efficiency-, complementarities-, novelty-, and lock-in-centered designs (Amit & Zott, 2001). The respective measures proposed by Amit & Zott (2007; 2008), originally stemming from e-business, are applied to a setting of high-technology manufacturing firms. The findings of this analysis show that the positive influence of technological innovation on firm performance is negatively moderated by efficiency- and complementarities-centered business model designs. Novelty and lock-in show no significant effects. Consequently, firms have to take their business model and potential redesigns thereof into additional account in order to fully profit from their technological innovation activities.

INTRODUCTION

Prominent innovations like the Nespresso capsule system have caused groundbreaking success for their innovating firms and fueled manifold adopters around the globe in recent years. What did Nespresso particularly do to convert these developments to such an outstanding success saga and what can high-technology companies learn from these stories?

While the importance of technological innovation is a rather classic tale in management literature, research on the innovation – performance relationship recently received a lot of scholarly attention (Evanschitzky, Eisend, Calantone, & Jiang, 2012; Hauser, Tellis, & Griffin, 2006; Rosenbusch, Brinckmann, & Bausch, 2011; Rubera & Kirca, 2012). A technological innovation represents the transformation of a fresh idea into a new or improved saleable product, including the technical, commercial, and financial steps required for its successful development and commercial use (Stead, 1976). This broad definition already hints at the insight that a groundbreaking technological development alone does not guarantee a bestselling product for the innovator. Rather, other factors such as the right market positioning towards customers and complementary assets have been characterized as relevant for success (Teece, 1986). Researchers have been analyzing the working mechanisms behind innovation success by testing for interaction effects between different innovation types (Damanpour, Walker, & Avellaneda, 2009) or for a number of organizational moderators (Covin & Slevin, 1989; Li & Atuahene-Gima, 2001), such as firm strategy (Zahra & Covin, 1994) or organizational change (Kaiser & Bertschek, 2004).

Recent advancements build upon Teece's (1986) earlier insights and increasingly associate the distinct concept of business model design (Amit & Zott, 2001; Zott, Amit, & Massa, 2011) with innovation, especially its important role in commercializing technology (Chesbrough & Rosenbloom, 2002). A business model is a system of interdependent activities performed by a focal firm together with its partners, including a description of the linking

mechanisms between these activities (Zott & Amit, 2010). Crafted by a firm's managers, a business model represents a template of how the firm conducts its business to best meet the perceived customer need and to ultimately create and capture economic value (Zott & Amit, 2013). Value creation is ultimately driven by a business model's degree of novelty-, efficiency-, complementarities-, or lock-in-centered design (Amit & Zott, 2001). Research has begun to empirically show the positive effects of business model design on firm performance (Morris, Shirokova, & Shatalov, 2013; Zott & Amit, 2007) and scholars have also started to analyze its role in commercializing technological innovations.

Recent case studies show that the process of integrating new business model design with the commercialization of technological innovations is dynamic and cyclical (Dmitriev, Simmons, Truong, Palmer, & Schneckenberg, 2014). Business models may also shape technologies by aligning the value propositions and design efforts over time in their specific path to the market (Calia, Guerrini, & Moura, 2007; Lehoux, Daudelin, Williams-Jones, Denis, & Longo, 2014). Even though this is an enduring job, adapting a new technology is regarded as relatively 'uncomplicated' compared to modifying a new business model, mostly for well established firms (Günzel & Holm, 2013). Further qualitative efforts have been undertaken to identify how new business model design accounts for the economic success of innovative technologies, such as cloud-based information systems (Khanagha, Volberda, & Oshri, 2014), disruptive digital innovations (Simmons, Palmer, & Truong, 2013), electric vehicles (Abdelkafi, Makhotin, & Posselt, 2013; Bohnsack, Pinkse, & Kolk, 2014) and renewable energies (Richter, 2013), as well as technology-based services (Palo & Tähtinen, 2013).

Even though scholars in the field of business model research have made significant efforts and reached valuable contributions, the ongoing academic discussion is lacking clarity about whether or not firms really need to change their business model when they plan to introduce an innovative technology or if the current business model design will lead to equal performance

outcomes. Baden-Fuller & Haefliger (2013, p. 5) recently called for "*scholars […] to unpick the interdependencies between business model choice, technology development, and success*" and proposed that "*[m]aking business model choice a moderator […] will lead to a better understanding of the fundamentals of the relationship*". Very recently, first steps into this moderating relationship have been made by Wei, Yang, Sun, and Gu (2014), who test the role of novelty- and efficiency-centered business model design as moderators of the relationship between exploratory and exploitative innovation on the growth of Chinese firms. While these analyses offer valuable contributions to the area of business model research and show the topic's great relevance for the current debate, a number of questions still remains unanswered. Accordingly, this study asks the following research question: How is the relationship between technological innovation and firm performance moderated by a focal firms' current novelty-, efficiency-, complementarities-, and lock-in-centered business model design?

This study takes on the work of Amit & Zott (2001; 2007; 2008, 2010) to measure and empirically test all four designs of the business models currently employed by established high-technology firms as moderators of the innovation – firm performance relationship. A number of central contributions to research on the business model concept and on technology and innovation management emerge from this analysis. First, the findings detail the relationship between technological innovation and firm performance: the design of a firm's existing business model also has to be taken into consideration when analyzing how firms can yield the full profit from their technological potential. Second, this study contributes to the academic debate by advancing the operationalization of the business model design concept by offering measures not only for novelty- and efficiency-centered, but also for complementarities- and lock-in centered business model designs (Amit & Zott, 2001; Zott & Amit, 2007; 2008, 2010). Third, all of these measures are tested as moderators of the innovation – firm performance relationship. The relationship is negatively moderated by efficiency- and complementarities-

centered business models. These results extend early insights around the business model as a 'mediating device' between technological inputs and economic outputs (Chesbrough & Rosenbloom, 2002; Wei et al., 2014).

CONCEPTUAL BACKGROUND AND HYPOTHESES

Innovation and firm performance

Schumpeter (1934) already considered innovations as the critical source of value creation. Classification is crucial for analyzing innovation and its adoption within organizations (Baden-Fuller & Haefliger, 2013). Out of the manifold typologies used in innovation research, Damanpour (1991) has found three pairs of categorizations that are most often referred to: radical and incremental, product and process, as well as technological and administrative innovations. While not mutually exclusive, these typologies provide researchers with a common language to communicate about actual findings, e.g. in association with the business model concept. While it seems hard to judge which type is 'most important', technological innovation has surely received most attention in business model research out of the categories mentioned above (Zott et al., 2011). While all remaining typologies are highly interesting from a business model point of view, the focus of this study will be on technological innovation due to its major relevance in the organizational context (Daft, 1978; Damanpour, Szabat, & Evan, 1989) other than business model innovation itself (Chesbrough, 2010).

The direct effect of technological innovation on firm performance has already received substantial attention from management research adjacent fields such as entrepreneurship or marketing (Evanschitzky et al., 2012; Hauser et al., 2006; Rosenbusch et al., 2011). While bearing high initial risks such as uncertainty about costs and potential returns (Ceccagnoli, 2009; Christensen, 1997; Koellinger, 2008; Liao & Rice, 2010), technological innovation has largely been reported to have a positive influence on firm performance (Deeds & Decarolis,

1999; Zaheer & Bell, 2005). Consequently, this study will take the relationship as given and focus on its moderation by the less researched concept of business model design.

In this regard, first empirical evidence is available on the moderating role of efficiency- and novelty-centered business model design (Wei et al., 2014). While related to a different measure of success, firm growth instead of financial firm performance, efficiency-centered business model design has been reported to enhance the negative effect of exploitative innovation and to weaken the positive effect of exploratory innovation. Moreover, novelty-centered business model design supposedly further weakens the negative effect of exploitative innovation (Wei et al., 2014). The fact that these results are based on a negative direct effect compared to the generally assumed positive influence of technological innovation on firm performance, show the high complexity inherent in the relationship. Further analyses of different innovation and performance measures as well as a more holistic take on the moderating effects of all four potential business model design themes are necessary.

The moderating role of business model design

Prior literature on business models has successfully linked Schumpeter's theory with the 'profiting from innovation' framework (Teece, 1986), which argues that effective protective rights and complementary assets increase innovations' value creation potential (Amit & Zott, 2001). More recently, Teece (2010) argues that, because capturing value from innovation is one of its key functions, the business model has also to be taken into additional account. In Teece's theory, it defines both the 'go to market' and 'capturing value' approaches of new product developments. Chesbrough & Rosenbloom (2002, p. 549) have early on given the business model the ultimate role of converting an innovation's technological core into economic value.

Business model design is essential for established firms to overcome the barrier of matching new technologies with market opportunities (Bond & Houston, 2003). Simple

relationships, where a novel product will automatically lead to higher performance, ignore the moderating role of business model design to determine a more comprehensive path to monetization (Baden-Fuller & Haefliger, 2013). The value of a technology will remain latent for the innovating company unless it manages to design the right business model (Björkdahl, 2009). Firms' market position as part of their business model has to fit their innovation activities in order to result in a competitive advantage (Liao & Rice, 2010).

While business model and innovation research can be regarded as natural complements, definitions of the business model concept vary broadly (George & Bock, 2011) and have basically developed in three distinct 'silos' of e-business, strategic management, and technology and innovation management literature (Zott et al., 2011). But ultimately, value creation and capture is what unites the different mindsets. Scholars should choose the definition that best suits their research purposes. From a technology and innovation management perspective, the business model shapes the realization of economic value from an innovation as it depicts how firms can deliver value to customers, charge them for it, and profit from the resulting payments (Teece, 2010). This understanding benefits from an integration with the previously introduced conceptualization of Zott & Amit (2001; 2010) in order to open the boundaries of the focal firm towards external players in its network for value creation and capture from manifold sources (Zott & Amit, 2010). Originated in e-business and derived from a study of 150 internet-based firms (Amit & Zott, 2001), this particular business model understanding was gradually broadened from entrepreneurial firms to established organizations and to a wider spectrum of industries (Zott & Amit, 2010; Zott et al., 2011). The business model itself could be used as the unit of analysis (Zott et al., 2011), but the focus of this study is on a focal firm's performance and it thus centers on the firm level of analysis. But the underlying conceptualization of the business model does account for the influence of external partnerships as will be shown in the following.

The influence of business model design on firm performance relies on the total value creation for all business model stakeholders such as the focal firm, customers, and suppliers and especially on the firm's ability to capture part of this value (Chesbrough & Rosenbloom, 2002; Zott & Amit, 2007). Value creation from business model design is possible by either increasing customers' willingness to pay or decreasing the opportunity costs of partners and suppliers (Brandenburger & Stuart, 1996). The total value that can be created represents the upper limit for appropriation by the focal firm (Brandenburger & Stuart, 1996; Nalebuff & Brandenburger, 1995). The task of capturing value is the same as monetizing on the value created (Baden-Fuller & Haefliger, 2013). As Chesbrough and Rosenbloom (2002, p. 551) note, "*the best measure of the worth of a given business model is the success of the enterprise*".

As indicated earlier, value creation is ultimately driven by a business models degree of novelty-, efficiency-, complementarities-, or lock-in-centered design (Amit & Zott, 2001; 2010): First, novelty centers on "*adoption of new activities, and/or new ways of linking the activities, and/or new ways of governing the activities*" of a business model (2010, p. 221); second, efficiency refers to the way that firms design their business model "*to aim at achieving greater efficiency through reducing transaction costs*" (2010, p. 221); third, complementarities "*are present whenever bundling activities within a system provides more value than running activities separately*" (2010, p. 221); fourth and ultimately, lock-in refers to a business model's "*power to keep third parties attracted as business model participants […,] manifested as switching costs, or as network externalities*" (2010, p. 221). These value drivers are theoretically anchored in transaction cost theory (efficiency), resource-based theory (complementarities), Schumpeterian innovation (novelty), and strategic networks (lock-in) (Zott & Amit, 2013). In the following, four hypotheses concerning their role as moderators of the relationship between innovation and firm performance are developed (see Figure 1).

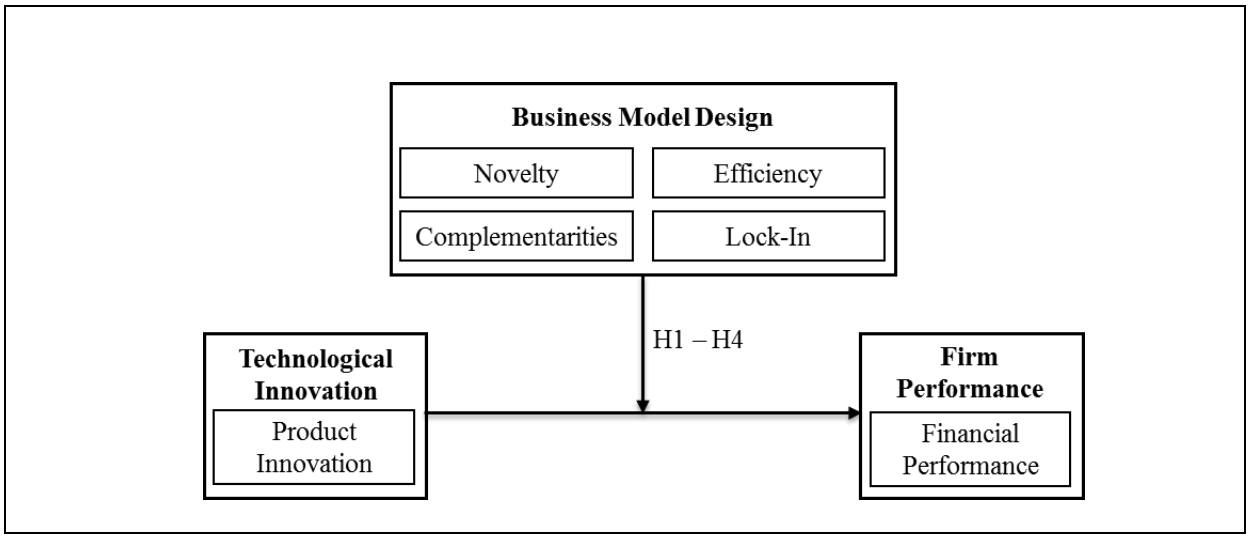

Figure 1: Proposed theoretical model

Novelty-centered business model design

A business model designed towards novelty-centered value creation may influence the positive relationship between technological innovation and firm performance. A novelty-centered business model offers fresh approaches to economic exchanges, for example new transaction mechanisms or alternative links between participants (Zott & Amit, 2007). A novelty-centered business model can improve stakeholders' acceptance of an innovation by moderating between the novel features of a product offering and the environment of the focal firm with the expectations and norms that it entails (Zott & Amit, 2008).

Firms that focus completely on novelty and innovation might experience a learning effect and become even better innovators over time (Zott, 2003). Recent empirical work has identified that the negative influence of exploitative innovation on firm growth is positively moderated by novelty-centered business model design (Wei et al., 2014). Organizations should update their initial design due to shifts in customer expectations and environmental influences in order to stay successful (Björkdahl, 2009; Hienerth, Keinz, & Lettl, 2011). Taking into consideration that without the openness to create novel designs, firms may not be able to capture all of the

positive performance effects of a superior technological innovation (Teece, 2010), one would expect that the relationship between technological innovation and firm performance is more positive when a novelty-centered business model design is in place.

> *Hypothesis 1: The positive relationship between technological innovation and firm performance is more positive under high levels of novelty-centered business model design than under low levels of novelty-centered business model design.*

Efficiency-centered business model design

While there should generally be a positive impact of technological innovation on firm performance, it may be lowered by efficiency-centered business model design. Essentially, efficiency-centered design summarizes the activities to achieve efficient business transactions through the business model (Zott & Amit, 2007; 2008). The basic goal is to reduce transaction costs for all participants in the business model by reducing uncertainty, complexity, or asymmetries of information (Williamson, 1975). In other words, value creation in this kind of business model is driven by imitation rather than innovation, by doing the same things that other firms do, but more efficiently (Aldrich, 1999; Zott & Amit, 2007).

Such a business model design is based on a finely tuned system gradually optimized towards complete efficiency, based on the current offerings and resources of the firm. Innovative technologies, such as novel product developments, especially more radical than incremental types, may lead to disturbances within the efficient system and ultimately, their positive effects on firm performance might suffer. A firm that introduces new products may even fail to learn how to become an even better and more efficient imitator (Zott, 2003). The high research and development costs (Chesbrough, 2010) as well as the risk (Ceccagnoli, 2009; Christensen, 1997; Koellinger, 2008) involved in bringing about innovations might further diminish their positive efficiency effects. Recent empirical evidence further shows that the relationship between exploitative as well as exploratory innovation and firm growth is

negatively moderated by efficiency-centered business models (Wei et al., 2014). These considerations imply that the relationship between technological innovations and firm performance will be less positive under an efficiency-centered business model design.

> *Hypothesis 2: The positive relationship between technological innovation and firm performance is less positive under high levels of efficiency-centered business model design than under low levels of efficiency-centered business model design.*

Complementarity-centered business model design

The positive relationship between technological innovation and the performance of a firm may be influenced by complementarity-centered business model design. Complementarities enfold their potential whenever a bundle of goods together creates more value than the sum of the individual goods' values (Amit & Zott, 2001). In the complementarity perspective of management research, firm performance depends on the fit between various organizational, technological, or managerial factors within companies (Whittington, Pettigrew, Peck, Fenton, & Conyon, 1999). Opening firm boundaries, Chesbrough & Rosenbloom (2002) see an important function of a business model to "describe the position of the firm within the value network linking suppliers and customers, including the identification of potential complementors […]" (p. 534).

Alignment between a technology and the value network of a business model is critical for value creation, where a positive alignment could leverage the value of a technology while negative alignment could result in a dissipation of potential value (Chesbrough & Rosenbloom, 2002). When interdependencies are strong, as would be the case in a complementarity-centered business model, synergies can form barriers that require changes in multiple elements of the system once one of the other elements is changed in order to function properly (Milgrom & Roberts, 1995). Technological innovations, especially radical rather than incremental ones, can result in disruptive effects for the innovating firm because they typically trigger broad changes

within organizations, especially when multiple products are introduced at once (Barnett & Freeman, 2001). Considering the systemic nature of a complementarity-centered business model design, one would expect that the relationship between technological innovation and firm performance is less positive in such a setting.

> *Hypothesis 3: The positive relationship between technological innovation and firm performance is less positive under high levels of complementarities-centered business model design than under low levels of complementarities-centered business model design.*

Lock-in-centered business model design

The positive effects of technological innovation may be influenced by a firm's business model focused on retaining customers and other stakeholders as participants of transactions with that firm. Such lock-in centered business models foster value creation by implementing switching costs to prevent customers and partners to move towards potential competitors (Amit & Zott, 2001). The main goal of innovation is to 'enlarge the economic pie' – create value – by either attracting new customers or by motivating existing customers to consume more (Markides, 2006). Lock-in-centered business model design tends to focus on the latter. The mayor aim of lock-in centered approaches is to positively influence customers' purchasing choices towards an incumbent offering over a competing alternative by increasing their loyalty (Klemperer, 1987). Locked-in customers are influenced on the industry as well as on the individual level. On the industry level, incumbent firms can benefit from market-entry barriers towards competing firms such as cost-advantages or better access to distribution channels (Karakaya & Stahl, 1989). On the individual level, customers can be locked-in by formal agreements such as contracts (Mooi & Ghosh, 2010) or rather informal and cognitive effects. Such cognitive lock-in may simply be the result of learning how to use a particular technology (Murray & Häubl, 2007) and does not necessarily depend on its trustworthiness or higher quality towards other offers (Johnson, Bellman, & Lohse, 2003). Cognitive lock-in can also

stem from customers timely preference of a novel product offering with low initial setup costs compared to potentially higher usage costs (Zauberman, 2003). Lock-in generally works in combination with additional factors influencing consumer behavior, such as word-of-mouth from other customers or exclusive distribution of new products, depending on the go-to-market strategy of an innovating firm (Peres & Van den Bulte, 2014).

While literature reports negative direct effects of lock-in on firm performance (Dong, Yao, & Cui, 2011), its influence for innovation-related activities is mostly reported as positive. Lock-in may increase customers' willingness to pay and decrease partners' opportunity costs towards the focal firm (Brandenburger & Stuart, 1996). It should be the dominant approach in early stages of a product's life cycle, before a broad market penetration has been reached (Gilbert & Jonnalagedda, 2011). Strong ties with customers can even positively influence innovation and the market success of a product (Fredberg & Piller, 2011). Taking into consideration potential first mover advantages of an innovating firm and the resulting lack of competition, lock-in-centered business model design would favor positive outcomes of such innovation behavior. Firms could profit from innovation activities that turn towards shaping long-term customer retention and involvement, away from purely focusing on creating new physical properties (Teichert & Rost, 2003). Thus lock-in-centered business model design is likely to positively influence the relationship between technological innovation and firm performance:

> *Hypothesis 4: The positive relationship between technological innovation and firm performance is more positive under high levels of lock-in-centered business model design than under low levels of lock-in-centered business model design.*

METHODS

Before being able to apply the analytical procedures to the data, the empirical research process and the structure of its reporting was geared towards recent publications employing

key-informant methodologies (Homburg, Artz, & Wieseke, 2012; Schilke, 2014). The empirical process consisted of two main steps, qualitative field interviews and the subsequent development and execution of a survey study as described in the following sections.

Exploratory field interviews and survey development

First, based on a conceptual framework that was developed exclusively from prior research (please see Study1 and Study 2 of this dissertation for further details), exploratory field interviews were conducted in the targeted electronics industry to gain more clarity about predominant business model designs, their role for firms' innovation behavior, and the potential implications for firm performance. Eight semi-structured telephone-interviews were conducted with representatives from the German Electrical and Electronic Manufacturers' Association (ZVEI), the central association of the electronics industry in Germany and one of the most important manufacturers' associations in the country (Baier & Salié, 2013). The interviews lasted between 30 and 60 minutes and were conducted in April of 2012. Informants were one of the association's general statistical experts as well as the heads of the following division: automation, domestic electrical appliances, domestic electric heating appliances, electric power tools, electric welding equipment, power capacitors, and safety/security/defense. While the business in some branches is largely shaped by government regulations and lobbyism (e.g. safety/security/defense) or standardization rather than innovation (e.g. power capacitors), the majority of informants agreed that the electronics industry in general and especially business models in electrical automation are driven by innovation as well as strong cooperation between the firms. These findings point towards the relevance of the initial framework and the boundary-spanning business model understanding.

Second, based on the initial framework and the insights from the field interviews, the survey instruments were developed to further understand the impact of different business model designs on the innovation – performance relationship. The interviews lead to the inclusion of a

number of external control variables such as industry branch, environmental dynamism and external shocks due to the financial crises. All items were first developed in English, translated into German, and then back into English under support of a native speaker of both languages (Brislin, 1970). The questionnaire was executed in German.

Third, detailed pretests with 13 practitioners, industry representatives, and scholars were conducted to ensure that informant were able to fully understand the survey. As a result of the pretest, several questionnaire items were reworded. The initial interviews, the subsequent survey development, and the pretest guaranteed the consideration of all relevant facets, an appropriate construct design, and practitioners' understanding of the survey questions.

Sample and survey data collection

The study population focuses on medium and large industrial firms in the electronics industry in Germany. More specifically, the study aimed at manufacturing firms active in the fields of automation technology, covering the areas of electric drives, control systems, switchgear, and measurement technology. The electrical automation industry in Germany represents one of the most innovative branches in the country (Centre for European Economic Research, 2012). The automation industry is situated in the business-to-business market. Industry in this sense is defined by "firms that use similar inputs and technologies, produce similar products, and serve similar customers" (Low & Abrahamson, 1997, p. 440). This understanding sets a common stage to effectively compare the differences in innovation behavior and business model design among otherwise similar firms.

In order to reach a representative firm sample, the 400 largest firms in the electrical automation industry in Germany were selected based on the number of total employees in Hoppenstedt Firmendatenbank, a large commercially available database of firms located in Germany (Schilke, 2014). Twelve firms had to be deleted due to a lack of fit with industry

criteria, e.g. they were service firms only or not active in automation at all, resulting in a target population of 388 firms. Potential informants were initially contacted by phone to promote the benefits of the study and to acquire their consent for participation. An email with a personal letter and the questionnaire as well as a link to its online version was then sent out to the informants who consented. The questionnaires included an introductory text explaining the study's purpose and setting as well as the major theoretical concepts. Follow up phone-calls were conducted and reminder e-mails have been sent out to further boost the response rate. Data collection lasted nine months from October 2012 until June 2013.

The goal was to collect data from different informants for the dependent and independent measures in each firm. As a result of the interviews, managers in R&D and product management were identified as the first respondent for the independent innovation and business model related measures based on their technical expertise. The second respondent with profound knowledge about the firm's performance compared to competitors was chosen by the position within the respective organization, resulting in the chief executive officers whenever possible or other members of the board such as head of marketing, business development or innovation management. This selection secured that informants interact with other employees to increase their knowledge about the innovation and business model design activities of the firm.

Ultimately, 209 respondents from 119 firms participated in the study, reflecting a response rate of 30.7 percent. This is consistent with other recent survey-based studies (e.g. Schilke (2014) and well above the average response rates for detailed online surveys, which range between 10 to 25 percent (Sauermann & Roach, 2013). Out of the 119 firms, 90 matched pairs could be formed with information from two informants for each firm, building the final sample. It uses information from the first respondent for all constructs except for the dependent variable, which was taken from the second respondent to reduce the threat of potential common method bias (Podsakoff & Organ, 1986).

Table 1: Sample composition

	Sample (%)
Industry (n= 90 firms)	
Electrical drives	9,4
Control systems and switchgear	31,1
Measurement technology and process automation	47,2
Other (e.g. electrical components)	12,2
Firm size (employees, n = 90 firms)	
< 100	2,2
100 - 249	26,7
250 - 499	29,4
500 - 999	21,7
1,000 - 4,999	14,4
>= 5000	5,6
Firm age (years, n = 90 firms)	
< 9	1,1
10 - 19	8,9
20 - 29	12,2
30 - 49	19,4
>= 50	58,3
Position of respondent (n = 180 informants)	
Member of executive board	23,3
Head of R&D	7,8
Member of R&D (e.g. project leader)	2,8
Head of Strategy/Business Development	3,3
Member of Strategy/Business Development	7,8
Head of Marketing/Sales	28,3
Member of Marketing/Sales	12,8
Other (e.g. head of product management)	13,9
Tenure of respondent in firm (years, n = 167 informants)	
<= 1	5,0
2 - 5	26,1
6 - 10	20,6
11 - 15	16,1
>= 16	25,0

In order to perform several sensitivity and reliability analyses, the fully crossed design (Hallgren, 2012) with information on all constructs from the full sample of all 209 informants was additionally employed. Table 1 provides an overview of the sample composition on both, the firm and the individual informant level. The sample firms can be regarded as established in their industry, with 77.7 percent of them being older than 20 years. Informants' tenure, with

61.7 percent of them working for their current firms for six years or longer, indicates their well-grounded expertise and verifies their appropriateness as respondents for the given study.

Nonresponse bias was tested in two distinct ways. First, additional information from the Hoppenstedt Firmendatenbank was used to analyze if the nonresponding firms differ from the responding firms regarding turnover, size (employees), and industry. A t-test between the 119 responding and the 268 nonresponding firms showed no significant differences in the three variables ($p > 0.05$). Second, early and late respondents were compared in a t-test between the first 33 percent and the last 33 percent of all respondents. The t-tests comparing the means of each of the theoretical constructs indicated no significant differences ($p > 0.05$) between early and late respondents. Both tests consistently show that nonresponse bias is not a problem.

A Kruskal-Wallis H test was performed to check whether there are differences in responses between the different informant groups such as top level management, head of R&D, head of business development, etc. The test results showed no significant differences across all theoretical constructs of the study ($p > 0.05$).

Measurement

The general measurement approach (see also Homburg et al., 2012) was mainly based on reflective measures for the survey data, except for one formative control variable (environmental dynamisms). A reflective measurement model and subsequent confirmatory factor analysis to assess measurement quality was employed if the observed items were manifestations of an underlying construct (Backhaus, Erichson, Plinke, & Weiber, 2006; Weiber & Mühlhaus, 2010). Formative measurement is more appropriate if a construct summarizes a number of observed variables in form of an index (Diekmann, 1995; Schnell, Hill, & Esser, 2011).

In developing the main constructs of this study, established scales from prior literature could only be used to a limited extent. Especially the moderating business model design variables have only been partially operationalized by Zott & Amit (2007; 2008) based on an expert rater methodology based on company-websites and appropriate measures were not publicly available at the time of designing the questionnaire. Thus, items for the four distinct novelty-, efficiency-, complementarities-, and lock-in-centered business model design constructs were specifically generated. For the firm performance, technological innovation, and control measures, established scales were used. Table 2 and 3 provide detailed information about the construct definitions, measurement items, scales, and the literature used to ground the measurement of the constructs. Table 2 additionally provides insights into the main dimensions of each of the four specifically operationalized business model constructs.

Business model design

The operationalization of the efficiency-, novelty-, complementarities- or lock-in-centered business model design constructs is based on conceptual insights (Amit & Zott, 2001; Zott & Amit, 2010) and early empirical work situated in the area of e-business research (Zott & Amit, 2007; Zott & Amit, 2008). Thereby, two measures for efficiency- and novelty-centered business model design based on expert panelists (Zott & Amit, 2007; 2008) could be used as foundation for the development of the scales. The complementarity- and lock-in scales exclusively built on prior conceptual research (Amit & Zott, 2001; 2010). All measures profit from insights of the exploratory interviews and suggestions in the literature (Bagozzi & Yi, 1988). The practitioner perspective of the interviews and the conceptual foundation delivered by Amit & Zott (2010) were especially helpful in transforming the items from a focus on e-business towards established manufacturing firms.

Table 2: Construct definitions, items for measurement, scales, and literature sources: Business model design themes

Construct	Definition	Basic Dimension	Items	Scale/Literature
Novelty-centered business model design	"The essence of novelty-centered business model design is the adoption of new activities (content), and/or new ways of linking the activities (structure), and/or new ways of governing the activities (governance)" (Zott & Amit, 2010)	Value creation with **newness** of the business model's combination of design elements	We want to offer new combinations of products, services and information with our business model. Our business model brings together new participants (e.g. customers, partners) to jointly conduct business. With our business model, we offer novel degrees of richness (e.g. quality, depth) of the business relationships between stakeholders (e.g. customers, partners). We offer access to an unprecedented variety of participants and goods.	• Reflective measure • Seven-point scale: 1 = "strongly disagree" and 7 = "strongly agree" • Zott & Amit, 2007, 2008, 2010
Efficiency-centered business model design	"Efficiency-centered design refers to how firms use their activity system design to aim at achieving greater efficiency through reducing transaction costs" (Zott & Amit, 2010)	Value creation with efficiency through a **reduction of transaction costs** depending on the combination of design elements	Overall, we offer high transaction efficiency for the participants in our business model. Our company's business model reduces the costs (e.g., production, marketing and sales) of its participants. Our business model offers simplified transactions for its participants (e.g. customers, partners).	• Reflective measure • Seven-point scale: 1 = "strongly disagree" and 7 = "strongly agree" • Zott & Amit, 2007, 2008, 2010
Complementarities-centered business model design	"Complementarities are present whenever bundling activities within a system provides more value than running activities separately" (Zott & Amit, 2010)	Value creation with **synergies** between the various activities of the business model	To create value, we aim to derive synergies between the resources we employ. We combine our various business activities in a way that they provide more value than they would provide separately. We derive more value from bundling our tasks instead of conducting them separately. We aim to provide products and services that yield synergies when utilized together.	• Reflective measure • Seven-point scale: 1 = "strongly disagree" and 7 = "strongly agree" • Amit & Zott, 2001, Zott & Amit, 2010
Lock-in-centered business model design	"Lock-in is the power to keep third parties attracted as business model participants. It can be manifested as switching costs, or as network externalities that derive from the structure, content and/or governance of the activity system" (Zott & Amit, 2010)	Value creation with power to keep third parties attracted as business model participants due to **increasing switching costs**	Participants in our business model (e.g. customers, partners) face high switching costs (costs for switching towards other players in the market). Participants in our business model face high switching costs due to required substantial learning investments. Participants in our business model face high switching costs due to the benefits they experience from the network made available to them.	• Reflective measure • Seven-point scale: 1 = "strongly disagree" and 7 = "strongly agree" • Amit & Zott, 2001, Zott & Amit, 2010

Table 3: Construct definitions, items for measurement, scales, and literature sources: Scales based on established measures

Construct	Definition	Items	Scale/Literature
Technological Innovation	The extent to which the firm introduces new product developments	We constantly introduce new products to the market. We place constant emphasis on developing new products through allocating substantial financial resources. Our organization develops a large variety of new product lines. Our organizations has a strong overall commitment to develop and market new products.	• Reflective measure • Seven-point scale: 1 = "strongly disagree" and 7 = "strongly agree" • Li & Atuahene-Gima (2001), Covin & Slevin (1989), Zahra & Covin (1993)
Firm Performance	Financial firm performance relative to industry competition	Relative to your competitors, how does your firm perform concerning the following statements? • Achieving overall performance. • Attaining market share. • Current profitability. • Return on investment. • Attaining earnings growth.	• Reflective measure • Seven-point scale: 1 = "much worse" and 7 = "much better" • Reinartz, Krafft & Hoyer (2004), Desphande, Farley & Webster (1993), Jaworski & Kohli (1990), Judge & Douglas (1998), Delaney & Huselid (1998)
Environmental Dynamism	Extent of changes in the firm's market environment	Environmental changes in our market are intense Our clients regularly ask for new products and services In our market, changes are taking place continuously	• Formative index • Seven-point scale: 1 = "strongly disagree" and 7 = "strongly agree" • Jansen, Bosch & Volberda (2006), Dill (1958)
Financial crisis	Extent of setbacks in demand caused by the 2007 financial crisis	Please rate the extent of setbacks in demand due to the financial crisis that your company has experienced during the prior 5 years:	• Seven-point scale 1 = "to no extent" and 7 = "to a great extent" • Reilly, Brett & Stroh (1993), Foss, Lyngsie & Zahra (2013)
Number of Innovation Projects	Number of projects related to innovation currently pursued by the firm	Please indicate the number of your current innovation projects	• Six-point rating scale: 1 = 0–1; 2 = 1–3; 3 = 3–10; 4 = 10–30; 5 = 30–100; 6 = more than 100 • Stead (1976)
Firm Size	Size of the firm	Please indicate the number of your full-time employees	• Metric number scale from 0 - ∞ • Simsek, Veiga & Lubatkin (2007)
Industry Segment	Main industry segment of the firm	Please indicate the segment in which your company is most active in: • Electric Drive Systems • Measurement and Process Automation • Switchgear, Controlgear, Industrial Control Systems • Other	• Dummy variables 0/1

Novelty-centered business model design was measured with a three-item scale assessing aspects of bringing together new participants (e.g. customers or partners), offering novel degrees of richness of business relationships between stakeholders, and offering access to an unprecedented variety of participants and goods with the business model (Zott & Amit, 2007; Zott & Amit, 2008). *Efficiency-centered business model design* was operationalized using three items regarding the measures to reduce costs (e.g. production, marketing, and sales), offer simplified transactions, and lower inventory costs for its participants such as customers or partners (Zott & Amit, 2007; Zott & Amit, 2008). *Complementarities-centered business model design* was measured with four items focused on the degree to which a firm's business model creates and appropriates value by focusing on complementary effects (Amit & Zott, 2001; Zott & Amit, 2010). Finally, *lock-in-centered business model design* is assessed with three items on the degree to which a firm's business model creates and captures value by motivating its stakeholders to engage in repeated transactions and to improve their association with the focal firm (Amit & Zott, 2001; Zott & Amit, 2010).

Firm performance

Firm performance was measured with five items. Respondents were asked to rate their companies' performance in comparison to their industry competitors regarding the achievement of overall performance, market share, current profitability, return-on-investment (ROI), and earnings growth (Deshpandé, Farley, & Webster, 1993; Reinartz, Krafft, & Hoyer, 2004). Superior performance of a firm compared to its direct industry competitors unites the goals of both innovation activities (Rosenbusch et al., 2011) as well as business model design (Chesbrough & Rosenbloom, 2002; Zott & Amit, 2007). Such comparative subjective performance measurement has very recently been applied in Management research (Schilke, 2014).

Several steps were undertaken in order to secure the accuracy of the dependent variable. In order to cross-validate this subjective measure, objective data on earnings before interest and tax (EBIT) measured as a percentage of total turnover was collected for a subsample of 39 firms. Significant partial correlation with the objective information, including the main model's control variables, supported the validity of the perceptual performance measure ($r = 0.39$, $p < 0.05$; bivariate: $r = 0.39$, $p < 0.05$). These values are in line with reports of other studies that correlate their subjective measures with objective information to support their scales (Boyer, 1999; Douglas & Judge, 2001). In a next step, the level of interrater reliability was determined by calculating intra-class correlation coefficients (ICC) using performance data from the first respondents that originally accounted for the independent, moderator, and control variables. Interrater reliability was assessed using a two-way mixed, consistency, average-measures ICC (McGraw & Wong, 1996) to assess the degree that informants provided consistency in their ratings of performance across firms (Hallgren, 2012). The resulting ICC was in an excellent range, ICC = 0.79 (Cicchetti, 1994), indicating that informants had a high degree of agreement. Consequently, firm performance was rated similarly across informants. This introduced a minimal amount of measurement error.

Technological innovation

Technological innovation was measured with four items developed by Covin & Slevin (1989), also used in a study by Li & Atuahene-Gima (2001). While technological innovations can comprise new developments in products, services and processes (Damanpour & Evan, 1984), product innovation was selected as a representative measure due to its broad occurrence in the high-technology manufacturing industry. The development and launch of new products represents the main focus of a firm's innovativeness and has major implications for its performance (Rubera & Kirca, 2012). In order to further evaluate the accuracy of the subjective measure, objective information on the R&D intensity (measured by R&D expenditures divided

by revenues) was employed, which could be collected for 66 firms. Triangulation of subjective technological innovation activity measures with a firm's R&D intensity as a proxy has been carried out very recently (Schilke, 2014). Analysis shows a significantly positive bivariate correlation between the average of the survey items and R&D intensity ($r = 0.33$, $p < 0.01$). While the strength of this correlation cannot be considered as high, it is in line with recent research (Boyer, 1999; Douglas & Judge, 2001).

Control variables

This study controls for both objective and subjective factors: environmental dynamism, firm size, number of innovation projects, industry type, and financial crisis. It is important to take both, firm level and environmental control variables into account when studying business model, innovation, and firm performance related effects (Zott & Amit, 2007).

First, a control variable for *environmental dynamism* accounts for potential performance effects due to the degree of instability and changes in a firm's competitive environment (Child, 1972; Dess & Beard, 1984). It is measured as a formative index based on three items pertaining to the intensity of environmental changes in the firms' markets, clients' regular demand for novel products and services, as well as the occurrence of continuous changes in the market (Dill, 1958; Jansen, Bosch, & Volberda, 2006; Volberda & Bruggen, 1997).

Second, *firm size* controls for larger firms' stronger bargaining power, greater potential for value creation and capture, and thus better performance (Zott & Amit, 2007). It is measured by calculating the logarithm of each firm's total number of employees.

Third, *innovation intensity* controls for effects of innovation related inputs on innovative outputs and firm performance (Rubera & Kirca, 2012) and has also been claimed to influence the performance effects of business model design (Zott & Amit, 2007). It was measured with a single item indicating the number of innovation projects currently pursued by the firm, offering

an advantage over traditional measures such as R&D expenditure, with no bias from a very few expensive projects increase the general average (Stead, 1976).

Fourth, *industry effects* with potential influences on firm-level variables such as business model design and performance (Dess, Ireland, & Hitt, 1990) were accounted for. Based on the official classification of the electrical automation industry in Germany, the firms were grouped into electrical drives, controls/switchgear, measurement technology/process automation, and other (Baier & Salié, 2013). A dummy variable was included for each of the first three groups.

Fifth and ultimately, in order to control for potential market effects of the 2008 *financial crises* was measured with a single item asking respondents to indicate the degree to which their firms experienced setbacks in turnover due to the financial crises in the past five years preceding the study (Foss, Lyngsie, & Zahra, 2013; Reilly, Brett, & Stroh, 1993).

Measurement properties of constructs

In order to ensure convergent and discriminant validity of the single reflective constructs as well as the goodness of fit of the overall model to the data, confirmatory factor analysis was conducted using the structural equations modeling software package AMOS 21 (Arbuckle, 2012) and the maximum likelihood approach (Hair, Black, Babin, Anderson, & Tatham, 2006). Additionally, reliability analysis of each single construct was conducted. Table 4 contains an overview of the measurement quality assessment including Cronbach's alphas (α), composite reliabilities (CR), average variances extracted (AVE) indicating both convergent validity and reliability of the individual constructs. Table 4 also confirms discriminant validity of this study's constructs with the square roots of the average variances extracted of each construct being greater than the correlation of each factor with all other factors in the model (Fornell & Larcker, 1981). Goodness of fit measures show satisfactory values ($\chi^2 = 369.03$; df = 278; χ^2/df = 1.33; CFI = 0.97; GFI = 0.81; RMSEA = 0.04; SRMR = 0.07).

Common method bias

Common method bias might pose a problem to studies that rely on key informant methodology (Podsakoff & Organ, 1986). Geared to recent research (Schilke, 2014), several steps were undertaken to limit its influence on the analyses. First and most importantly, separate informants for the dependent variable were employed compared to all other variables (Podsakoff & Organ, 1986). Second, Harman's one-factor test was performed with all items of the theoretical constructs using exploratory factor analysis. Its results suggest that common method bias is not a relevant problem in this study, with no single factor explaining more than 27 percent of the total variance in the variables, which is less than the recommended cutoff value of 50 percent (Podsakoff & Organ, 1986). Third, an additional Harman one-factor test was applied using confirmatory factor analysis (McFarlin & Sweeney, 1992). This version compares the intended six-factor model with a hypothetical single-factor model. Results show significantly worse fit values for the single-factor model ($X^2_{diff} = 513.77$; $df_{diff} = 48$; $p < 0.001$), which supports the earlier finding of no serious influence due to common method bias.

Analytical procedures

Hierarchical OLS regression analyses was employed to test the hypotheses, which allows the comparison between alternative models with and without interaction terms (Jaccard & Turrisi, 2003). Items of all theoretical multi-item constructs were averaged before adding them into the analyses. Both the independent and moderator variables were mean-centered prior to building the interaction terms in order to reduce multicollinearity between them and the original variables (Aiken & West, 1991).

Table 4: Correlations, decriptive statistics and discriminant validity

	Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
(1)	Firm performance	0.77												
(2)	Technological innovation	0.39	0.83											
(3)	Novelty	0.23	0.34	0.76										
(4)	Efficiency	0.12	0.25	0.32	0.76									
(5)	Complementarities	-0.02	0.25	0.35	0.54	0.82								
(6)	Lock-in	0.04	0.29	0.48	0.37	0.20	0.71							
(7)	Environmental dynamism	0.14	0.37	0.19	0.21	0.26	0.07	–						
(8)	Financial crisis	-0.09	-0.03	-0.21	-0.08	-0.03	0.08	0.11	–					
(9)	Number of innovation projects	0.25	0.33	0.27	0.28	0.24	0.19	0.25	-0.03	–				
(10)	Firm size (ln)	0.18	0.23	0.16	0.10	0.24	0.02	0.10	-0.03	0.09	–			
(11)	Industry_1	-0.15	-0.02	-0.05	-0.00	0.10	-0.20	0.10	0.13	-0.01	-0.00	–		
(12)	Industry_2	-0.16	-0.20	-0.21	-0.05	-0.04	-0.03	-0.21	-0.05	-0.09	0.08	-0.21	–	
(13)	Industry_3	0.25	0.21	0.24	-0,01	0.01	0.07	0.18	-0.03	0.01	-0.03	-0.30	-0.64	–
Summary Statistics														
	Theoretical values	1 – 7	1 – 7	1 – 7	1 – 7	1 – 7	1 – 7	1 – 7	1 – 7	1 – 6	0 - ∞	0/1	0/1	0/1
	Mean	4.62	4.35	3.69	4.30	4.88	3.63	4.62	4.38	3.03	6.24	0.09	0.31	0.48
	SD	0.89	1.40	1.23	1.17	1.25	1.23	1.13	1.82	1.13	1.14	0.29	0.47	0.50
	Cronbach's Alpha	0.88	0.90	0.84	0.80	0.89	0.75	0.72	–	–	–	–	–	–
	Composite reliability (CR)	0.88	0.90	0.84	0.80	0.89	0.75	–	–	–	–	–	–	–
	Average variance extracted (AVE)	0.59	0.69	0.58	0.58	0.67	0.50	–	–	–	–	–	–	–

n = 90; numbers on the diagonal show square roots of AVE; numbers below the diagonal show bivariate correlations; AVE and CR not available (–) for formative or single item constructs; correlations with abs. value > 0.21 are significant at $p < 0.05$ and > 0.28 at $p < 0.01$

Interaction effects were tested by examining whether or not the interaction terms contributed significantly to the variance explained in the dependent variable over the main effects of the independent variables (Jaccard & Turrisi, 2003). Only one interaction term per model was considered due to suggestions in the literature (Cohen, Cohen, West, & Aiken, 2003). This included an analysis of the regression coefficients and partial F associated with the resulting change in R^2. A significant interaction term together with a significant increase in R^2 suggest the presence of linear moderation. The form of moderation was analyzed with simple slopes for the significant interaction terms at one standard deviation above and below the mean of each moderator variable (Cohen et al., 2003; O'Connor, 1998).

RESULTS

Six models were tested in the regression analyses (Table 5). Model 1 includes the control and moderator variables. Model 2 adds the direct effect of technological innovation. Models 3, 4, 5, and 6 are the main models that include the interaction terms between technological innovation and business model design. To check for potential multicollinearity, variance inflation factor (VIF) scores were calculated for all models. Multicollinearity does not have a severe influence on the results, with the highest VIF value of 2.77 referring to the industry control "measurement technology/process automation" in model 5 (Cohen et al., 2003).

The direct effect in model 2 shows a positive and highly significant regression coefficient ($\beta = .20$, $p < 0.01$), indicating that firms with higher levels of technological innovation have a significantly higher performance. Model 4 shows a significantly negative interaction effect of efficiency-centered design and technological innovation ($\beta = -.26$, $p < 0.05$) and model 5 shows a significant negative interaction effect of complementarities-centered design and technological innovation ($\beta = -.25$, $p < 0.05$). The regression coefficients for the interaction terms in Model 3 and Model 6 do not show any significant effects on the performance of the firms in the sample. Thus, Hypotheses H1 and H4 are not supported by the data.

Table 5: Regression results

	Firm Performance					
	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**
Intercept	3.24*** (0.67)	3.64*** (0.66)	3.67*** (0.67)	3.58*** (0.64)	3.66*** (0.64)	3.62*** (0.67)
Control variables						
Industry A	-0.32 (0.42)	-0.34 (0.40)	-0.32 (0.41)	-0.29 (0.39)	-0.35 (0.39)	-0.35 (0.40)
Industry B	-0.06 (0.31)	0.03 (0.30)	-0.02 (0.30)	-0.01 (0.29)	0.00 (0.29)	-0.02 (0.30)
Industry C	0.29 (0.30)	0.22 (0.29)	0.22 (0.29)	0.216 (0.276)	0.16 (0.28)	0.22 (0.29)
Firm size	0.14† (0.08)	0.10 (0.08)	0.10 (0.08)	0.11 (0.08)	0.11 (0.8)	0.10 (0.08)
Number of innovation projects	0.16† (0.09)	0.11 (0.09)	0.10 (0.09)	0.15 (0.08)	0.13 (0.08)	0.11 (0.09)
Environmental Dynamism	0.05 (0.09)	-0.02 (0.09)	-0.01 (0.09)	-0.01 (0.08)	0.03 (0.09)	-0.02 (0.09)
Financial crisis	-0.01 (0.05)	-0.00 (0.05)	-0.00 (0.05)	-0.03 (0.05)	-0.02 (0.05)	-0.00 (0.05)
Moderator variables						
Novelty-centered business model	0.13 (0.10)	0.12 (0.09)	0.12 (0.10)	0.06 (0.09)	0.11 (0.09)	0.12 (0.09)
Efficiency-centered business model	0.12 (0.10)	0.11 (0.10)	0.11 (0.10)	0.08 (0.09)	0.10 (0.09)	0.12 (0.10)
Complementarities-centered business model	-0.17† (0.09)	-0.18† (0.09)	-0.18* (0.09)	-0.18* (0.09)	-0.21* (0.09)	-0.18* (0.09)
Lock-in-centered business model	-0.09 (0.09)	-0.14 (0.09)	-0.13 (0.09)	-0.14 (0.09)	-0.13 (0.09)	-0.14 (0.09)
Direct Effects						
Technological innovation		0.20** (0.07)	0.20* (0.08)	0.21** (0.07)	0.19* (0.07)	0.20** (0.08)
Interaction effects						
Technological innovation * Novelty			-0.02 (0.06)			
Technological innovation * Efficiency				-0.13* (0.05)		
Technological innovation * Complementarities					-0.13* (0.05)	
Technological innovation * Lock-In						0.01 (0.05)
$\mathbf{R^2}$	0.21	0.28	0.28	0.34	0.34	0.28
$\mathbf{\Delta R^2}$	0.21†	0.07**	0.00	0.06*	0.06*	0.00

n= 90; unstandardized coefficients and standard errors (in parentheses) are reported; † $p < 0.1$; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

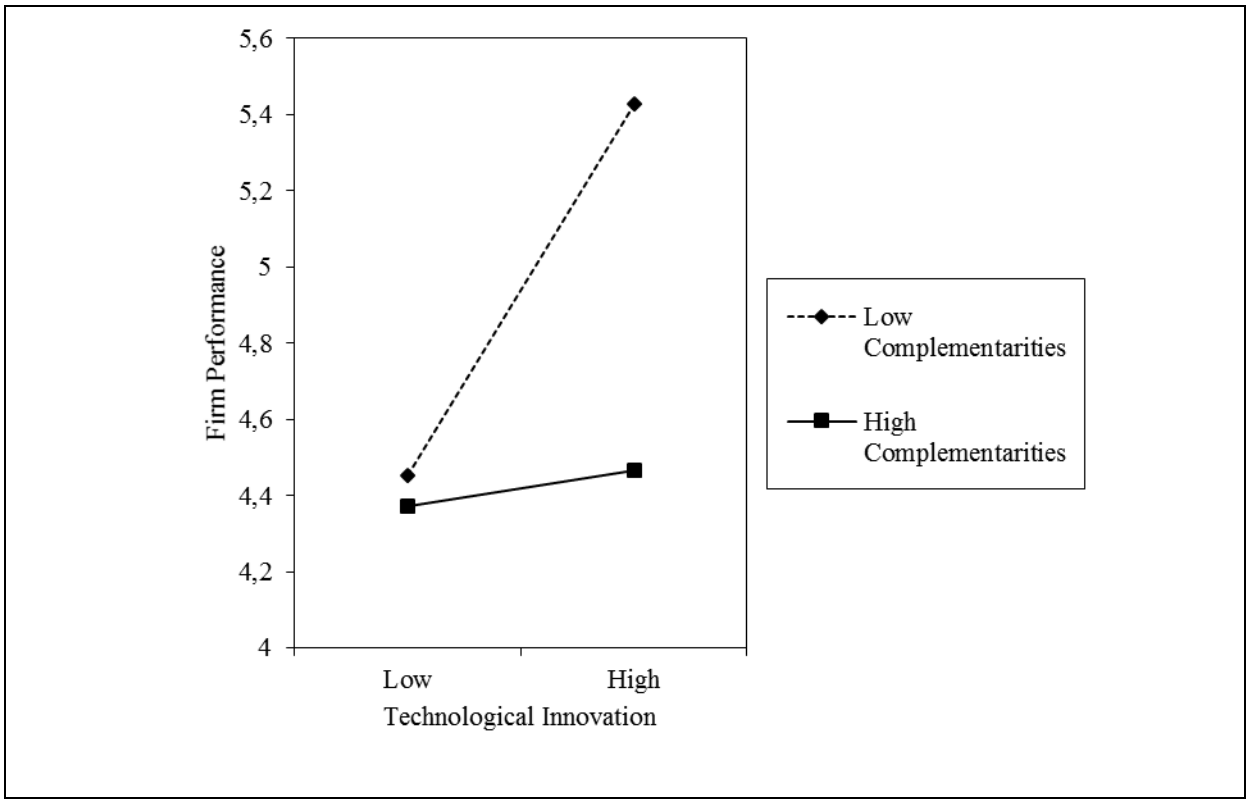

Figure 2: Simple slope analysis graphical illustration for complementarities-centered business model design

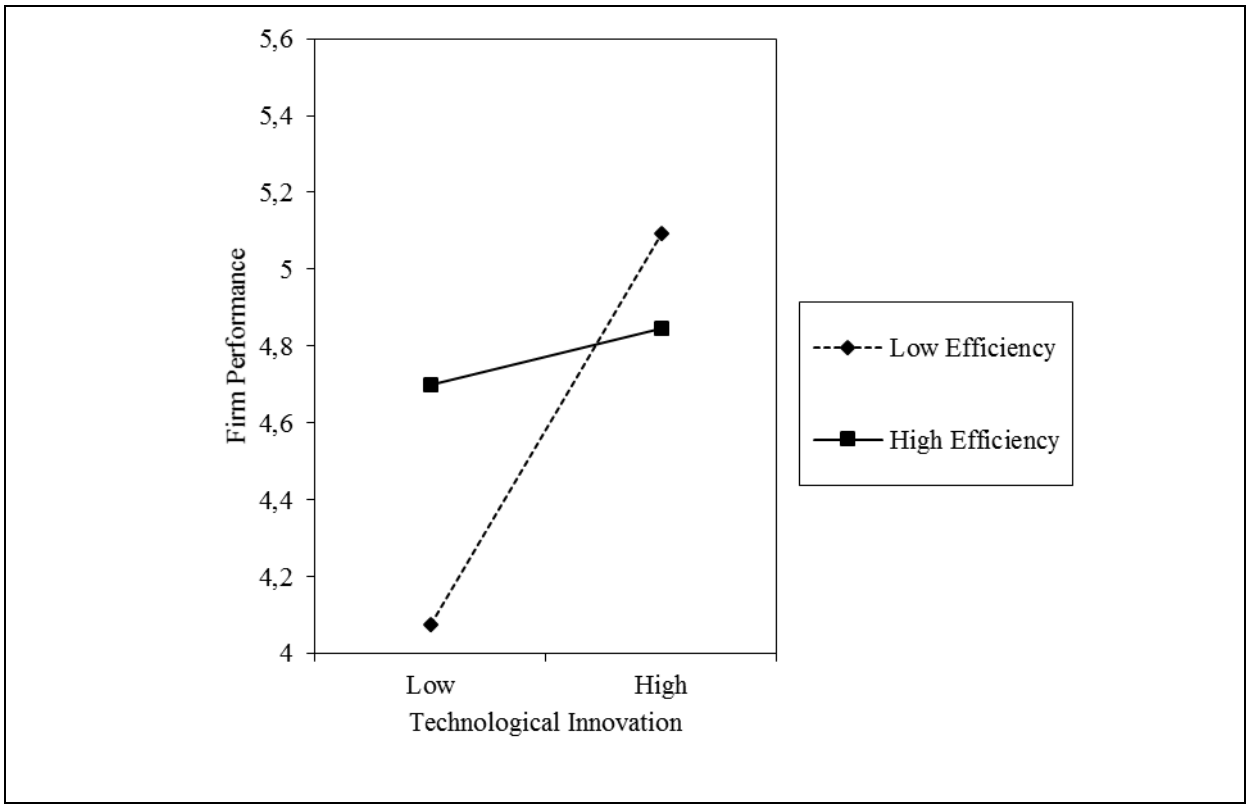

Figure 3: Simple slope analysis graphical illustration for efficiency-centered business model design

The negative and significant interaction terms in Model 4 and 5 suggest that the relationship between technological innovation and firm performance varies across different degrees of efficiency- and complementarities-centered business model design. In order to depict the nature of the interactions, simple slope analysis was performed. Figure 2 illustrates the results for complementarities, which negatively moderate the relationship between technological innovation and firm performance. In a similar vein, Figure 3 shows a negative moderation effect for efficiency. The positive impact of technological innovation on firm performance is stronger under low level of complementarities- and efficiency-centered business model design. These findings provide empirical support for hypotheses H2 and H3. Both business model designs are not significantly correlated ($p > 0.1$) with the criterion variable firm performance, making them pure moderators (Sharma, Durand, & Gur-Arie, 1981).

SENSITIVITY ANALYSES

To test the robustness of the results, several sensitivity analyses were performed. First, the regression model was re-estimated using only single informant data from the full sample of 119 firms. All independent, moderator, dependent and control variables were measured using data from the informant that was higher in position and thus offered more profound knowledge about the organization including performance relevant information. Informants were the chief executive officers or other members of the board such as head of marketing or business development. The results for all hypothesized effects remained qualitatively the same. The effect of technological innovation remained positive and statistically significant ($p \leq 0.05$). The interaction terms remained negative and significant, with efficiency-centered business model design at the $p < 0.05$ level and complementarities-centered business model design only at the $p < 0.1$ level compared to $p < 0.05$ in the original model (See Table 6).

Table 6: Sensitivity analyses 1 – Single informant data

	Firm Performance					
	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**
Intercept	3.35*** (0.58)	3.39*** (0.57)	3.39*** (0.57)	3.47*** (0.56)	3.42*** (0.57)	3.36*** (0.58)
Control variables						
Industry A	-0.33 (0.30)	-0.31 (0.30)	-0.31 (0.30)	-0.30 (0.29)	-0.29 (0.30)	-0.33 (0.30)
Industry B	-0.43† (0.25)	-0.42† (0.25)	-0.42† (0.25)	-0.40 (0.24)	-0.39 (0.25)	-0.41 (0.25)
Industry C	0.24 (0.24)	0.25 (0.24)	0.25 (0.24)	0.20 (0.23)	0.22 (0.24)	0.25 (0.24)
Firm size	0.11 (0.07)	0.09 (0.07)	0.09 (0.07)	0.10 (0.06)	0.09 (0.07)	0.09 (0.07)
Number of innovation projects	0.16* (0.07)	0.13† (0.07)	0.13† (0.07)	0.15* (0.07)	0.14* (0.07)	0.13† (0.07)
Environmental Dynamism	-0.04 (0.07)	-0.09 (0.07)	-0.09 (0.07)	-0.07 (0.07)	-0.08 (0.07)	-0.09 (0.07)
Financial crisis	-0.08† (0.04)	-0.08† (0.04)	-0.08† (0.04)	-0.09* (0.04)	-0.08† (0.04)	-0.08† (0.04)
Moderator variables						
Novelty-centered business model	0.21* (0.07)	0.19* (0.07)	0.19* (0.07)	0.16* (0.07)	0.19* (0.07)	0.18* (0.07)
Efficiency-centered business model	0.11 (0.08)	0.11 (0.08)	0.11 (0.09)	0.08 (0.08)	0.10 (0.08)	0.11 (0.08)
Complementarities-centered business model	-0.02 (0.08)	-0.02 (0.08)	-0.02 (0.08)	-0.02 (0.08)	-0.03 (0.09)	-0.02 (0.08)
Lock-in-centered business model	-0.13† (0.07)	-0.14* (0.07)	-0.14* (0.07)	-0.14* (0.07)	-0.14* (0.07)	-0.14* (0.07)
Direct Effects						
Technological innovation		0.13† (0.06)	0.13† (0.07)	0.13* (0.06)	0.11† (0.06)	0.13† (0.06)
Interaction effects						
Technological innovation * Novelty			-0.00 (0.06)			
Technological innovation * Efficiency				-0.18* (0.07)		
Technological innovation * Complementarities					-0.13† (0.08)	
Technological innovation * Lock-In						0.03 (0.08)
$\mathbf{R^2}$	0.35	0.37	0.37	0.41	0.39	0.37
$\mathbf{\Delta R^2}$	0.35***	0.02†	0.00	0.04*	0.02†	0.00

n= 119; unstandardized coefficients and standard errors (in parentheses) are reported; † $p < 0.1$; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

Table 7: Sensitivity analyses 2 – Aggregated cases

	Firm Performance					
	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**
Intercept	3.32*** (0.56)	3.36*** (0.54)	3.38*** (0.55)	3.30*** (0.53)	3.38*** (0.54)	3.25*** (0.54)
Control variables						
Industry A	-0.35 (0.27)	-0.29 (0.26)	-0.30 (0.26)	-0.24 (0.25)	-0.25 (0.26)	-0.40 (0.27)
Industry B	-0.33 (0.23)	-0.31 (0.22)	-0.31 (0.22)	-0.22 (0.22)	-0.26 (0.22)	-0.29 (0.22)
Industry C	0.16 (0.21)	0.18 (0.21)	0.18 (0.21)	0.20 (0.20)	0.17 (0.21)	0.17 (0.20)
Firm size	0.09 (0.06)	0.06 (0.06)	0.06 (0.06)	0.08 (0.06)	0.07 (0.06)	0.07 (0.06)
Number of innovation projects	0.21** (0.07)	0.14† (0.08)	0.14† (0.08)	0.12 (0.08)	0.14† (0.08)	0.14† (0.08)
Environmental Dynamism	-0.07 (0.07)	-0.14† (0.07)	-0.14† (0.07)	-0.10 (0.07)	-0.13† (0.07)	-0.13† (0.07)
Financial crisis	-0.08† (0.04)	-0.08* (0.04)	-0.08* (0.04)	-0.09* (0.04)	-0.09* (0.04)	-0.08† (0.04)
Moderator variables						
Novelty-centered business model	0.12 (0.08)	0.08 (0.08)	0.08 (0.08)	0.10 (0.07)	0.10 (0.08)	0.07 (0.08)
Efficiency-centered business model	0.23* (0.09)	0.22* (0.09)	0.22* (0.09)	0.17† (0.09)	0.20* (0.09)	0.23* (0.09)
Complementarities-centered business model	-0.07 (0.08)	-0.05 (0.08)	-0.05 (0.08)	-0.04 (0.08)	-0.05 (0.08)	-0.06 (0.08)
Lock-in-centered business model	-0.06 (0.07)	-0.08 (0.06)	-0.08 (0.06)	-0.06 (0.06)	-0.07 (0.06)	-0.08 (0.06)
Direct Effects						
Technological innovation		0.18** (0.07)	0.18* (0.07)	0.17* (0.07)	0.16* (0.07)	0.18** (0.07)
Interaction effects						
Technological innovation * Novelty			-0.01 (0.06)			
Technological innovation * Efficiency				-0.17** (0.06)		
Technological innovation * Complementarities					-0.11† (0.07)	
Technological innovation * Lock-In						0.11† (0.07)
$\mathbf{R^2}$	0.35	0.39	0.39	0.43	0.41	0.41
$\mathbf{\Delta R^2}$	0.35***	0.04**	0.00	0.04**	0.02†	0.02†

n= 119; unstandardized coefficients and standard errors (in parentheses) are reported; † $p < 0.1$; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

Second, the regression models were additionally tested by making use of the fully crossed design of the data, which allowed the aggregation of cases for firms were two respondents were available. The analysis was then carried out with a sample of 119 firms out of which 90 firms were represented by two aggregated cases for each variable in the model. As in the analysis before, all hypothesized effects remained qualitatively the same. Interestingly, the interaction effect of lock-in-centered business model design with technological innovation is positive and significant at the $p < 0.1$ level, which was not the case in the original model. Overall, the sensitivity analyses further support this study's hypotheses (See Table 7).

DISCUSSION

Theoretical implications

This study contributes to business model research as well as the literature on technology and innovation management in a number of ways. First, it extends early insights into the important moderating role of business model design for the innovation – firm performance relationship (Wei et al., 2014) by testing complementarities- and lock-in-centered business model designs in addition to novelty and efficiency only. Moreover, this study employs different measures for both the innovation as well as the firm performance constructs in order to analyze their relationship. Based on an alternative theoretical and empirical approach, this study's findings generally support the earlier insights of the business model's central importance in profiting from innovation (Teece, 2010; Wei et al., 2014). While this consistency shows the substance of the hypothesized theoretical relationships between innovation, business model, and performance, the different measures employed to test them also illustrate their high complexity as indicated by prior research (Baden-Fuller & Haefliger, 2013).

By combining this study's recent findings with earlier insights, patterns of the moderating role of the business model start to emerge. These patterns could then be used to further classify

the working mechanisms behind the vital innovation – firm performance relationship. Building on the four business model design themes already was a good start. Second, this study contributes to business model research by fully operationalizing the holistic concept of business model design by Amit and Zott (2001). This study builds on prior research on business model design and tests the four value-driving design themes novelty and efficiency as well as complementarities and lock-in in the context of high-technology manufacturing firms. Recent empirical work has built only on two of these design themes – efficiency and novelty (Wei et al., 2014; Zott & Amit, 2007; Zott & Amit, 2008). Measurement of all four constructs at the same time covers a broad range of potential approaches that firms can take with their current business model (Amit & Zott, 2001). This study can serve as a decisive spark for further empirical analyses by paving the way for purposeful data collection using key-informant methodologies for example.

Third, this study's findings offer support for the evolving conceptualization about the business model as a mediating device between technological potential and economic value creation, converted through customers and markets (Chesbrough & Rosenbloom, 2002). As hypothesized, analyses show that the moderating effects of both, efficiency- and complementarities-centered designs are negative, meaning that the influence of technological innovation on firm performance is less positive with high levels of efficiency and novelty implemented in firms' current business models. Regarding novelty, these findings support earlier research that has identified a negative moderation of exploitative as well as exploratory innovation's influence on firm growth (Wei et al., 2014).

An important extension of these insights are this study's findings regarding the moderating effect of complementarities-centered business model design, showing the necessity to embrace the holistic opportunities offered by the business model concept to grasp the mechanisms of the innovation – firm performance relationship. It is of great import to note the

setting of this study, as it analyzes firms' as-is business model in conjunction with their innovation behavior. The resulting negative moderation by current designs are in line with the emerging understanding that new technological developments require and even potentially trigger complementary business model change (Calia et al., 2007) .

Fourth, two of this study's hypotheses proposed positive moderating relationships of novelty- and lock-in-centered business models, which would have increased the positive influence of technological innovation on firm performance even more. Surprisingly, the data in the main model does not support these hypotheses. While the sensitivity analyses with an extended data set show some empirical support for the positive moderation of lock-in-centered business models (see Table 7), the effect remains close to zero in the main model, as does the influence of novelty-centered design. These results, especially the lack of support for a positive moderation effect of novelty-centered design are somewhat surprising, given recent empirical evidence that novelty-centered business models can weaken the negative effect of exploitative innovation on firm growth (Wei et al., 2014).

While firm growth is only one aspect included in the broader measure of firm performance applied in this study, which additionally includes market share, current profitability, return-on-investment (ROI), and earnings growth (Deshpandé et al., 1993; Jaworski & Kohli, 1993; Reinartz et al., 2004), there are also other potential explanations why the data did not show the hypothesized effects. One of them is that a business model, which is generally centered on novelty, may not be customized enough to account for the specific requirements of different technological innovations. This would further support concepts that call for a joint design of business models together with new product development (Björkdahl, 2009). Another reason could be that novelty-centered design is simply not new enough to account for the demands of innovative technologies, as a business model innovation potentially could.

Regarding lock-in-centered business models, one reason for the nonexistence of a significant moderation effect on the innovation – performance relationship may be that the positive effects of lock-in for innovation, as hypothesized, are diminished by the negative effects that are to be expected regarding overall firm performance (Dong et al., 2011). A firm's strategic assets, e.g. its brand name and trust between buyer and seller, may positively contribute to the effects of lock in (Amit & Zott, 2001) and thus on the performance effects of technological innovations. But network externalities (Shapiro, Varian, & Becker, 1999), which have a positive effect especially when there is a large number of other customers consuming a good (Katz & Shapiro, 1985), might suffer from necessary adoptions to novel product developments (Hargadon & Douglas, 2001). In addition, positive effects of lock-in centered business model design might be negatively affected by the challenge of keeping up high switching costs with customer loyalty programs or familiar product features (Amit & Zott, 2001; Williamson, 1975) when new technological developments are introduced.

Ultimately, while aiming at the moderating role of business model design, this study offers additional empirical evidence on the innovation – firm performance relationship itself in a setting of high-technology manufacturing firms. These findings are in support of a majority of studies that see a positive direct relationship between technological innovation and firm performance (Deeds & Decarolis, 1999; Zaheer & Bell, 2005), which in turn is an indicator of the quality of the given data set. The findings clearly show the large potential of efficiency-, complementarities-, novelty-, and lock-in-centered design when examining and explaining performance related effects of innovation. The business model has proven to be an essential concept in the realms of innovation.

Managerial implications

A number of important implications emerge from the analyses for managerial practice in the areas of innovation management and business strategy. Findings reveal that the negative

moderation effects of the currently employed business model design can explain part of the challenges that managers in high-technology industries face with profiting from their innovation activities (Baden-Fuller & Haefliger, 2013). Innovating firms should recognize that high levels of efficiency and complementarity in their business model may constrain performance when engaging in technological innovations. The impact will still be positive, but weaker than when levels of these business model designs are low. Firms should take their business model, and especially adaptations thereof, into account if they want to tap the full potential of their new product developments.

Interestingly, attaching customers to the firm by designing the business model around lock-in and high switching costs does not, positively nor negatively, affect the firm related outcomes of innovative activities. The findings further suggest that novelty-centered business model design may not be profound enough to enhance the positive effects of technological innovations on firm performance. In line with the literature on business models (Björkdahl, 2009), practitioners should consider applying more radical tools like the engagement in business model experiments (McGrath, 2010; Sosna, Trevinyo-Rodríguez, & Velamuri, 2010), which have the potential to yield insights for complete business model innovation and change and ultimately deliver the intended benefits for fresh technologies and sustainable firm performance.

Limitations and Outlook

A few limitations apply to this study. First, the analyses are based on cross-sectional data. Although the theoretical model implies certain causal relationships, cross-sectional data cannot be employed to confirm causality due to the potential risk of endogeneity issues (Antonakis, Bendahan, Jacquart, & Lalive, 2010, 2012). Longitudinal studies are thus highly encouraged to replicate the models with time series or panel data. Second, large and medium-sized high-technology manufacturing firms are examined with this study's sample. Its findings may

therefore not be directly transferred to the study of small firms that often face a different availability of resources, resulting in smaller R&D expenditures and a different innovation behavior. Third, there are some limitations regarding the four business model design themes. Novelty-centered design was tested to account for anticipated changes of the business model due to technological innovation. Scholars should to go one step further and begin to operationalize the concept of business model innovation more profoundly in dependence of specific technologies or in a more generic manner. Moreover, this study does not account for potential interrelations between the business model designs. Thus, additional studies on the effects of these potentially complementary effects (Zott & Amit, 2007) are needed, also to clarify their impact on the innovation – firm performance relationship.

The steps taken in this study offer a solid foundation for future research efforts in the areas of business model design and innovation management. The chosen methodological approach and data do not allow for explicit test of which innovation characteristics work best with what kind of business model design. Thus, further, especially qualitative approaches (e.g. Björkdahl (2009), Calia et al. (2007)) are encouraged that analyze how certain technologies can be successfully combined with certain business model designs. While this study is limited to the test of technological innovations only, future studies are strongly encouraged to test different innovation types for moderation by the business model, e.g. service, process, or management innovations. Additionally, different settings such as service firms in particular offer great potential for studying the effects of different business model designs. Applications of varying innovation typologies, e.g. incremental versus radical, need further research to reach a better understanding of the innovation – performance relationship and the role of the business model within it. The legitimacy of the business model concept will profit from such courageous empirical studies that cross the boundaries of business model research towards promising adjacent fields such as technology and innovation management.

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STUDY 4: THE ROLE OF BUSINESS MODEL CHANGE IN CREATING VALUE FROM TECHNOLOGICAL INNOVATION

ABSTRACT

The business model of a focal firm together with its partners and other stakeholders experiences a central function in commercializing new technologies. Focused on resource-based theory, this article theoretically and empirically tries to gain clarity about the complex relationships that can arise from actively changing the elements of a business model in an attempt to maximize value creation from different types of technological innovations. The elements of a business model are content, structure, and governance. Business model change happens through a renewal of one, two, or even all three of the single elements. While there are differences in the levels of significance, there are generally strong positive effects of changes to each single element as well as of systemic business model changes on value creation from incrementally and radically new products as well as from process developments. The data to test these relationships stems from a large-scale sample of 2346 manufacturing and service firms in Germany. To test the robustness of the results and to advance insights into the causality between business model change and technological innovation, additional propensity-score matching was applied to the cross-sectional data. Additionally, the effects were tested with a subsample of 684 firms based on longitudinal data with a time lag of two to four years. Both analyses support the initial findings.

INTRODUCTION

A successful business model depicts how firms use customers and markets to convert their technological resource potential into the creation and appropriation of economic value (Björkdahl, 2009; Chesbrough & Rosenbloom, 2002). Scholars have begun to realize the potential benefits of business model design, either as a critical success factor by itself or as a major complement to technological innovation, due to its high value creating potential and its lower requirements of up-front investments in R&D and specialized resources (Amit & Zott, 2012). According to the 17th PwC Annual Global CEO Survey (PriceWaterhouseCoopers, 2014), the majority of managers see technological advancements as the 'next big thing' to impact their companies in the upcoming decade, naming 'business model change' as the number one reason to believe so. Thus, new technologies will increase the need for complementary business model developments.

In situations where a business model does not match the characteristics of a new technology, managers will have to change it to successfully capture the full value potential from that innovation to their firm (Chesbrough & Rosenbloom, 2002). Thereby, the business model is a separate construct from technology, even though it is essentially connected to technological innovation (Baden-Fuller & Haefliger, 2013). The prominent example of Kodak, a company that used to have one of the most successful business models for analog film technology and the products, services, and processes that came with it, cruelly shows the significance that business model changes may have for firms' well-being. Kodak even invested the know-how and financial means necessary to develop a technology that could have led them into a prospering future – the first digital camera – but did not manage to find a viable business model to benefit from it and as a result almost went bankrupt. A once successful business model does not last forever. Definitely, cutting-edge products and services are elementary for the favorable outcomes of these firms. But also the most innovative technologies may need an innovative

business model designed to unpack their full commercial potential (Björkdahl, 2009; Zott & Amit, 2008). At the end of the day, firms should prefer to proactively initiate changes to their business model, rather than wait until external forces dictate them (Teece, 2010).

Despite a still preliminary theoretical and empirical understanding of what a business model actually is and what it does due to the fragmented literature base (George & Bock, 2011), the field of research has reached some important commonalities. Recent work sees emerging common themes regarding the business model concept as a new unit of analysis, as emphasizing a holistic and system wide approach to explain how firms' do business, as taking into account the importance of company activities for its conceptualizations, as well as seeking to explain value creation and not only value capture (Zott, Amit, & Massa, 2011). The relationship of the business model construct with technological innovation cannot exhibit such clarifying advancements yet. Its state of understanding is at least as unresolved and characterized as highly complex (Baden-Fuller & Haefliger, 2013). Two major roles of technology have emerged so far: technology may function as an enabler of a business model (Calia, Guerrini, & Moura, 2007; Khanagha, Volberda, & Oshri, 2014) and business models may be required as a complement to innovative technologies (Björkdahl, 2009; Dmitriev, Simmons, Truong, Palmer, & Schneckenberg, 2014). This study focusses on the latter. In general, firms should proactively initiate changes to their business model instead of being forced to passively do so (Teece, 2010).

Going back to Teece's (1986) framework of complementary assets responsible for innovative profits, the business model concept has evolved to integrate the creation of value for the customer together with its appropriation for the focal firm (Casadesus-Masanell & Ricart, 2010). New technologies are of major importance for companies, but may not be sufficient to guarantee sustainable firm performance (Doganova & Eyquem-Renault, 2009). Even though many firms are successful without changing their business model, scholars have regularly pointed towards the hidden performance potential of such changes as a complementary activity

to technological innovation (Chesbrough, 2007; Chesbrough, Ahern, Finn, & Guerraz, 2006). While there seems to be growing agreement on the positive effect of business model change on innovation success, there is a lack of large scale quantitative empirical evidence on its existence, needed to resolve ubiquitous complexity. We as researchers don't know enough about what elements of the business model have to be changed in order to impact value creation from technological innovation, if they have to be changed alone or in concert, and if the effects of change differ by innovation type. Thus, the critical question arises: *What business model changes are needed to ensure high value creation from different types of technological innovation?*

With a focus on resource-based theory, this article contributes to business model research and the literature on technology and innovation management in a number of ways. First, the study offers solid quantitative empirical evidence for the positive effects of business model change on the value creation and capture from technological innovation in 2346 established manufacturing and service firms. Second, and more specifically, the single elements of business model change content, structure, and governance differ in their influence on value created by innovation type. Organizations should seek to understand the importance of changing specific elements according to their innovation behavior, e.g. incremental versus radical product innovation or process developments. Third, offering evidence for business models' often proposed systemic nature, findings show that a positive and highly significant simultaneous effect exists when firms change more than one business model element at the same time. Additional propensity score matching analysis shows that the effect is greatest for value creation with incremental product innovations, followed by process innovation and weakest for radical product innovation. Sensitivity analyses based on a longitudinal subsample even indicate that these effects stay sustainably effective after a three-year time lag. These encouraging results approve the often discussed potential of business model change in

complementing technological innovation, as a highly valuable instrument for companies facing strong competitive pressures in dynamically changing environments.

CONCEPTUAL BACKGROUND

The business model concept and its constituent elements

Out of the manifold understandings (George & Bock, 2011), Amit & Zott (2001) propose an emerging common definition of the business model and its underlying components as "*the content, structure, and governance of transactions designed as so as to create value through the exploitation of business opportunities*" (p. 494). Originated in e-business, the authors have expanded this understanding towards established companies from different industries and sizes (Zott & Amit, 2010). Based on these considerations, Zott, Amit & Massa (2011) have found consent on the business model as a firm-centric, yet boundary-spanning system of interdependent activities conducted by the focal firm together with its stakeholders such as vendors, customers, etc. The business model is explicitly distinct from other performance oriented constructs such as strategy, as it is a "stand alone concept in its own right" (Baden-Fuller & Haefliger, 2013, p. 419) reflecting a realization of the corporate strategy (Casadesus-Masanell & Ricart, 2010, p. 204).

Content, structure, and governance are the three design elements of a business model (Amit & Zott, 2001; Zott & Amit, 2010). First, business model *content* refers the actual goods or information of a business transaction as well as the required resources and capabilities to enable that transaction (Amit & Zott, 2001). It represents the selection of the ultimately performed activities (Zott & Amit, 2010). Second, business model *structure* depicts the parties involved in a business transaction and their connections to each other as well as the order of the transactions and the selected exchange mechanism to enable them (Amit & Zott, 2001). Consequently, the structure describes the activities' interlinkages and their relevance for the

business model, e.g. core, supporting or peripheral (Zott & Amit, 2010). Third, business model *governance* describes the legal form of the business, the relevant parties' control of the flow of goods, information, and resources as well as the incentives to participate in transactions overall (Amit & Zott, 2001). It depicts who performs which activities within the boundary-spanning system (Zott & Amit, 2010).

Value creation and the business model

Business models' value creation can take several forms and has previously been associated with superior firm performance (McGrath, 2010; Zott & Amit, 2007; Zott & Amit, 2008), competitive advantage (Teece, 2010), financial value (Alessandri & Bettis, 2003; Demil & Lecocq, 2010; Garnsey, Lorenzoni, & Ferriani, 2008), and also non-economic outcomes such as firm survival (Andries & Debackere, 2007), societal value (Dahan, Doh, Oetzel, & Yaziji, 2010; Thompson & MacMillan, 2010; Yunus, Moingeon, & Lehmann-Ortega, 2010) and organizational learning (Gambardella & McGahan, 2010; Itami & Nishino, 2010).

Porter (1985), as the creator of the value chain concept, proposes that new value is created through a firm's invention of novel technologies, methods of production, or new forms of resources. Resource-based theory partially extends those ideas and proposes that a resource is valuable if it helps to exploit opportunities, neutralizes an organizations' threats (Barney, 1991), allows them to meet customer needs better (Bogner & Thomas, 1994) or at lower costs then their competition (Barney, 1986). Based on these considerations, two important approaches on value creation and capture are worth noting in the area of the business model concept.

The first approach introduces two types of value: use value and exchange value (Bowman & Ambrosini, 2000). Use value represents a consumer's subjective estimation of the benefits of consumption, e.g. the performance features of a new product or service (Lepak, Smith, & Taylor, 2007). An increase in use value requires innovation or change to the status-quo in form

of either higher willingness to pay for a novel benefit (e.g. radically new products or services), for something perceived to be better (e.g. incremental improvements to products or services), or a lower unit cost for the same previously perceived benefit (e.g. process improvements) (Priem, 2007). Exchange value represents the actual monetary amount paid by a customer for the use value of a certain offering (Lepak et al., 2007). It thus directly depends on an increased experienced benefit of the customer, potentially leading to higher overall payments to the group of companies connected within a firm's value network (Priem, 2007) such as the business model.

The second approach of 'total value created' (Brandenburger & Stuart, 1996) is closely related to the conceptualization of use value and especially of exchange value. Total value in the business model field is represented by the sum of all values that its participants – the focal firm, customers, or partners – create altogether (Amit & Zott, 2001). The firm then appropriates its share of this total value: the profit (Baden-Fuller & Haefliger, 2013). The business model specifically includes the creation of value before its appropriation and thus extends earlier concepts dealing with firms' innovation success, e.g. complementary assets (Björkdahl, 2009; Teece, 1986). While value capture is crucial for firms' survival and growth, managers should not leave their customers' perceived benefit and the resulting revenue stream to chance, but rather aim to maximize their use value in an ever increasing competitive environment (Priem, 2007).

While the concept of total value centers on how the whole business model's value created is divided between its participants, the concept of use and exchange value rather aims at explaining how the value is originally generated. Both concepts are strongly interrelated and work hand in hand to depict how business models go about value creation from technological innovation.

Technological innovation and business model change

Realizing and appropriating the valuable potential that can emerge from technological innovations are management activities closely associated with the business model (Björkdahl, 2009). An innovation ultimately represents the sum of an invention and its commercialization (Afuah, 1998) and new technological developments thus have to be brought to market using complementary capabilities or assets (Teece, 1986). Changes in business model design may stand for their own (Desyllas & Sako, 2013) or represent exactly the complementary actions needed for successful new products and processes (Schumpeter, 1934). If done well, these redesigns may result in either lower cost or higher value for customers, leading to increased returns for the focal firm until novel features are imitated (Teece, 2010). As indicated before, this depends on an increase of the use value of the target customer and the monetization thereof (Priem, 2007). Here, complementary business model changes enfold their advantage over pure technological innovation by reshaping the positioning of a new technology towards customers and markets (Chesbrough & Rosenbloom, 2002). Business models ultimately define how and to whom a technology is offered. The probability of innovative success strongly benefits from such entrepreneurial actions (Goel, Miesing, & Chandra, 2010; Ireland, Hitt, Camp, & Sexton, 2001).

The many different understandings of business model change in the literature vary between „the capacity to create new strategies which modify the rules of the competitive game in an industry“ (Yunus et al., 2010, p. 312), “a strategic renewal mechanism“ (Sosna, Trevinyo-Rodríguez, & Velamuri, 2010, p. 385) and “a novel approach to commercializing [a firm’s] underlying assets“ (Gambardella & McGahan, 2010, p. 263). Taking these understandings into account, this study explicitly builds on the conceptual work of Amit & Zott (2001, 2012; 2010) together with insights from resource-based theory (Barney, 1991; Penrose, 1959) to advance insights into the working mechanisms of business model adoption and change. *Business model*

change is finally defined as the thorough adoption of one or more of the three business model design elements, each adaption strong enough to change the system itself: *content* by "adding novel activities", *structure* by "linking activities in novel ways", or *governance* by "changing one or more parties that perform any of the activities" (Amit & Zott, 2012, p. 44). Consequently, the degree of novelty increases with the number of business model elements that are subject to change.

To explain the process of value creation behind business model change, resource-based theory offers three basic value creating tasks: resource allocation, combination, and exchange (Chen, 1996; Sirmon, Hitt, & Ireland, 2007). When recalling the above elements of business model change, parallels emerge with resource-based value creation: content change may require the allocation of fresh assets, structure change potentially concerns their distinct combination with existing ones, and governance change may relate to a firm's capability to leverage its resource-base through exchanges with external players. Organizations create economic value for themselves, their stakeholders and society based on the allocation and orchestration (Hitt, Ireland, Sirmon, & Trahms, 2011) as well as combination and exchange of resources by interacting with their market environment (Moran & Ghoshal, 1999). The boundary-spanning nature (Zott & Amit, 2007) of the business model concept facilitates these tasks.

But how do business model change and value creation from innovation relate to each other? Despite its enormous potential for improvement in both research and practice (Baden-Fuller & Haefliger, 2013), the influence between the two areas has received little attention in the respective literature to date. One potential starting point is the commonly applied categorization of innovations according to their degree of novelty – incremental versus radical - which has broadly been shown to influence value creation (Garcia & Calantone, 2002). Another complementary set of categories proposes to cluster technological innovations into novel products, services, or processes (Damanpour & Evan, 1984). Recent qualitative empirical

works have begun, without specifically looking at the differences between innovation types, to analyze the role of business model changes in concert with various technological innovations. They focus on radical product innovations (Abdelkafi, Makhotin, & Posselt, 2013; Bohnsack, Pinkse, & Kolk, 2014; Khanagha et al., 2014; Simmons, Palmer, & Truong, 2013), but also incremental product innovations (Lehoux, Daudelin, Williams-Jones, Denis, & Longo, 2014) and service innovations (Palo & Tähtinen, 2013).

Process innovations differ from new product developments concerning the objectives they follow as well as regarding the attention that they receive from business model scholars. The aim of new process developments is rather on decreasing costs of production rather than increasing output figures such as turnover (Boer & During, 2001; Damanpour & Gopalakrishnan, 2001). Even though these differences seem to call for well-chosen approaches regarding the process-related requirements for business model change, literature remains rather slow to pick up on this promising area of investigation and start off with contradicting opinions. While conceptual efforts see a rather minor relevance in accompanying a firm's incremental manufacturing process improvements by changes to its business model (Teece, 2010), earlier qualitative evidence tells a different story of the crucial relevance of business model change for the economic success of process innovations, for example in the handling of waste water (Björkdahl, 2009).

Generally, diverse organizational efforts seem necessary for different innovations, which in turn may have manifold implications on their success (Calia et al., 2007). Regarding the business model, the more radical the new technology, the steeper are the requirements for the revenue architecture and thus likely changes thereof (Teece, 2010). Increasing radicalness may even make the search for new partnerships within a firm's value network, and thus changing business model governance, more complicated (Dmitriev et al., 2014). While differences seem to exist regarding the relationship between business model change and the various innovation

types, a generally positive influence can be assumed judging from the recent, mostly qualitative, research advancements. But neither business model literature nor resource–based theory offer enough detailed insights to be able to delineate specific hypotheses on the relationships between each single elements of business model change and the resulting value creation from different types of innovation. This study is an attempt to provide research on this subject matter, as the hypotheses in the following paragraphs will show. Figure 1 illustrates the underlying theoretical model.

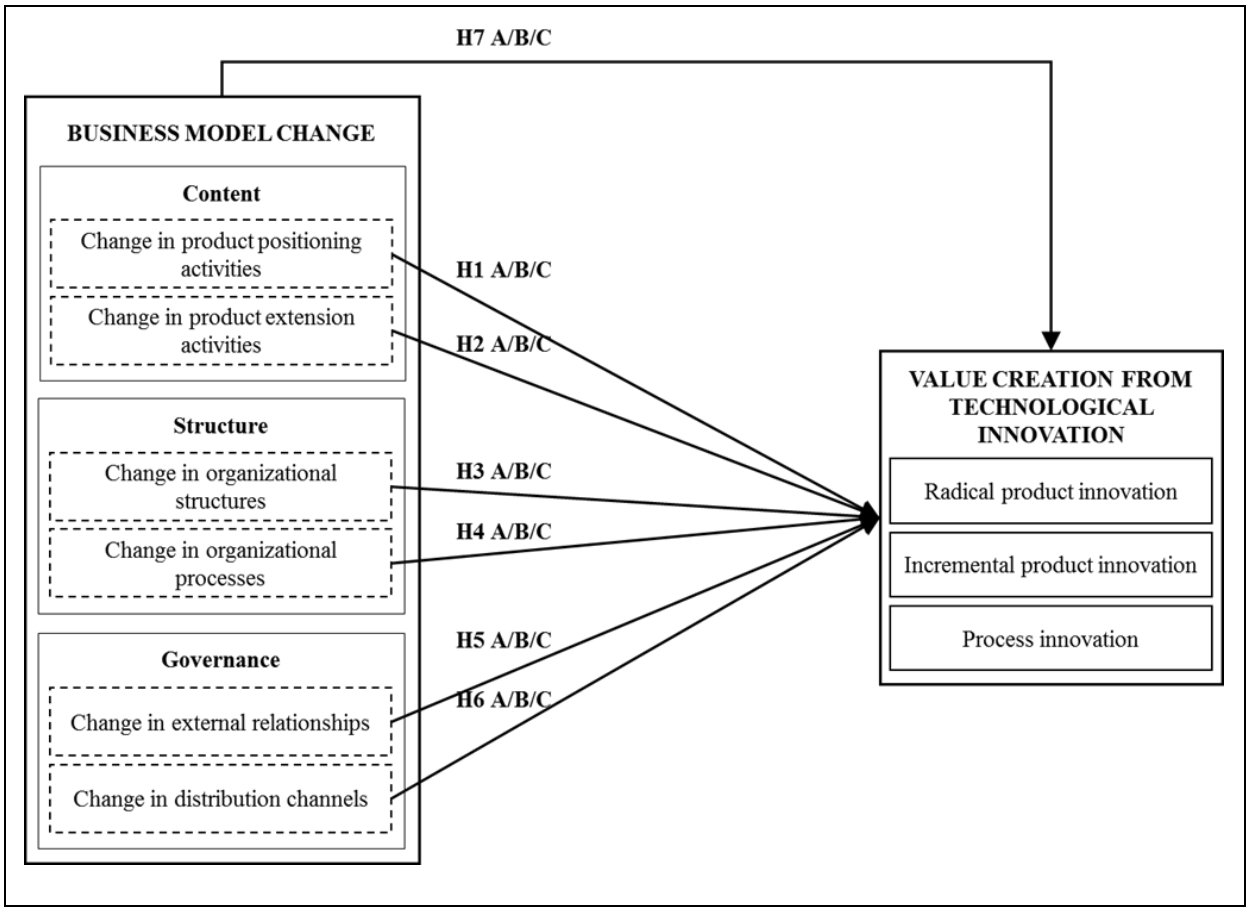

Figure 1: Proposed theoretical model

HYPOTHESES

Changing business model content

In its very core, changing the business model content means adding novel activities to the system (Amit & Zott, 2012). Major activities in that sense selling products to customers (Bonaccorsi, Giannangeli, & Rossi, 2006) as well as turning certain strategic choices about customers, markets, and value propositions into value (Smith, Binns, & Tushman, 2010). A value proposition defines the value created in the customers' eyes based on a technology such as a novel product or service (Chesbrough & Rosenbloom, 2002). It is thus the business model content element that has to deliver a formula for finding the right customer for the right technological development. Offering large parallels with marketing literature (Keegan, 1969), two important aspects of this key task are product positioning and product extension activities. First, new content must clarify the product positioning activities to create customer value such as proposing the right offering to new target markets (Björkdahl, 2009; Schindehutte, Morris, & Kocak, 2008). A novel offering can lead to a change in the value proposition for customers and the focal firm (Demil & Lecocq, 2010; Dewald & Bowen, 2010; Mustar et al., 2006).

Second, novel content may contain specific product extension activities to attract new customer groups and facilitate commercialization. In order to win and retain those new customers, it does not only refer to what customers pay for, e.g. the actual offering (McGrath, 2010), but also the resources and capabilities that are required for an exchange, such as incentive systems (Casadesus-Masanell & Llanes, 2011) and brands (Desyllas & Sako, 2013). These aspects have implications for the value proposition describing the use value and consequently also the exchange value that can be generated from new offerings (Björkdahl, 2009; Mahadevan, 2000).

Resource-based theory suggests that the allocation – next to the combination and exchange – of new resources is a major aspect leading to value creation (Penrose, 1959; Wernerfelt, 1984). Sustaining a firm's performance may call for innovation of the business model (McGrath, 2010) and the competences it employs (Amit & Schoemaker, 1993; Crook, Ketchen, Combs, & Todd, 2008). The business model requires novel resources (Andries & Debackere, 2007; Chatterjee, 2005) that can lead to important new business capabilities (Athreye, 2005; Grönlund, Sjödin, & Frishammar, 2010; Mangematin et al., 2003; Möller, Rajala, & Westerlund, 2008). All assets that enable a firm to realize new value creating strategies can be considered relevant firm resources (Barney, 1991), applicable to changed business model content. Firms are more likely to profit from new technological developments if they employ relevant assets and capabilities to support their positions within a market or industry (Teece, 1986). Recalling that while differences in both quality and size seem to exist regarding the effects between business model change and different innovation types, a generally positive influence can be assumed, this article proposes:

> *Hypothesis 1: Changing the content of a business model by introducing changed product positioning activities is positively related to value creation from technological innovation in form of a) incremental product innovations, b) radical product innovations, and c) process innovations.*

> *Hypothesis 2: Changing the content of a business model by introducing changed product extension activities is positively related to value creation from technological innovation in form of a) incremental product innovations, b) radical product innovations, and c) process innovations.*

Changing business model structure

Change of the business model's structure can be accomplished by linking activities within the system in new ways (Amit & Zott, 2012). It entails adapting how an enterprise is organized to meet the needs of its customers in the best possible way (Gambardella & McGahan, 2010; Teece, 2010). It further contains a set of structured and interconnected operational relationships (Doz & Kosonen, 2010) and employs an organizational architecture of competencies, people

and processes for value creation (Smith et al., 2010). Business model structure thus covers the two aspects organizational structures and processes. First, adapting the organizational structure determines the capability to scale-up rapidly with rising demands for a new technology (Amit & Zott, 2001; Athreye, 2005). It represent a key building block of a business model next to resources and competences (Demil & Lecocq, 2010; George & Bock, 2011). Second, in order to organize the activities required to create value, structure must contain a description of operational processes (Baden-Fuller & Morgan, 2010; Casadesus-Masanell & Ricart, 2010).

In general, resource-based theory proposes that a unique combination of specialized resources and capabilities may foster value creation (Amit & Schoemaker, 1993; Barney, 1991; Penrose, 1959; Wernerfelt, 1984). Firms that generate such exclusive syntheses increase the likelihood to achieve an advantage over firms that do not take such action (Dyer & Singh, 1998). Having a set of resources at ones proposal is thus only one aspect of resource-based value creation. Deploying them in unique bundles in order to exploit their full potential is another (Crook et al., 2008). The improvement of a business model requires a process of capability development where firms bundle their resources in new ways and leverage the contributions of existing resources to establish novel activities (Huygens, Baden-Fuller, Van Den Bosch, & Volberda, 2001; Winter, 1995). These specialized configurations, based on new technologies for example, can then be deployed with resource advantage, market opportunity or entrepreneurial strategies to create value for customers and achieve a competitive advantage for the firm (Hitt et al., 2011). Based on the above considerations and taking into account the generally assumed positive influence of business model change on different innovation types, including potential variances in both quality and size of the effects, this article proposes:

> *Hypothesis 3: Changing the structure of a business model by introducing changed organizational structures is positively related to value creation from technological innovation in form of a) incremental product innovations, b) radical product innovations, and c) process innovations.*

Hypothesis 4: Changing the structure of a business model by introducing changed organizational processes is positively related to value creation from technological innovation in form of a) incremental product innovations, b) radical product innovations, and c) process innovations.

Changing business model governance

Change of the business model governance comprises a reorganization of the parties that are responsible for performing the relevant business activities within the system (Amit & Zott, 2012) and the way they are controlled through legal forms or incentives (Amit & Zott, 2001). The business model serves the construction of an innovation's techno-economic network (Doganova & Eyquem-Renault, 2009). Its governance plays a central role in networked value creation (Amit & Zott, 2001), affecting the exchange value available to firms (Priem, 2007).

Especially two aspects have to be considered for a change of the business model's governance. First, it specifies how a firm needs to connect itself to a network of customers, suppliers and partners in order to create and capture value (Andries & Debackere, 2007; Garnsey et al., 2008; Mason & Leek, 2008). Business model governance depicts how organizations open up their boundaries to cooperate with partners in order to anticipate and respond to changing market situations (Day, 2011). Second, the governance dimension is mainly driven by the respective value delivery mechanisms or distribution channel of the new model. It defines how a firm delivers the valuable outcomes, e.g. from novel technological developments, to their target customers (Chatterjee, 2005; Itami & Nishino, 2010). Scholars agree that the design of a business model has to cover not only the value creation and capture mechanisms, but also the value delivery mechanisms employed (Chesbrough & Rosenbloom, 2002; Desyllas & Sako, 2013; Teece, 2010; Zott et al., 2011). This distribution domain (Wirtz, Schilke, & Ullrich, 2010) controls the value stream towards buyers of an innovative technology by offering the necessary logistical capabilities that are critical to the business (Mahadevan, 2000).

In resource-based theory, such economic exchange is generally considered to be the major mechanism responsible for realizing most of the productive potential of resources and capabilities, as it rearranges the services that are within the reach of each participant in the transaction (Moran & Ghoshal, 1999). Firms can profit from the resources available in their environment to implement a novel business model by rethinking their organizational boundaries towards external players (Zott & Amit, 2007). A firm's relationships with other firms in its environment even represent an organizational capital resource by itself (Barney, 1991). Designing a business model requires gaining appropriate control over a system of interdependent assets (Desyllas & Sako, 2013; Henderson & Clark, 1990; Zott & Amit, 2010). Potential modes of such control are ownership on the one hand, which facilitates incentive alignment, and strategic partnerships on the other hand, potentially leading to added credibility of the innovator (Teece, 1986).

The strategic actions of business model change are required to develop and effectively benefit from a firm's network (Ireland et al., 2001). Resource networks help firms to access previously unavailable capabilities, leading to advantages such as risk sharing, enhanced innovation proficiency and faster market access (Hitt, Dacin, Levitas, Arregle, & Borza, 2000). Business models describe joint value creation of a focal firm and its exchange partners (Zott et al., 2011). Novel business models imply high switching costs for customers and partners due to the lack of alternative business opportunities (Zott & Amit, 2007). Taking into consideration that while the effect of business model change on value creation may vary in quality and size depending on innovation type, the general influence can be assumed as positive, this article suggests:

> *Hypothesis 5: Changing the governance of a business model by introducing changed inter-organizational relationships is positively related to value creation from technological innovation in form of a) incremental product innovations, b) radical product innovations, and c) process innovations.*

Hypothesis 6: Changing the governance of a business model by introducing changed distribution channels is positively related to value creation from technological innovation in form of a) incremental product innovations, b) radical product innovations, and c) process innovations.

Combination of business model innovation elements

The degree of business model change, as indicated earlier, may vary from the adoption of only one element, for example business model content, to the complete change of all three elements and thus the full model (Amit & Zott, 2012). Organizational change literature suggests that such concerted, system-wide changes will lead to the strongest impacts on firm performance under the assumption of synergies between the single elements of change (Milgrom & Roberts, 1990, 1995; Whittington, Pettigrew, Peck, Fenton, & Conyon, 1999). Are such holistic changes also relevant for business models and how can they be explained?

Orchestrating the interdependent activities of a firm and its stakeholders is regarded as the essence of business model design (Zott & Amit, 2010). The varying theoretical understandings of a business model mutually acknowledge the interrelated nature of its constituent elements. They are either seen as interdependent administrative routines (Winter & Szulanski, 2001), interdependent relationships of a firm and its stakeholders (Doz & Kosonen, 2010), comprehensive and coherent attributes (Dahan et al., 2010) or interactive dimensions (George & Bock, 2011). These attributes point towards the potential inherent in a purposeful combination of novel content, structure, and governance. The systemic perspective of the business model which simultaneously concerns the content (what) and the process (how) of 'doing business' (Zott et al., 2011) further supports this assumption. Resource-based theory suggests that resource orchestration actions – allocating, bundling, and leveraging resources – should be properly synchronized to positively influence intended outcomes such as value creation (Hitt et al., 2011). Recalling the assumed generally positive influence of business

model change on value creation from innovation based on different innovation types, this article proposes:

> *Hypothesis 7: Changing more than one element of the business model simultaneously is positively related to value creation from technological innovation in form of a) incremental product innovations, b) radical product innovations, and c) process innovations.*

METHODS

Dataset and sample

This study uses data from the Mannheim Innovation Panel (MIP) – representing the Community Innovation Survey (CIS) for Germany. Prior works in the areas of strategic management and innovation research have successfully employed CIS/MIP data before (Cantner, Joel, & Schmidt, 2011; Czarnitzki & Hottenrott, 2011; Horbach, 2008). The MIP is an annual survey on the innovation activities of the German manufacturing and service industries. It follows OECD's recommendations on how to measure innovation related constructs (OECD, 2005). The previously tested questions lead to high quality data (Laursen & Salter, 2006) and international comparability of the results (Cantner et al., 2011). Data acquisition methodology is based on a representative, stratified random sample. MIP administration conducts a non-response analysis to prove that it properly represents the population (Janz, Ebling, Gottschalk, & Niggemann, 2001).

While survey data typically shares the risk of potential common method bias, prior work on critically assessing CIS measures has concluded that it is not a major issue within MIP data (Mairesse & Mohnen, 2007, 2010). Additionally, the questionnaires for the CIS and the MIP surveys are specifically designed to prevent common method bias by especially implementing barriers for respondents to keep them from associating different input fields (Klingebiel & Rammer, 2014). Common method bias is thus not very likely to influence the results.

Analyses are based on the 2009 wave of the MIP covering the three-year period of 2006 – 2008. The initial sample consisted of 6404 firms. This study's focus on high-, medium-high-, medium-low, and low-technology manufacturing as well as knowledge-intensive and other service firms led to the exclusion of 746 firms that did not fit the industry classification proposed by Eurostat as well as prior studies (Cantner et al., 2011; Schmidt, 2010). Applying listwise deletion of cases with missing values led to a final sample of 2346 firms that are well-distributed across the industry sub-categories: the manufacturing industry is represented with 122 high-, 389 medium-high-, 380 medium-low-, and 392 low-technology firms, while 621 firms are located in knowledge-intensive services and 442 firms are from other service areas such as logistics (see Table 1 for descriptive statistics). A Chi-square goodness-of-fit test of the industry distribution between the original sample and the final sample shows no significant differences at the $p < 0.01$ level. The final sample should thus be representative of the initial population.

Measures

Business model change

Thoroughly operationalizing the business model concept and its change is a challenging task due to the high complexity that can arise from firms' various conditions and objectives (Casadesus-Masanell & Llanes, 2011). To the knowledge of the author, none of the prior works operationalizes change or innovation of a focal firm's single business model elements. Existing measurement approaches exemplarily consist either of business model taxonomies (Wirtz & Lihotzky, 2003; Zott & Amit, 2007; Zott & Amit, 2008), representations by nearby constructs such as changes of products and markets (Andries & Debackere, 2007; Bonaccorsi et al., 2006), and mathematical simulations (Casadesus-Masanell & Zhu, 2011; 2013).

Table 1: Descriptive statistics and correlations

	Construct	Scale Range	Mean	SD	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
(1)	Value creation from incremental innovations	0 - 100	12.57	22.19																				
(2)	Value creation from radical innovations	0 - 100	3.44	10.69	0.59																			
(3)	Value creation from new process innovations	0 - 100	2.14	5.60	0.38	0.27																		
(4)	Content A: New product positioning activities	0/1	0.26	0.42	0.33	0.17	0.18																	
(5)	Content B: New product extension activities	0/1	0.23	0.42	0.21	0.11	0.17	0.36																
(6)	Structure A: New organizational structures	0/1	0.29	0.46	0.23	0.11	0.17	0.23	0.23															
(7)	Structure B: New organizational processes	0/1	0.33	0.47	0.31	0.15	0.22	0.273	0.27	0.51														
(8)	Governance A: New external relationships	0/1	0.18	0.39	0.25	0.116	0.14	0.26	0.26	0.38	0.36													
(9)	Governance B: New distribution channels	0/1	0.25	0.43	0.28	0.18	0.23	0.34	0.45	0.29	0.30	0.29												
(10)	Log of firm size	0 - ∞	3.72	1.68	0.13	0.00	0.11	0.18	0.11	0.23	0.27	0.15	0.11											
(11)	Multinational group	0/1	0.31	0.46	0.12	0.04	0.12	0.14	0.06	0.16	0.18	0.13	0.09	0.47										
(12)	Continuous R&D activities	0/1	0.24	0.43	0.54	0.32	0.35	0.31	0.23	0.28	0.33	0.25	0.25	0.33	0.23									
(13)	Export share	0 - ∞	73.92	1391.42	0.04	0.01	0.01	0.00	0.05	0.00	0.05	0.01	-0.00	0.19	0.07	0.08								
(14)	Environmental dynamism	0 - 3	0.90	0.82	0.20	0.11	0.10	0.19	0.08	0.09	0.12	0.09	0.11	0.01	0.04	0.15	-0.02							
(15)	Environmental competitiveness	0 - 3	1.57	0.93	-0.10	-0.07	-0.04	0.05	0.01	0.00	-0.02	-0.01	0.02	0.04	0.04	-0.08	-0.02	0.13						
(16)	High-technology manufacturing	0/1	0.05	0.22	0.22	0.09	0.11	0.10	0.08	0.04	0.10	0.07	0.10	0.06	0.03	0.24	0.01	0.12	-0.08					
(17)	Medium-high-technology manufacturing	0/1	0.17	0.37	0.16	0.05	0.12	0.09	0.03	0.09	0.12	0.03	0.03	0.17	0.11	0.24	0.08	0.02	-0.08	-0.10				
(18)	Medium-low-technology manufacturing	0/1	0.16	0.37	-0.05	-0.07	0.01	-0.05	-0.04	-0.04	-0.02	-0.04	-0.05	0.04	0.02	0.03	-0.01	-0.04	0.048	-0.10	-0.20			
(19)	Low-technology manufacturing	0/1	0.17	0.37	-0.08	-0.06	-0.05	0.07	-0.01	-0.04	-0.08	-0.05	-0.01	0.00	-0.03	-0.09	-0.02	-0.02	0.148	-0.11	-0.20	-0.20		
(20)	Knowledge-intensive services	0/1	0.26	0.44	0.05	0.09	0.01	-0.02	0.02	0.02	0.02	0.08	0.06	-0.18	-0.04	-0.06	-0.03	0.07	-0.09	-0.14	-0.27	-0.26	-0.27	
(21)	Other services	0/1	0.19	0.39	-0.21	-0.12	-0.15	-0.13	-0.04	-0.06	-0.10	-0.07	-0.10	-0.04	-0.07	-0.24	-0.02	-0.11	0.05	-0.11	-0.22	-0.21	-0.22	-0.29

n = 2346, correlations with absolute value >0.09 are significant at the 0.1% level, with absolute value > 0.05 at the 1% level, and with absolute value > 0.04 at the 5% level.

To resolve this hindering situation, this study specifically builds on the conceptual work of Amit & Zott regarding the three business model elements content, structure, and governance (Amit & Zott, 2001; 2010) and especially their dynamic changes (Amit & Zott, 2012). Accordingly, each element representing business model change is explicitly measured by two distinct dummy variables (1 = yes, 0 = no) asking if relevant adaptions have been carried out during the two years preceding the study, resulting in a total of six distinct dummy variables accounting for business model change. In order to test Hypothesis 7, an additive index of all six individual variables is calculated. Table 2 contains an overview of the three constructs, their definitions, the variables employed, as well as the respective scales and sources in the literature.

Table 2: Construction of the independent measures for business model content, structure, and governance change

Construct	Definition	Independent Variables	Description	Scale/Literature
Business model content change	A change in the goods or information of an exchange and in the resources and capabilities that are required for the exchange	New product positioning activities	Introduction of significantly modified product/service designs in the years 2006 - 2008 as a result of new marketing concepts (e.g. new design or packaging concept to address new customer groups)	▪ 0 = no, 1 = yes ▪ Amit & Zott (2001, 2012), Zott & Amit (2010)
		New product extension activities	Introduction of new marketing activities, usage of new media channels or creation of new brands in the years 2006 - 2008 (e.g. first use of a new medium, brands, methods of customer retention)	
Business model structure change	A change in the parties that participate in an exchange, the ways in which these parties are linked, the order of the exchanges and the exchange mechanisms to enable transactions	New organizational structures	Introduction of new formats of work/labor organization in the years 2006 - 2008 (e.g. decentralization, job rotation, teamwork, realignment of department structures)	▪ 0 = no, 1 = yes ▪ Amit & Zott (2001, 2012), Zott & Amit (2010)
		New organizational processes	Introduction of new methods for the organization of business processes in the years 2006 - 2008 (e.g. quality management, supply chain management, lean production, knowledge management)	
Business model governance change	A change in the ways in which flows of goods, resources, and information are controlled by the relevant parties, the legal form of organization, and the incentives to participate in transactions	New external relationships	Introduction of new formats of external relationship management with other companies and public institutions in the years 2006 - 2008 (e.g. alliances, cooperation agreements, customer relationship, supplier integration)	▪ 0 = no, 1 = yes ▪ Amit & Zott (2001, 2012), Zott & Amit (2010)
		New distribution channels	Introduction of new distribution channels in the years 2006 - 2008 (e.g. direct marketing, e-commerce, franchising, new forms of product presentation)	

Value creation from technological innovation

The MIP offers several established measures for the successful value creation from technological innovation (see also Cantner et al. (2011), Laursen and Salter (2006), Mairesse and Mohnen (2002), and Wagner (2013)). They differ in their focus on the degree of novelty, e.g. incremental or radical developments, as well as in their focus on innovation type, e.g. product or process. These characteristics represent an ideal basis for studying the suitability of specific business model changes for different technological innovations. Moreover, the three dependent variables facilitate a comprehensive measurement of the value created by accounting for either a higher willingness to pay for a novel benefit (e.g. radically new technologies), for something perceived to be better (e.g. incremental innovation), or a lower unit cost for the same previously perceived benefit (e.g. process innovations) (Priem, 2007). All three dependent variables are measured as the share of total annual turnover or total annual costs in 2008 ranging from 0 to 100 percent. Measures concerning new products represent new services for service firms. Table 3 gives an overview of the three variables, their descriptions, and respective scales.

Table 3: Construction of the dependent measures of value creation from technological innovation

Dependent Variable	Description	Scale/Literature
Value creation from incremental technological innovations	Share of total turnover in 2008 due to new or significantly improved products that were introduced between 2006 and 2008.	▪ 0 – 100% ▪ Mairesse & Mohnen (2002), Laursen & Salter (2006), Cantner et al. (2011)
Value creation from radical technological innovations	Share of total turnover in 2008 of products that have no forerunner products and are thus new to the world, introduced between 2006 and 2008.	▪ 0 – 100% ▪ Mairesse & Mohnen (2002), Laursen & Salter (2006), Cantner et al. (2011)
Value creation from process innovations (cost reduction)	Share of cost reductions from the total cost in 2008 of the firm that can be attributed to new process innovations introduced between 2006 and 2008.	▪ 0 – 100% ▪ Cantner et al. (2011)

Control variables

Several control variables were included. Table 4 provides an overview of their measurement, descriptions and respective scales. *Firm size* is controlled for due to potential

effects on the firms' innovation behavior (Wagner, 2013). The model control for firms that belongs to a *multinational group* in order to consider influences of the overarching organizational structure, which can lead to varying business model choices between different business units (Chesbrough & Rosenbloom, 2002). It further controls for firm's engagement in *continuous R&D activities* (Cantner et al., 2011).

Table 4: Construction of the control variables

Control Variable	Description	Scale
Log of firm size	Log of Number of employees in 2008	0 - ∞
Multinational group	One, if the firm belongs to a multinational group	0/1
Continuous R&D activities	One, if the firm is engaged in R&D activities on a continuous basis	0/1
Export share	Share of turnover made from abroad divided by total turnover	0 – 100%
Environmental dynamism	Degree to which a firms products become obsolete in its prime market	0 = "not be the case" – 3 = "always be the case"
Environmental competitiveness	Degree to which a firm's products can be substituted by competing firms' products	0 = "not be the case" – 3 = "always be the case"
High-technology manufacturing	One, if the firm belongs to NACE (Rev. 2) 21, 26, 30.3	0/1
Medium-high-technology manufacturing	One, if the firm belongs to NACE (Rev. 2) 20, 25.4, 27-30 (excl.30.1, 30.3), 33	0/1
Medium-low-technology manufacturing	One, if the firm belongs to NACE (Rev. 2) 18.2, 19, 22-24, 25 (excl. 25.4), 30.1, 33	0/1
Low-technology manufacturing	One, if the firm belongs to NACE (Rev. 2) 10-17, 18 (excl. 18.2), 31, 32 (excl. 32.5)	0/1
Knowledge-intensive services	One, if the firm belongs to NACE (Rev. 2) 50-51, 58-63, 64-66, 69-75, 78, 80, 84-93	0/1
Other services	One, if the firm belongs to NACE (Rev. 2) 45-47, 49, 52-53, 55-56, 68, 77, 79, 81-82, 94-96, 97-99	0/1

Adopted from Cantner et al. (2011)

A number of contextual factors are also controlled for because value creation may differ by varying target markets or user groups, since they may have different perceptions of the novelty and appropriateness of a technology (Lepak et al., 2007). In addition, a business model can only be determined against a particular environment (Teece, 2010). In this regard, a variable for *export share* controls for activities in international markets, which may lead to higher competition and thus affect the success of newly introduced products and processes (Frenz &

Ietto-Gillies, 2009). Control variables for *environmental competitiveness* and *environmental dynamism* account for uncertainties associated with the rapid change of markets, which may have an effect on the success of innovations, e.g. due to a higher pressure to innovate. Specific *industry effects* on firms' innovative outcomes are controlled for by five dummy variables for high-, medium-high-, medium-low-, and low-technology manufacturing as well as knowledge-intensive services.

Analytical procedure

Based on the characteristic of the data and especially the dependent variables, the basic methodological procedure used by Mairesse and Mohnen (2002) and Laursen and Salter (2006) is adopted. Both studies utilize CIS data from different waves and countries (the first international CIS wave of 1992 and CIS UK wave of 2005 respectively). By applying a log-transformed Tobit model to the data, Mairesse and Mohnen (2002) explicitly offer a solution to two basic challenges of the CIS or the MIP. First, the log transformed Tobit regression allows to use both, innovating and non-innovating firms for the analysis, thus solving a 'selection problem' that researchers face due to a filter in the survey asking firms whether they have introduced innovations within the two preceding years of the survey. Second, and closely related, this approach allows for estimating linear relationships with truncated dependent variables.

The dependent variables are by definition double censored ranging from 0 to 100 percent of total turnover or costs, resulting in a truncation on both sides. As in the model of Laursen and Salter (2006), the variables are skewed towards the lower end and as a consequence depart from normality. Thus, a log-transformation of the three dependent variables is applied as a first step prior to running the Tobit estimations. This approach includes the introduction of a logarithmic transformation of the observed measures, e.g. INCRINN for value from

incremental product innovations, into a new latent variable INCRINN* based on the following logic: INCRINN* = log (1 + INCRINN) (Laursen & Salter, 2006; Wagner, 2013).

To demonstrate the robustness of the results, propensity score matching estimators of business model change were applied on the final data set (see Cantner et al. (2011)). The matching approach allows to compare the means of the outcome variables of a firm that experiences a treatment (business model change) with those of a firm with similar predefined characteristics that does not experience the treatment (control group, e.g. no business model change). This procedure offers a number of benefits. First, it represents an optimal tool for studying causal questions from large observational data sets (Rubin, 1997), also in combination with other evaluation techniques (Caliendo & Kopeinig, 2008) such as Tobit regression. Second, it has previously been successfully applied to data from the CIS and the MIP (Aerts & Schmidt, 2008; Cantner et al., 2011; Czarnitzki, Ebersberger, & Fier, 2007) and it is well discussed in the literature (Caliendo & Kopeinig, 2008; Imbens, 2004). Third, matching preserves firms' heterogeneity while allowing for comparisons within similar contexts and thus qualifies very well for the analysis of the resource based view (Teichert & Sofka, 2006) and also the complex characteristics of business model change. Finally, the (non-parametric) matching procedure does not require the specification of an underlying function (Cantner et al., 2011) and thus enables the analysis of truncated and skewed dependent variables.

In order to be able to apply propensity score matching, a new variable for business model change was constructed based on the work by Cantner et al. (2011), who compute a comparable measure for knowledge management activities. It is represented by a dummy variable coded 1 if the firm fully changed at least one of the three business model elements (content, structure, governance) during the years 2006 and 2008. 'Fully changed' in this sense means that both variables of each element (e.g. product positioning and product extension) have been answered with 'yes'. Because propensity score matching requires a dummy coded treatment variable to

model a quasi-experimental setting (Caliendo & Kopeinig, 2008), this measure is not the same as the additive index employed in the Tobit regression to test Hypothesis 7.

Multiple variations of propensity score matching were tested, but due to the best matching results, 1-to-1 nearest-neighbor matching without replacement and with a caliper of 0.01 under common support was chosen. This selection represents a standard approach in prior studies applying matching algorithms (Caliendo & Kopeinig, 2008). A sensitivity analysis was performed to check the influence of the selected settings on the evaluation of the treatment effects of the three dependent variables, showing robust results (Becker & Caliendo, 2007).

RESULTS

Table 5 summarizes the results of the log-transformed Tobit regression models. Models I, III, and V analyze the direct effects of the six single business model change variables on firm's value captured from incremental and radical product innovations as well as from process innovations respectively. Models II, IV, and VI include an additive index of all six business model change variables to test for potential simultaneous effects.

Results show strong empirical support for Hypothesis 1A, 1B, and 1C on the effect of changed product positioning activities as part of a change in business model content on value creation from all technological innovation types with positive and significant regression coefficients. The effect is stronger on value creation from incremental ($b = 0.98$, $p < 0.001$) and radical ($b = 0.65$, $p < 0.001$) product innovation than from process innovations ($b = 0.38$, $p < 0.05$). Regarding the influence of changed product extension activities as part of new business model content, the data solely supports Hypothesis 2C with a positive and significant coefficient on value creation through new process developments ($b = 0.34$, $p < 0.05$). Regarding the change in a business model's structure, Hypotheses 3A and 3C experience empirical support with positive and significant coefficients of changed organizational structures on value created with

incremental product innovations ($b = 0.33$, $p < 0.01$) and process innovations ($b = 0.51$, $p < 0.001$). The effect on value created from radical product innovations is positive, but not significant. Hypotheses 4A, 4B, and 4C on changed organizational processes as part of the business model's structure are strongly supported by the empirical analysis, with significant regression coefficients on value created with incremental ($b = 0.88$, $p < 0.001$) and radical ($b = 0.55$, $p < 0.001$) product innovation as well as with process innovation ($b = 0.84$, $p < 0.001$).

The regression coefficients for new external relationships as part of a change in business model governance only support Hypotheses 5A on the positive influence on value created from incremental product innovations ($b = 0.29$, $p < 0.05$). Hypotheses 5B and 5C are not supported by the data. New distribution channels as part of a change in business model governance show positive and highly significant regression coefficients on value created with incremental ($b = 0.77$, $p < 0.001$) and radical ($b = 0.98$, $p < 0.001$) product innovations as well as new process developments ($b = 0.63$, $p < 0.001$), thus supporting Hypotheses 6A, 6B, and 6C. Models II, IV, and VI show strong empirical support for the hypothesized interrelated nature of the three elements content, structure, and governance. Regression coefficients are positive and highly significant on value creation from incrementally ($b = 0.58$, $p < 0.001$) and radically ($b = 0.44$, $p < 0.001$) new products as well as new processes ($b = 0.46$, $p < 0.001$), supporting Hypotheses 7A, 7B, and 7C. An inspection of the variance inflation factors (VIF) of all the independent variables revealed that the highest VIF is 1.55 and the mean VIF equals 1.43. This suggests that multicollinearity is not a major issue in this study (Cohen, Cohen, West, & Aiken, 2003).

The propensity-score matching estimates support these results. An initial probit model calculates the likelihood that an organization engages in business model change (see Table 6). The resulting propensity scores are then used for the actual matching procedure, which yielded a subsample of 1166 matched cases with 583 treatment (engaging in business model change) and 583 control firms (not engaging in business model change).

Table 5: Tobit regression to test Hypotheses 1 – 7

Model	I		II		III		IV		V		VI	
Dependent variable	Value creation with incremental product developments				Value creation with radical product developments				Value creation with new process developments			
Independent variables	Coefficient	S.E.	Coefficient	S.E.	Coefficient	S.E.	Coefficient	S.E.	Coefficient	S.E.	Coefficient	S.E.
Constant	-2.86***	0.23	-2.96***	0.23	-3.89***	0.32	-3.95***	0.32	-5.07***	0.37	-5.05***	0.37
Log of firm size	0.07	0.04	0.07	0.04	0.03	0.05	0.02	0.05	0.15**	0.05	0.16**	0.05
Multinational group	0.20	0.12	0.21	0.12	0.06	0.15	0.07	0.16	0.16	0.16	0.17	0.16
Continuous R&D activities	2.77***	0.13	2.80***	0.13	2.47***	0.16	2.49***	0.16	1.83***	0.17	1.84***	0.17
Export share	-0.00	0.00	-0.00	0.00	0.00	0.00	0.00	0.00	-0.00	0.00	-0.00	0.00
Environmental dynamism	0.37***	0.06	0.39***	0.06	0.32***	0.08	0.33***	0.08	0.20*	0.09	0.21*	0.09
Environmental competitiveness	-0.17**	0.06	-0.16**	0.06	-0.13	0.08	-0.12	0.08	-0.03	0.08	-0.03	0.08
High-technology manufacturing	1.47***	0.25	1.57***	0.26	1.22***	0.32	1.32***	0.32	1.79***	0.35	1.81***	0.35
Medium-high-technology manufacturing	1.21***	0.19	1.31***	0.20	0.87**	0.26	0.94***	0.26	1.73***	0.28	1.77***	0.28
Medium-low-technology manufacturing	0.87***	0.20	0.93***	0.20	0.91***	0.26	0.96***	0.26	1.44***	0.29	1.46***	0.29
Low-technology manufacturing	0.80***	0.19	0.89***	0.20	0.63*	0.26	0.71**	0.26	1.28***	0.29	1.28***	0.29
Knowledge-intensive services	0.96***	0.18	1.01***	0.18	0.89***	0.24	0.94***	0.24	0.96***	0.27	0.95***	0.27
Change of business model content												
New product positioning activities	0.98***	0.12			0.65***	0.15			0.38*	0.16		
New product extension activities	0.17	0.13			-0.03	0.16			0.34*	0.17		
Change of business model structure												
New organizational structures	0.33**	0.12			0.22	0.15			0.51**	0.16		
New organizational processes	0.88***	0.12			0.55***	0.15			0.84***	0.16		
Change of business model governance												
New external relationships	0.29*	0.13			0.22	0.16			-0.05	0.17		
New distribution channels	0.77***	0.13			0.98***	0.16			0.63***	0.16		
Content + Structure + Governance			0.58***	0.03			0.44***	0.04			0.46***	0.04
No. of obs	2346		2346		2346		2346		2346		2346	
No. of left-censored obs	1371		1371		1720		1720		1802		1802	
No. of right-censored obs	0		0		0		0		0		0	
Log likelihood	-2637.2		-2652.4		-1948.8		-1959.2		-1768.6		-1776.1	
Chi-square	1650.5***		1620.2***		864.4***		843.5***		739.1***		724.1***	
Pseudo R^2	0.238		0.234		0.182		0.177		0.173		0.169	

Two-tailed t-test applied. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Compared to the unmatched sample, the matched subsample shows no significant differences between the selected covariates (see Table 7). Finally, the resulting means of the outcome variables are significantly higher for firms that change their business model compared to their non-changing counterparts (see Table 8).

In order to further test the robustness of the results, two supplemental analyses were conducted. First, the original Tobit regression models I, III, and V were re-estimated based on the cross-sectional data set of 2346 firms using formative indices for each of the single elements of business model change. The indices were computed by adding the two dummy variables (e.g. product positioning and product extension) of each structure. The effects of business model content, structure, and governance change based on the new measures were positive and highly significant ($p < 0.001$) for all three indices and thus lent further support to Hypotheses 1 to 6.

Table 6: Probit estimation for propensity score matching

	Change of at least one out of three possible business model dimensions content, structure, or governance	
	Coefficient	S.E.
Constant	-1.38***	0.12
Log of firm size	0.11***	0.02
Multinational group	0.06	0.07
Continuous R&D activities	0.91***	0.07
Export share	-0.00	0.00
Environmental dynamism	0.12**	0.04
Environmental competitiveness	0.04	0.33
High-technology manufacturing	-0.05	0.15
Medium-high-technology manufacturing	-0.06	0.10
Medium-low-technology manufacturing	-0.22*	0.10
Knowledge-intensive services	0.12	0.09
Other services	-0.09	0.10
Number of observations	2346	
Log likelihood	-1240.6	
Chi^2	348.93***	
Pseudo R^2	0.123	

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 7: Matching covariates balancing properties

		Mean		t-test		Standardized bias	
Variables	Sample	Treated	Control	t	p > |t|	%bias	|bias|
Log of firm size	Unmatched	4.292	3.492	10.73	0.000	48.0	94.5
	Matched	3.939	4.015	-0.46	0.644	-2.6	
Multinational group	Unmatched	0.413	0.263	7.24	0.000	32.1	95.4
	Matched	0.376	0.369	0.24	0.809	1.5	
Continuous R&D activities	Unmatched	0.485	0.146	18.60	0.000	78.4	99.5
	Matched	0.398	0.400	-0.06	0.952	-0.4	
Export share	Unmatched	90.395	67.158	0.37	0.713	1.9	79.3
	Matched	69.360	64.549	0.19	0.852	0.4	
Environmental dynamism	Unmatched	1.060	0.834	6.09	0.839	27.7	87.1
	Matched	1.015	0.986	0.61	0.543	3.6	
Environmental competitiveness	Unmatched	1.577	1.563	0.33	0.741	1.5	2.2
	Matched	1.599	1.585	0.27	0.791	1.5	
High-technology manufacturing	Unmatched	0.082	0.040	4.21	0.000	17.8	75.7
	Matched	0.079	0.069	0.67	0.502	4.3	
Medium-high-technology manufacturing	Unmatched	0.215	0.146	4.14	0.000	18.2	97.5
	Matched	0.196	0.194	0.07	0.941	0.4	
Medium-low-technology manufacturing	Unmatched	0.138	0.172	-2.05	0.040	-9.5	95.0
	Matched	0.145	0.1458	-0.08	0.934	-0.5	
Low-technology manufacturing	Unmatched	0.157	0.172	-0.87	0.386	-4.0	-4.9
	Matched	0.161	0.177	-0.70	0.482	-4.2	
Knowledge-intensive services	Unmatched	0.281	0.258	1.15	0.249	5.2	3.7
	Matched	0.276	0.298	-0.84	0.401	-5.0	
Other services	Unmatched	0.127	0.213	-4.87	0.000	-23.0	68.1
	Matched	0.144	0.117	1.39	0.164	7.3	

Table 8: Treatment effects - results after matching

	Mean firms with business model change	Mean firms without business model change	Difference = Treatment effect
Value creation from incremental product innovation	22.17	15.60	6.57*** (1.39)
Value creation from radical product innovation	6.10	4.05	2.05* (0.82)
Value creation from new process innovation	3.76	2.52	1.24*** (0.35)

Note: Bootstrapped standard errors in parentheses (100 repetitions, *** p < 0.001)

Second, a new longitudinal subsample was generated to further test into the causality of the proposed relationships. Due to a common identification number within each wave of the MIP, it was possible to merge the given covariates of the 2009 data set, which account for the years 2006-2008, with a dataset containing the three dependent innovation variables measured in the year 2010 (MIP wave of 2011). The resulting time lag between two and four years is nearly ideal to increase causal interference through temporal order in the design of the empirical

study, while not going past the end date of the intended outcome (Rindfleisch, Malter, Ganesan, & Moorman, 2008; Schilke, 2014). The new subsample consisted of N = 684 firms with the following industry-distribution: 34 high-, 94 medium-high-, 116 medium-low-, and 133 low-technology manufacturing as well as 164 knowledge-intensive and 143 other service firms.

Based on the new longitudinal subsample, models I to VI were re-estimated (See Table 9). The combinatory effects of changes to the business model elements stayed positive and highly significant for all three technological innovation outcomes ($p < 0.001$), lending further important support to Hypothesis 7 and the causality of the proposed relationships. Moreover, while the time lag and the decrease in sample size compared to the cross-sectional data led to lower overall significance levels, the majority of the identified effects stayed positive and significant, albeit some of them only at the $p < 0.1$ level.

Interestingly, new product extension activities as part of new business model content and new external relationships as part of new governance lose their initially positive effects after an average time lag of three years. New organizational processes as part of the structure element lose their significant influence on value creation from radical product innovation. In turn, the effect of new organizational structures becomes positive and highly significant for the same outcome variable after the time lag ($p < 0.01$). All in all, the longitudinal subsample supports the proposed relationships with positive and significant effects of all single business model change elements on each of the three dependent innovation variables in addition to the previously discussed combinative effects.

Table 9: Tobit regression with longitudinal subsample to test hypotheses 1 – 7

Model	I		II		III		IV		V		VI	
Dependent variable	Value creation with incremental product developments				Value creation with radical product developments				Value creation with new process developments			
Independent variables	Coefficient	S.E.	Coefficient	S.E.	Coefficient	S.E.	Coefficient	S.E.	Coefficient	S.E.	Coefficient	S.E.
Constant	-3.82***	0.52	-3.87***	0.53	-4.99***	0.75	-5.09***	0.76	-4.44***	0.66	-4.51***	0.66
Log of firm size	0.16†	0.09	0.15†	0.09	0.18†	0.11	0.15	0.11	0.10	0.10	0.07	0.10
Multinational group	-0.02	0.29	0.07	0.29	-0.35	0.35	-0.18	0.35	0.14	0.33	0.21	0.32
Continuous R&D activities	3.57***	0.31	3.54***	0.13	3.09***	0.38	3.10***	0.38	2.34***	0.35	2.34***	0.35
Export share	-0.00	0.00	-0.00	0.00	-0.00	0.00	-0.00	0.00	0.00	0.00	0.00	0.00
Environmental dynamism	0.43**	0.14	0.41**	0.14	0.08	0.17	0.08	0.17	0.12	0.16	0.10	0.16
Environmental competitiveness	-0.15	0.13	-1.13	0.13	0.03	0.16	0.09	0.16	0.11	0.14	0.14	0.14
High-technology manufacturing	1.15*	0.56	1.19*	0.56	1.25†	0.69	1.14	0.69	1.19†	0.63	1.35*	0.63
Medium-high-technology manufacturing	1.25**	0.45	1.37**	0.44	1.18*	0.59	1.20*	0.58	0.95†	0.52	1.18*	0.52
Medium-low-technology manufacturing	0.76†	0.43	0.86*	0.43	0.97†	0.57	1.01†	0.57	0.99*	0.49	1.15*	0.49
Low-technology manufacturing	0.89*	0.41	0.98*	0.41	1.04†	0.55	1.13*	0.56	0.98*	0.48	1.11*	0.48
Knowledge-intensive services	1.06**	0.40	1.14**	0.40	0.74	0.56	0.77	0.57	0.13	0.50	0.24	0.50
Change of business model content												
New product positioning activities	0.57*	0.28			0.76*	0.32			0.57†	0.30		
New product extension activities	-0.07	0.28			0.06	0.33			-0.04	0.31		
Change of business model structure												
New organizational structures	0.61*	0.27			0.94**	0.32			0.28	0.30		
New organizational processes	0.46†	0.27			-0.18	0.32			0.77*	0.30		
Change of business model governance												
New external relationships	-0.03	0.30			-0.23	0.34			-0.24	0.33		
New distribution channels	1.04***	0.27			0.74*	0.31			0.84**	0.29		
Content + Structure + Governance			0.46***	0.07			0.37***	0.09			0.40***	0.08
No. of obs	684		684		684		684		684		684	
No. of left-censored obs	477		477		556		556		552		552	
No. of right-censored obs	0		0		0		0		0		0	
Log likelihood	-588.8		-593.5		-391.7		-397.2		-406.8		-411.0	
Chi-square	459.1***		449.9***		281.5***		270.5***		262.1***		253.7***	
Pseudo R^2	0.281		0.275		0.264		0.254		0.244		0.236	

Two-tailed t-test applied. † $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

DISCUSSION

Theoretical implications

This article's results contribute to resource-based theorizing and research on business models as well as technology and innovation management in a number of ways. They advance resource-based theory (e.g. Barney (1991)) towards an explanation of the effects between business model change and value creation from innovation. This study theoretically argues and empirically shows that the three mayor value creating tasks of resource allocation, resource combination, and resource exchange (Chen, 1996; Sirmon et al., 2007) each account for change of the single business model elements content, structure, and governance. The findings further indicate that resources and their value creating tasks alone or orchestrated all together (Hitt et al., 2011) are critical in creating value from technological innovation through business model change.

The idea of dynamically changing a static resource orchestration to successfully create maximum value from technological innovations helps to further advance the discussion on whether a business model is a static or a dynamic entity. From a dynamic perspective, business models evolve due to changing environmental requirements (Grönlund et al., 2010) or firms' problem solving activities (Mason & Leek, 2008). This article acknowledges the need of dynamically changing the business model and the underlying resource orchestration (Moran & Ghoshal, 1999), especially in reaction to novel technological opportunities. But in accordance with Demil and Lecocq (2010), it still supports the idea of a static business model design (Dahan et al., 2010; Fiet & Patel, 2008) while simultaneously being able to address change and innovation by actively adopting the content, structure, and governance elements. Their connections with resource-based value creating tasks contribute to resource-based theory and offer additional guidance in the resolution of one of the business model concept's biggest weak spots – a lack of common theoretical support (Zott et al., 2011).

Moreover, the results of the empirical analyses have noteworthy implications for research into business models and technology and innovation management. In accordance with other conceptual and qualitative empirical works (Björkdahl, 2009; Chesbrough & Rosenbloom, 2002; Teece, 2010), this study offers empirical support for the essential role of adapting the business model in order to create more value from technological innovation. The findings show that this great value creating potential is also based on the resources and capabilities controlled by a firm and evolves through both increasing turnover and reducing cost (Amit & Zott, 2001; Brandenburger & Stuart, 1996; George & Bock, 2011). Firms that adapt their business model are thus better able to profit from technological developments and the exploitation of available resources (Wernerfelt, 1984). Additional analyses such as propensity score matching and the employment of a longitudinal subsample provide rich empirical evidence on the causality of these relationships and the sustainability of the outcomes of business model adaption and change.

This study further untangles the complex relationship between the business model and technological innovation (Baden-Fuller & Haefliger, 2013). Regarding the business model, the data set offered the possibility to thrive deeper into its underlying working mechanisms (Zott et al., 2011) by operationalizing the single dimensions of content, structure, and governance change as proposed by Amit & Zott (2012) alone and altogether. Each element is represented by two distinct variables in order to measure up to the highly complex nature of the concept arising from firms' various conditions, objectives, and industrial environments (Casadesus-Masanell & Llanes, 2011) and critically hampering empirical advancements. The measures are a fruitful alternative to the typologies used in the majority of empirical studies (Bonaccorsi et al., 2006; Wirtz & Lihotzky, 2003) with the potential to test a multitude of antecedents and consequences of the business model and thus to further advance the field of research in general. The technological innovation side of the relationship benefits from detailed insights into how

the effects on value creation vary by innovation type, e.g. incrementally and radically new products or new processes, based on a wide variety of industries in both manufacturing and service firms.

First, business model content change and both of its resource allocating aspects – product positioning and extension activities – have a positive effect on cost reductions with novel process innovations, while only a change in positioning affects value creation with incrementally and radically new products. Product extension measures do not affect product innovation related value creation. This may be due to the fact that customers first have to become familiar with an innovation before they can realize its full potential (Hargadon & Douglas, 2001) and attraction measures can take their full effect. Second, firms that recombine available resources to change their business model's structure by introducing organizational structures as well as processes can experience higher value creation from incrementally improved products and novel processes. Radically new products benefit solely from novel organizational processes and not so much from changes of the organizational structures. Third, exchanging and leveraging available resources in form of governance changes by adapting external relationships and distribution channels positively affects the success of incremental product innovations. Interestingly, firms that introduce radically new technologies as well as new process developments profit strongly from changed distribution channels but not so much from engaging in new external relationships. This may be due to increased coordination costs implied by new strategic partnerships (Christensen, Olesen, & Kjær, 2005) lowering the value creation potential of an innovation.

In addition to these individual effects, this study makes an important contribution by providing empirical evidence for the widely theorized interrelated nature of the business model's elements (Doz & Kosonen, 2010; Mason & Leek, 2008; Winter & Szulanski, 2001). Broader change of all three elements at the same time and thus a complete redesign of the

underlying resource orchestration (Hitt et al., 2011) leads to significantly increased value creation arising from technological innovation. More specifically, propensity score matching shows that the combinative effect of business model change is higher for firms engaging in incremental product innovations as well as in process developments than firms that introduce radically new products. Longitudinal data shows that these effects stay effective even after an average three year time lag.

Managerial implications

The findings have some significant implications for practitioners active in the areas of strategic management, innovation and technology management, and corporate entrepreneurship. First, business model change can lead to increased value creation from technological innovation through higher turnover and lower cost for the firm under consideration of international, dynamic, and competitive environments. Interestingly, entering new strategic partnerships as part of governance change is more important for incremental technological innovations than for radically new products and novel processes. Second, this study provides detailed insights into the right elements of a business model that have to be changed in order to increase the likelihood of higher success with specific types of innovation. This is a big improvement over prior empirical studies focusing rather on what type of business model design effects firm outcomes, e.g. novelty-centered or efficiency-centered (Zott & Amit, 2007; 2008). For example, firms that introduce radical product innovations should focus on changing their business model regarding the adaption of product positioning activities, organizational processes, and distribution channels. Furthermore, managers should consider the positive effects associated with interrelated nature of the three business model elements. Third, the intense experimentation and learning efforts necessary to conduct business model change (Sosna et al., 2010) require the broad commitment of resources and thus represent tough investment decisions, especially for established firms (Govindarajan & Trimble, 2005). Despite

these challenges, the positive findings should motivate practitioners to engage in business model change and unleash its full potential for their innovating organizations.

Limitations and outlook

Some limitations apply to this study. First, the main data set is cross-sectional in nature, even though it covers a three year time span. Several methodological approaches, e.g. propensity score matching, and a longitudinal subsample are employed to increase the results' robustness. Despite these efforts, further research into the long term effects of business model change on value creation is encouraged. Second, by proposing six distinct variables to operationalize the three underlying dimensions of business model change, this study can only come close to mapping the full complexity of the construct. Further efforts may address the effects of other business model characteristics such as the cost structure or profit potential of producing an offering (Chesbrough & Rosenbloom, 2002). Third, an additive index is used to test potential combinatory effects between business model content, structure, and governance changes and thus interactions between single elements cannot be analyzed but offer great potential for future studies.

Based on this study's findings, further empirical studies into the antecedents and consequences of business model innovation and change are especially encouraged. While there is a broad body of conceptual literature, the insights into the origins and performance relevant effects are rather limited. Further research is needed regarding the influence on firms' overall performance such as profitability or growth in order to gain a better understanding for firms to capture the value that they create. As much remains to be explored, there are great opportunities for further research into the antecedents and consequences of business model innovation.

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GENERAL CONCLUSION AND OUTLOOK

This dissertation shows the substance that the business model concept has for technological innovation and vice versa. With four distinct studies, this project was set out to make a small but hopefully significant contribution to resolving the high complexity of a vital relationship and the constructs it involves. So what do we know after the four studies? How do they empirically and theoretically contribute to the area of business model research and its adjacent fields such as strategy, entrepreneurship, as well as innovation management?

The empirical advancements of this dissertation consist of multiple methods, data sources, and industries individually selected for each one of the four studies to ensure high degrees of methodological fit. The toolkit employed covers conceptual approaches such as a systematic review of highly regarded literature, qualitative empirical processes such as case study analysis based on triangulated data, as well as a number of quantitative empirical techniques such as Tobit regression models and propensity score matching, partially based on longitudinal information. These algorithms utilize two distinct quantitative data sets: high quality secondary data from the Mannheim Innovation Panel (MIP) for over two thousand firms from multiple industries as well as a manually collected set of primary survey data to be able to look at specific aspects of the complex relationship between business models and technological innovation. The discovery and preparation of an ideally suited data set such as the MIP offers a major benefit for scholars interested in business model and innovation research. In addition, this dissertation extends operationalizations of the business model construct regarding both its static configurations in form of novelty-, efficiency-, complementarities-, and lock-in-centered designs, as well as for its dynamic changes represented by distinct variables of central firm activities nested in novel business model content, structure, and governance.

The introductory framework of this dissertation offered an ideal foundation to generate detailed theoretical insights into the intersection of business models and technological innovations, into the business model construct itself, and into the process that leads to its development. In 2011, the beginning of the work on this dissertation thesis, the business model field made first considerable advancements towards conceptual consolidation, mainly based on the consequential literature reviews by Zott et al. (2011) and George & Bock (2011).

In order to increase the chances for further cumulative research, the first study of this dissertation project took the next logical step and integrated the different conceptualizations in combination with resource-based theory to reach a unifying business model understanding. A first hypothesis that was supported by the later studies in this dissertation is based on the identified internal and external antecedents and consequences of business model design: successful business modelling is more an art of purposefully adjusting the fit between the elements of a business model with corporate strategy, technological know-how, and market opportunities rather than a precisely projectable process. As also indicated by prior research, experimentation is of elementary importance to master one of the business models biggest advantages – but also highest challenges – compared to other performance oriented concepts: its systemic nature.

In an attempt to resolve these challenging tasks of creating a novel, even radically new business model, the second study of this dissertation delineates the three-stage process of how established high-technology manufacturing companies can succeed in such a holistic endeavor. Complementary technological developments, strategic partnerships and an increasing openness towards the external environment as well as little pressures to be profitable during early stage business model innovation are in favor of successfully overcoming the internal and external barriers of business model innovation.

Moreover, the initial framework offered the possibilities for two further studies aimed at business models in concert with technological innovation. We have learned from the case study and the literature review that multiple types of innovations might be necessary to enable a viable business model. But as stated earlier, the business model and especially changes to its system of activities can also take a complementary function in exploiting the full economic potential of new technologies. While the third study of this dissertation has shown that efficiency- and complementary-centered business models moderate the relationship between technological innovation and firm performance, the analysis does not support the hypothesized positive effects of novelty-centered business model designs. Instead, study four shows that in order to sustainably benefit from innovation financially, novelty-centered designs alone are not enough, an actual systemic change of the business model is required.

Analyses show that the benefits of business model change, especially of changing more than one element at the same time, are valid complements for many different types of technologies such as incrementally and radically new products and services as well as new processes. These positive effects do not only account for value creation in form of higher turnover for the focal firm, but can also lead to lower costs. This makes business model innovation not only a highly valuable complementary tool for technology commercialization, but also an important strategic stand-alone approach to economic value creation itself.

Even though the scope of a dissertation project does offer more room for analysis than a single paper, manifold potential areas for further research advancements had to be left untouched, but should be shared to provide ideas to the interested audience. First, other types of innovation, especially novel administrative or managerial practices, offer promising paths towards value creation in combination with the business model, either as an enabler or a complement to change. Second, a major area that should concern future studies is the appropriability of a successful business model and thus the question of what makes it difficult

to copy by competitors, especially in absence of formal intellectual property protection? Entrepreneurship literature has some answers, but what about insights for management research and established firms? Connected to these issues is the question of what constitutes 'good' business models. Further insights are needed into how they can be evaluated from a strategic management perspective. Third, what are the cultural and individual characteristics that lead to critical assessment of an existent business model and consequently to insights that changes might be necessary? Which organizational setting is more likely to generate new business ideas in the first place and then create the corresponding models – individual managers, small specialized teams or larger business units with the focus on innovation?

Fourth, what can managers of established firms learn from startups and individual entrepreneurs and what drives the commonalities and differences between their business model innovation processes? Fifth and finally, if the decision for the development of a novel business model has been made and the process is handled well, how can established firms embrace the new model? Ambidexterity literature has begun to dive into this promising field of research, but insights are not yet conclusive about the possibilities that arise when a transition from an old to a new business model is required. In order to give viable answers to these questions, thorough conceptual argumentation, multiple methodological approaches and strong empirical evidence will be required. Only with such immense scientific efforts will it be possible to increase researchers' and practitioners' understanding of how to work with business models in order to secure firms' long term competitiveness, performance, and excellence.

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PEER-REVIEWED CONFERENCE PAPERS DURING DOCTORATE YEARS

Höflinger, N. (2014). **The business model concept and its antecedents and consequences – towards a common understanding.** *Paper presented at the AOM annual meeting, Philadelphia, Pennsylvania, USA.*

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Heinzen, M., Höflinger, N. (2011). **People in R&D: The impact of human resource practices on the performance of lean product development**. *Paper presented at the AOM annual meeting, San Antonio, Texas, USA.*

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EDUCATION

University of Mannheim, Mannheim, Germany **Feb. 2011 – Jul. 2015**
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Academic exchange year
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