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New Perspectives And Insights On The Intersection Of Business Model Design And Open Innovation: A Multi-Method Approach

Alexander Hermann Tobias Hagenmeyer
Wayne State University

NEW PERSPECTIVES AND INSIGHTS ON THE INTERSECTION OF BUSINESS MODEL DESIGN AND OPEN INNOVATION: A MULTI-METHOD APPROACH

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ALEXANDER HERMANN TOBIAS HAGENMEYER

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DEDICATION

To my partner, Ms. Maïté Maisonneuve

For your support, encouragement and understanding
about the many hours invested in this work

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Alexander Hermann Tobias Hagenmeyer

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LIST OF ABBREVIATIONS

ANOVA	ANALYSIS OF VARIANCE
CATPCA	CATEGORICAL PRINCIPAL COMPONENT ANALYSIS
CIS	COMMUNITY INNOVATION SURVEY
EFA	EXPLORATORY FACTOR ANALYSIS
IP	INTELLECTUAL PROPERTY
MIP	MANNHEIM INNOVATION PANEL
NIH	NOT-INVENTED-HERE
OEM	ORIGINAL EQUIPMENT MANUFACTURER
PCA	PRINCIPAL COMPONENT ANALYSIS
R&D	RESEARCH AND DEVELOPMENT
VAF	VARIANCE ACCOUNTED FOR
VIF	VARIANCE INFLATION FACTOR

CHAPTER 1
GENERAL INTRODUCTION

"Like seeing the doctor for an annual exam, regularly assessing a business model is an important management activity that allows an organization to evaluate the health of its market position and adapt accordingly."

Osterwalder and Pigneur (2010, p. 212)

Everyone knows that innovativeness is vital to the success of enterprises. Firms that do not innovate will sooner or later be put out of business by their competitors. This is not news. The current environmental climate, characterized by uncertainty, rapid change and highly competitive landscapes, however, challenges enterprises to innovate effectively, which requires them, in turn, to increasingly innovate openly. The key concept of open innovation is that *"not all the smart people work for you"* (Chesbrough, 2006a, p. 22). Instead, useful ideas and knowledge are spread over firms of all sizes in many parts of the world. But at present, even the use of external knowledge sources to buy and sell intellectual property (IP) in order to stimulate the internal product-development process, is no guarantee for business success any longer. Firms must take their business models into consideration by aiming for innovations, and thus, find ways to more effectively connect technological innovations to economic results in order to increase competitive advantage and to stay relevant in a highly dynamic and complex environment. This is news.

Business models shape industries as well as academic discussions in the field of management and are the subjects of a sharp increase in publications in recent years (Zott, Amit, & Massa, 2011). But while the concept finds practical use in the industry, empirical research in this field is still hampered by an imprecise definition, unclear working mechanism and missing connection to related areas of strategy and innovation management (George & Bock,

2011). Its relationship to technological innovation, and therefore to open innovation that determines the process of value creating and capturing, is characterized by a high degree of complexity (Baden-Fuller & Haefliger, 2013). According to Chesbrough (2006a), the focus of business modelling rests on the idea that *"there is no inherent value in a technology per se"* (p. 43), and the value instead is specified by the corporate business model used to *"convert technological potential into economic value"* (p. 108).

The scope of this dissertation thesis explores in detail, patterns of open innovation behavior of enterprises across industries, including the role of business model design with its inherent uncertainties (Edmondson & McManus, 2007). Hence, the interaction between different open innovation practices ranging from collaboration to external knowledge sourcing on one side, and the diversity of business models that allow enterprises to connect their technological innovation to economic output on the other side, is examined. In order to lay the foundation for this dissertation project and the research settings that it contains, the basic terminologies need to be defined and their relationships assessed.

Scholars highlight that *"today, innovation must include business models, rather than just technology and R&D"* (Chesbrough, 2007a, p. 12). A business model reflects the strategic choices of an enterprise (Magretta, 2002; Zott & Amit, 2008). According to Magretta (2002); business models are *"at heart, stories – stories that explain how enterprises work"* (p. 87) and they provide detailed information in answer to the following questions: *"Who is the customer?"* (p. 87), *"What does the customer value?"* (p. 87) and *"What is the underlying economic logic that explains how we can deliver value to customers at an appropriate cost?"* (p. 87). While this definition is relatively broad and imprecise, Chesbrough and Rosenbloom (2002) in particular connect the design of business models to ideas and define it as the *"heuristic logic that connects technological potential with the realization of economic value"* (p. 529). In the same vein, Chesbrough (2006a) describes the business model as *"a useful*

framework to link ideas and technologies to economic outcome" (p. 108). Hence, each firm has a business model, even if it is not obvious and specifically mentioned (Chesbrough, 2006a). The role of a business model can be reduced to the following main operations and described as follow: it creates value through innovative actions, and it captures a certain extent of that produced value (Chesbrough, 2006a; Chesbrough & Rosenbloom, 2002; Zott & Amit, 2010). These statements illustrate that both technology and business models are intertwined and can be subject to innovation (Amit & Zott, 2012). Therefore, innovation activities have to regularly consider a change in existing models in order to achieve the best possible alignment and to maximize the captured value from a technological innovation (Amit & Zott, 2012; Teece, 2010). Furthermore, technologies have the potential to drive entirely new corporate business models by creating new opportunities for enterprises (Osterwalder & Pigneur, 2010; Teece, 2018). Uber's technology and business model, for instance, reflects the concept of 'coherence' and illustrates the need for technological advancement from Global Positioning Systems (GPS), smart phones and computing power as the foundation and a driver for Uber's business model (Teece, 2018).

As the business model is *"a reflection of the firm's realized strategy*" (Casadesus-Masanell & Ricart, 2010, p. 195), the choice of open innovation requires it to define the respective activities within the corporation and in relation to the external partner network in order to stimulate value creation and capture (Hienerth, Keinz, & Lettl, 2011; Vanhaverbeke, 2006). Chesbrough (2006a) proposes that open business models *"create value by leveraging many more ideas, due to their inclusion of a variety of external concepts"* (p. 2). Hence, an open business model utilizes available external innovation labor and separates the innovation creation and the subsequent production and commercialization process meaning, in such a system, one party may develop a new technology but instead of bringing it to market itself will out-license or sell the innovation to another actor that supports all remaining activities

(Chesbrough, 2006a). The open innovation model follows the idea that knowledge and experience within an organization are necessarily limited (Chesbrough, 2003; Dahlander & Gann, 2010). In the worst case, it is even further limited by corporate practices, processes and bureaucracy (Assink, 2006). Excessive bureaucracy often found in large organizations demands allegiance to rules and procedures from employees. As people become used to working and thinking in certain ways at work, many of them find it relatively difficult to break out of these molds and adopt new ways of doing things which leads to a reduction of creativity and thus, willingness to take risks. (Antons & Piller, 2015; Assink, 2006). Open innovation also benefits from the principal of cross-functional teams (Gemser & Leenders, 2011). Diverse teams tend to be more creative compared to teams in which all members have the same backgrounds (Sethi, Smith, & Park, 2001). These external sources, which can be accessed and leveraged through open innovations, follow the same principle and bring diversity into internal teams of an organization. This openness to ideas and technologies from the external environment can support the process of implementing new ways of 'doing things'.

In practice, firms operate under uncertainty and rapidly changing industrial environments in which no one best way regarding their strategy and innovation behavior can be determined a priori (Leiponen & Drejer, 2007). However, prior research suggests that firms in the same 'technological regimes' and thus industry, tend to structure innovative activities in similar ways, because these enterprises share information and technology sources, perceive similar opportunities for innovation and have similar customers with similar needs, ideas and demand for innovation (Audretsch, 1997). Contrary to previous empirical findings on technological regimes, Leiponen and Drejer (2007) suggest that industries are not at all uniform regarding the innovation behavior of firms and that within industries three or even more innovation modes tend to exist. This indicates that the rising pressure and complexity in the technological environment inhibit firms' path towards homogenous behavior patterns within industries. But

if the industry affiliation is not the main driver, what else might stimulate similar innovation activities among firms? In order to examine in detail the innovation behavior of firms in today's complex environment and to derive innovation patterns, this dissertation research examines the innovation focus of firms using two distinct dimensions, novelty of business model and novelty of technological innovation, within and across industries.

RESEARCH GOAL OF THE THESIS

The open business model framework and its relationship to open innovation still reveals an overall lack of clarity and empirical knowledge (Zott et al., 2011). Particularly, the term 'open' in the context of business model design, needs further clarification. Generally, academic literature relates it to the boundaries of an enterprise and thus to the interactions of a firm with its ecosystem. While most research assumes a closed innovation approach as the point of departure and an open innovation model as the ultimate goal, this dissertation proposes that an ideal degree of openness follows a dynamic pattern, driven by the innovation focus of an enterprise. Additionally, little is known so far about the open business model innovation process itself, as well as the required steps to utilize partnerships in order to effectively open up a firm's business model. These elements can be stated in the following overarching research question: *How can firms utilize the concept of open innovation to more effectively generate business model innovations and to achieve best fit between technological efforts and business models?*

To examine in detail this overall research question, a paper-based approach was identified and chosen as the most appropriate method. For this purpose, the research question was split into three subcategories, each with an individual research focus. Each sub question was addressed in an independent journal article, intending to contribute to the governing research question and to generate as many insights as possible to this emerging field. Figure 1.1

illustrates the research question of each paper, the exact area of open business models that is tackled as well as the relationship of the articles to each other.

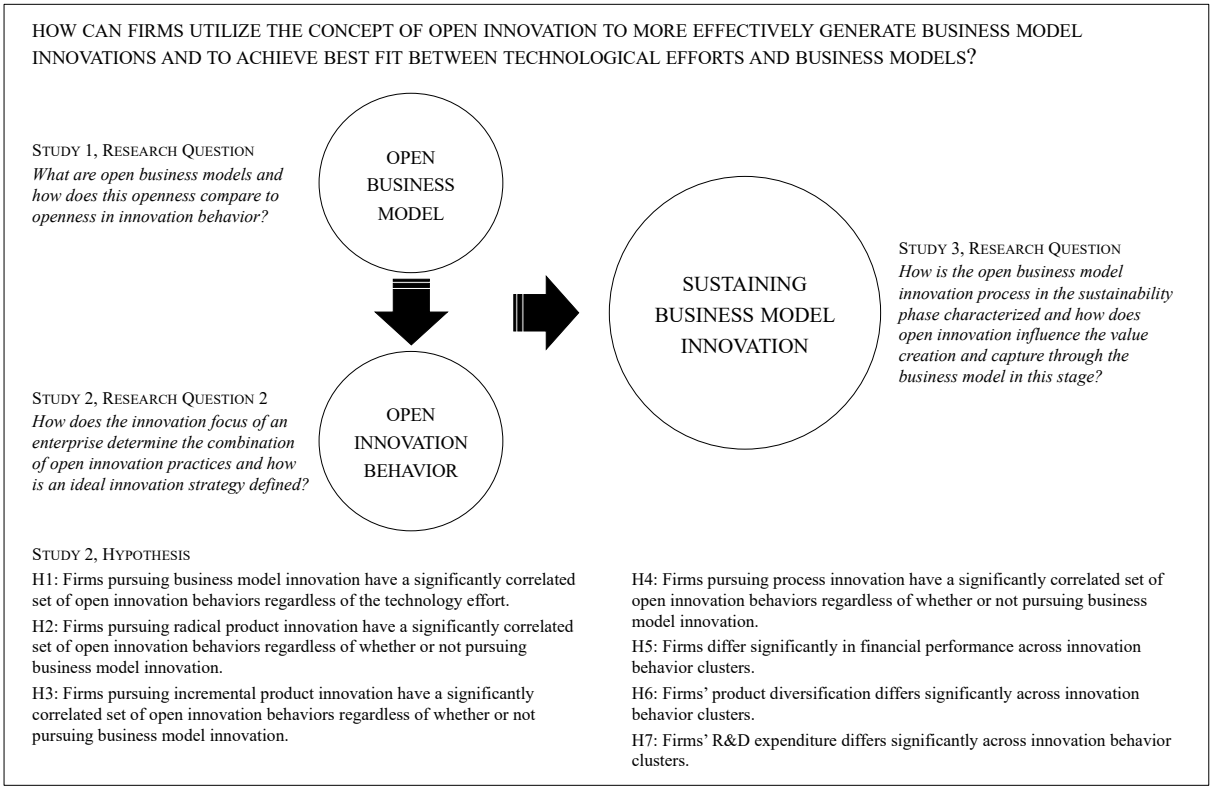

Figure 1.1: Overarching research framework

STRUCTURE OF THE THESIS

The thesis follows the logic of a paper-based dissertation grounded on a hybrid methodical approach. This means the dissertation consists of individual scientific articles, each with its own specific research focus and based on an appropriate methodology and data source in order to derive extensive knowledge of the heterogeneity of innovation activities arising at the intersection of technological innovations and open business model design. Therefore, the dissertation project is divided into five chapters and includes, besides this introduction, three independent papers, each tackling a distinct research question, as well as a general conclusion of the main empirical findings and possible next steps in open business model research. The sections below, including Figure 1.2, describe the structure of the dissertation project and

define the methodological characteristic of each research study ranging from the scope and method to the data source and the empirical setting.

	THESIS STRUCTURE		
	CHAPTER 1 GENERAL INTRODUCTION		
	CHAPTER 2 FIRST RESEARCH STUDY	CHAPTER 3 SECOND RESEARCH STUDY	CHAPTER 4 THIRD RESEARCH STUDY
TITLE OF THE STUDY	The concept of open business models and its relationship to open innovation: Towards a common understanding	Business model design and technological innovations: A dynamic approach towards ideal open innovation behavior	The open business model innovation process: Insights from the mobility joint ventures of DAIMLER AG and BMW GROUP
RESEARCH SCOPE	Analysis of highly regarded academic articles in the domain of open business models with the intention to derive a common understanding of the concept, distinguish it from related fields of open innovation and business model design, determine theoretical building blocks, and define working mechanisms of the framework.	Analysis of ideal and dynamic sets of open innovation practices with respect to the innovation focus of a firm. The study suggests that a firm's innovation behavior is influenced by both dimensions, novelty of the technology and novelty of the business model, and thus is expected to be highly correlated for each unique combination of these dimensions.	Analysis of the innovation process at the intersection of novel business models and product innovations from the perspective of established technical-oriented firms. The emphasize lies on the identification of the innovation process steps and their characteristics necessary to adapt and enhance a novel business model after its implementation.
RESEARCH QUESTION	What are open business models and how does this openness compare to openness in innovation behavior?	How does the innovation focus of an enterprise determine the combination of open innovation practices and how is an ideal innovation strategy defined?	How is the open business model innovation process in the sustainability phase characterized and how does open innovation influence the value creation and capture through the business model in this stage?
DATA ANALYSIS	Systematic literature review based on relevant academical papers published over a time period of 13 years with the first publication in 2006.	Research method is based on a two-step data analysis approach: ▪ Categorical principal component analysis (CATPCA) ▪ *k*-means cluster analysis	In-depth case study research based on a multiple-case design and multiple data sources including primary and secondary data.
DATA SOURCE	▪ Top-class research journals ▪ EBSCO Business Source Complete database	▪ Secondary data from the German part of the 2012 wave of the large-scale Community Innovation Survey (CIS) of the European Union	▪ Telephone interviews ▪ Secondary data sources such as press releases, fact sheets, promotional documents and corporate websites
EMPIRICAL SETTING	Top-class academic journals and books (literature sample restricted to scientific papers in English language).	Firms considered by the 2012 wave of the Mannheim Innovation Panel (MIP); industry classification include in total 21 aggregated economic sectors based on the ZEW indicator report.	Mobility joint ventures, SHARE NOW (carsharing) and REACH NOW (Mobility-as-a-Service), recently established by incumbent technical-oriented firms in the automotive sector.
	CHAPTER 5 GENERAL CONCLUSION AND OUTLOOK		

Figure 1.2: Basic structure of the thesis

In chapter 2, the paper 'The concept of open business models and its relationship to open innovation: Towards a common understanding' builds the theoretical groundwork for the dissertation project with the aid of a systematic literature review (Short, 2009). For this purpose, this article analyses highly regarded journals in the domain of business model and open innovation research for the last 13 years. The intention of this paper is to derive

comprehensive insights from the interdependencies between both concepts, establishing a unifying understanding of the framework and identifying antecedents and consequences in order to examine their relevance for innovation activity patterns of firms.

In chapter 3, the paper 'Business model design and technological innovations: A dynamic approach towards ideal open innovation behavior' identifies optimal and dynamic patterns of open innovation practices with regard to a firm's innovation focus. The study spans a 2x3 matrix of six distinct 'technology and business model' combinations depending on the degree of novelty, in order to categorize the innovation activities of a large-scale sample of German enterprises and to derive innovation patterns with the aid of a cluster analysis. In principle, each quadrant offers a unique innovation focus that implies specific opportunities for decoding the respective open innovation behavior and enables identification of innovation patterns in broad-cross sections of enterprises in Germany. The overall goal for this empirical setting is to provide guidance, based on ideal combinations of innovation activities, for business executives to ensure that naturally limited corporate resources are put to work in the most efficient way.

In chapter 4, the paper 'The open business model innovation process: Insights from the mobility joint ventures of Daimler AG and BMW Group' analyzes the innovation activities of established technically oriented firms necessary to develop and sustain a radically new business model. The research setting follows an in-depth case study approach (Yin, 1994) in order to generate a deeper understanding of the underlying reasons for the process of business model innovation as well as the resulting structures and working mechanisms (George & Bock, 2011; Zott et al., 2011) of this complex phenomenon. The case study is based on an example of the automotive industry. The incumbent players in heavy engineering and technology-oriented industries – especially in the automotive sector – currently must deal with a rapidly changing environment and are challenged to rethink their existing business models. While still in their infancy, new technology trends in the automotive industry are overlaid with new mobility

services such as carsharing which are challenging the individual car ownership model. Therefore, this sector provides ideal research conditions. In order to increase the likelihood to generalize findings, the study follows a multiple-case approach and analyses the new mobility joint ventures, including carsharing and multimodal services, of the BMW Group and one of the largest vehicle manufacturers worldwide, Daimler Group.

CHAPTER 2
THE CONCEPT OF OPEN BUSINESS MODELS AND ITS RELATIONSHIP TO OPEN INNOVATION: TOWARDS A COMMON UNDERSTANDING

ABSTRACT

The importance of open business models has been significantly increasing for business practitioners as well as the academic community. But the emerging concept still lacks a clear definition and distinction from related fields of open innovation and business models. In particular, in today's increasingly networked environment 'openness' in the form of collaborations seems to be a given for many enterprises. Hence, openness plays a vital role not only for open business models but also in the open innovation and business model literature. Consequently, this new role has caused some confusion and led to a certain degree of inaccuracy of the term 'openness' as well as the concept itself. In order to resolve these tensions and to derive an integrative understanding of the framework of open business models, as well as its constituent elements, a systematic review of prior academic work was performed.

INTRODUCTION

In the past few years, the relevance of the framework of open business models has considerably increased for both academics and business practitioners (e.g. Casadesus-Masanell & Ricart, 2010; McGrath, 2010). The emerging concept introduced by Chesbrough (2006a), ties together the open innovation approach and the business model phenomenon and thus, describes the value generated through the integration of externally available knowledge into the firm's business model innovation process. To date, scholars have developed multiple definitions of the term open business model (e.g. George & Bock, 2011; Hamel, 2000; Shafer, Smith, & Linder, 2005) and their different interpretations have led to some degree of imprecision and confusion. Research is further hampered by a lack of differentiation between the open business model framework and related concepts of open innovation and business model design. These concerns need to be addressed to provide more clarity about an evolving concept.

The increase in popularity of the business model framework since the late 1990s was mainly due to a few events, such as the rise of the World Wide Web (Amit & Zott, 2001; Teece, 2010), the shift in importance from the manufacturing sector towards technology, information and services (Perkmann & Spicer, 2010), as well as the tremendous growth of emerging economies (Seelos & Mair, 2007). At a macro level, a business model is often classified as either a conceptual tool (George & Bock, 2011; Osterwalder, Pigneur, & Tucci, 2005) or a framework (Afuah, 2004) that aims to produce value for consumers and defines ways to effectively capture part of that value by turning received payments into financial gains (Teece, 2010). Therefore, a business model represents *"a template that depicts the way the firm conducts its business"* (Zott & Amit, 2013, p. 404) and drives competitive advantage (Casadesus-Masanell & Zhu, 2013). According to Chesbrough (2006a), every firm ranging from a multinational enterprise to a start-up company, has at least one business model, whether

it is visible and clearly communicated or not, to approach its target market and to convert technological potential into economic value. Despite the growing attention in the academic literature and its importance for companies in operating a sustainable business, the business model has been often studied in prior work without precisely defining the concept and thus is a potential source of confusion (Shafer et al., 2005).

Similar to the business model framework, the concept of open innovation obstructs cumulative research progress due to its conceptual ambiguity (Dahlander & Gann, 2010). Since the term was formed by Chesbrough (2003), the interest in the use of the openness framework has been rising rapidly (West & Bogers, 2014). One of the most commonly used but also relatively broad definitions, is provided by Chesbrough (2003) and describes openness as follows: *"open innovation is a paradigm that assumes that firms can and should use external ideas as well as internal ideas, and internal and external paths to market, as firms look to advance their technology"* (p. XXIV). Therefore, the approach of open innovation challenges enterprises in multiple ways. First, the new system in which one party develops an idea and sells it to another party, rather than bringing it to the market by itself, drives new organizational models by creating new divisions of innovation labor outside the firm (Chesbrough, 2006a). Second, globalization and new communication technologies have created new opportunities but also needs for more effective collaboration across physical distances for firms to leverage this new division of labor (Chesbrough, 2006a). Third, the importance as well as the flexibility requirements of intellectual property (IP) management have considerably risen in such a market environment (Chesbrough, 2006a, 2007b). Despite the growing number of publications related to the field of open innovation, the academic literature still defines the term 'openness' relatively broadly and provides different interpretations. While Laursen and Salter (2006), for instance, relate openness to their concept of external search breadth and depth and thus to *"the number of external sources […] that firms rely upon in their innovative activities"* (p. 134) and

"the extent to which firms draw deeply from the external sources" (p. 134), Henkel (2006), instead, equates openness to revealing ideas and knowledge previously hidden inside corporations.

Consequently, it is not surprising that combining both literature streams of open innovation and business model design under the same umbrella come at a price of missing clarity of the open business model concept. But a common language is an essential requirement in each research field in order to establish a solid ground for further empirical work and to generate complementary knowledge. Hence, this article contributes to the present academic body in multiple ways. First, a comprehensive overview of a systematic evaluation of relevant scholarly work in the area of open business models is provided. Second, a common understanding of the concept is derived in order to lay the foundation for future research in an emerging domain. This understanding includes the use of the concept by different authors, as well as how scholars differentiate open business models from related fields. Third, a conceptual framework of the theoretical building blocks and the working mechanisms of the emerging concept is generated with the intention to make the framework accessible and tangible for business practitioners.

METHODS

In order to gather deep insights from the current state of open business models and to derive a thorough understanding of the framework, relevant academic articles are identified with the aid of a systematic literature search based on keywords and an initial check of the relevance of each article. Per the recommendations of Short (2009) and Zott et al. (2011), this paper follows a multi-step process. First, an in-depth literature review will explore *"the body of relevant conceptual and empirical works in top management outlets, as well as specialty outlet"* (Short, 2009, p. 1313). Following Short (2009), the initial list of scientific business and management journals for this systematic literature review includes, *Academy of Management Journal (AMJ), The Academy of Management Review (AMR), Administrative Science*

Quarterly (ASQ), Journal of Management Studies (JMS), Journal of Management (JOM), Organization Science (OS), and *Strategic Management Journal (SMJ).* According to Zott et al. (2011), this initial scholarly literature base is further expanded by top global practitioner journals of *California Management Review (CMR), Harvard Business Review (HBR),* and *MIT Sloan Management Review (MSM)* as well as the following specific journals due to their significant importance for management research: *MIS Quarterly* and *Management Science (MS).* This first search step was conducted based on the term 'open business model' in the title or keywords and generated an initial set of six papers.

Second, due to the low number of hits, the initial literature search was extended to the EBSCO Business Source Complete database (see e.g. Zott et al., 2011). The scholarly business database provides a list of more than 1,300 academic journals and is considered to be one of the largest and most comprehensive sources on management research articles. The search which was conducted in May of 2019 based on the search string "open business model*" and with no constraints regarding the years of publications but restricted to paper published in English, resulted in a set of 66 articles and books. Consequently, the final set of literature consists of 70 articles, considering that two articles of the second search occurred already in the original literature sample. The final sample contains one book, which was included in the literature review due to its high impact on open business models. A check of this final sample carried out through reading the titles of the papers, the prefaces as well as the abstracts and opening pages, showed that some of the identified journal articles were not centered around the framework of open business models and did not provide a clear focus of the concept. Therefore, based on the recommendations of Zott et al. (2011), the following additional criteria were adopted to guarantee that the entire literature sample included in this study supports its research purpose: (1) a research paper must address open business models in depth, so that further clarity of the concept is provided; (2) an article must be published in a journal that is ranked in the

ISE Web of Science to ensure high data quality. The implementation of these criteria led to the elimination of 43 papers and thus, to a final set of 27 articles for further in-depth analysis.

Third, after carefully reading these articles, an analytical review scheme was developed in order to systematically analyze the final data set (Ginsberg & Venkatraman, 1985), centered around a table that contains basic information such as the author(s), the title and year of the publication as well as detailed information, including the main findings, the authors' understanding of open business models and its distinction and overlaps to the correlated domain of open innovation.

EMERGENCE OF THE LITERATURE

As demonstrated in Figure 2.1, the body of literature in open business models is still rather limited, but the academic interest and awareness in this emerging field has significantly increased over the past years. The relevant literature for this paper was published over a time period of 13 years with the first publication in 2006. Some researchers have considered activities of enterprises to connect the business model innovation process to its environment in order to stimulate the firm's innovativeness through external knowledge sourcing and collaborations pre-2006 (e.g. Osterwalder et al., 2005; Shafer et al., 2005); however, Chesbrough (2006a) gave the emerging concept a name, linked it explicitly to open innovation and distinguished it from related academic fields such as business model design. Additionally, these earlier occurrences lack a clear definition of the term and fail to provide a distinct framework. By labelling the emerging concept, Chesbrough (2006a) gave it an identity and enabled other scholars to channel their research activities and to develop a body of literature in this field.

The journals – *California Management, Industrial Marketing Management, Industrial and Corporate Change, Irish Journal of Management,* and *Journal of Management Studies* – account for almost 50 percent of the identified articles in the final data set of this literature

review. Furthermore, the literature sample of 27 articles illustrates that the main focus of the reviewed academic work is based on a qualitative empirical research method with a total of 13 articles, while 10 articles are purely conceptual in nature. Out of the four remaining articles, three articles are quantitative empirical studies, while one article pursues mixed methods research by using quantitative and qualitative data. This distribution might be explained by the newness of the concept in research as well as the difficulties in conceptualizing the business model construct and thus, in developing a validated measurement scale (Clauss, 2016). The aim of the qualitative empirical publications ranges from identification of main characteristics, elements and antecedents of open business models to strategic difficulties and challenges related to an increased openness of the concept regarding IP ownership, utilization of open innovation practices and the design of incentive systems.

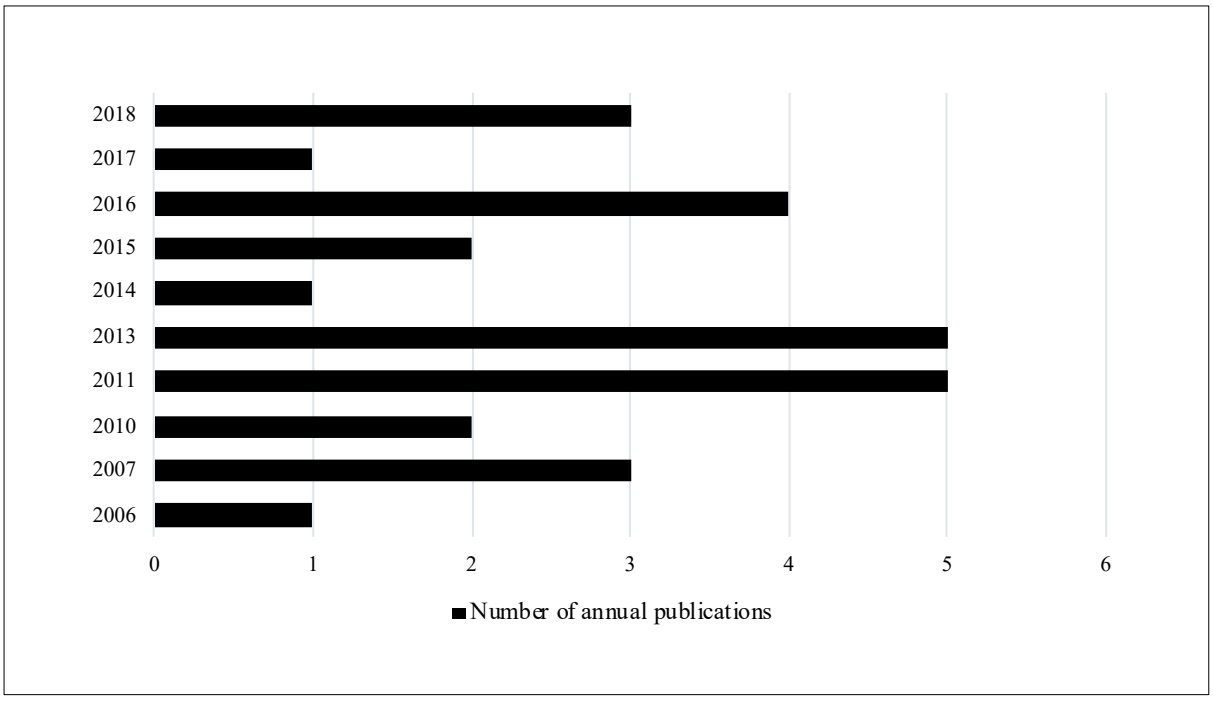

Figure 2.1: Number of annual publications

The reviewed qualitative research papers in the final data set rely primarily on case studies as main methodology for providing insight. This approach includes in-depth studies of a single firm (Spieth & Schuchert, 2018), multiple firms and business models (Davey, Brennan,

Meenan, & McAdam, 2010, 2011a; Davey et al., 2011b; Djelassi & Decoopman, 2013; Frankenberger, Weiblen, & Gassmann, 2013, 2014; Ghezzi, Balocco, & Rangone, 2016; Holm, Günzel, & Ulhøi, 2013; Visnjic, Neely, & Jovanovic, 2018) as well as longitudinal studies (Chanal & Caron-Fasan, 2010; Cozzolino, Verona, & Rothaermel, 2018; Deslee & Ammar, 2016). The quantitative empirical work focuses largely on the effect of open business model elements and design parameters on the financial and innovation output of enterprises. In this context, two important types of experimental designs are determined ranging from the use of large scale surveys from 1,000 Taiwanese service firms (Cheng, 2011) to the analysis of secondary data, such as event announcements of US-exchange listed firms (Alexy & George, 2013) and recordings of 500 innovative software startups which raised venture capital in 2018 (Colombo, Cumming, Mohammadi, Rossi-Lamastra, & Wadhwa, 2016). Within the set of literature, only one academic paper relied on mixed methods research by applying qualitative and quantitative approaches in order to gain a deeper insight into the dynamics and interactions of platform business models and regional developments (Yun, Won, Park, Yang, & Zhao, 2017). In this study, the authors used various techniques ranging from in-depth interview methods to system dynamics simulations and statistical analyses.

As indicated earlier, Chesbrough (2006a), one of the key scholars in the domain of open business models, has played an active part in the establishment and enhancement of the concept and has coined the term by bringing together two related concepts of open innovation and business model design. Consequently, the author was the main force for forming a framework and bringing the emerging concept of open business model to management scholars' attention in order to stimulate research in this field. The author extends the critical concept of open innovation by emphasizing that *"there is no inherent value in a technology per se"* (p. 43) and thus appropriate business models are required to bring technologies to the market to give them value. Moreover, modern products and the technology that supports them are too complex to

be developed in isolation by a single firm. This is why firms must leverage the division of a creative workforce outside of their corporate boundaries and learn to engage with each other.

The analysis of the articles further illustrates that the scholars share a common understanding of 'openness' and refer to it as a firm's collaboration with external partners such as other companies, communities, or customers. With respect to 'business model', however, there seems to be a lack of definition and clarity among the authors. In the reviewed articles the term is described in manifold ways and referred to as interrelated building blocks (Holm et al., 2013), a conceptual device (Holm et al., 2013), a collaborative network (Romero & Molina, 2011), or a framework that provides firms a mechanism to *"link ideas and technologies to economic outcomes"* (Chesbrough, 2006a, p. 108). But there is still a general agreement in the literature that the main responsibilities of a business model are the creation and capture of value (Chesbrough & Rosenbloom, 2002; Zott & Amit, 2008, 2010).

Moreover, the literature review demonstrates that there are only a few attempts in which authors have addressed the complex concept of open business models with the aid of a precisely derived and articulated theoretical foundation. As one of the few, Saebi and Foss (2015) for instance, examine the moderating role of business models on the relationship of open innovation strategies and innovation performance and thus, explicitly link both concepts to each other. The authors' understanding of the business model with its main design parameters, content, structure, and governance, follows the framework of Amit and Zott (2001), an early and major contribution in this sphere. The work of Amit and Zott (2001) is based on the integration of various academic concepts such as value chain analysis (Porter, 1985) and dynamic capabilities (Teece, Pisano, & Shuen, 1997). That said, it should be noted that less than half of the reviewed academic papers verifiably base their research efforts in the field of open business models on an existing conceptual base. Given the variety of conceptions regarding the open business model term, a common view is unlikely. However, the different

perceptions and understandings among scholars can be analyzed and grouped in order to explore the relationship to related domains and to reach a common position. Table 2.1 provides a comprehensive overview of the final literature sample including the main findings of each paper as well as the open business model definition and its link to open innovation.

Table 2.1: Summary of relevant academic work on open business models

Author (Year) / Type of Article	**Selected Research Results**	**Open Business Model Understanding**	**Relationship OI / OBM**
Chesbrough (2006a) Conceptual	Explaining how firms can manage their IP differently in order to innovate more openly. Furthermore, a diagnostic tool is provided to help firms in assessing where their existing business model stands and to explain how to eliminate obstacles on their way to an increased openness in business models.	An open business model uses the *"growing division of innovation labor "* outside a firm's boundaries (p. 2) to perform *"two important functions: value creation and value capture"* (p. 108).	Open innovation activities incorporated in business model concept, but business model requires some adaption.
Chesbrough (2007b) Conceptual (Illustrative cases of three firms from distinct sectors with distinct product portfolios)	Business models that embrace open innovation address both issues, rising R&D costs and decreased product revenues. Hence, the shift from closed to open business models can improve the effectiveness of an innovation effort and increases the competitive advantage of enterprises.	An open business model *"creates value by leveraging many more ideas because of their inclusion of a variety of external concepts"* (p. 22) and increases value capture by *"utilizing a firm's key asset, resources or position not only in that organization's own operations but also in other companies' businesses"* (p. 22).	Open innovation activities incorporated in business model concept, but business model requires some adaption.
Chesbrough & Schwartz (2007) Conceptual (Illustrative cases from various sectors ranging from pharma and high-tech to software and consumer products)	Partnerships in R&D are an efficient instrument to innovate the business model of an enterprise and thus to improve the effectiveness of innovation. The key elements for successful long-term R&D partnerships are precisely defined objectives and aligned business models among partner firms.	An open business model utilizes external cooperation partners for the development of novel products or services. Therefore, the use of open innovation practices creates new business model options.	Open innovation activities incorporated in business model concept, but business model requires some adaption.
Pisano & Teece (2007) Conceptual	Examining how a firm's operating environment can be controlled such that it supports firms to capture value from their innovations. Tools include pushing technologies into the public domain, helping to shape standards, and promoting modularity.	In an 'open innovation model' firms *"make much greater use of external ideas and technologies in their own business […]"* (p. 289).	For the most part both concepts are used in an interchangeable manner.
Chanal & Caron-Fasan (2010) Longitudinal in-depth case study of the web start-up CrowdSpirit	Web platforms centered around innovation communities are valuable resources but can result in strategic difficulties related to ownership rights and usage of intellectual property. Therefore, the respective business model requires regular adaptations.	An open business model in web platforms is based on external and anonymous knowledge incorporation that take advantage of idea communities as strategic resources.	For the most part both concepts are used in an interchangeable manner.
Davey et al. (2010) In-depth case study approach of four healthcare technology companies	Developing open business models enables firms to manage effectively the many-sided ideas of various external input sources and allows to launch products much faster. Particularly, competitor networks can be of great benefit in form of improved product marketing and intelligence gains.	The study adopts an open business model perspective based on Chesbrough (2006a) and thus refers to the implementation of open business model activities.	Open innovation activities incorporated in business model concept, but business model requires some adaption.

Author (Year) / Type of Article	Selected Research Results	Open Business Model Understanding	Relationship OI / OBM
Casadesus-Masanell & Llanes (2011) Conceptual (econometric data modelling)	With the aid of a 'two-period game' approach, the study explores that the business model settings, including the degree of openness are the results of a firm's active search to improve value capture of the model and thus to maximize its revenue.	The study assumes that a business model has different degrees of openness and does not explicitly differentiate between business models and open models. Provided definition in line with Mangematin & Baden-Fuller (2008) and Casadesus-Masanell & Ricart (2010).	For the most part both concepts are used in an interchangeable manner (though open innovation is not explicitly mentioned).
Cheng (2011) Quantitative analysis of survey data from 1,000 Taiwanese service firms	The variable 'dynamic service innovation capability' has an inverted U-shaped effect on radical new services. Open business models can help to overcome such obstacle by stimulating greater exploration of radically new service innovations.	The study adopts the open business model view of Chesbrough (2006a) and *"emphasises the flexible use of resources and the reconfiguration of processes with third parties"* (p. 232) accordingly.	Open innovation principles are incorporated in business model framework.
Davey et al. (2011a) In-depth case study of seven firms, based in United Kingdom and Ireland, operating in the medical device industry	Establishing beneficial value networks is critical for firms operating in the medical device industry in order to reach the market quicker. Therefore, business model elements are identified, and an explanatory model of a firm's value network is created.	The study adopts the open business model view of Chesbrough (2006a) and stresses that an open business model *"captures the multifaceted ideas of scientists, engineers, clinicians and indeed patients […]"* (p. 807) which helps to reduce the innovation time.	For the most part both concepts are used in an interchangeable manner.
Davey et al. (2011b) In-depth case study of two different emerging healthcare technologies	Developing a framework to clearly realize the value of medial innovation at the concept stage in order to use limited financial resources effectively. A sufficient interaction between all shareholders, including the customers in an early development stage is crucial for the success of innovation.	The study adopts the open business model view of Chesbrough (2006a) and points out that *"an open business model, when used holistically, forces managers to consider the integrative nature of their business activity from an open innovation perspective"* (p. 62).	For the most part both concepts are used in an interchangeable manner.
Romero & Molina (2011) Conceptual (literature review on the creation of value with third parties)	Collaborative firm networks, including customer communities, are becoming a main element of value creation. Furthermore, a reference framework is developed for creating and analyzing these interface networks.	An open business model is defined as 'collaborative business model' and is the driver of value creation as well as allows firms to access new ideas, share risks and resources with third parties.	Open innovation activities incorporated in business model concept, but business model requires some adaption.
Alexy & George (2013) Quantitative analysis of 77 events announced by 52 US-exchange listed firms	Exploring the evolution of commercial engagement in open source software as an illustration of open innovation. Firms tend to use more and more open innovation practices to leverage R&D spending and access new innovations, users, and market segments.	An open business model refers to *the "mechanisms by which firms access knowledge beyond their boundaries to create value, sometimes by ceding control of product development pathways and its own intellectual property rights"* (p. 174).	Open innovation principles are incorporated in business model framework.
Coombes & Nicholson (2013) Conceptual (literature review of business models)	The impact of marketing discipline on business model literature is limited. It appears that there is *"no natural home for business model literature"* (p. 662). Furthermore, the element of 'value exchange' between parties plays a key role in the literature. Hence, the main potential for business model progress lies in co-creation.	An open business model considers value creation between the firm and third parties and *"holds the potential to offer clarity and transparency in reciprocal value exchange between multiple stakeholders"* (p. 663).	For the most part both concepts are used in an interchangeable manner (though open innovation is not explicitly mentioned).

Author (Year) / Type of Article	Selected Research Results	Open Business Model Understanding	Relationship OI / OBM
Djelassi & Decoopman (2013) In-depth case study of five consumer goods companies practicing crowdsourcing operations	Crowdsourcing has an impact on each element of the business model and is a *"driver of open innovation that offers access to a wide range of innovation capabilities"* (p. 690). They provide *"a great opportunity to increase and optimize each organization's links with its customers and allow new solutions to be brought to market"* (p. 690).	An open business model describes a model that mainly takes advantage of crowdsourcing, *"a form of user-driven innovation and co-creation"* (p. 683), based on interactions between customers and companies.	Open innovation activities incorporated in business model concept, but business model requires some adaption.
Frankenberger et al. (2013) In-depth case study of three solution providers, named 3M Services, SAP, Geberit	Highlighting the important role of networks for business models. Solution customer centricity as a main element for a successful open business model and moderator for the relation between partner networks and open business model performance. Generally, there are various ways, how a business model can be opened up to external partners.	An open business model *"explains value creation and value capture of a focal firm, whereby externally sourced activities contribute significantly to value creation"* (p. 672).	For the most part both concepts are used in an interchangeable manner (though open innovation is not explicitly mentioned).
Holm et al. (2013) In-depth case study of the two largest privately-owned newspaper publisher in Denmark	Exploring the role of different degrees of 'openness' in business models. A 'broad openness' is reflected in a more complex model structure by higher transaction costs and less dependency, while 'deep openness' reduces a firm's control of activities and gives external partners more influence. A framework is derived to classify a business model based on the types of openness.	Business models can be divided into two groups based on their degree of openness: 'deep-broad' and 'inward-outward'. The first is *"strongly related to the concept of boundary-spanning activities"* (p. 336), while the latter is *"linked to the concepts of open innovation"* (p. 336).	Open innovation activities incorporated in business model concept, but business model requires some adaption.
Frankenberger et al. (2014) In-depth case study of eight firms with four very different forms of openness regarding business model design	First, main antecedents of open business models are derived: *inconsistency, need to create and capture value, experience with collaboration, open model patterns, and industry convergence*. Second, with the aid of distinct types of open business models, the relationship and relevance of these antecedents is examined.	An open business model is described as *"a subclass of business models in which collaboration of the focal firm with its ecosystem is a decisive or novel element of value creation and capturing"* (p. 175).	Open innovation activities incorporated in business model concept, but business model requires some adaption.
Kohler (2015) Conceptual	Business models are *"complex systems full of interdependencies and side effects"* (p. 81). Hence, business model reinvention should be a continual and inclusive process. In this context *"being transparent and listening to input from the crowd is crucial"* (p. 81) for evolving the model.	The study adopts the open business model perspective of Chesbrough (2006a) and stresses that through opening up internal processes many more resources become available to the firm and further allows the focal firm *"to share ideas and technologies with other"* (p. 64).	For the most part both concepts are used in an interchangeable manner.
Saebi & Foss (2015) Conceptual	Highlighting, that *"different open innovation strategies require different levels of 'openness' in companies' business models"* (p. 209). Therefore, a contingency model of open business models is developed by connecting open innovation practices to the main business model design elements as defined by Zott and Amit (2008, 2010).	An open business model combines business model and open innovation framework. Firms *"can choose from a variety of business models that have to match its (open) innovation practices on the corporate as well as business-unit level"* (p. 205).	Open innovation activities incorporated in business model concept, but business model requires some adaption.
Colombo et al. (2016) Quantitative analysis of secondary data from 500 software entrepreneurial ventures	Investigation of how the adaption of open business models in software ventures impacts the governance of investments. Open source software startups tend to receive venture capital investment in multiple funding rounds and have a greater likelihood that multiple financiers join forces and invest together in the same venture.	The study adopts the open business model view of Chesbrough (2006a) and emphasizes that *"the main source of value generation is leveraging of external sources of knowledge and technologies and/or sharing of internally developed knowledge and technologies they develop with third parties"* (p. 353-354).	Open innovation principles are incorporated in business model framework.

Author (Year) / Type of Article	Selected Research Results	Open Business Model Understanding	Relationship OI / OBM
Deslee & Ammar (2016) Longitudinal in-depth case study of the French public railway company SNCF	The study provides evidence on how existing corporate routines can support firms in reinventing their business models and transforming them from a *"functionalist to a customer-centric and then to an open business model"* (p. 468) that exploits newly available opportunities.	A business models uses *"bundles of key resources to create and deliver value to customers"* (p. 471). These resources represent the *"assets of the firm, which may come from external markets or be developed internally; competencies refer to the abilities and skills that manger develop individually or collectively"* (p. 470).	For the most part both concepts are used in an interchangeable manner (though open innovation is not explicitly mentioned).
Ghezzi et al. (2016) In-depth case study of 15 firms operating in the telecommunications industry	Exploring how open innovation activities influence a corporate business strategy within the telecommunication industry. The study identifies six different cross-themes describing the open innovation – strategy relationship.	In an open business model the focus *"shifts from the best internal processes configuration to the management of the relationships with external partners and the opportunities to find ideas externally"* (p. 592).	For the most part both concepts are used in an interchangeable manner.
Kortmann & Piller (2016) Conceptual	Development of a matrix of nine distinct business model domains that capture the increase in openness towards customers. While the horizontal axis considers the entire product life cycle, the vertical axis differentiates three collaboration types. Each of the domains allows to derive an individual market strategy.	An open business model involves the *"organizational use of external partners in closing the value chain loop"* (p. 90). This includes the *"impact of increasingly informed, networked, empowered, and active customers"* (p.90).	Open innovation activities incorporated in business model concept, but business model requires some adaption.
Yun et al. (2017) Mixed methods research (In-depth case study of two major smartphone app store platforms, and two hotel reservation platforms; system dynamics simulation; statistical analysis)	Examining dynamics and degrees of openness of 'online-platform' business models as an entrepreneurial ecosystem as well as their effects on regional development. The study suggests that the strong dynamic of these models likely results in income inequalities, if supplier and customer have connected open platforms. Businesses further made dynamic changes in the cluster structure of the industries.	An open business model is a kind of an entrepreneurial ecosystem that can be defined as a network of inter-connected organizations that create new value through innovation.	For the most part both concepts are used in an interchangeable manner.
Spieth & Schuchert (2018) In-depth single case study of a leading car manufacturer in the premium segment	Incumbent firms rely more and more on alliances as a supplier for resources in order to redefine their business models. A framework for open models is created that allows a firm to utilize alliances in an effective way by redesigning the following dimensions: dynamic, relational and architectural.	Business model innovation alliances are formed to jointly innovate a firm's business model. Alliances *"involve two or more partners sharing knowledge (or other resources) and coordinating their activities"* (p. 6).	Open innovation activities incorporated in business model concept, but business model requires some adaption.
Cozzolino et al. (2018) Longitudinal in-depth case study of the Italian publisher GEDI	Analysis of the reaction and business model change process of an incumbent after disruption. The reaction is driven by the type of disruptive innovation (technology vs. business model). Furthermore, external economies of scale provide incentives for firms to use external resources. A two-phased model is created to show the evolution of the business model adaption process.	The main characteristics of open business models are *"access to external knowledge sources, innovative role of users, support of enabling tools or platforms, intrinsic motivations, open approach to intellectual property, and the ability to incur lower costs"* (p. 1177).	Open innovation activities incorporated in business model concept, but business model requires some adaption.
Visnjic et al. (2018) In-depth case study of 12 firms operating in six different sectors	Firms in the manufacturing and software sector have positioned themselves more and more as a service provider to strengthen their financial results. Therefore, firms tend to reach out for external partners to deliver activities outside their competence base. However, this increases the dependency and results in a loss of control over the activity system.	An open business model represents *"a redesign of the activity system, involving more of these external firms in the execution of selected activities"* (p. 48).	For the most part both concepts are used in an interchangeable manner.

CONCEPTUAL FRAMEWORK

THE OPEN BUSINESS MODEL CONCEPT AND ITS BUILDING BLOCKS

Most of the reviewed papers share a common understanding about 'openness' in business models and are in line with Chesbrough (2006a). However, regarding the term 'business model', the literature review has shown that there are a number of varying views among scholars. In the following section the open business model, and in particular, its constituent elements are further examined in order to derive deeper insights of an emerging concept which currently lacks a clear definition and understanding.

Djelassi and Decoopman (2013) take practitioners' perspectives based on five individual case studies of firms in the consumer sector that allow the authors to derive a detailed open business model framework with its main categories, 'infrastructure' as well as 'offering and customers' that can be divided in line with existing work on open business models in the following four underlying elements: *customer centricity, value proposition, strategic resources,* and *value networks.* In the same vein, Spieth and Schuchert (2018) determine the main building blocks of an open business model by emphasizing the aspect of open innovation activities and thus, of partner networks in order to support the development of business model innovations. Regarding the definition of business model, the authors follow Amit and Zott (2001) and define it as the *"content, structure, and governance of transactions designed so as to create value through the exploitation of business opportunities"* (p. 511). The authors' view is consistent with the definitional elements of Djelassi and Decoopman (2013), and therefore, builds an ideal basis to explore the complex nature of open business models. Table 2.2 illustrates the results of a systematic analysis of the literature sample and demonstrates that the definitional elements of open business models used in other papers can be grouped under the umbrella of the four building blocks derived from the framework of Djelassi and Decoopman (2013) in accordance with Amit and Zott (2001) and Spieth and Schuchert (2018). It is worth

noting, that open business models across industries likely put emphasis on a particular mix of the constituent elements, and therefore, adopt slightly different patterns and weightings of these components.

Table 2.2: Constituent elements of open business models based on Djelassi and Decoopman (2013)

Author (Year)	Customer centricity	Value proposition	Strategic resources	Value network	Author (Year)	Customer centricity	Value proposition	Strategic resources	Value network
Chesbrough (2006a)	x	x	x	x	Frankenberger et al. (2013)	x	x	x	x
Chesbrough (2007b)		x	x	x	Holm et al. (2013)	x	x	x	x
Chesbrough & Schwartz (2007)	x	x	x	x	Frankenberger et al. (2014)	x	x	x	x
Pisano & Teece (2007)		x		x	Kohler (2015)	x	x	x	x
Chanal & Caron-Fasan (2010)	x	x	x	x	Saebi & Foss (2015)	x	x	x	x
Davey et al. (2010)	x	x	x	x	Colombo et al. (2016)			x	x
Casadesus-Masanell & Llanes (2011)	x	x	x	x	Deslee & Ammar (2016)	x	x	x	x
Cheng (2011)			x	x	Ghezzi et al. (2016)		x	x	x
Davey et al. (2011a)	x	x		x	Kortmann & Piller (2016)	x		x	x
Davey et al. (2011b)	x	x		x	Yun et al. (2017)	x			x
Romero & Molina (2011)	x	x	x	x	Spieth & Schuchert (2018)	x	x	x	x
Alexy & George (2013)			x	x	Cozzolino et al. (2018)			x	x
Coombes & Nicholson (2013)	x		x	x	Visnjic et al. (2018)	x	x	x	x
Djelassi & Decoopman (2013)	x	x	x	x					

As the first element of the analytic framework, the ‘customer centricity’ is of particular interest to management scholars and is defined as the *“degree to which the focal firm focuses on customers in the joint delivery of solutions”* (Frankenberger et al., 2013, p. 671). There is a general agreement in the reviewed sample that open business model design is centered around customer-focused value creation (Chesbrough, 2006a; Coombes & Nicholson, 2013). According to Holm et al. (2013), the business model describes *“the value which a company offers to one or several (segments of) customers, the architecture of the internal processes of the firm, and the network of partners it has built up for creating, marketing and delivering this*

value in order to generate revenue streams and profit" (p. 327). The decisive role of customer focus is further emphasized by Coombes and Nicholson (2013) who argue that the main objective of a firm's business model is to express how value is generated for all business participants ranging from customers to associated enterprises and the firm itself. Moreover, Frankenberger et al. (2013) suggest that a key characteristic of business models is the *"interplay between the internal dimension of a business, such as the firm's resources and activities, and the external dimension, such as the firm's customers and partners"* (p. 672). As Amit and Zott (2001) illustrate, business models *"are often customer centric in their design"* (p. 513) and firms increasingly involve the end-consumer in the value creation process (Colombo et al., 2016; Frankenberger et al., 2013). Generally, the aspect of co-value creation, and thus the deep integration of external sources in a firm's innovation process, makes it even more important to identify *"what customers want, how they want it, and how the enterprise can organize to best meet those needs"* (Frankenberger et al., 2013, p. 673), because several players have to align their co-creation activities in an open business model accordingly (Djelassi & Decoopman, 2013).

Second, the 'value proposition' is frequently mentioned by scholars as a main element of the concept and is described as a *"selected bundle of products and/or services that caters to the requirements of a specific customer segment"* (Djelassi & Decoopman, 2013, p. 686). For this purpose, the business model has to outline in as much detail as possible how value is created by the focal firm through its product offerings (Holm et al., 2013). Besides the definition of the recipients of the value offering such as customers, stakeholders and/or market segments and the answer on 'how' value is generated, a firm must clearly define the kind of value that is provided. Furthermore, Coombes and Nicholson (2013) argue that the main intention of a business model is to link a firm's strategy and tactics with each other. A frequently highlighted factor in this context is the customer value proposition (Coombes &

Nicholson, 2013; Frankenberger et al., 2013, 2014). As indicated earlier, the *"customer is no longer simply a purchaser of a company's products or a target of its value proposition"* (Djelassi & Decoopman, 2013, p. 683). Instead, value is often co-created between the focal firm and its consumers. Consequently, the emerging concept of co-creation recognizes the *"increasing role of consumers as innovators in the development of a value proposition"* (Coombes & Nicholson, 2013, p. 662).

Third, the 'strategic resources' of an open business model contain core competencies such as skills, knowledge, unique capabilities, strategic assets, core processes, as well as financial assets that allow the focal firm to carry out its tactics and strategies in order to increase the efficiency and effectiveness of its business (Djelassi & Decoopman, 2013). Therefore, every business model requires key resources, which likely vary between models and allow firms to deliver the value proposition to customers, entering new markets, building and maintaining relations with customer segments, as well as increasing returns (Deslee & Ammar, 2016). Thus, the construct of business model is strongly linked to the performance and competitive advantage of an enterprise and stimulated by the resources of the focal firm (Cozzolino et al., 2018). According to Djelassi and Decoopman (2013), social and economic actors, such as customers, should be considered as key strategic resources of an enterprise and be involved in various stages of the development process ranging from the product design face to the advertising campaign and eventually the sale of new merchandise. This suggests that key resources, including skills, know-how, creativity, and imagination can be acquired directly from customers (Djelassi & Decoopman, 2013; Romero & Molina, 2011). Compared to traditional resources, this new category of innovation labor cannot be fully managed at any time because they generally have no contractual relationship with the firm (Chanal & Caron-Fasan, 2010). In addition, Frankenberger et al. (2014) emphasis that inconsistency regarding business model components is a strong driver for companies to adopt more open models and

to integrate missing external resources. The authors describe inconsistency in this regard as an arrangement of business model elements that are not self-reinforcing. Potential risks of an open business model that need to be considered by companies involve the exploitation of internal resources and the protection of intellectual property (Holm et al., 2013).

Fourth and finally, the 'value network' defined as a *"network of cooperative agreements with other companies needed to efficiently offer and commercialize value"* (Holm et al., 2013, p. 327) is a key element in order to open up a business model. Consequently, it links *"suppliers and customers, including […] potential complementors and competitors"* (Chesbrough, 2006a, p. 109). The value network represents the externally available division of the innovation workforce used by an enterprise for the creation of value as well as to capture a share of that value (Chesbrough, 2006a, 2007b). Hence, open business models *"create value by leveraging many more ideas, due to their inclusion of a variety of external concepts"* (Chesbrough, 2006a, p. 2). Furthermore, they increase *"value capture by utilizing a firm's key asset, resource or position not only in that organization's own operations but also in other companies' businesses"* (Chesbrough, 2007b, p. 22). Therefore, openness in the context of business model refers to cooperation, partnerships, as well as the joint value creation with external partners (Amit & Zott, 2001). According to Chesbrough and Schwartz (2007) this openness results in a number of positive outcomes such as access to new markets, reduction of research and development (R&D) expenses and risks, and an increase of innovative performance of firms through access to new skills and knowledge. This list is further expanded by Frankenberger et al. (2013) by adding aspects such as an increased understanding of the products, a more efficient knowledge transfer, and a better access to resources. As Davey et al. (2011a) put it, if a firm is continually engaging with its diverse value network, and therefore, with innovation partners such as customers, suppliers, and industry experts in order to actively find and create opportunities, then it is likely that the focal firm stays ahead of the game by generating

competitive advantage. But such a networked economy also has inherent challenges, including higher costs of maintaining additional ties to partners, information overload (Frankenberger et al., 2013) as well as the challenge of preserving value because these networks are also accessible to competitors and allow them to substitute internal assets (Amit & Zott, 2001; Zott & Amit, 2007).

CLARIFICATION OF TERM OPENNESS IN THE BUSINESS MODEL CONCEPT

The reviewed literature sample illustrates that the majority of articles does not provide a precise description of 'open business models'. To examine the emerging concept in more detail, this paper follows Frankenberger et al. (2014) who suggest that an open business model is a *"subclass of business models in which collaboration of the focal firm with its ecosystem is a decisive or novel element of value creation and capturing"* (p. 175) and therefore, divides the term into its main components 'open' and 'business model' for further analysis. While the academic literature has several detailed literature reviews that explore the concept of 'business model' from multiple perspectives (Zott et al., 2011), the deeper analysis of openness in this context remains under researched. For that reason, the following section seeks to shed light on the understanding of the extent of openness required to classify a firm's business model as 'open'.

According to Chesbrough (2006a, 2007b), openness in business models indicates that a firm opens up essential elements of the related innovation process to the external environment. More precisely it is defined as a systematic collaboration with outside partners (Frankenberger et al., 2013; Osterwalder & Pigneur, 2010) meaning that scholars generally relate openness in business models to the leverage of external know-how and ideas and thus, to the concept of open innovation (Chesbrough, 2006a; Djelassi & Decoopman, 2013). Conversely, Frankenberger et al. (2013) define a business model as closed, if firms *"focus primarily on internal value creation and rarely collaborate with partners; they only maintain simple buyer-*

seller relationships with the outside world" (p. 672). But in today's environment characterized by growing interdependencies among the world's economies, populations, and cultures, there is hardly any company that does not foster tight relations with its environment (Chesbrough, 2006a; Weiblen, 2014). Therefore, the assumption that a business model is considered to be 'open' as soon as the firm collaborates with external partners in any form, regardless of the depth and breadth as well as the purpose of these relationships, does not seem to be sufficient in modern networked economies (Weiblen, 2014). Hence, a framework to classify the degree of openness of a business model is needed in order to derive further insights into this emerging concept and its respective body of literature.

For this purpose, this paper follows the conceptual framework suggested by Weiblen (2014) that gives a guideline to evaluate whether a business model is open or not. The proposed subjective method allows the user to differentiate between pre-defined degrees of openness in business models. Generally, Weiblen (2014) distinguishes between three forms of open business models with different exposure to open innovation, namely (1) open innovation based business models, (2) open innovation based open business models, and (3) open business model only (not affecting R&D). This model allows a more fine-grained analysis compared to other frameworks, although it admittedly cannot capture the entire broad range between 'open' and 'closed' business models with its many nuances. Following the suggestion of Weiblen (2014), the main criteria to distinguish between the three different constructs is whether openness is *"required to explain the firm's value creation and capturing logic on a business model level"* (p. 54). The exchange of a firm with its environment has to go beyond simple buyer-seller relationships, and has therefore, to show a significant level of depth in order to be considered in this framework. Table 2.3 illustrates the result of the categorization of open business models of each article based on the following 'types of openness' defined by Weiblen (2014, p. 57):

(1) Open innovation only falls together with the business model concept if it contributes to a firm's sustained creation and value capturing.

(2) Open innovation only falls together with the open business model concept if it leads to collaboration as a central part of the business model.

(3) A business model is open only if the aspect of collaboration is central in explaining the overall logic of value creation and capturing.

Table 2.3: Clustering of open business models based on Weiblen (2014)

Author (Year)	OI based business model	OI based open business model	Open only business model	Representative quotes about Open Business Models
Chesbrough (2006a)		x		▪ *An open business model uses this new division of innovation labor – both in the creation of value and in the capture of a portion of that value (p. 2)* ▪ *Open [business] models create value by leveraging many more ideas, due to their inclusion of a variety of external concepts (p.2)* ▪ *Open [business] models […] enable greater value capture, by using a key asset, resource, or position […] also in other companies' businesses (p. 3)*
Chesbrough (2007b)		x		▪ *Open business models enable an organization to be more effective in creating as well as capturing value (p. 22)* ▪ *[…] create value by leveraging many more ideas because of their inclusion of a variety of external concepts. (p. 22)* ▪ *[…] allow greater value capture by utilizing a firm's key asset, resource or position not only in that organization's own operations but also in other companies' businesses (p. 22)*
Chesbrough & Schwartz (2007)		x		▪ *Open business models advances the idea of innovating the business model itself, not just the technologies that feed into the model (p. 55)* ▪ *External technology partnerships allow open business models to accomplish even more (p. 55)* ▪ *[Open business model] requires new approaches […] to absorb more external ideas into the company, and to create more pathways for ideas to go to market outside of the company (p. 55)*
Pisano & Teece (2007)			x	▪ *Open business models summarize a strategy whereby companies make much greater use of external ideas and technologies in their own business, while letting their own unused ideas be used by others […] (p. 289-290)*
Chanal & Caron-Fasan (2010)		x		▪ *Open business models in web platforms are based on external […] knowledge incorporation that take advantage of idea communities as key strategic resources (p. 323)* ▪ *[…] collaborative web-based platform […] enables communities to imagine and design innovative products (p. 318)* ▪ *[…] crowdsourcing platforms act as intermediaries in multi-sided markets and, as such, are at the core of a knowledge sharing and IP transfer process between multiple actors (p. 335)*
Davey et al. (2010)			x	▪ *Open business models […] enable companies involved in the development and delivery of healthcare to work more effectively together […] (p. 22)* ▪ *An open business model, when used holistically, forces managers to consider the integrative nature of their business activity from an open innovation perspective (p. 24)* ▪ *A successful open business model creates heuristic logic that connects technical potential with the realization of economic value (p. 24)*
Casadesus-Masanell & Llanes (2011)		x		▪ *An open business model has the potential to improve value creation due to its efforts of utilizing a large community of external developers (p. 1212)*
Cheng (2011)		x		▪ *[…] an open business model emphasizes the flexible use of resources and the configuration of processes with third parties […] (p. 232)* ▪ *[…] firms are beginning to share their internal resources with their third parties to create value, while simultaneously incorporating external resources into their own business model (p. 232)*

Author (Year)	OI based business model	OI based open business model	Open only business model	Representative quotes about Open Business Models
Davey et al. (2011a)			x	▪ *[…] open business models within the health care technology base […] engage scientists, engineers, clinicians and indeed patients at earlier stages of the process thus allowing viable technologies to reach the market more quickly in a way that is evidence-focused (p. 808)* ▪ *A successful open business model creates heuristic logic that connects technical potential with the realization of economic value (p. 809; see Chesbrough, 2006a)*
Davey et al. (2011b)			x	▪ *[…] open business model, when used holistically, forces managers to consider the integrative nature of their business activity from an open innovation perspective (p. 62; see Chesbrough, 2006a)* ▪ *Open business models create value by leveraging many more ideas, due to their inclusion of a variety of external concepts […] (p. 62; see Chesbrough, 2006a)* ▪ *A successful open business model creates heuristic logic that connects technical potential with the realization of economic value. The economic value of a technology remains latent until it is commercialised in some way (p. 62; see Chesbrough, 2006a)*
Romero & Molina (2011)		x		▪ *An open business model is defined as 'collaborative business model' and is the driver of value creation as well as allows firms to access new ideas, share risks and resources with third parties (p. 447)*
Alexy & George (2013)	x	x	x	▪ *An open business model refers to the mechanism by which firms access knowledge beyond their boundaries to create value, sometimes by ceding control of product development pathways and its own IP rights (p. 174)* ▪ *[…] three of the open business model types […] explicitly encourage a hybrid business model design that incorporates the joint deployment of open as well as traditional, closed elements (p. 179)*
Coombes & Nicholson (2013)		x		▪ *An open business model examines the creation of value between stakeholders, rather than simply considering the value created within the boundaries of a single firm (p. 658)* ▪ *Open business models […] hold the potential to offer clarity and transparency in reciprocal value exchanges between multiple stakeholders (p. 663)*
Djelassi & Decoopman (2013)		x		▪ *An open business model that makes use of crowdsourcing is based on the interactions between customers and companies (p. 690)* ▪ *[…] customers may be viewed as key partners and valuable co-producers (p. 686)*
Frankenberger et al. (2013)		x		▪ *An open business model explains value creation and value capture of a focal firm, whereby externally sourced activities contribute significantly to value creation (p. 672)*
Holm et al. (2013)			x	▪ *[…] a more nuanced view and balanced understanding of the term 'openness' as regards business models is needed […] (p. 324)* ▪ *[…] openness to innovations and openness of business models needs to be adequately recognised, understood, and treated as separate phenomena if timely and sufficient responses are to be made (p. 341)* ▪ *[…] the notion of 'openness' in business model configurations is regarded as being both innovative and profitable, which companies can use to effectively create and capture value by systematically collaborating with outside partners (p. 325)*
Frankenberger et al. (2014)		x		▪ *[…] we understand open business models as a subclass of business models in which collaboration of the focal firm with its ecosystem is a decisive or novel element of value creation and capturing (p. 175)*
Saebi & Foss (2015)	x	x	x	▪ *[…] different open innovation strategies require different levels of openness in companies' business models. […] continuum of 'openness' along the dimensions of business model content, structure and governance (p. 209)*

Author (Year)	OI based business model	OI based open business model	Open only business model	Representative quotes about Open Business Models
Kohler (2015)			x	▪ *Opening processes and resources to external creators can transform a product into an interactive platform. This makes a significantly greater set of resources available […] (p. 64)* ▪ *[…] crowdsourcing platforms leverage technology to exploit social networks, peer- to-peer technologies, user-generated content, […] to invite users to participate in value creation activities (p. 64)* ▪ *[…] business models transfer value-creating activities to a crowd. By taking on certain activities, crowd members co-create value with the platform provider […] the company facilitates interactions and exchanges along the entire process of value creation (p. 64)*
Colombo et al. (2016)		x		▪ *[…] main source of value generation is leveraging of external sources of knowledge and technologies and/or the sharing of internally developed knowledge and technologies they develop with third parties (p. 353-354)*
Deslee & Ammar (2016)		x		▪ *[…] business models use bundles of key resources to create and deliver value to customers (p. 471)* ▪ *[…] resources represent the assets of the firm, which may come from external markets or be developed internally […]. Both are needed to deliver the customer value proposition (p. 470)*
Ghezzi et al. (2016)		x		▪ *Business models were substantially modified by open innovation […] value proposition was innovated thanks to the combination of external and internal knowledge, […]; the value infrastructure changed radically, as open innovation broke down the companies' boundaries […] (p. 583)* ▪ *Open innovation and business model […] determining the firm's logic of value creation and capture […] (p. 580)*
Kortmann & Piller (2016)	x	x	x	▪ *An open business model involves the organizational use of external partners in closing the value chain loop. This includes the impact of increasingly informed, networked, empowered, and active customers (p. 90)* ▪ *[…] introduction of different business model archetypes that demonstrate how innovating firms are moving towards closed-loop value chains and simultaneously incorporating external partners into increasingly open business models (p. 101)* ▪ *[…] distinguish between three stages of value creation that offer various options to capture value (p. 91)*
Yun et al. (2017)		x		▪ *An open business model is a kind of entrepreneurial ecosystem […] defined as a network of interconnected organizations, connected to a focal firm or platform, which incorporates both production and use of side participants and creates and appropriates new value through innovation (p. 808)* ▪ *Open business models allow ideas to travel from invention to commercialization through at least different companies and not just through a hosting company (p. 809)*
Spieth & Schuchert (2018)	x			▪ *Open innovation practices, especially alliances are viewed as a vehicle to support incumbent firms to innovate their business models and to support the shift towards a more open system (p. 20)*
Cozzolino et al. (2018)		x		▪ *The main attributes of open business models are access to external knowledge sources, innovative role of users, support of enabling tools or platforms, intrinsic motivations, open approach to intellectual property, and the ability to incur lower costs (p. 1177)* ▪ *[…] company uses the division of labor to create greater value by leveraging more external ideas and to capture greater value by using key assets, resources, or positions […] (p. 1171; see Chesbrough, 2006a)*
Visnjic et al. (2018)		x		▪ *[…] rely increasingly on partners and suppliers to provide new activities that are outside their competence base. This open business model allows […] to grow new service businesses effectively and efficiently (p. 46)* ▪ *[…] open business model represents a redesign of the activity system, involving more of these external firms in the execution of selected activities (p. 48)* ▪ *Manufacturers are increasingly adopting open business models as they integrate consumers and other external parties into value creation and value capture (p. 48)*

CONCLUSION AND OUTLOOK

The review of scholarly literature has shown that the emerging concept of open business models is of tremendous importance for both researchers and practitioners and that the evolving conceptual framework allows a better grasp of corporate activities related to value creation and capture. But in today's increasingly networked economies driven by globalization, collaborations and openness towards external actors seem to be an absolute necessity for enterprises and deeply embedded in the corporate culture. Therefore, the differentiation between similar concepts of business models and open innovation becomes even more difficult. This situation is aggravated by an unclear definition of open business models which further increases the lack of conceptual clarity. This paper presents an approach to reduce these barriers and to shed light into the multifaceted field of open business model research.

For the purpose of generating a new and broad understanding of open business models, the concept was broken down into its constituent elements of customer centricity, value proposition, strategic resources, and value networks. The study has shown that there is consensus among scholars regarding these elements and that each reviewed academic paper names at least two of these components, many of them even all four, as an inherent part of the open business model concept. Furthermore, the term 'openness' was analyzed and categorized with the aid of a conceptual framework derived from the literature sample. The thorough analysis of the academic work has shown that the term can be grouped into three clusters named (1) open innovation based business models, (2) open innovation based open business models, and (3) open business model only (not affecting R&D). This procedure has sharpened the perception of 'openness' among scholars and helped to achieve more clarification and accuracy regarding the meaning of the term and its distinction to closely related management fields. Future research may deepen the knowledge about 'openness' as well as the interdependencies of the four constituent elements of the open business model framework and derive more insight

into the circumstances under which it is beneficial for an enterprise to shift towards a system of a more open business model. Generally, open business model research is still a young domain, but our interconnected industries worldwide provide a vast variety of areas that would be worthwhile to investigate from an open business model point of view.

CHAPTER 3
BUSINESS MODEL DESIGN AND TECHNOLOGICAL INNOVATIONS: A DYNAMIC APPROACH TOWARDS IDEAL OPEN INNOVATION BEHAVIOR

ABSTRACT

Besides technological innovation, the business model plays a central function for enterprises in establishing competitive advantage. The theoretical starting point of this empirical study is the evolutionary economic idea that the innovation behavior of firms differs and an ideal open innovation strategy follows a dynamic pattern that is determined by the firm's innovation focus, defined as degree of novelty of the technology and degree of novelty of the business model. Multiple, fine-grained behavioral clusters with different emphasis and degrees of openness are extracted from the large-scale sample of 674 enterprises using microdata of the Community Innovation Survey in Germany. The study further finds that firms' strategic differentiations are significantly determined by the innovation interest regarding business model and process innovation. This differentiation suggests that companies increasingly overcome sector-specific pressure and form homogenous behavior clusters based on their innovation interest.

INTRODUCTION

Innovation creates competitive advantage and drives the success of firms such as Microsoft, Dell, Procter & Gamble, Pfizer and many others (Chesbrough & Schwartz, 2007). Therefore, innovation is a crucial mechanism that gives firms an edge in staying ahead of the competition (Van de Ven, 1986). An early definition of innovation was provided by Thompson (1965): *"Innovation is the generation, acceptance and implementation of new ideas, processes, products or services"* (p. 2). Given the different disciplinary perspectives, many more variations in the definition have arisen over the decades. A much-quoted and more detailed definition with a focus on knowledge management was suggested by Plessis (2007): *"Innovation is the creation of new knowledge and ideas to facilitate new business outcomes, aimed at improving internal business processes and structures and to create market driven products and services. Innovation encompasses both radical and incremental innovation"* (p. 21). This definition captures an integral part of innovation, namely the degree of novelty of technologies, as well as the aspect of commercialization.

Christensen (1997) posited the concepts of sustaining or incremental versus disruptive or radical product innovation. Sustaining, or incremental innovations, pursue the objective to make existing products and services even better and to increase customer satisfaction. These upgrades and small improvements to current products include such changes as an additional blade in a razor for a cleaner shave or an improved panel in a television for a clearer picture. Hence, the period of incremental product change begins when the dominant design arises (Utterback, 1994; Utterback & Abernathy, 1975). Once a new standard becomes established, competitors tend not to offer identical goods, but most products embody identical core features and architecture (Laursen & Salter, 2006). Incremental product innovations play an essential role in the product portfolio of firms. Even though incremental new products tend to provide returns that are less spectacular, their development is less risky and significantly reduces the

development effort of corporations (De Brentani, 2001). Additionally, performed through an existing business model, these innovations provide a high degree of fit with the strategies, resources, and commercialization experiences of a firm and thus, increase the rate of product success (Song & Montoya-Weiss, 1998). In comparison, definitions of radical, or discontinuous innovations, highlight the newness of a product (De Brentani, 2001). Hence, radical innovations are classified as either *"truly novel or unique technological solutions"* (De Brentani, 2001, p. 170) or at least perceived as totally different to existing products that require significant changes in terms of the thinking and behavior of consumers (Rogers, 2003). Radical innovations tend to provide a greater opportunity for performance differences and have the potential to disrupt an existing market with its established products by displacing the existing technology (Garcia & Calantone, 2002; Laursen & Salter, 2006). Furthermore, Damanpour (1991) differentiates between product and process innovation. While the main motives for product innovations are related to a firm's need to develop new products in order to satisfy customer demand as well as the desire to penetrate new target markets, process innovations are concerned with efficiency improvements and flexibility increase in a manufacturing environment (Boer & During, 2001).

Besides the technology, the firm's business model is of significant importance. It is the business model that defines the commercial success of ideas because *"the same idea or technology taken to market through two different business models will yield two different economic outcomes"* (Chesbrough, 2010, p. 354). Chesbrough (2007a) suggests that *"today, innovation must include business models, rather than just technology and R&D"* (p. 12). Generally, the business model is defined as a framework to *"link ideas and technologies to economic outcomes"* (Chesbrough, 2006a, p. 108). Hence, every firm has a business model, whether it is clearly expressed or not (Chesbrough, 2006a). These statements reveal the relevance of the business model in order to ensure the success of technological innovations and

demonstrate how intertwined both elements are. While Chesbrough and Rosenbloom (2002) suggest that under certain circumstances a current business model might be sufficient to bring a new product to the market, Teece (2010), instead, emphasizes that in order to maximize economic output and to achieve best fit between technological innovation and a firm's business model, *"every product development effort should be coupled with the development of a business model"* (Teece, 2010, p. 183).

CONCEPTUAL BACKGROUND

Based on the experience of a corporation, the business model can be categorized into the following dimensions: 'current business model' and 'new business model', while the technological innovation can be divided into 'incremental product innovation', 'radical product innovation' and 'process innovation'. Generally, the Community Innovation Survey (CIS) and Oslo Manual (OECD/Eurostat, 2005, 2018) used in this paper collects output data on the innovativeness of an enterprise by identifying whether a new or significantly changed product or process has been launched during a pre-defined time period of three years. Hence, the measures proposed by the OECD help to generate insights into the advantage of different degrees of technological innovation for an enterprise. In comparison to technological innovation with its three distinct groups, the construct of business model innovation is more complex and rather difficult to measure. The proposed innovation survey does not include a specific measurement scale to capture the extent of business model change. For that purpose, this empirical study builds on the theoretical basis of Clauss (2016) and assumes that a slight but systematic modification of organizational structures by a company results in a change in design of the business model. This allows one to derive the previously defined broad categories of 'current' and 'new' business models.

Consequently, the dimensions of the constructs, 'degree of novelty of the technology' and 'degree of novelty of the business model', allow one to theoretically construct a 2x3 matrix of

six distinct combinations (see Figure 3.1). The proposed conceptual framework, a permutation of the innovation landscape map of Pisano (2015), has been extended by another dimension named process innovation, in order to integrate Utterback and Abernathy's model and its perspective on the importance of both product and process innovation during an industry life cycle (Utterback, 1994; Utterback & Abernathy, 1975).

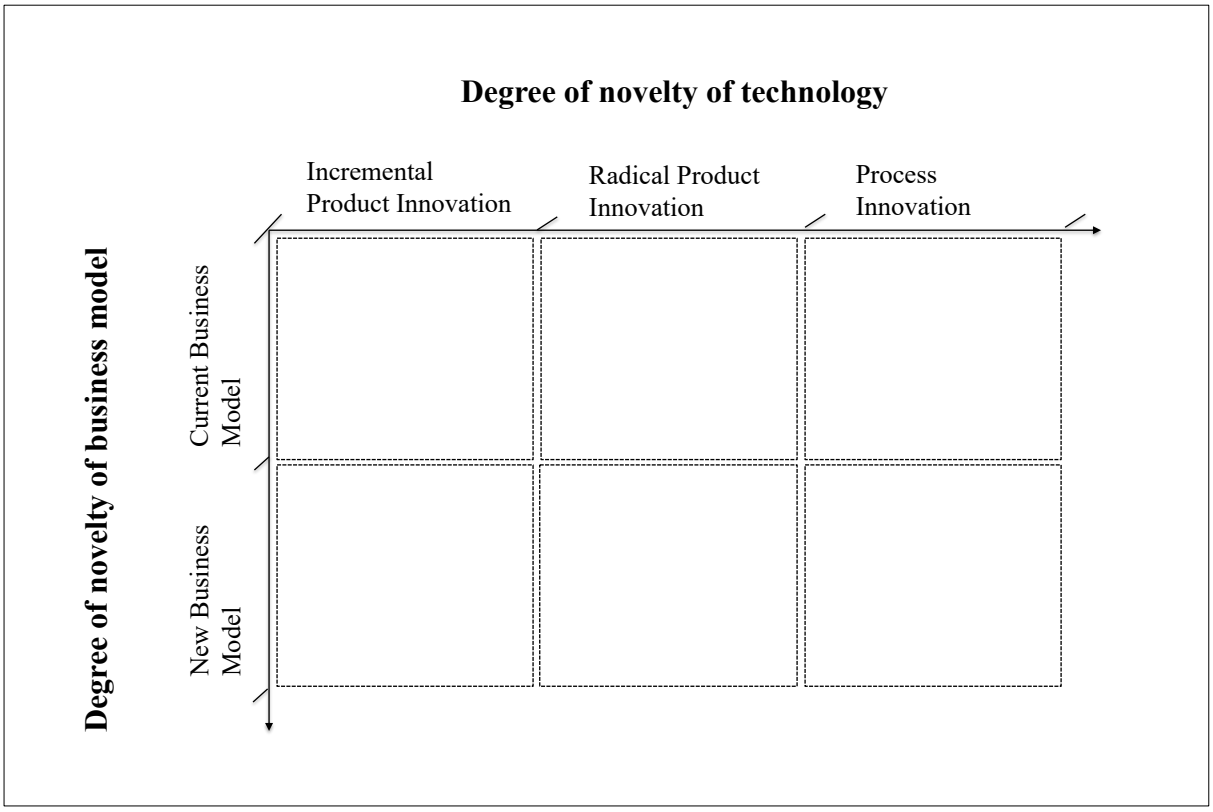

Figure 3.1: Proposed theoretical framework

Prior empirical work has further considered the impact of business model change for incumbents as an industry matures and suggests a succession of the innovative focus of firms from product to process innovation, and finally to business model change (Massa & Tucci, 2014). Hence, declining profit margins and competitive pressure which are characteristics of a mature industry tend to increase the necessity for firms to innovate their business model and provide an opportunity for differentiation (Chesbrough, 2010; Eggert, Hogreve, Ulaga, & Muenkhoff, 2014; Neely, 2008). While Pisano's approach is conceptual in nature and seeks to

describe how a potential innovation fits with a firm's existing business model and technical capabilities, this empirical analysis aims to derive concrete bundles of innovation activities for the different innovation interests of an enterprise in order to provide guidance for corporate executives regarding their innovation strategy in a dynamic and complex environment. According to Pisano (2015), the difficulty with innovation efforts lies in a lack of innovation strategy of companies rather than in a failed execution. Innovation strategy is defined as a *"set of coherent, mutually reinforcing policies and behaviours aimed at achieving a specific competitive goal"* (Pisano, 2015, p. 44). Like all models, this research framework is a considerable simplification of reality. But the intention of the model is to isolate important issues that are not immediately and clearly visible in the complex reality in which firms operate (Chesbrough, 2006a).

Sustaining continuous innovation is hard (Cole, 2001) and many firms have started to rethink their innovation approach and recognize the benefits of combining internal with external R&D to access widely distributed knowledge (Arora, Fosfuri, & Gambardella, 2001; Laursen & Salter, 2006). This can be done through an open innovation system in multiple ways, for instance, by bringing in new human capital, engaging in R&D and manufacturing alliances, acquiring technology ventures and purchasing knowledge and ideas in the form of patents (Mazzola, Bruccoleri, & Perrone, 2012). At the same time, internal inventions that are not pursued by the firm should not simply be shelved, but rather used for commercialization through, for instance, out-licensing to generate additional revenues (Chesbrough, 2003). Considering this diversity, the academic body usually distinguishes between various forms of open innovation activities such as inbound, outbound, and coupled mode (Chesbrough, 2003; Gassmann & Enkel, 2004). While inbound open innovation describes the absorption of externally available knowledge, outbound refers to the opposite and thus to commercializing firm's unused technology assets. The coupled open innovation mode as a further concept

combines inbound and outbound operations and relates to the joint development and commercialization of ideas with external partners. Furthermore, in order to derive a more complete picture of open innovation the literature captures the degree of openness of a firm with the aid of the concept of breadth and depth of knowledge search (Laursen & Salter, 2006). While external search breadth describes the number of different sources of knowledge for innovation utilized by a company and thus captures the diversity of external knowledge sources (Laursen & Salter, 2006), external search depth, in contrast, is seen as the intensity by which a company pulls knowledge from the various innovation sources (Laursen & Salter, 2006). Firms with a high degree of search depth are deeply integrated in the innovation process of the customer and used frequently as an innovation source. This deep integration of external partners into a firm's internal innovation process seems to be the preferred methodology when companies jointly develop novel products or services in R&D alliances or joint ventures (Saebi & Foss, 2015). These examples demonstrate the variety of ways provided to corporate executives for achieving innovations. Each open innovation practice has its distinct advantages and disadvantages. Mazzola et al. (2012) illustrate that certain innovation practices are more beneficial than others and that the influence on innovation and financial performance measures of a company differs. Furthermore, managers have to define the ideal degree of openness. According to Laursen and Salter (2006), there is a positive correlation between inbound open innovation practices and performance, but there are also inflection points after which a further increase of openness may negatively impact the innovative performance of an enterprise.

Therefore, the degree of novelty of the technology and the degree of novelty of the business model in the proposed matrix (see Figure 3.1) defines the innovation strategy with its best bundle of innovation activities and ideal degree of openness in order to maximize the innovative performance of an enterprise. While most scholars suggest a closed innovation system is the point of departure and an open innovation approach the final and most beneficial

stage in the transformation of an enterprise, this paper is based on the assumption that a firm's innovation behavior evolves in different directions by aiming for competitive advantage and rather, expects that an ideal innovation strategy follows a dynamic pattern that is determined by the innovation focus.

DIFFERENCES IN OPEN INNOVATION BEHAVIOR

Early research has focused on internal R&D investment as the main influence parameter of corporate innovation behavior, while later academic studies have applied a significantly broader view by considering further activities such as R&D outsourcing (Veugelers & Cassiman, 1999), external knowledge sourcing (Laursen & Salter, 2006), collaborations with external partners (Veugelers, 1997) as well as the protection of intellectual property (IP) through formal and informal appropriation mechanisms (Cohen, Nelson, & Walsh, 2000). The following subsections analyze in detail the selected variables used in this study to describe a firm's open innovation behavior and illustrate their dependency on the innovation focus, defined as the degree of novelty of both the technology and the business model.

THE INFLUENCE OF INBOUND OPEN INNOVATION PRACTICES

Utterback and Abernathy's model gives an explanation about 'how' and 'when' firms adjust their innovation focus during the different stages of an industry life cycle in order to remain competitive at any time. The model indicates that after a dominant design is in place, a firm's focus shifts from product innovation towards the continuous improvement of the matured products (Johnson, 2010; Utterback, 1994). In this stage, the firm tends to search for inspiration outside of its boundaries to 'fine-tune' the dominant design (Laursen & Salter, 2006). For this purpose, firms likely draw knowledge from a broader range of external members without establishing deep relationships (Laursen & Salter, 2006), meaning that firms with a strong focus on incremental innovations performed through a familiar business model

are expected to be characterized by low inbound knowledge search depth and high inbound knowledge search breadth (Laursen & Salter, 2006). But the more a firm shifts its focus towards radical product innovation by keeping its business model stable, the more the firm seems to embrace the establishment of deep relationships with external partners as a frequent source of knowledge input. Prior scholars illustrate the importance of a few knowledge-intensive external sources, especially at the early phase of a product life cycle (Laursen & Salter, 2006; Urban & Von Hippel, 1988). That means, at this stage, firms are expected to seek strategic R&D arrangements with a small number of partners, in particular with lead-users (Urban & Von Hippel, 1988; Von Hippel, 1988, 2005), universities and research institutes (Perkmann & Walsh, 2007) or other firms (Van de Vrande, Lemmens, & Vanhaverbeke, 2006).

Moreover, prior scholars have examined business model change and suggested that the innovation focus of firms shifts over the life cycle from product to process novelties and finally to the new design of business models (Massa & Tucci, 2014; Waldner, Poetz, Grimpe, & Eurich, 2015). But crafting a new business model is among the most difficult and important steps for new market creation (Teece, 2010) and encourages firms to enhance their internal and external search for novel ideas (Chesbrough, 2006a; Chesbrough & Rosenbloom, 2002). According to Morris, Schindehutte, and Allen (2005), external knowledge sourcing is a necessity for a sustainable development of a firm's business model. Chesbrough and Schwartz (2007) indicate that innovative firms, seeking for a new business model, tend to use multiple external knowledge sources in order to enhance the effectiveness of their own model and to maximize the economic outcome of both incremental and radical technologies. By the same token, Yun, Yang, and Park (2016) suggest that *"the process of business model development will begin from diverse channels of open innovation and follow the process of new combinations of technologies and markets"* (p. 8). Hence, an essential tool to foster innovativeness concerning a firm's business model is to increase and incentivize the integration

of externally available knowledge. Therefore, it is expected that firms with a greater degree of openness are more willing to reinvent their business models (Huang, Lai, Lin, & Chen, 2013).

THE INFLUENCE OF COUPLED OPEN INNOVATION PRACTICES

Prior scholars have extensively analyzed the motivation and impact of collaboration regarding innovation practices and innovation output (e.g. Criscuolo & Haskel, 2003; Klomp & Van Leeuwen, 2001). The various theoretical approaches such as resource dependency theory (Pfeffer & Salancik, 1978), transaction cost theory (Williamson, 1985), and organizational learning theory (Cohen & Levinthal, 1990) analyze from slightly different angles the impact on the companies' boundaries and thus the shift in the degree of openness by accessing competencies and resources needed to both manufacture products and deliver service. The main reasons among all theories used to explain the increase in collaborations range from entering new markets and accessing novel ideas to sharing innovation risks and leveraging complementary skill sets (Eisenhardt & Schoonhoven, 1996; Kleinknecht & Reijnen, 1992; Mowery, Oxley, & Silverman, 1996). Also, the innovation management literature has shown a strong interest in the intersection of innovation and collaborations. In this context, alliances, and thus the joint creation of knowledge and ideas, are often mentioned as the foundation for competitive advantage with positive long-term effects on the financial and innovation performance of firms (Argote & Ingram, 2000; Armour & Teece, 1980; Klomp & Van Leeuwen, 2001). Furthermore, the management literature has extensively discussed explanations for collaborative R&D that include aspects such as shortening the product innovation cycle (Pisano, 1990), risk sharing (Das & Teng, 2000; Tyler & Steensma, 1995), handling regulations and sector specific requirements (Nakamura, 2003) as well as realizing efficiency gains through synergistic effects (Das & Teng, 2000; Kogut, 1988).

In addition, some scholars have analyzed and explored the reasons for partnerships between firms (e.g. Belderbos, Carree, & Lokshin, 2004; Cassiman, Perez-Castrillo, &

Veugelers, 2002; Cassiman & Veugelers, 2002; Kleinknecht & Reijnen, 1992; Powell, Koput, & Smith-Doerr, 1996; Tether, 2002) and suggested that different forms of collaborations are likely to pursue different objectives (Tether, 2002). In particular, the search for incremental innovation seems to be much more predictable, compared to radical innovation, which lacks standardization due to its less frequent occurrences. Feller, Parhankangas, and Smeds (2006) conclude that it is *"likely that companies seeking to develop radically new technologies, products, or processes turn to partners fundamentally different from themselves"* (p. 178). Fritsch and Lukas (2001) suggest by analyzing German corporations in the manufacturing sector that an interest in process innovation likely includes backward-vertical collaborations with vendors, while product innovation tends to lead to forward-vertical collaborative partnerships with customers. Lassen and Laugen (2017) discover a negative relation between the 'degree of novelty of the technology' and the engagement of suppliers, meaning that vendors most likely participate in incremental product innovation efforts and therefore in areas in which they have the most expertise. Moreover, the authors find a weak and insignificant relationship between the novelty of technologies and the involvement of customers and competitors. Hence, it can be expected that these actors are usually unable to supply radical product innovations and their contribution is most likely limited to incremental innovations. Prior literature has also suggested that radical innovations require collaborations with knowledge-intensive partners, in particular with universities and research institutes (e.g. Lassen & Laugen, 2017; Monjon & Waelbroeck, 2003; Perkmann & Walsh, 2007). However, Mohnen and Hoareau (2003), noted that firms seeking for radical product innovations tend to source ideas from universities but do not cooperate directly with them.

Moreover, knowledge and ideas can be geographically spread out and force companies into R&D collaborations with partners in distant locations. According to Bellamy, Ghosh, and Hora (2014) supply network accessibility, defined as *"the speed and effectiveness of*

information and knowledge access opportunities between a firm and its supply network" (p. 358), is a significant driver for innovation output. Dutta and Weiss (1997) suggest a positive correlation between both local and foreign R&D collaborations, and the number of issued patents, and thus the innovation performance of companies. But the authors also illustrate that the number of issued patents is greater for local collaborations than for international collaborations. This can be explained by an increase of complexity regarding the required set of skills and background of foreign collaborations with respect to social, organizational, and cultural barriers (De Meyer, 1991). The empirical literature further argues that R&D partnerships with the intent to develop incremental innovation are greater in number and have more linkages with foreign countries compared to collaborative efforts with the intent to deliver radical innovation (Feller et al., 2006). Incremental innovations also tend to be more likely developed through collaborations in which the partnering firms are not clustered within a particular geographic area (Tödtling, Lehner, & Kaufmann, 2009). However, in a different stream of research, scholars have found a positive influence of knowledge exchange across sectors as well as geographical regions in order to stimulate the development of radial product innovations (Becker & Dietz, 2004; Powell et al., 1996).

According to Amit and Zott (2001), the main reason incumbent players are disrupted is not their inability to conceive disruptive technologies, but rather, conflicts between the current and new business model which is needed to take advantage of the full economic potential of the emerging, disruptive technology. Typically, gross margins for the emerging technologies differ, but so do, end customers and necessary distribution channels (Chesbrough, 2010). Firms need to have a 'road map' that can provide guidance and some overall direction for the introduction of necessary practices to change, adopt and develop business models. The degree of openness, and in particular collaborations, plays a central role in this context. Giesen, Berman, Bell, and Blitz (2007) find that external collaborations are the most common and

successful paths towards business model innovations. In particular, networks with external partners enable older firms to stay agile and to adapt quickly to external changes while leveraging their scale, brand, and long-standing strengths. Chesbrough (2006a) and Nonaka and Takeuchi (1995) named collaborations and learning outside the firms' boundaries as a main factor for technological innovations as well as the creation of novel business models. The first and crucial step towards a fresh business model lies in the idea generation phase. Briggs, Vreede, and Nunamaker (2003) suggest that the generation of ideas requires effective internal and external team collaboration. Moreover, Gavetti and Levinthal (2000) show that sharing, creating, and integrating knowledge across inter- and intra-firm boundaries is an important requirement to generate business model ideas.

THE INFLUENCE OF APPROPRIATION MECHANISMS

The focus of the academic literature has been primarily on the use of patents as the main mechanism to protect innovative output of enterprises (Hall, Helmers, Rogers, & Sena, 2014). But according to Hall et al. (2014) the degree of innovativeness of the focal firm determines significantly the use of IP appropriation mechanisms. Studies among corporations in the United Kingdom illustrate that only about four percent of firms that have developed innovations and new technologies applied for a patent (Hall et al., 2014). In fact, empirical studies, even in high-technological manufacturing industries such as the semiconductor sector, suggest that the focus of firms has shifted from the use of patents towards gaining lead time advantages and utilizing learning curve effects in order to safeguard innovations (Cohen et al., 2000; Levin, Klevorick, Nelson, & Winter, 1987). Generally, the literature differentiates between formal and informal IP protection instruments. The first set of appropriation mechanism include patents, design registrations, trademarks and copyrights, while the latter comprises aspects such as complex design of goods and services, lead time advantages over competitors, secrecy, and confidentiality agreements (Hall et al., 2014). Formal IP intends to reward innovators by

granting time-limited legal rights to innovators to exclusively use the outputs of their innovation activities and thus, to protect resulting knowledge, a nonexcludable intangible asset (Hall et al., 2014). Consequently, formal appropriation mechanisms are easily measurable and comparable while informal instruments are more difficult to be observed by third parties (Zobel, Lokshin, & Hagedoorn, 2017).

Several scholars put forward that the multiple types of appropriation mechanisms have slightly different functions. Generally, product innovations tend to contain multiple inventions, which can be individually protected by different appropriation mechanisms (Hall et al., 2014). According to Arundel and Kabla (1998), the use of patents is significantly higher for product innovators, compared to process innovators. A possible explanation is that patents generally reveal too much detailed information that allows competitors in particular for process related innovations to easily invent around the patents. According to Levin et al. (1987), lead time, learning curves, as well as sales efforts are more effective than patents in protecting innovative products. Furthermore, Brouwer and Kleinknecht (1999) highlight the significance of lead time and keeping qualified employees, especially for the protection of process innovation. And while Levin et al. (1987) suggest that secrecy is an efficient way to protect product innovation, Cohen et al. (2000), instead, found evidence that secrecy is perceived as less impactful in this context. The potential lack of importance of secrecy for product innovation might be explained by the desire of corporations to advertise novel features of their newly developed products and to ensure that potential customers can experience the benefits of their merchandise (Levin et al., 1987). Hence, maintaining secrecy about new or improved products is rather difficult and likely undesirable (Levin et al., 1987).

Additionally, scholars emphasize the importance of formal and informal IP for open innovation. Alexy, Criscuolo, and Salter (2009), for instance, suggest that patents are a useful tool for defining the scope of collaborative innovation efforts and underline the innovative

capability of an enterprise, which in turn supports the identification of appropriate partners. Moreover, the use of formal IP provides evidence that relevant knowledge is available and thus promotes the transfer of knowledge between companies (Alexy et al., 2009; Hurmelinna, Kyläheiko, & Jauhiainen, 2007). Besides formal IP, prior research shows that informal IP protection mechanisms are also an essential element in the overall appropriation strategy of enterprises with regard to open innovation (Huizingh, 2011; Laursen & Salter, 2014). By increasing the search effort for external knowledge, companies tend not to reveal all elements of their knowledge base. Hence, informal ways to protect a firm's IP gain importance with an increased degree of openness towards the external environment (Hall et al., 2014).

THE INFLUENCE OF RESEARCH AND DEVELOPMENT INTENSITY

Although transaction cost theory emphasizes the substitutional aspect of internal research investment and the acquisition of external ideas (Pisano, 1990; Williamson, 1985), rigorous research suggests that both external knowledge sourcing and in-house R&D are complementary (e.g. Freeman, 1991; Rigby & Zook, 2002). Arora and Gambardella (1994) analyze, for instance, four different external sourcing strategies and found evidence that firms with greater internal knowledge exposure are more actively involved in establishing external linkages. Moreover, Veugelers (1997) found evidence for the reverse relationship and thus, for the fact that external knowledge sourcing positively correlates with internal R&D expenditures. Hence, recent research shifts the focus away from cost minimization of organizing and managing innovations towards performance improvement through knowledge sharing and inter-firm linkages (Grant, 1996). In this context, scholars have regularly named internal R&D investments as an important contributor to technological knowledge and thus, for absorptive capacity[1]. Internal R&D is the key element in developing in-house technological knowledge

[1] The conceptual framework of absorptive capacity is described as a company's *"ability to recognize the value of new information, assimilate it, and apply it to commercial ends"* (Cohen & Levinthal, 1990, p. 128).

that allows corporations to better manage and understand tacit knowledge nested in external technologies and to incorporate acquired ideas into the firm's internal product development process (Chesbrough & Teece, 2012; Cohen & Levinthal, 1990; Tsai & Wang, 2009). Companies with a greater internal R&D intensity also tend to constantly screen their environment in order to find opportunities for external ideas to stimulate the in-house product development process (Laursen & Salter, 2006). Besides valuing and assimilating external ideas, greater internal R&D capacity enables firms to better forecast technology trends, evaluate market opportunities and identify collaborative R&D projects (Cohen & Levinthal, 1994). Regarding the joint creation of technological innovations, Schmidt (2010) finds that companies with reduced R&D intensity are unlikely to create sufficient technological abilities to recognize the similarities and differences regarding the skills and knowledge of potential external partners. Consequently, this aspect negatively impacts the selection process of promising external knowledge partners.

In contrast, previous research in social psychology has demonstrated that in situations characterized by knowledge exchange and interactions with external partners, the attitudes of each involved person often directly affect the decision-making process of individuals and lead to biased behavior (Ajzen, 2001). In this context, the literature frequently identifies the 'not-invented-here' (NIH) syndrome as the bias with the most significant influence on individual decision making (Katz & Allen, 1982; Kostova & Roth, 2002). The NIH syndrome indicates that firms with a larger exposure to external sources may negatively stimulate employee behavior that resists the integration of externally absorbed knowledge (Laursen & Salter, 2006). The NIH syndrome is often critical in strong technically oriented firms with well-established internal norms and value systems (Katz & Allen, 1982). Hence, absorptive capacity and expenditure for internal research are strongly related subjects and determine the efficiency of externally sourced knowledge.

HYPOTHESES

Each domain of the 2x3 matrix (see Figure 3.1) provides a specific arrangement of technological innovation and business model design that allows one to examine in depth the inherent relationships and effects on open innovation activities of firms. As illustrated above, the academic literature suggests that open innovation behavior of firms acts in highly correlated ways for each dimension of the innovation matrix. Consequently, it is expected that firms with the same innovation focus find their ways to a global optimum by adopting a similar open innovation behavior. Based on these considerations this article proposes the following empirically operationalized hypothesis:

Hypothesis 1: Firms pursuing business model innovation have a significantly correlated set of open innovation behaviors regardless of the technology effort.

Hypothesis 2: Firms pursuing radical product innovation have a significantly correlated set of open innovation behaviors regardless of whether or not pursuing business model innovation.

Hypothesis 3: Firms pursuing incremental product innovation have a significantly correlated set of open innovation behaviors regardless of whether or not pursuing business model innovation.

Hypothesis 4: Firms pursuing process innovation have a significantly correlated set of open innovation behaviors regardless of whether or not pursuing business model innovation.

According to Audretsch (1995) and Winter (1984), the different innovation behaviors of firms is influenced by unevenly available information which results in different technological opportunities for enterprises. Yildizoglu (2002) argues that differences regarding the firms' expectations about returns to R&D investments drive different innovation behavior and results in performance inequalities. Another approach towards technological regimes underlines the significance of the use of patents and secrecy as a main differentiation factor (Cohen, Goto, Nagata, Nelson, & Walsh, 2002). In a similar vein, the academic literature on competitive strategy suggests that the firm's affiliation to a specific strategic group such as cost leadership

vs. differentiation leads to a distinct innovation behavior and performance of enterprises (Peteraf & Shanley, 1997). In contrast, dynamic capability theory identifies a firm's flexibility regarding the composition of internal and external knowledge capacity as a main driver for handling rapid environmental changes, which in turn causes differences in corporate innovation strategies and profitability (Teece et al., 1997). Hence, the more complex an environment is the more important are dynamic capabilities and the more likely it is that firms will adopt different innovation behavior because they simply cannot predict all possible outcomes in order to identify the ideal global mix of innovation practices that maximizes firm performance (Levinthal, 1997; Simon, 1955). Naturally, this leads to several innovation clusters, defined as a 'group of firms with a correlated set of open innovation behaviors'. Therefore, the paper posits the following:

Hypothesis 5: Firms differ significantly in financial performance across innovation behavior clusters.

In addition, the academic literature on technology and innovation management suggests that the degree of product diversification affects the open innovation behavior of firms and vice versa. Firms with a limited product portfolio are more likely to focus on internal R&D as well as external technology exploitation rather than on knowledge sourcing (Teece, 1986). According to Cesaroni (2004), these corporations have generally adequate expertise to develop and produce the main parts of their limited product portfolio. Furthermore, innovation activities are cost, time and labor intensive. Hence, an inefficient bundle of open innovation activities is expected to hinder innovation and financial performance of enterprises. These previous empirical findings are considered in the following hypotheses:

Hypothesis 6: Firms' product diversification differs significantly across innovation behavior clusters.

Hypothesis 7: Firms' R&D expenditure differs significantly across innovation behavior clusters.

METHODOLOGY

SAMPLE AND DATA SELECTION

This empirical paper takes advantage of longitudinal survey data from the Mannheim Innovation Panel (MIP) to carry out a cluster analysis to group enterprises that are following a similar open innovation behavior pattern to examine the influence of a firm's innovation focus, defined as the 'degree of novelty of the technology' and the 'degree of novelty of the business model', on the innovation strategy.

The Mannheim Innovation Panel belongs to the European Union's Community Innovation Survey (CIS) and represents the German part of the survey. The Community Innovation Survey is considered to be the major statistical tool of the European Union and serves to screen and track its advancement in innovations (Mention, 2011). Although the focus of the CIS was originally on the manufacturing sector, and thus, included a technology-oriented definition of innovation, the relevance of the CIS as a large-scale survey to capture innovation aspects besides technological innovation such as open innovation and business model innovation, has now been widely acknowledged (e.g. Horbach, 2008; Laursen & Salter, 2006; Waldner et al., 2015). The survey relies on a harmonized questionnaire and follows OECD's recommendations regarding the use of definitions and methodologies in order to measure innovation related constructs (OECD/Eurostat, 2005, 2018). The CIS, and more specifically, the MIP are self-reported surveys which have inherent quality risks such as non-response and response accuracy (Laursen & Salter, 2006). To ensure a high-quality data standard the CIS and MIP use a non-response analysis to guarantee that the innovation surveys contain a representative sample of the population as well as design techniques to establish barriers so participants cannot associate different data input fields (Klingebiel & Rammer, 2014). Moreover, Laursen and Salter (2006) noted the high quality of the survey data by emphasizing that *"interpretability, reliability, and validity of the survey were established by extensive piloting and pre-testing before*

implementation within different European countries" (p. 137). Hence, common method bias is unlikely to influence the results (Mairesse & Mohnen, 2007).

For the purpose of this research study, a dataset was constructed by using the 2012 wave of the Mannheim Innovation Panel with an initial sample size of 6,208 firms. An individual survey wave of the MIP is based on a timeframe of three years and refers in this empirical analysis to the collected innovation data of German corporations between the year 2010 and 2012. The derived sample is restricted to firms with product, process and business model innovations due to the research focus of this paper; otherwise companies that have consciously decided not to pursue innovations would be treated equally to companies whose innovation efforts had failed (Grimpe & Kaiser, 2010). Furthermore, in order to derive the final data set, cases with missing values were deleted. Missing values, and thus an unbalanced dataset, can occur due to the circumstance that occasionally firms do not answer the survey (Grimpe & Kaiser, 2010). Applying these criteria to the initial data set led to the exclusion of 5,534 cases. Consequently, the final sample consists of 674 observations.

ANALYTIC PROCEDURE

Early empirical work in the areas of technology and innovation management pointed to internal research investment as one of the major influence parameters of a firm's innovation strategy (Hall, Griliches, & Hausman, 1986). Over time, the research focus has shifted and significantly broadened the perspective, as reflected by concepts such as open innovation that describe a more decentralized approach to innovations, based on the idea that knowledge is widely distributed (Chesbrough, 2003, 2006a). This strategic shift in the innovation focus of enterprises is also partly visible in the questionnaire of the MIP that contains not only different types of R&D expenditures (Grimpe & Kaiser, 2010), but also sections that refer to external, internal and collaborative sourcing of knowledge (Laursen & Salter, 2006; Mention, 2011) as well as outsourcing of research projects (Veugelers & Cassiman, 1999).

Table 3.1: Operationalized construct of open innovation behavior

Variable	Description [a]	Items	Scale
INBOUND OPEN INNOVATION: EXTERNAL KNOWLEDGE SOURCES [b]			
IB-OI: Customer	Importance of customers (private and public sector) as information sources to stimulate innovativeness	2	▪ 0 = not used – 3 = high importance
IB-OI: Supplier	Importance of suppliers as information sources to stimulate the innovativeness	1	▪ 0 = not used – 3 = high importance
IB-OI: Competitor	Importance of competitors as information sources to stimulate the innovativeness	1	▪ 0 = not used – 3 = high importance
IB-OI: Consultant	Importance of consultants as information sources to stimulate the innovativeness	1	▪ 0 = not used – 3 = high importance
IB-OI: University	Importance of universities as information sources to stimulate the innovativeness	1	▪ 0 = not used – 3 = high importance
IB-OI: Research institutes	Importance of public and private research institutions as information sources to stimulate the innovativeness	2	▪ 0 = not used – 3 = high importance
IB-OI: Other sources	Importance of science-based information sources such as fairs, journals, associations, etc. to stimulate innovativeness	5	▪ 0 = not used – 3 = high importance
IB-OI: Breadth	Number of external information sources firms rely on	13	▪ 0 – 13
IB-OI: Depth	Extent to which firms draw information from the various external sources	13	▪ 0 – 13
COUPLED OPEN INNOVATION: COLLABORATION PARTNERS [b]			
C-OI: Supplier	Collaborations with suppliers	2	▪ 0 = no; 1 = yes
C-OI: Competitor	Collaborations with competitors	2	▪ 0 = no; 1 = yes
C-OI: Research institutes	Collaborations with private research institutes	1	▪ 0 = no; 1 = yes
C-OI: Breadth	Collaborations breadth	8	▪ 0 – 8
APPROPRIATION MECHANISMS [c]			
IP: Patents	Effectivity of IP protection mechanisms in form of patent and utility patent for improvement of competitiveness	2	▪ 0 = not used – 3 = high importance
IP: Design complexity	Effectivity of IP protection mechanisms in form of complex product design for improvement of competitiveness	1	▪ 0 = not used – 3 = high importance
IP: Lead time	Effectivity of IP protection mechanisms in form of lead time advantages for improvement of competitiveness	1	▪ 0 = not used – 3 = high importance
IP: Breadth	Number of different IP protection sources firms rely on	8	▪ 0 – 8
IP: Depth	Extent to which firms use specific IP protection	8	▪ 0 – 8
RESEARCH AND DEVELOPMENT INTENSITY [d]			
R&D: Internal	Expenditures for internal R&D activities to create new knowledge / divided by sales revenue	1	▪ 0 – 1
R&D: External	Expenditures for R&D that the focal firm has contracted out to other firms / divided by sales revenue	1	▪ 0 – 1

[a] Description of the variables is based on information provided by the Mannheim Innovation Panel (2012) and the Oslo Manual (OECD/Eurostat, 2005, 2018).

[b] While the questionnaire in the Mannheim Innovation Panel (2012) contains additional information and collaboration sources, the author believes that the selected variables represent the most important aspects of external knowledge sourcing in alliance with the most frequently identified open innovation practices by prior research (Mazzola et al., 2012).

[c] The data focus on the most relevant formal and informal intellectual property protection mechanisms for this research study related to its main dimensions of product and process innovation. This obviously excludes other possible measures such as copyright, trademarks, and secrecy (Levin et al., 1987).

[d] Both measures, internal and external intensity, and their significant influence on the innovation strategy of a firm is described with the aid of the concept of absorptive capacity (Cohen & Levinthal, 1989, 1990).

The extracted variables concerning the open innovation behavior used in this analysis (see Table 3.1) have been identified based on the most common open innovation practices suggested by prior research (Mazzola et al., 2012) and by ensuring that they describe in as much detail as possible, given the constraints of the content of the MIP dataset, the innovation activities of enterprises. Furthermore, the individual variables were selected by taking into consideration the dimensions of innovative activities suggested by Pavitt (1984). These dimensions include aspects such as external knowledge sources as well as defense mechanisms for the protection of IP rights. In addition, this analysis incorporates the concept of breadth and depth of knowledge search introduced by Laursen and Salter (2006) and applies it to other relevant areas such as collaborative partnerships and appropriation mechanisms to gain deeper insights into the different use of these elements by each individual company.

In order to investigate open innovation behavior patterns among firms, this study follows a two-step data analysis suggested by Hollenstein (2003). First, in order to test hypothesized factor structures and to explore relationships between each observed variable measuring the latent construct of open innovation behavior of an enterprise, a categorical principal component analysis (CATPCA) is carried out on the set of variables presented in Table 3.1. All observed variables are qualitative (categorical) in nature and while standard methods assume that the input variables are either continuous measures following a multivariate normal distribution or ordinal measures with a scale that is broad enough to identify reasonable covariance metrics (Timm, 2002), the CATPCA, as an exploratory technique, allows one to uncover patterns among categorical variables in large contingency tables (Linting, Meulman, Groenen, & Van der Kooij, 2007). For this purpose, numeric values are assigned to groups of variables with nominal and ordinal scales and converted into numeric value variables with the aid of a method known as ‘optimal scaling’ (Linting et al., 2007).

Second, the component loadings generated through the CATPCA and defined as the strength of the association between each variable and all identified factors, serve as an entry value for the subsequent *k*-means cluster analysis (Leiponen & Drejer, 2007). The intention of the performed cluster analysis is to group firms in such a way that businesses with a similar innovation behavior, described by an identical combination of factor intensities, are clustered in the same distinct groups. Third and finally, the extracted clusters are further analyzed by exploring the distribution in the open innovation behavior between clusters with regard to the innovation focus, financial performance, product dependency as well as R&D intensity of firms with the intention to answer the initial research question and its related hypotheses.

MEASUREMENT OF INNOVATION FOCUS

The following subsections define the dimensions, 'degree of novelty of the technology' and 'degree of novelty of the business model', used in this paper to span the 2x3 matrix and to determine the innovation focus of an enterprise.

MEASURES OF THE DEGREE OF NOVELTY OF TECHNOLOGY

The research study relies on established measures provided by the MIP to determine the value creation from technological innovation. The measurement scales reflect both the type of innovative performance described by product or process innovation as well as the level of newness captured with the aid of incremental or radical innovation. The characteristics represent an excellent basis for examining ideal combinations of innovation behavior regarding business model change as well as product and process inventions. All three proxies reflecting the various types of innovations are quantified as the 'portion of the total sales or total costs' in 2012 (Cantner, Joel, & Schmidt, 2011; Laursen & Salter, 2006). Hence, the variable radical innovation that has the highest degree of novelty is estimated as the *"fraction of the firm's turnover relating to products new to the world market"* (Laursen & Salter, 2006, p. 140), while

the variable incremental innovation is expressed by the *"fraction of the firm's turnover pertaining to products new to the firm and [...] significantly improved"* (Laursen & Salter, 2006, p. 140). According to Cantner et al. (2011), process innovation, in contrast, is measured as the *"share of cost reductions realized in the year prior to the survey"* (p. 1456), that is attributed to process changes. The scale of all three variables ranges from 0 to 100 percent and has been applied frequently by related research in the domain of technology and innovation management (e.g. Laursen & Salter, 2006; Poot, Faems, & Vanhaverbeke, 2009). Table 3.2 contains the three items including their definitions and scales.

Table 3.2: Operationalized construct of technological innovation

Variable [a]	**Innovation Element**	**Scale / Literature**
Fraction of firms' turnover in 2012 relating to products new to the world market, introduced during 2010 to 2012	Radical Product innovation	▪ 0 – 100 % ▪ Laursen & Salter (2006)
Fraction of the firms' turnover in 2012 relating to products new to the firm or significantly improved, introduced during 2010 to 2012	Incremental Product innovation	▪ 0 – 100 % ▪ Laursen & Salter (2006)
Share of cost reductions related to total costs in 2012 due to process innovations of firms, introduced between 2010 to 2012	Process innovation	▪ 0 – 100 % ▪ Cantner et al. (2011)

[a] Description of the variables is based on information provided by Canter et al. (2011), Laursen & Salter (2006), the Mannheim Innovation Panel (2012), and the Oslo Manual (OECD/Eurostat, 2005, 2018).

MEASURES OF THE DEGREE OF NOVELTY OF BUSINESS MODEL

Prior academic work has mainly targeted areas such as the definition and conceptualization of business model innovation and has employed case study research as the primary methodology (Clauss, 2016). But in order to further enhance the understanding of this complex construct among scholars and business practitioners, it is necessary to take advantage of large-scale empirical research that allows one to achieve more generalizable findings (Clauss, 2016; Zott & Amit, 2010). Despite the great importance, thoroughly operationalizing the concept of business model innovation is extremely difficult because it is subject to many factors such as the business environment as well as specific objectives and conditions of companies

(Casadesus-Masanell & Llanes, 2011; Casadesus-Masanell & Ricart, 2010). Although the MIP has been using a broad variety of innovation variables ranging from product and process innovation to marketing and organizational innovation, the large-scale survey does not ask companies directly about business model innovation (Clauss, 2016). To resolve this hinderance, Waldner et al. (2015) applied a multi-step expert rating method to the various elements in the MIP in order to identify which questions in the survey are relevant to business model change and to bring them in line with the following main aspects of the concept: creating, delivering, and capturing value. As a result, each identified item that represents and quantifies the construct of business model innovation (see Table 3.3) is measured with the aid of a distinct dummy variable (0 = no, 1 = yes).

Table 3.3: Operationalized construct of business model innovation

Variable [a]	**Business Model Element**	**Scale / Literature**
Introduction of new or significantly improved products (goods or services) onto your market before your competitors in the years 2010 – 2012	Value creation Value delivery	▪ 0 = no; 1 = yes ▪ Waldner et al. (2015)
Introduction of new or significantly improved products (goods or services) first in either your country, Europe or in the rest of the world first in the years 2010 – 2012	Value creation	▪ 0 = no; 1 = yes ▪ Waldner et al. (2015)
Introduction of new or significantly improved logistics or distribution methods for your inputs, goods or services in the years 2010 – 2012	Value delivery	▪ 0 = no; 1 = yes ▪ Waldner et al. (2015)
Introduction of new business practices for organizing procedures in the years 2010 – 2012	Value creation Value delivery	▪ 0 = no; 1 = yes ▪ Waldner et al. (2015)
Introduction of new methods of organizing external relations with other firms or public institutions in the years 2010 – 2012	Value creation Value delivery Value capture	▪ 0 = no; 1 = yes ▪ Waldner et al. (2015)
Introduction of new marketing methods for product placement or sales channels in the years 2010 – 2012	Value delivery Value capture	▪ 0 = no; 1 = yes ▪ Waldner et al. (2015)
Introduction of new marketing methods of pricing goods or services in the years 2010 – 2012	Value capture	▪ 0 = no; 1 = yes ▪ Waldner et al. (2015)

[a] Description of the variables is based on information provided by Waldner et al. (2015), the Mannheim Innovation Panel (2012), and the Oslo Manual (OECD/Eurostat, 2005, 2018).

In total, the seven dummies simply determine whether significant adjustments have been made in the relevant sections of business model design by an enterprise during the time horizon of the survey. Although it is necessary to systematically modify organizational structures in

order to achieve business model innovations, it is not required to change more than one dimension of the construct at the same time (Clauss, 2016). In order to perform a cluster analysis, an additive index of all seven selected predictor variables, each with equal weighting, is computed.

MEASUREMENT OF OPEN INNOVATION BEHAVIOR

The following subsections describe all relevant unobserved variables including inbound search breadth and depth, collaboration breadth, intellectual property breadth and depth, as well as internal and external R&D intensity, used in this paper to define the construct of open innovation behavior. Furthermore, Appendix A provides a comprehensive overview of the questionnaire wordings of the Mannheim Innovation Panel which either allow to derive the unobserved variables or directly lead to the observed variables of a firm's open innovation behavior as defined in Table 3.1.

MEASURES OF INBOUND OPEN INNOVATION

This research paper uses the proxies of inbound search breadth and depth and thus the conceptual framework of Laursen and Salter (2006), which is widely recognized and accepted in the academic community (e.g. Chiang & Hung, 2010; Ferreras-Méndez, Newell, Fernández-Mesa, & Alegre, 2015; Leiponen & Helfat, 2010; Luo, Lui, & Kim, 2017). The term inbound search breadth is defined as *"the number of external sources or search channels that firms rely upon in their innovative activities"* (Laursen & Salter, 2006, p. 134). The MIP asks its participants particularly about the usage of 14 knowledge information sources in the years 2010 – 2012 including information sources within the firm's own enterprise group. But open innovation stresses the usage and exchange of information with subjects outside of the system boundaries (Fey & Birkinshaw, 2005). In accordance with the literature, this study considers partner firms of the same enterprise group to be within the system boundaries and thus excludes

the respective dummy variable (Cricelli, Greco, & Grimaldi, 2015). Consequently, inbound search breadth can be described as an aggregate of 13 external knowledge sources (see Table 3.4). Accordingly, each item used to quantify the construct of external search breadth is gauged with the aid of an individual dummy variable (0 = no, 1 = yes) that simply evaluates whether the respected source has been used by the focal firm (Cricelli et al., 2015). In order to construct a total measure for inbound search breadth of each firm, all 13 individual variables are simply added (Cricelli et al., 2015).

Table 3.4: Operationalized construct of inbound search breadth and depth

Variable [a]	**Information source**	**Scale / Literature**
Clients or customers from the private sector	Lead user	▪ 0 = no; 1 = yes ▪ Laursen & Salter (2006)
Clients or customers from the public sector	Lead user	▪ 0 = no; 1 = yes ▪ Laursen & Salter (2006)
Suppliers of equipment, materials, components, or software	Vertical	▪ 0 = no; 1 = yes ▪ Laursen & Salter (2006)
Competitors or other enterprises in your sector	Horizontal	▪ 0 = no; 1 = yes ▪ Laursen & Salter (2006)
Consultants and commercial labs	Consultancy	▪ 0 = no; 1 = yes ▪ Laursen & Salter (2006)
Universities or other higher education institutions	Science-based	▪ 0 = no; 1 = yes ▪ Laursen & Salter (2006)
Government or public research institutes	Science-based	▪ 0 = no; 1 = yes ▪ Laursen & Salter (2006)
Private research institutes	Science-based	▪ 0 = no; 1 = yes ▪ Laursen & Salter (2006)
Conferences, trade fairs or exhibitions	Other sources	▪ 0 = no; 1 = yes ▪ Laursen & Salter (2006)
Scientific journals and trade or technical publications	Other sources	▪ 0 = no; 1 = yes ▪ Laursen & Salter (2006)
Professional and industry associations	Other sources	▪ 0 = no; 1 = yes ▪ Laursen & Salter (2006)
Patent files	Other sources	▪ 0 = no; 1 = yes ▪ Laursen & Salter (2006)
Standards or standardization boards and documents	Other sources	▪ 0 = no; 1 = yes ▪ Laursen & Salter (2006)

[a] Description of the variables is based on information provided by the Mannheim Innovation Panel (2012) and the Oslo Manual (OECD/Eurostat, 2005, 2018).

The term inbound search depth, in contrast, is defined as *"the extent to which firms draw deeply from the different external sources or search channels"* (Laursen & Salter, 2006, p. 134-135). Besides the information about the usage of the knowledge sources, the MIP also requests from its participants the importance (low, medium or high) of each source. In order to calculate inbound search depth, the same 13 information and knowledge sources are used, and the distinct dummy variables are coded in alliance with the literature as follows: 1, if high information was obtained from a source and 0, if the source was either not used, or used to a low to medium degree (Cricelli et al., 2015). In a subsequent step, all 13 variables are summed in order to derive a comprehensive measure for inbound search depth of each firm.

MEASURES OF COUPLED OPEN INNOVATION

This research paper defines a proxy of coupled open innovation through survey items about collaborators provided by the MIP. Participants of the survey indicate the type of innovation collaboration partners such as suppliers, customers, competitors etc. and the location of the respective partner companies in the years 2010 – 2012. The MIP proposes a total of nine different types of co-operations including partnerships within the firm's own group. Naturally, companies that belong to the same corporate group exchange their ideas, knowledge and innovation practices and engage with one another. But the definition of open innovation emphasizes the use of *"purposive inflows and outflows of knowledge"* (Chesbrough, 2006b, p. 1) and thus refers to the system boundaries that distinguish the focal firm from other actors (Fey & Birkinshaw, 2005).

According to the literature, the research study considers companies of the same enterprise group to be within the firms' boundaries and their technological achievements as closed innovation (Cricelli et al., 2015). Hence, the respective distinct dummy variable is excluded and not considered to be part of the definition of collaboration breadth. The remaining eight types of co-operations and therefore each element representing collaboration breadth

(see Table 3.5), is gauged with the aid of an individual dummy variable (0 = no, 1 = yes) asking whether a partnership was established with the respective external firm during the relevant period (Cricelli et al., 2015). In order to derive a comprehensive measure of collaboration breadth for each firm, all eight individual variables are simply added (Cricelli et al., 2015).

Table 3.5: Operationalized construct of collaboration breadth

Variable [a]	**Information source**	**Scale / Literature**
Clients or customers from the private sector	Lead user	▪ 0 = no; 1 = yes ▪ Cricelli et al. (2015)
Clients or customers from the public sector	Lead user	▪ 0 = no; 1 = yes ▪ Cricelli et al. (2015)
Suppliers of equipment, materials, components, or software	Vertical	▪ 0 = no; 1 = yes ▪ Cricelli et al. (2015)
Competitors or other enterprises in your sector	Horizontal	▪ 0 = no; 1 = yes ▪ Cricelli et al. (2015)
Consultants and commercial labs	Consultancy	▪ 0 = no; 1 = yes ▪ Cricelli et al. (2015)
Universities or other higher education institutions	Science-based	▪ 0 = no; 1 = yes ▪ Cricelli et al. (2015)
Government or public research institutes	Science-based	▪ 0 = no; 1 = yes ▪ Cricelli et al. (2015)
Private research institutes	Science-based	▪ 0 = no; 1 = yes ▪ Cricelli et al. (2015)

[a] Description of the variables is based on information provided by the Mannheim Innovation Panel (2012) and the Oslo Manual (OECD/Eurostat, 2005, 2018).

MEASURES OF APPROPRIATION MECHANISMS

This empirical analysis applies the definition of the proxies of inbound search breadth and depth as defined by Laursen and Salter (2006), to the construct of intellectual property rights in order to derive the variables of intellectual property breadth, captured as the ‘number of different IP defense mechanisms that firms rely upon in their innovative activities’ as well as intellectual property depth, described as ‘the extent to which firms utilize the different IP defense mechanisms’. Participants in the 2012 wave of the MIP have to specify both the usage of a total of eight different intellectual property protection mechanisms, ranging from patents and design registrations to complex product designs and lead time advantages as well as the

importance of each item. Every variable is measured with the aid of a four-point Likert scale and requests its respondents to determine the level of importance (not used, low, medium or high) of each protection mechanism. According to the literature, intellectual property breadth is measured with the aid of a dummy variable (0 = no, 1 = yes) for each of the eight protection mechanism items (see Table 3.6). Therefore, each item is recoded as follows: 1, if low, mid, high importance was obtained from a source and 0, if the item was not used (Cricelli et al., 2015). A total measure for intellectual property breadth of each enterprise is then derived by simply adding all eight individual dummy variables (Cricelli et al., 2015).

Table 3.6: Operationalized construct of intellectual property protection mechanism breadth and depth

Variable [a]	**Information source**	**Scale / Literature**
Patent	Patent	▪ 0 = no; 1 = yes ▪ Cricelli et al. (2015)
Utility patent	Patent	▪ 0 = no; 1 = yes ▪ Cricelli et al. (2015)
Registered design	Design patent	▪ 0 = no; 1 = yes ▪ Cricelli et al. (2015)
Trademark	Trademark	▪ 0 = no; 1 = yes ▪ Cricelli et al. (2015)
Copyright	Copyright	▪ 0 = no; 1 = yes ▪ Cricelli et al. (2015)
Secrecy	Confidentiality	▪ 0 = no; 1 = yes ▪ Cricelli et al. (2015)
Complex product design	Product design	▪ 0 = no; 1 = yes ▪ Cricelli et al. (2015)
Lead time advantages	Process design	▪ 0 = no; 1 = yes ▪ Cricelli et al. (2015)

[a] Description of the variables is based on information provided by the Mannheim Innovation Panel (2012) and the Oslo Manual (OECD/Eurostat, 2005, 2018).

Furthermore, in order to measure intellectual property depth the same eight variables are used and the distinct dummy variables are coded as follows: 1, if the protection mechanism was of high importance for a firm and 0, if the protection mechanism was either not used or used to a low to medium degree (Cricelli et al., 2015). Finally, to derive a total measure for intellectual property depth for each firm, an additive index of all eight items is computed.

MEASURES OF RESEARCH AND DEVELOPMENT INTENSITY

The MIP covers a broad range of various types of innovation expenditures ranging from R&D-related costs to other innovation-related investments such as acquisition of machinery, equipment and software as well as training for innovative activities. As indicated earlier, this study focuses on internal and external R&D investments as the most relevant innovation expenditures. Generally, both variables account for a substantial portion of the total investments associated with innovative activities and allow to derive a more finely grained picture of the construct of open innovation behavior (Eurostat, 2004). In accordance with the literature, R&D intensity is defined as a *"firms R&D expenditure divided by firm sales"* (Laursen & Salter, 2006, p. 141). Hence, the extent of internal and external R&D expenditures is divided by the sales of a corporation (see Table 3.7) in order to avoid misinterpretation of the data due to size-related effects (Grimpe & Kaiser, 2010).

Table 3.7: Operationalized construct of research and development intensity

Variable	Description [a]	Scale / Literature
Percentage of internal R&D expenditure / sales revenue	Share of a firm's expenditure related to systematic creative work for the expansion of knowledge and carried out by the focal firm during 2010 – 2012	▪ 0 – 100 % ▪ Grimpe & Kaiser (2010), Laursen & Salter (2006)
Percentage of external R&D expenditure / sales revenue	Share of a firm's expenditure related to systematic creative work for the expansion of knowledge and contracted out to other enterprises during 2010 – 2012	▪ 0 – 100 % ▪ Grimpe & Kaiser (2010), Laursen & Salter (2006)

[a] Description of the variables is based on information provided by the Mannheim Innovation Panel (2012) and the Oslo Manual (OECD/Eurostat, 2005, 2018).

CONTROL VARIABLES

The model controls for several variables. Table 3.8 provides a comprehensive overview of all control variables used in this research study including their measurement, description and respective scales. Variables such as 'environmental competitiveness', control for external uncertainties that may lead to rapid market changes and influence the innovation behavior of firms by increasing the need to innovate (Hung & Chou, 2013). Environmental competitiveness

is described, based on the guidance of the OECD, as the extent to which firms' goods or services can be easily substituted by competing offerings. This means, if the switching costs for consumers are low, there is little if anything preventing the consumer from buying the competing substitute. This increases the sector-based pressure and negatively affects the success of new products and processes (Cassiman & Veugelers, 2006; Jansen, Van den Bosch, & Volberda, 2006). In addition, the model controls for specific 'industry effects' and the 'firm size' due to their potential impact on the innovation behavior of enterprises. The first control variable is captured with the aid of a dummy variable for each of the 21 aggregated economic sectors (Malerba, 2005), based on the ZEW indicator report of the innovation panels (cf. Appendix B), while the latter is measured, in accordance with the literature, by the firm's book value of tangible assets per employees, expressed in logarithms. Firm size is monitored due to the assumption that major enterprises likely have more potential, for instance, in the form of resources, to generate higher financial (Aschhoff & Schmidt, 2008; Lin & Wu, 2010) and innovative outcomes (Kim & Park, 2010; Un, Cazurra, & Asakawa, 2010). Finally, the study controls for enterprises that belong to a 'multinational group' with subsidiaries in other European countries. Chesbrough and Rosenbloom (2002) suggest that organizational structures tend to influence business model choices between different business units.

Table 3.8: Operationalized control variables

Variable	**Description** [a]	**Scale / Literature**
Environmental competitiveness	Extent to which firms' goods or services can be easily substituted by competing offerings	▪ 0 = not be the case – 3 = always be the case
Multinational enterprise group	Focal firm is part of a European group	▪ 0 = no, 1 = yes
Firm size	Log of firms' book value of tangible assets per employee	▪ 0 – ∞
Industry sectors	Defined by 21 aggregated economic sectors categorized by the ZEW indicator report of the innovation panel	▪ 0 = no, 1 = yes

[a] Description of the variables is based on information provided by the Mannheim Innovation Panel (2012) and the Oslo Manual (OECD/Eurostat, 2005, 2018).

RESULTS

As indicated earlier, this paper follows a two-step data analysis approach. In the first stage, a categorical principal component analysis on the variables defining the open innovation behavior (see Table 3.1) is applied. Multivariate data reduction techniques, such as the categorical principal component analysis (CATPCA), principal component analysis (PCA), and exploratory factor analysis (EFA), are frequently used during the analysis of large amounts of data to convert an original data set of variables into a smaller number of uncorrelated components, minimizing the loss of information at the same time (Linting et al., 2007). This step reduces the data input into the subsequent *k*-means cluster analysis and facilitates its interpretability by bringing out strong patterns in a dataset.

In an intermediate step of the CATPCA to verify the pre-defined open innovation behavior and to exclude variables with bad fits, the study relies on the *variance accounted for (VAF)* measure. (Linting et al., 2007; Linting & Van der Kooij, 2012). This paper follows Comrey (1973) and defines the thresholds for VAF as follows: 10 percent = poor fit, 20 percent = fair fit, 30 percent = good fit, 40 percent = very good fit and 50 percent = excellent fit (Linting & Van der Kooij, 2012, p. 19). Therefore, only variables with a total value of VAF of 0.2 or greater are considered for the final CATPCA. VAF on the component level is described by the eigenvalue. The four extracted components account for 54 percent of the variance in the 23 ordinal and nominal variables with VAF of the first component of 24.2 percent, the second component of 11.7 percent, the third component of 11.1 percent and the fourth component of 7.1 percent.

The determination of number of components relies on the 'eigenvalue greater than one' criterion as well as the scree analysis. Cattell's (1966) scree test of the subsequent factors, visualized in Figure 3.2, reveals that the actual elbow, the point in which the decrease in size of the eigenvalue begins to stabilize, starts after the third or fourth component (Cattell &

Jaspers, 1967). The eigenvalues of the first four components are all greater than one. Furthermore, the extraction of more than four components does not significantly increase the total variance explained by the proposed model. The intention of the framework is to explain a sufficient level of variance with as few factors as possible.

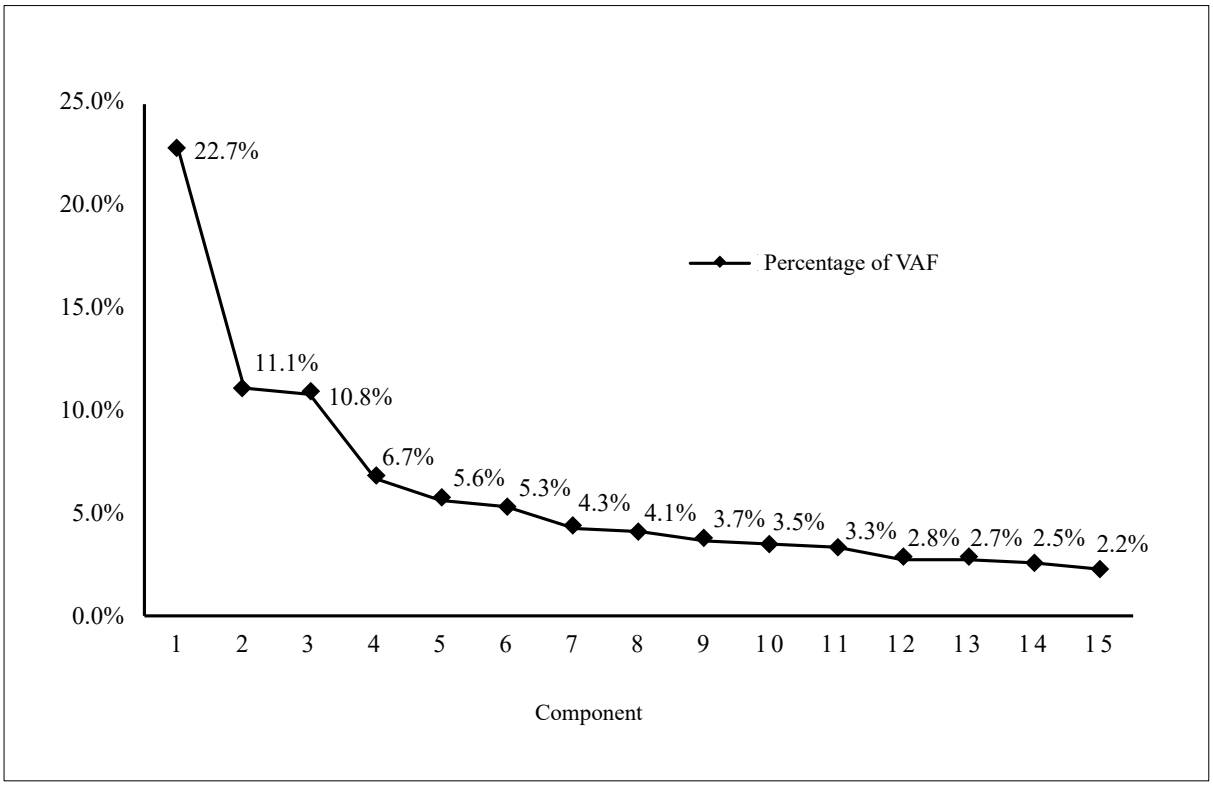

Figure 3.2: Scree plot of the four-component solution

In order to gain more certainty for the appropriate number of extracted components and to support the analysis of the scree test, this study introduces a third criterion, the ‘interpretability of the components’. In comparison to the pattern matrix based on three extracted factors, the four-component solution provides a significantly clearer picture with items loading highly and precisely on one component with no cross-loadings. Consequently, the loading behavior observed in the four-factor solution supports the interpretability of the resulting pattern matrix far more effectively and also allows a more fine-grained assessment of the open innovation strategies of the final data sample of 674 German enterprises during the year 2010 to 2012. Table 3.9 illustrates the preferable final grouping of items based on the four extracted

components of open innovation behavior as well as the respective eigenvalue and variance explained by each factor.

Table 3.9: Rotated factor loadings of a four-dimensional categorical principal component analysis

Extracted factors: Open innovation behavior Germany, *N = 674*	**Internal driven Factor**	**Science based Factor**	**Collaboration dominated Factor**	**Knowledge intensive Factor**
IB-OI: Customer	.157	-.132	.086	.595
IB-OI: Supplier	-.072	-.027	.019	.589
IB-OI: Competitor	-.037	.141	-.128	.642
IB-OI: Consultant	-.168	.689	-.066	.100
IB-OI: University	.184	.731	.069	-.114
IB-OI: Public research	-.007	.851	.060	-.071
IB-OI: Private research	-.058	.845	.034	-.031
IB-OI: Other sources	.057	.132	-.037	.637
IB-OI: Breadth	.052	.832	-.066	.221
IB-OI: Depth	.020	-.020	.163	.844
C-OI: Supplier (local)	-.013	-.140	.728	.112
C-OI: Supplier (intern.)	.017	-.054	.475	-.029
C-OI: Competitor (local)	-.156	.079	.501	.027
C-OI: Competitor (intern.)	-.127	-.045	.508	.109
C-OI: Private research (local)	-.024	.079	.623	-.031
C-OI: Breadth	.018	.069	.898	.010
IP: Patents	.779	.008	.026	-.077
IP: Complex product design	.765	.005	-.157	.078
IP: Lead time	.830	.038	-.093	.000
IP: Breadth	.945	.039	-.118	-.004
IP: Depth	.750	-.168	.084	.170
R&D: Internal	.496	-.010	.293	-.102
R&D: External	.217	.159	.476	-.155
Eigenvalue	5.573	2.684	2.543	1.625
Variance	24.2 [%]	11.7 [%]	11.1 [%]	7.1 [%]

Following Hetzel (1996), the *promax* rotation method is used to extract principal components and to ensure easy interpretation of the results through simplification and clarification of the data structure (Osborne & Costello, 2009). Each extracted factor is labeled based on its main emphasis of open innovation behavior and characterized by its variables and

the respective component loadings. The loadings range between -1 and 1 and represent the Pearson correlations between the observed variables and the extracted factors (Linting & Van der Kooij, 2012). While the magnitude defines the strength of the association between the quantified variables and the factors, its sign determines the direction of their relationship. All variables load clearly and strongly onto one component, which is illustrated by factor loadings greater than 0.45 as well as small loadings onto other factors (Masaki, 2010). The items that are retained in the model deliver meaningful and interpretable factors and reduce the insubstantial noises to a minimum. It should be noticed that many causal models including this study theorize relationships among variables that are unobserved and operationalized with the aid of directly observable indicator variables, which might lead to the common problem of multicollinearity. It occurs when predictor variables are highly correlated and potentially reduce the predictive capability of the respective research model (Belsley, 1984). For this purpose, unobserved variables such as inbound search breadth and depth, intellectual property breadth and depth as well as collaboration breadth are tested for multicollinearity by using the *variance inflation factor (VIF)* in order to determine the increase of variance in an estimated regression coefficient based on the correlation of the predictor variables (Hair, Anderson, Tatham, & Black, 1995). For the assessment, the paper follows the suggestions of Hair et al. (1995) and defines VIF of less than 10 as indicative of inconsequential collinearity. Based on the proposed rule of thumb, the model does not show any signs of multicollinearity.

The first principal component, labeled ‘internal driven’, reflects a strong reliance on a company’s internal research department and follows a closed innovation approach. Besides the strong reluctance to open the internal innovation process to the external environment, the factor also reflects the defensive mechanisms adopted by enterprises in the form of, for instance, patents. Both variables, intellectual property breadth and depth, show high loadings on this factor which emphasizes the simultaneous usage of multiple defensive mechanisms as well as

the extent to which firms rely on them. Firms operating in this space tend to show considerable not-invented-here tendencies, which negatively influence the implementation of open innovation behavior. The second factor, named ‘science based’, reflects a strong reliance on actively absorbing external knowledge from a variety of sources such as consultants, universities as well as private and public research institutions. This is not surprising, considering today’s global markets, which are characterized by vigorous competition. Therefore, knowledge and its circulation are crucial factors that determine the success as well as survival of businesses. According to Fabrizio (2006), public science has the potential to stimulate the productivity of the internal innovation process of an enterprise in multiple ways. The third extracted ‘collaboration dominated’ component of the model emphasizes the aspect of partnerships and, thus, the co-development of innovative products between firms. This includes horizontal and vertical cooperation with local and international suppliers as well as competitors. Furthermore, the aspect of collaboration breadth and, therefore, the number of simultaneous uses of different collaboration partners, plays a vital role. The fourth factor, titled ‘knowledge intensive’, is the opposite of ‘collaboration dominated’ and refers to the acquisition and integration of external knowledge from a few, well selected clients, suppliers and competitors with close relationships to the focal firm.

In the second stage, the factor loadings obtained from the categorical principal component analysis (see Table 3.9) serve as input data for a *k*-means cluster analysis. The intention of this subsequent analysis is to categorize the remaining 674 firms of the 2012 wave of the Mannheim Innovation Panel into homogenous categories based on their open innovation behavior, described by the four previously extracted components. Figure 3.3 illustrates the results of the *k*-means cluster analysis with its four extracted clusters, each named after the main performed open innovation activities and described by its respective frequency and cluster size. The corresponding chart allows one to quickly identify the distribution of each input factor for each

defined cluster. Furthermore, Appendix C demonstrates the relevance of the different industry sectors for the innovation clusters.

	Cluster 1	Cluster 2	Cluster 3	Cluster 4
Clusters: Open innovation behavior Germany, *N = 674*	**Science-driven innovators**	**External knowledge-driven innovators**	**Protective collaborators**	**Ad hoc innovators**
Internal-driven factor	0.13	0.40	**0.69**	-0.55
Knowledge-intensive factor	0.07	**1.01**	0.14	-0.68
Collaboration-dominated factor	-0.24	-0.37	**1.97**	-0.35
Science-based factor	**1.29**	-0.23	0.60	-0.79
Cluster size *[N]*	149	159	96	270

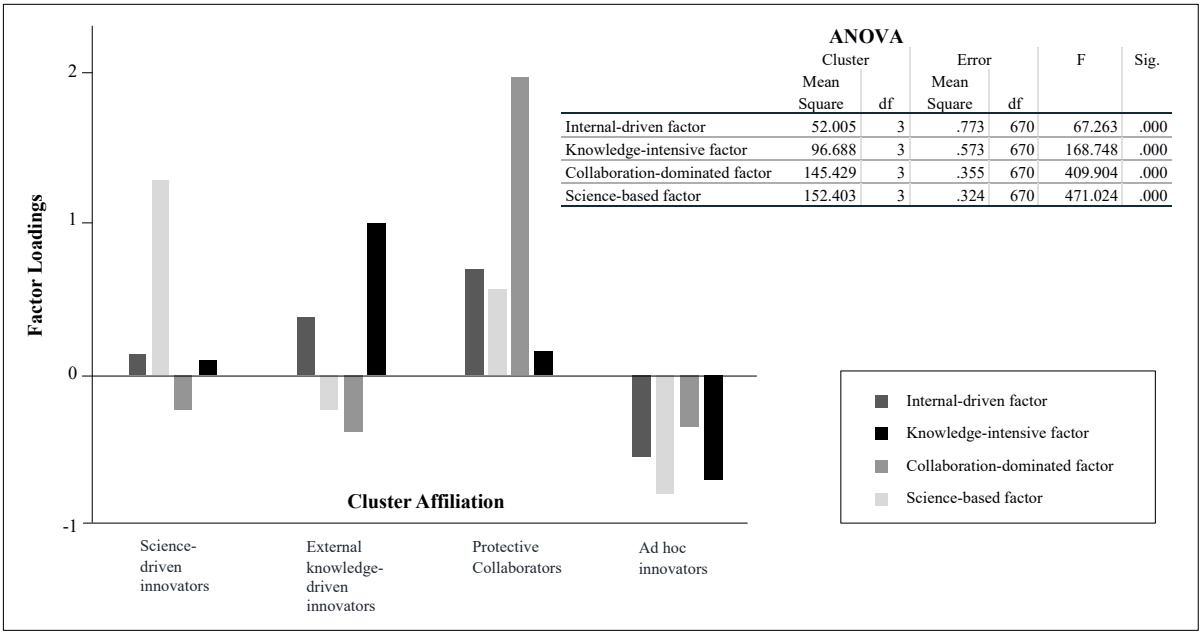

Figure 3.3: Categorization of open innovation behavior

The *k*-means cluster analysis was chosen for its performance because it tends to be as good as or even better than comparable cluster techniques, as well as for its computational efficiency with large data sets (Zhao & Karypis, 2004). During a subsequent procedure, the cluster centroids, defined as *"means of the cluster score for the elements of a cluster"* (Crowther & Lauesen, 2017, p. 202), are examined with the aid of an analysis of variance (ANOVA) in order to determine how distinct the four defined clusters are (Crowther & Lauesen, 2017). The

magnitude of *F*-values on each dimension generated by the ANOVA provides clarification on *"how well the respective dimension discriminates between clusters"* (Crowther & Lauesen, 2017, p. 202). All relevant *F*-values in this model reflect a clear allocation of input components to a specific cluster.

Cluster 1 refers to the 'science-driven innovators'. Firms in this category are mainly characterized by the science-based factor and therefore, by corporations which are actively absorbing external technologies from higher education and research institutions as well as external advisors. This allows these firms to access radically new ideas and to tap into unknown markets, untainted by competition. The greater failure rate for these types of ideas explains the emphasis on external knowledge search breadth of firms operating in this space. The internal-driven factor, and thus, aspects such as internal R&D and intellectual property defense mechanisms, plays a subordinate role just like the knowledge-intensive and collaboration-dominated factor. Cluster 2 is called the 'external knowledge-driven innovators' and defines a group of firms that focuses on absorbing externally available knowledge, similar to cluster 1, but with the difference that these enterprises appear to incorporate more practical knowledge from local and international industrial partners such as suppliers and competitors but also from lead-users. Moreover, the priority for firms operating in this category, relies clearly on close and long-term relationships with external sources rather than on the number of partnerships. Even though the main focus of this cluster is on the knowledge-intensive factor, companies also acknowledge the need for internal R&D and intellectual property defense mechanisms. External knowledge acquisition has the potential to increase the efficiency of internal R&D (Cassiman & Veugelers, 2006). Furthermore, internal research increases one's own product knowledge, and thus the likelihood to identify the most relevant external knowledge sources, according to the maxim 'to become a good buyer you have to be a good maker' (Veugelers & Cassiman, 1999). Innovation activities of the collaboration-dominated and science-based

factor, however, are of no importance to firms in this space. Firms in cluster 3, the ‘protective collaborators’, rely very strongly on collaborations with external partners, in particular, with local and international suppliers and competitors. Firms tend to prioritize a larger number of co-developers over a deeper integration of these external sources into the internal innovation process. Besides the focus on the collaboration-dominated factor, firms in this segment pay special attention to the protection of their own intellectual property through patents, but also in the form of complex product design and process advancement. Another characteristic of the internal-driven factor for this cluster is the focus on internal R&D activities. Furthermore, firms maintain relationships with public and private research institutions, consultants, as well as universities. Even though these partnerships seemed to be not as important as the collaborations with suppliers and competitors, they still play a vital role in the innovative activities of these enterprises. Cluster 4 is labeled as ‘ad hoc innovators’ and comprises firms that are rather passive in their innovation activities and that show a lack of a clear strategy and objectives in their innovation efforts. These firms neither actively source externally available knowledge, nor collaborate with partners in R&D related projects. They also do not focus much on their internal R&D department. But that does not mean that these firms are not innovative, it just means that there is no systematic innovation approach.

The results of the cluster analysis illustrate that clearly defined innovation patterns with a specific innovation focus and a different degree of openness can be extracted among firms participating in the 2012 wave of the Mannheim Innovation Panel. But to further understand the innovation process and to derive recommendations for corporate executives, it is necessary to examine the influence of the innovation focus and therefore, of the ‘degree of novelty of the business model’ and the ‘degree of novelty of the technology’ on the innovation strategy. The first variable is quantified through the business model innovation index that expresses the degree of change in a firm’s business model (Hypothesis 1), while the latter is captured by the

degree of radical (Hypothesis 2) and incremental product innovation (Hypothesis 3) as well as process innovation (Hypothesis 4). Furthermore, to obtain a reasonable, comprehensive picture of the innovation strategy in each group, possible differences in the financial performance (Hypothesis 5), the product dependency (Hypothesis 6) and the R&D intensity (Hypothesis 7) of firms between clusters is assessed.

To examine the direct effect of the 'degree of novelty of the business model' the partial correlation coefficient between the cluster affiliation and the business model innovation index (see Table 3.3) is calculated while controlling for the various control variables presented in Table 3.8. This relationship, and thus Hypothesis 1, is confirmed by a partial correlation coefficient of $b = -0.12$ ($p < 0.01$). Figure 3.4 summarizes the distribution of the business model innovation index in each cluster.

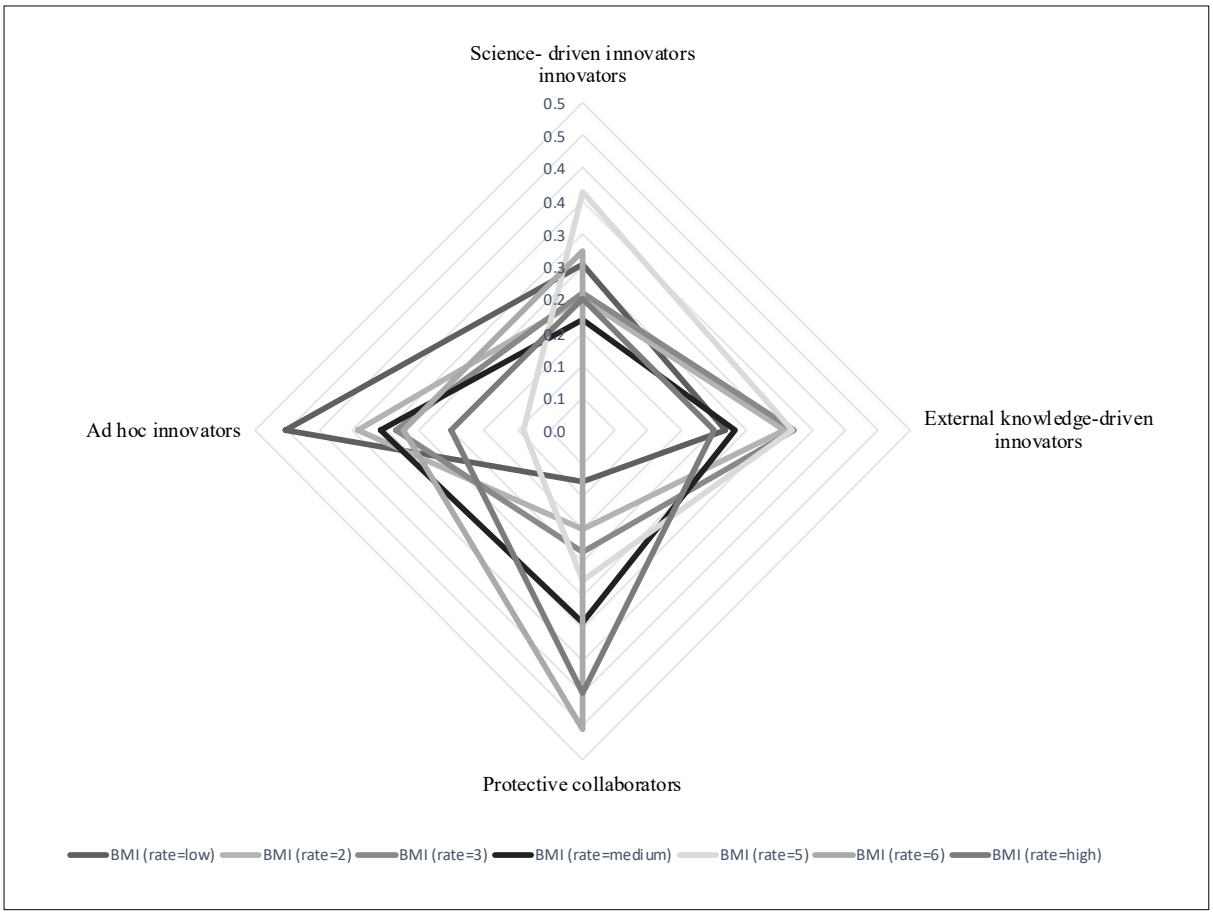

Figure 3.4: Cluster distribution of the business model innovation index

The radar chart allows one to compare and visualize multiple quantitative variables in a two-dimensional chart. The web lacks a high density around its center and shows instead long spikes, which indicates significant differences in the business model innovation index between clusters. Particularly, the multiple and relatively long spikes concentrated at cluster 3 underlines the importance of business model change in the innovation process of 'protective collaborators'. This is not surprising, considering that flexible work arrangements and processes are a necessity for both business model innovations and strong and successful partnerships with external entities. Consequently, adjustments of the corporate model might be more natural for this type of innovators. 'Ad hoc innovators', in contrast, show the greatest level of resistance to incorporate business model change in their innovation effort. These innovators are highly opportunistic, and the absence of formal innovation management structures seems to hinder the development of a new business model.

Concerning, the 'degree of novelty of the technology', and in particular the correlation between radical ($b = 0.02$, $p > 0.05$) and incremental product innovation ($b = -0.01$, $p > 0.05$) and cluster affiliation, however, cannot be confirmed by the model. Hence, it seems that enterprises are not defining their open innovation behavior based on the different types of product innovation that they intend to achieve. It might be that firms do not recognize the distinction between incremental and radical product innovation and thus do not have individual corporate R&D structures in place that allow them to pursue specific types of technological innovations. Consequently, Hypothesis 2 and Hypothesis 3 are rejected.

However, with respect to process innovation, a partial correlation coefficient of $b = -0.10$ ($p < 0.05$) between cluster affiliation and process innovation, while taking previously defined control variables into account, provides evidence for a significant relationship, and thus supports Hypothesis 4. The density and long spikes of the web in the radar chart, visualized in Figure 3.5, emphasize the importance of process innovation, in particular for 'science-driven

innovators'. This group of innovators has a strong focus on knowledge sourcing from scientific organizations with a diverse knowledge base. These organizations understand that know-how, ideas and knowledge are closely related, and therefore, universities as well as public and private research institutions, are great suppliers for cutting-edge knowledge as well as skilled researchers. Hence, 'science-driven innovators' tend to defend their core business and market position as well as competitive advantage by further developing their manufacturing processes in order to increase market entry barriers for competitors, while searching actively for breakthrough innovations.

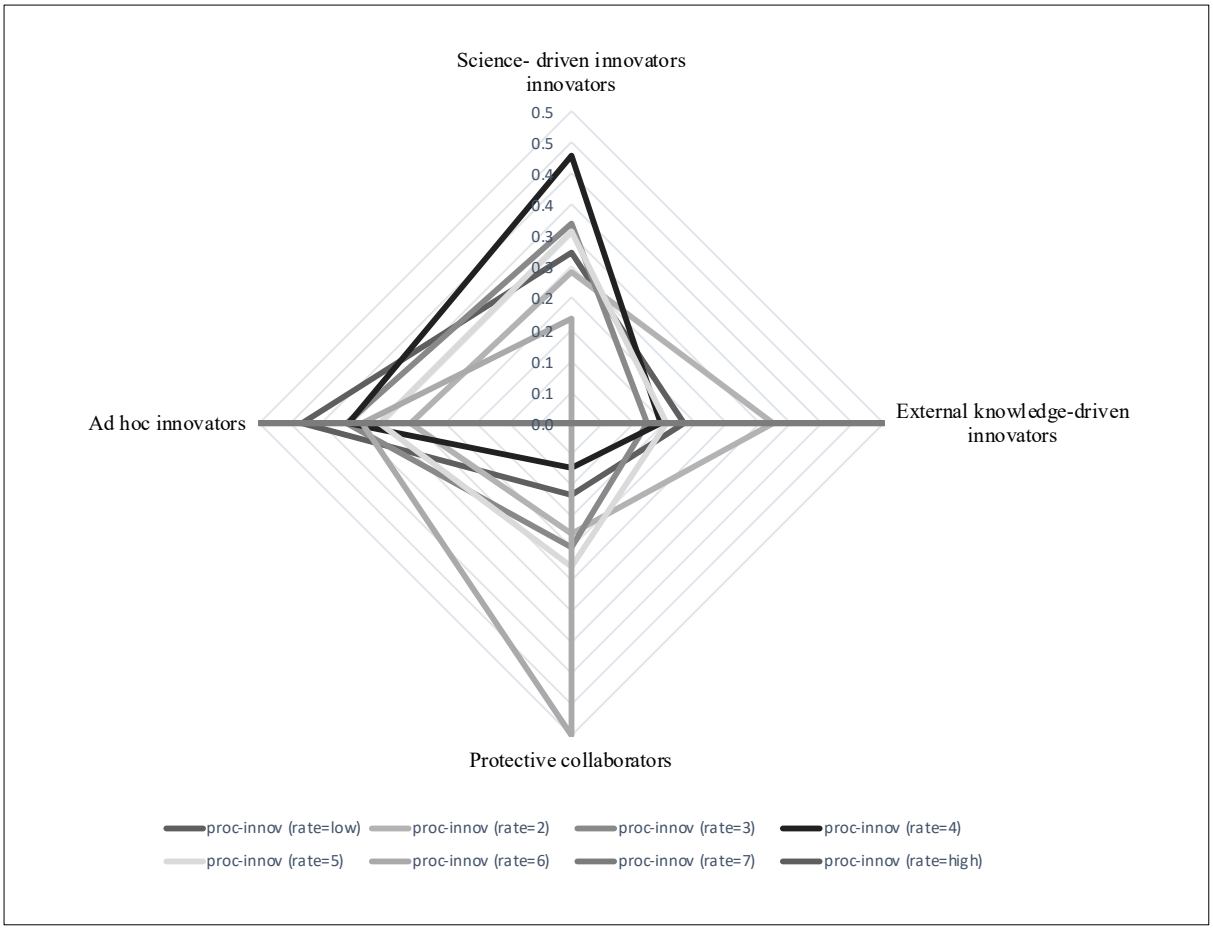

Figure 3.5: Cluster distribution of the process innovation variable

Regarding the financial performance (Hypothesis 5), measured as the 'return on sales in the last two years' (cf. Appendix A), the model does not find significant differences between the clusters ($b = 0.02$, $p > 0.05$) but shows some interesting tendencies. The most important is

the high number of enterprises with extremely high operating profit margins of greater than 15 percent in cluster 1, which points to the relevance of information sourcing from knowledge-intensive partners, in particular universities and research institutes, to stimulate radical product innovations with generally higher profit margins (Lassen & Laugen, 2017; Mohnen & Hoareau, 2003; Monjon & Waelbroeck, 2003; Perkmann & Walsh, 2007).

Concerning the product dependency of firms, measured by the 'proportions of turnover from the most important product' (cf. Appendix A), the data supports Hypothesis 6 with a positive and significant partial correlation coefficient of $b = 0.11$ ($p < 0.05$). The significantly larger mean value of cluster 4 compared to the remaining groups underlines the dependency of 'ad hoc innovators' on their current product portfolio, in particular their high runner products. Furthermore, the study confirms Hypothesis 7 ($b = -0.11$, $p < 0.05$) and identifies significant differences in the overall R&D intensity of firms, quantified by the 'total R&D expenditure as a share of the turnover' (cf. Appendix A). Particularly noteworthy is that 'protective collaborators' have much higher R&D expenditures compared to other clusters. A simultaneously strong focus on co-development, external knowledge sourcing as well as internal R&D seems to significantly drive up costs. This cost increase is further emphasized by a significantly higher ratio of personnel expenditures to turnover ($b = -0.11$, $p < 0.05$) of firms in this segment.

CONCLUSION AND OUTLOOK

This paper has empirically analyzed the differences in the innovation strategies as well as the influence of the innovation focus on the open innovation behavior of enterprises using microdata of the Community Innovation Survey in Germany during the year 2010 to 2012. The point of departure for this empirical study was the assumption that an ideal innovation strategy follows a dynamic pattern with different degrees of openness determined by the innovation focus of an enterprise. This premise was conceptualized with the aid of a 2x3 matrix, a

permutation of the innovation landscape map of Pisano (2015), with the following dimensions: degree of novelty of the technology and degree of novelty of the business model. The conceptual framework resulted in various hypotheses with respect to the open innovation behavior of firms. While the first set of hypotheses examined innovation activity clusters as well as the influence of the innovation focus of enterprises defined by the degree of product, process and business model innovations, the second set of hypotheses analyzed potential differences regarding the financial performance, product diversification and R&D intensity of firms across the different extracted behavioral clusters in order to shed light into innovation strategies.

In regard to the first set of hypotheses, the study illustrated that enterprises indeed follow multiple patterns of open innovation behavior with different emphases and degrees of openness. Each cluster pays attention to very specific open innovation activities. While, for instance, the science-based cluster lays its focus on the acquisition of knowledge from universities and research institutions, the protective collaborators show a strong interest in strengthening their internal R&D process as well as in fostering multiple collaborations with various external actors such as suppliers, competitors, and clients. Hence, it became obvious that most firms have shifted from a traditional closed innovation approach to a system in which open innovation activities play a vital role. It seems that firms have noticed that an increasingly complex environment driven by globalization requires sufficient openness to stimulate a firm's innovativeness and to keep up with competitors. But despite the growing number of firms with an increased degree of openness, this paper has also demonstrated that there is still a considerable number of firms that are not guided by precisely defined innovation goals and therefore, do not reveal systematic innovation activities. These firms are at risk of missing financial and strategic benefits of technology acquisition and exploitation. Moreover, the study has provided evidence that a firm's interest in business model change defines its open

innovation behavior. Generally, a business model innovation can be achieved in multiple ways, for instance, through the modification of the income generation, the product portfolio or the institutional structure of an enterprise (Zott et al., 2011). Hence, it is not necessary that all items of the multi-dimensional construct of business model innovation change simultaneously. Instead, changes in one dimension and, for instance, later modification of other subconstructs are, in many cases, sufficient to systematically adjust the business model (Clauss, 2016). Protective collaborators showed the greatest desire to dynamically change their business model and its underlying resource orchestration. This group of innovators creates value by combing resources and capabilities to reach greater innovativeness through network effects such as economies of scale (Dussauge, Garrette, & Mitchell, 2000). Collaborations can create, capture, and deliver value, and therefore, actively stimulate business model innovation (Osterwalder & Pigneur, 2010). Firms in this cluster acknowledge the potential of business model innovation to generate additional value, from their technological developments in the form of a more efficient use of available resources and an increase in profit margins (Wernerfelt, 1984). In contrast, ad hoc innovators seem to be quite reluctant to incorporate business model change in their innovation efforts. The lack of a clear focus in these firms' innovation strategies seems to hinder business model change that requires intense experimentation and learning efforts, and therefore, difficult investment decisions as well as a broad commitment of human and natural resources by the management (Sosna, Trevinyo-Rodríguez, & Velamuri, 2010). Furthermore, with regards to the relation between technological innovation and the open innovation behavior, the study has shown the importance of process innovations, particularly for science-driven innovators. These firms seem to develop specific capabilities in-house to establish a sufficient degree of absorptive capacity in order to successfully manage technology transactions with external actors (Lambe & Spekman, 1997; Soh & Roberts, 2005). In addition to the acquisition of cutting-edge knowledge from university-affiliated think tanks, these

innovators seem to simultaneously protect their market position by increasing the cost pressure on their competitors through steady improvements in their manufacturing process of goods.

With respect to the second set of hypotheses, the study could not detect systematic differences in the financial performance of enterprises across the four extracted clusters, but the results point, in particular, to the appropriateness of knowledge sourcing from scientific organizations in order to stimulate innovativeness, and therefore, the firm's internal R&D processes. Alliances that play an important part in the innovation strategy of enterprises, however, are associated with additional revenue potential but also with large costs (Kale & Singh, 2009). These large costs are confirmed by the fact that protective collaborators have much higher R&D expenditures compared to other clusters. Unfortunately, many partnerships do not unleash their full performance potential. This moderation of performance might have different causes, such as a lack of attention of managers to the fundamentals of partnerships in order to align both the interest of a firm and of the alliance, or a lack of direction and unclear goals (Osterwalder & Pigneur, 2010). In addition, the present study has shown that companies with a diversified range of products tend to show a higher degree of openness in their innovation activities as well as a more precisely defined innovation strategy. A plausible explanation could be that a firm's internal capabilities and resources are naturally limited and in order to fulfill the desire for a greater product line, and thus, for more independence, created the need for additional external innovation input through knowledge sourcing, but also in form of collaborations.

This empirical study leads to new research questions. While the paper has revealed significant differences in the innovation behavior of firms there are further, more finely grained analyses of the extracted behavioral clusters necessary in order to identify within-group heterogeneity regarding the innovation strategy. It is likely that firms within each domain form several sub clusters with regard to their innovation strategy due to their different capabilities

to access and process information. Consequently, inconsistently available information might result in different technological opportunities for firms and create advantages for either incumbents or entrants (Audretsch, 1995; Winter, 1984). Additionally, this might deliver further insights into the role of radical and incremental product innovation regarding the innovation activities of firms. As of today, little research is available on the evolution of open innovation behavior, and therefore, on how frequently firms shift their innovation focus and actively adjust their innovation strategies. Prior empirical work has found evidence that changing the fundamental components of an existing business model is extremely difficult and risky for firms (Girotra & Netessine, 2013). Hence, it is crucial for corporate executives to know when it becomes necessary to fundamentally change the focus from product and process innovations to business model innovations and vice versa, in order to grasp the full impact and consequences on the innovation behavior so as to effectively redirect financial and human R&D resources consistent with the appropriate combination of open innovation practices. However, the present analysis is limited by its time span of only three years. Therefore, further research covering an entire technological life cycle with the intention of deriving insights into long term effects of innovation approaches, is encouraged. Presently, European innovation survey data does not provide specific measures to examine in depth business model innovations. The scale used in this study was provided by Waldner et al. (2015) and is based on a multi-stage expert rating process. Applying this measure to the 2012 wave of the Mannheim Innovation Panel, however, requires thorough examination of country and time specific differences. Hence, this empirical analysis can only get close to capturing the entire complex nature of this multi-dimensional construct. Finally, as illustrated above, there is a wide range of opportunities to further enhance the body of literature, in particular, regarding longitudinal empirical analysis of open innovation behavior and the evolution of innovation strategies over time.

CHAPTER 4
THE OPEN BUSINESS MODEL INNOVATION PROCESS: INSIGHTS FROM THE MOBILITY JOINT VENTURES OF DAIMLER AG AND BMW GROUP

ABSTRACT

This article explores the open business model innovation process in the sustainability phase and the influence of a firm's value network on the process of value creation and capture. An in-depth case study approach is used to analyze the novel mobility business models centered around the carsharing service of SHARE NOW and the multimodal mobility platform of REACH NOW. The findings of this paper have several contributions for corporate executives and the existing business model research. First, three generic innovation process phases are derived to further advance radically new business models and to ensure sustainable growth: (1) evaluation and improvement, (2) efficiency and refocusing, (3) sustaining growth and scaling. Second, the significance of open business model elements and design themes in each of the three proposed stages as well as their interdependencies are illustrated. Finally, the study examines how the increased openness towards the external environment stimulates the business model innovation process of corporations.

INTRODUCTION

All firms, start-ups as well as established multinational companies, have one or even more business models to hit the target market and to create and capture value for all shareholders (Chesbrough, 2006a). The business model concept which provides a *"framework to link ideas and technologies to economic outcomes"* (Chesbrough, 2006a, p. 108), emerged in the management literature during the 'tech bubble' in the late 1990s (Teece, 2010). Generally, a business model gives an answer to *"how companies of all sizes can convert technological potential into economic value"* (Chesbrough, 2006a, p. 108) and thus can be seen as the *"design of organizational structures to enact a commercial opportunity"* (George & Bock, 2011, p. 99). Therefore, the business model that mirrors the strategic choice of a company can be reduced to the following main functions: value creation and value capture (Chesbrough, 2006a). Value is created through the implementation of a number of business operations that eventually lead to novel goods and services. But offering a useful product alone is not sufficient. The pricing and cost structure of a product or service defined by the firm must accommodate appropriate value capturing (Chesbrough, 2006a).

Casadesus-Masanell and Ricart (2011) characterize a winning business model as follows: *"they align with the company's goals, are self-reinforcing, and are robust. Above all, successful business models generate virtuous cycles, or feedback loops, that are self-reinforcing. This is the most powerful and neglected aspect of business models"* (p. 103). But crafting a fresh business model is not only a crucial task that significantly determines the firm's performance potential, it is also a tremendous challenge for both entrepreneurs who create new ventures and for corporate executives who are challenged with redesigning existing models in order to ensure and sustain competitive advantage (Chesbrough, 2006a; Zott & Amit, 2010). Moreover, a precisely defined business model is of importance because each model requires a slightly different combination of activities, within the enterprise as well as between its

cooperation partners, and consequently different resources and capabilities to perform and execute them (Zott & Amit, 2010). This inherent openness in the business model concept, due to the consideration of other actors in the value network such as collaborators, suppliers and customers, allows the different partners to share the innovation work (Chesbrough, 2007b; Zott et al., 2011). But so far, the organizational process of how these different actors cooperate for the purpose of innovation after the implementation of the business model in the so-called 'sustainability phase' and how this collaborative process leads to constantly updated business models, is little explored in the literature. As a result, the following research question emerges: *How is the open business model innovation process in the sustainability phase characterized and how does open innovation influence the value creation and capture through the business model in this stage?*

This paper attempts to examine this research question with the aid of in-depth case studies based on the new mobility joint ventures, SHARE NOW and REACH NOW, of Daimler AG and the BMW Group. Both ventures focus on creating and providing a transportation network that allows users to plan their journey and travel conveniently and quickly from point A to B at minimal costs. The firms SHARE NOW for carsharing and REACH NOW for multimodal services are deeply interconnected and reinforce each other. The intelligent network of joint ventures, and thus, the merger of leading carsharing models of car2go (Daimler AG) and DriveNow (BMW Group) as well as of the innovative mobility platforms moovel (Daimler AG) and ReachNow (BMW Group) represent an outstanding opportunity to explore open business model innovations.

Fundamental changes in energy sources and stringent emission legislation due to climate changes as well as an increase in urbanization and a rise in cost of car ownership – joined with evolving customer needs regarding more flexibility – are accelerating the evolution of radical new mobility needs of customers worldwide and promoting new ownership models and

mobility patterns (Shaheen & Cohen, 2007). In particular, traffic in metropolitan areas has a variety of unfavorable and damaging effects such as congestion, noise, air pollution and CO_2 emissions (Giesel & Nobis, 2016). Therefore, approaches that are minimizing urban driving and traffic are increasing in popularity. Especially, the carsharing service which has seen tremendous growth over the past years is one of the most promising concepts for sustainable transportation in cities. The considerable public interest in carsharing is largely due to the 'free-floating' concept which creates flexibility for the user by providing a cost-effective one-way car rental option (Giesel & Nobis, 2016). Furthermore, the carsharing concept encourages positive vehicle and behavior-related changes such as the use of low emission vehicles as well as the overall reduction of car usages and ownership (Giesel & Nobis, 2016). These events prompted significant changes in the business model of original equipment manufacturers (OEMs) and introduced a new historical phase in which their focus has shifted from selling vehicles towards providing mobility.

To date, there is limited empirical research at the intersection of open innovation and business models (Saebi & Foss, 2015). This is even more surprising considering that both frameworks are deeply interconnected and significantly determine the success of an enterprise. The business model that is *"a reflection of the firm's realized strategy"* (Casadesus-Masanell & Ricart, 2010, p. 195) requires outlining how value is generated, delivered and captured by the focal firm, which in turn, implies the definition of the level and kind of necessary support and involvement of external sources (Hienerth et al., 2011; Vanhaverbeke, 2006). Therefore, prior literature suggests that organizational capabilities have to be matched with open innovation activities to improve innovative performance (Keinz, Hienerth, & Lettl, 2012). Hence, firms engaging in open innovation practices are strongly encouraged to adjust their business models. This adjustment leads to the question of the ideal degree of openness and influencing factors in each step of the business model innovation process.

CONCEPTUAL BACKGROUND

Prior empirical work reveals that a business model focus is mainly on the creation of value and to ensure that sufficient profits from that value are captured (Shafer et al., 2005). Therefore, an open business model can be described as a *"representation of the firm's underlying core logic and strategic choices for creating and capturing value within a value network"* (Shafer et al., 2005, p. 202). According to Chesbrough (2006a), the business model is a *"useful framework to link ideas and technologies to economic outcomes"* (p. 108). Hence, the assumption that new product developments lead necessarily to greater financial performance of an enterprise ignores the moderating role of the business model (Baden-Fuller & Haefliger, 2013). Furthermore, to take full advantage of technological progress, firms have to examine novel business models in order to optimize both the delivery of their value proposition and the capturing of value (Chesbrough & Rosenbloom, 2002; Teece, 2010). Consequently, business model and innovation research are completing each other and are united by the search for value creation and capture. Some scholars highlight, in particular, the boundary-spanning character of business models and show the significance of resources and capabilities of market participants such as collaborators, competitors, and customers for a firm's internal innovation process (Zott & Amit, 2010; Zott et al., 2011).

The concept of open innovation to enhance innovation potential of firms has been widely debated in the literature. Chesbrough (2006a) was one of the earliest authors to link the two related concepts of open innovation and business model design. The author emphasizes that modern products and the technology that supports them are too complex to be developed and commercialized in isolation by a single firm. In order to leverage the growing number of external innovation labor and to maximize the innovation and financial performance, enterprises need to learn to cooperate with each other to increase innovativeness in both the development of novel products and business models (Zott & Amit, 2008, 2010). Consequently,

open innovation activities influence the entire chronological sequence of the various business model innovation process steps, ranging from the ideation, feasibility and prototyping phase to the decision-making, implementation and sustainability phase (Johnson, 2010; Johnson, Christensen, & Kagermann, 2008; Teece, 2010).

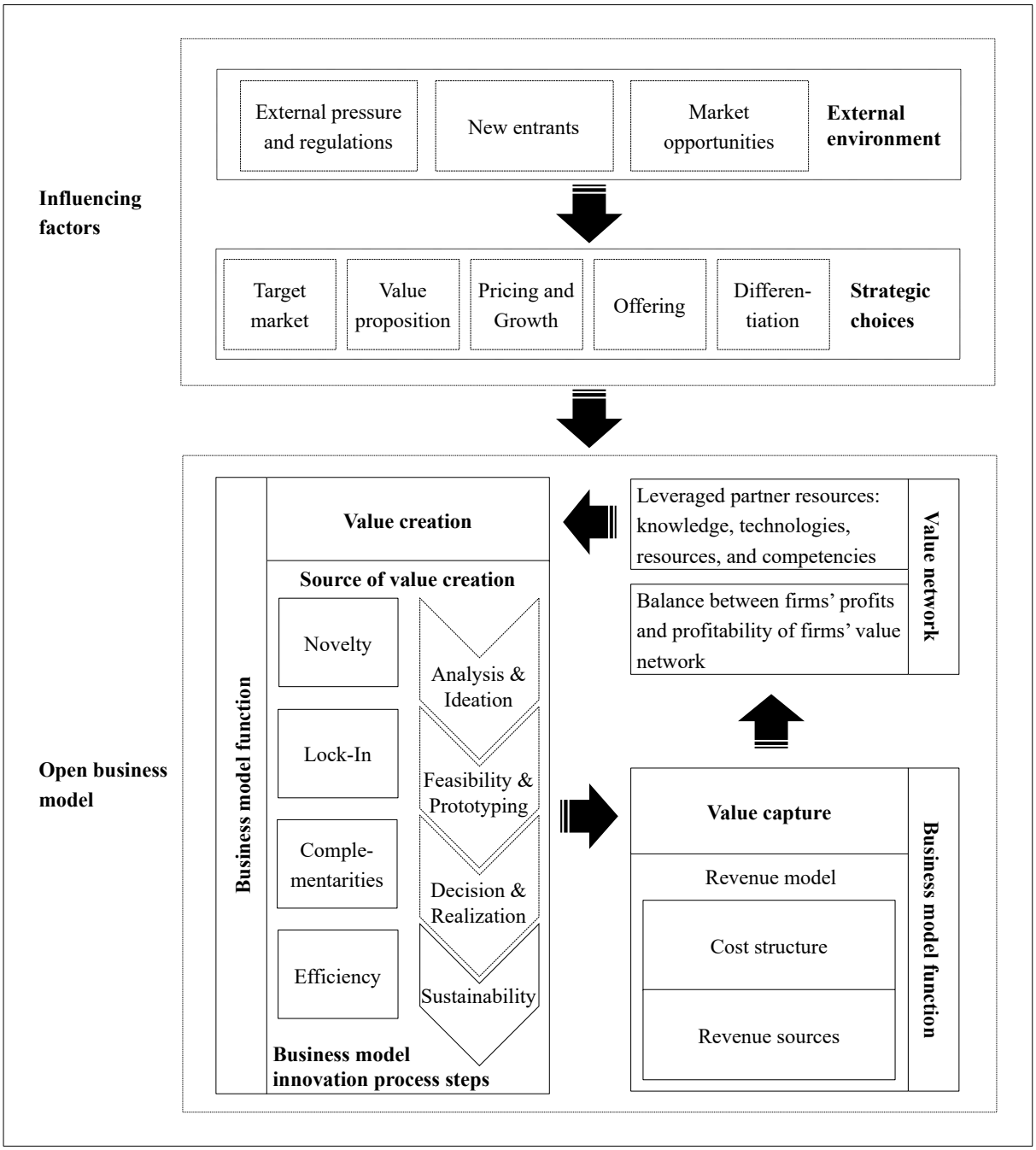

Figure 4.1: Proposed theoretical model

To date, little is known about the value creation and capture procedure through an open business model after its implementation. Therefore, the explored innovation process steps to gradually develop a business model in the sustainability phase (see Figure 4.1) are systematically analyzed on various levels based on their main value creation drivers; novelty, lock-in, complementarities, and efficiency (Amit & Zott, 2001; Zott & Amit, 2010) as well as their cost structure, pricing, and partner network (Shafer et al., 2005). While 'novelty' defines the implementation of new activities as well as new forms of connecting them, the 'lock-in' effect raises the loyalty of customers and locks them into the firm's world of products and services (Zott & Amit, 2010). According to Zott and Amit (2010), 'complementarities' refer to the bundling of activities in order to increase the customer value proposition whereas 'efficiency' aims to reduce the overall transaction costs for all participants.

In order to theoretically ground the in-depth case study, a comprehensive literature review, based on present studies, has been conducted, aiming to conceptualize the open business model concept and to identify its main elements in accordance with the proposed research framework (see first study for further details). The systematic literature review expresses a strong mutual understanding that an open business model is more than a way a company does its business and emphasizes the model part of the concept with the internal structures designed to exploit market opportunities as well as its inherent openness towards the external environment (e.g. Chesbrough, 2006a; George & Bock, 2011). As a result, the 'model-based' definition of the concept centered around its underlying and distinct constructs – *customer centricity, value proposition, strategic resources,* and *value network* – will be the key aspect of the analytic framework and point of departure for the empirical settings of this research study at the intersection of business models and open innovation. Table 4.1 provides a comprehensive overview of these elements, their definitions as well as relevant questions and respective data sources.

Table 4.1: Constituent elements of the open business model framework

Construct	Relevant Questions	Data Sources
Open business model (Djelassi and Decoopman, 2013)		
CUSTOMER CENTRICITY A business model provides an answer about *"what customers want, and how an enterprise can best meet those needs"* (Teece, 2007, p. 1329)	▪ Could the focal firm make the process of fulfillment and support substantially easier or more enjoyable for customers? ▪ Has the focal firm given the customers the information they need to make empowered and intelligent purchasing decisions?	▪ Fact-based information from cooperate websites, press statements and cooperate publications indicating personalized and quality customer experience, delivery of right service at the right time, focus on constructive relationship with customers ▪ Interviewees' description of their customer experiences, problem solving
STRATEGIC RESOURCES The strategic resources of a firm positively affect value creating strategies and can be divided into three categories: *physical capital resources* (Williamson, 1975), *organizational resources* (Tomer, 1987), as well as *human capital resources* (Becker, 1964)	▪ What are the firm's deep core competencies that allow to deliver value to customers? ▪ How could the focal firm deploy those benefits in new and unique ways? ▪ Could the focal firm's strategic assets be valuable in other industry settings? ▪ Can the focal firm imagine a radically different core process that would deliver the same benefit and reduces the resource intensity? ▪ Could the focal firm use its process expertise to disrupt other industries?	▪ Fact-based information from cooperate websites, press statements and cooperate publications about aspects such as the availability (e.g. number of cities and cars) of the mobility services and number of employees ▪ Interviewees' description of availability and accessibility of the service offerings, customer service and average waiting time
VALUE PROPOSITION The value proposition of a firm's business model is specified as *"a company's bundle of products and their characteristics"* that increase the value for the user (Holm et al., 2013, p. 327)	▪ Who are recipients of the company's value offering (customer, stakeholders, market segments, etc.) ? ▪ What kind of value is provided to the different recipients?	▪ Fact-based information from cooperate websites, press statements and cooperate publications indicating price, customer experience, etc. ▪ Interviewees' description of customer experiences, problem solving, price compared to conventional taxis, etc.
VALUE NETWORK The value network refers to the inherent openness of a business model with its focus on cooperation, partnership, and joint value creation with external parties (Zott & Amit, 2008)	▪ How effectively is the focal firm using suppliers, partners, and alliances as a source of innovation? ▪ What opportunities might be available to the focal firm, if it could 'borrow' the assets and competencies of others and incorporate them into the internal business model innovation process?	▪ Fact-based information from cooperate websites, press statements and cooperate publications about new national and international alliances, joint ventures, mergers ▪ Interviewees' description describing the positive and negative effect of new partnerships

As a key component of the research study, the 'open business model' is seen as a *"conceptual device that helps articulate which business processes account for actual value creation and capture"* (Holm et al., 2013, p. 327) and can therefore be analyzed as a set of interrelated building blocks (Osterwalder et al., 2005) comprising customer centricity, value proposition, strategic resources, and value network. The 'customer centricity' is characterized as a *"hypothesis about what customers want and how an enterprise can best meet those needs*

and get paid for doing so" (Teece, 2007, p. 1329). In a similar vein, Magretta (2002) highlights that a *"good business model answers Peter Drucker's age-old question: Who is the customer? And what does the customer value?"* (p. 87). Furthermore, prior scholars have identified 'strategic resources' that positively influence value creating strategies and have classified these attributes into the following three categories: 'physical capital resources' such as equipment, geographic location, and access to raw material (Williamson, 1975), 'organizational resources' like reporting structure, controlling, as well as formal and informal planning (Tomer, 1987), and 'human capital resources' including experience, training, relationships and intelligence (Becker, 1964). An important element in this context is the effective use of strategic resources, or as Barney (1997) puts it, a firm's resources *"are valuable if, and only if, they reduce a firm's net costs or increase its revenues compared to what would have been the case if this firm did not possess those resources"* (p. 147).

According to Holm et al. (2013) the 'value proposition' is defined as the value offering and thus as a *"company's bundle of products and their characteristics"* (p. 327) including services, level of standardization, differentiation and the brand itself. The 'value network' and therefore, the inherent openness of a business model with its focus on partnerships, cooperation and collaborations with external parties (Magretta, 2002; Zott & Amit, 2008), allows information to flow consistently in and out of the innovation development process at any point in time and likely strengthens the creation, delivery, and capture of value by employing organizational key resources in conjunction with that of other enterprises (Chesbrough, 2007b). Such patterns of economic exchange with external partners can trigger more effective business models that increase the output of innovative products and services, decrease research-related costs, and provide new market opportunities (Chesbrough & Schwartz, 2007). According to Hamel (2000), value networks broaden the resources of a corporation and stimulate the creation and capture of value, which in turn drives revolutionary business models.

Besides the open business model, the construct of ‘technological innovation’ plays an important part in determining the performance of an enterprise. Technological innovation may alter the business model in its primary role of creating and capturing value, and thus its value proposition for its recipients (Grönlund, Rönnberg-Sjödin, & Frishammar, 2010). Technological innovation serves as an input variable for the business model that provides a structure to connect these technologies to economic performance (Chesbrough, 2006a; Chesbrough & Rosenbloom, 2002). In other words, it converts ideas and technological potential into economic value to derive market leadership and secure market shares. Hence, the business model significantly determines the commercial success of technological innovations because *“the same idea or technology taken to market through two different business models will yield two different economic outcomes.”* (Chesbrough, 2010, p. 354). Consequently, technological innovation acts as a facilitator of the business model (Teece, 2010). Furthermore, Calia, Guerrini, and Moura (2007) illustrate that the impact of technological innovations is not necessarily limited to new product aspects; it may also alter the operational and commercial activities of the focal firm, and thus, its business model.

Furthermore, the proposed analytical framework takes the ‘market environment’ in which an enterprise operates into consideration. The market environment and thus the world surrounding the focal firm is expanding rapidly and brings new challenges as well as new opportunities to the design process of business models and the management of enterprises (Casadesus-Masanell & Ricart, 2010; Chesbrough, 2006a). Externalities might determine how firms create entirely new business models and develop existing ones further (Sosna et al., 2010). Zott and Amit (2007) suggest in their empirical work that the external environment serves as a moderator for the correlation between business models and the performance of an enterprise. Generally, the environment in which business models must be created and managed influences all elements of the business model such as costs, resource accessibility, as well as

the value chain and partner network (Demil & Lecocq, 2010). The environment has been increasing in complexity, in particular in terms of competition driven by globalization, the management of intellectual property (IP) and the degree of openness (Chesbrough, 2006a). IP-based firms, for instance, utilize external partners and their business models to commercialize their internal technologies. These IP-based firms likely seek to license and acquire IP. This new environment allows firms to experience a great deal of design freedom and offers new ways to tap into markets as a supplier of IP in order to sell internal technologies, but also as a customer to acquire and utilize unwanted IP (Chesbrough, 2006a). According to Chesbrough (2006a), technologies that *"connect directly to a company's business model, create additional power and leverage for the other part of the strategy"* (p. 131). But the risk of successful business models lies in the fact that they may create inertia, which makes it difficult for the focal firm to adapt its business model to a rapidly changing environment (Chesbrough, 2006a).

METHOD AND SETTING

This paper follows Eisenhardt's (1989) and Yin's (1994) methodology and uses a multiple-case research design, aiming to explore *how* the open business model innovation process in the sustainability phase unfolds and to uncover *how* open innovation practices influence the business model process of value creation and capturing. The case study approach is especially appropriate to answer '*how'* questions but has difficulties to handle *'what'* questions as its generalizability is limited, due to its small sample sizes (Björkdahl, 2009). But in-depth case studies allow the researcher to develop a deeper understanding of the underlying reasons for a phenomenon, particularly in complex areas in which knowledge is rather limited, such as in the process of business model innovation and the resulting structures and working mechanisms (George & Bock, 2011). Besides complexity, business model innovations vary and strongly depend on the business sector (Casadesus-Masanell & Llanes, 2011).

Yin (1994) suggests that in-depth case study research is suitable when the emphasis is on reasons behind observed phenomena and on present, behavioral events as well as on real-life circumstances that are not controlled. This research study satisfies the different criteria named by Yin (1994). Furthermore, there are compelling reasons to believe that mobility behavior services are still in the beginning of theoretical development which suggests an explorative research approach (Edmondson & McManus, 2007). Both single and multiple case studies have advantages and disadvantages. Despite some disagreements, scholars agree that multiple case studies lead to comparative data collection that increases the generalizability of the theoretical findings (Yin, 1994). While Van Maanen (1982) argues that researchers should avoid a priori commitment to any theory, this study instead, follows Whyte's (1984) suggestion that substantial research needs to be directed by *"good ideas about how to focus the study and analyze those data"* (p. 225).

CASE SELECTION

This case study is based on the new mobility joint ventures, SHARE NOW and REACH NOW of Daimler AG and the BMW Group. The newly established free-floating carsharing service SHARE NOW, combines Daimler's car2go and BMW's DriveNow and allows customers to rent vehicles anytime and anywhere via smartphone. Carsharing tends to increase the utilization of vehicles and thus leads to a significant reduction of the total number of cars in dense cities (fs_201911_sn_1, pr_20190228_sn_4). Besides the carsharing service the strategic partnership for sustainable urban mobility in which the two German automotive manufacturers are developing and pooling their services in order to meet new mobility trends and to establish a new global player in the segment of transportation innovation, includes another joint venture, namely REACH NOW for multimodal transport (pr_20180328_dmo_1, pr_20190222_dmo_2).

REACH NOW's seamless mobility approach is one of the most radical and comprehensive modes of today's transportation. Users have a maximum degree of flexibility by choosing from a wide range of private, shared, and public forms of transportation that is blurring the boundaries between sectors (pr_20190211_rn_8). Mobility is delivered through a combination of *e*-scooters, bike rental, taxi ride-hailing, and shared vehicles, with public transit as the backbone (pr_20190211_rn_8). All this variety in transportation modes is enabled through the REACH NOW app, an intelligent software platform that provides Mobility-as-a-Service by handling multimodal traffic flows (pd_201802_rn_1). Both mobility joint ventures are reinforcing each other and forming a new intelligent transportation network with the intention to move people much more efficiently.

The case selection follows Eisenhardt (1989) and is based on a number of reasons. First, the mobility network of the two German automotive OEMs is the first of its kind and stands for a radically new open business model approach that has the potential to shape current and future urban mobility (pr_20180328_dmo_1). This intermodal mobility approach defined as a new mixture of different means of transport, from the bicycle to the car, from the suburban railway to the taxi, will likely determine the future of transport. The philosophy of the venture network is that every means of transport is justified, as long as it is in the interest of the users and thus supports shortened commuting time and reduced cost of a journey (pr_20190211_rn_8). The combination of a software platform that connects public transportation, bicycle rental, and the public transit system with the OEMs' own carsharing service is a comprehensive mobility approach which is totally unique (pr_20190222_dmo_2, pr_20190211_rn_8). Second, both ventures – SHARE NOW and REACH NOW – were recently established, and thus, are in the initial phase of value creation and implementation (pr_20190222_dmo_2). This phase provides an ideal starting point for qualitative research with the aim of exploring the design process of business model innovation. Third and finally, even

though the car manufacturers may combine the ventures in the future, at this point in time, the firms are set up as independent units, situated in the same industry and competing in the same field for the same customers (pr_20190222_dmo_2). This juxtaposition makes the firms highly comparable and their different approaches to transportation allows one to examine the design process of different and competing business model innovations. Table 4.2 provides an overview of the mobility joint ventures SHARE NOW and REACH NOW of the car manufactures, Daimler AG and BMW Group.

Table 4.2: Overview of the business models of the mobility joint ventures

	First Case Study SHARE NOW	**Second Case Study** REACH NOW
Mobility alliance between Daimler AG and BMW Group: Two joint ventures to 'shape the future of transportation'		
COMPANY	In February 2019, the BMW GROUP and DAIMLER AG announced to combine their carsharing services, DRIVENOW (BMW GROUP) and CAR2GO (DAIMLER AG) in order to form an equally-owned joint venture. SHARE NOW will be one of the largest carsharing provider worldwide.	In February 2019, the BMW GROUP and DAIMLER AG announced to join forces and to merge their multimodal services, MOOVEL (DAIMLER AG) and REACHNOW (BMW GROUP) in order to form an equally-owned joint venture, named REACH NOW.
SERVICE	SHARE NOW provides a 'free-floating' carsharing service. This system defines a geo-fence, alongside a certain radius from the city center, in which a customer can hire and drop of cars. Hence, customers don't have to visit stations for pick-up or drop-off. Vehicles are located through smartphones.	REACH NOW provides access to a wide variety of different transportation modes within a multimodal mobility platform. This includes mobility options such as bus, train, carsharing, ridehailing, and bike rentals. The service can be accessed via app that allows to plan, book and pay for trips in order to commute conveniently and inexpensively from point A to B.
VISION	"Now a new movement for everyone"	"A world without traffic jams"
AVAILABILITY	SHARE NOW as free-floating carsharing service provider operates a total of 20,000 vehicles (3,200 electric cars) in 27 cities in 14 countries.	REACH NOW operates worldwide and its service is available in 21 cities.
CUSTOMERS	SHARE NOW provides its service to more than 4 million customers.	REACH NOW provides its service to more than 6.7 million users.
HQ	Berlin (Germany)	Berlin (Germany)
EMPLOYEES	> 700 employees	> 300 employees
PRICE	Chicago (Illinois, United States) Registration: USD 5 + tax (USD 15 credit) Per minute (smart fortwo): USD 0.24 + tax Per minute (Mercedes CLA/GLA): USD 0.29 + tax Packages: 30min (40 miles), 1hr (60 miles), 3hr (80 miles), 6hr (120 miles), 1day (150 miles), 2days (300 miles), 3days (450 miles) Packages (24hr, 150 miles, smart): USD 59 + tax Packages (24hr, 150 miles, Mercedes CLA / GLA): USD 79 + tax Included: parking, insurance, fuel, maintenance, etc.	REACH NOW is a service to connect passengers with different mobility options and providers. The transit agency, REACH NOW claims a commission for each successful order placement. The fare rates, incl. any extra charges or surcharges, are determined by local provider and regulations in the cities and regions where REACH NOW operates.
	Information provided above are based on publicly available data as of January 2020	

DATA COLLECTION AND ANALYSIS

Several data sources were used to explore the open business model development process in the sustainability phase and to examine the role of open innovation behavior in fostering value creation and capture through the business model. The data sources are comprised of in-depth semi-structured interviews (n = 5) and publicly accessible information for SHARE NOW and REACH NOW including corporate websites (n = 2), press releases (n = 23), fact sheets (n = 2), and promotional documents (n = 4) to complement and enhance the findings from the primary data sources and to ensure validity through empirical triangulation (cf. Appendix D).

The interviews were conducted with five carefully selected top-level and middle-level managers from different functional areas of the new mobility joint ventures, SHARE NOW and REACH NOW as well as the shareholder Daimler Mobility AG and its wholly-owned subsidiary, Daimler Mobility Services GmbH (see Table 4.3), in order to get both retrospective and prospective views on the complex open business model design activities. The interviewing process allows for the gathering of information which is otherwise privileged to the managers themselves. All research participants have extensive experience in managing enterprises. Due to their career experience and position within the organization at the time of the interview, three participants had deep knowledge and insights of all business model related processes and procedures of both mobility joint-ventures, SHARE NOW and REACH NOW. Consequently, the corresponding interviewees provided information about both companies. According to Eisenhardt and Graebner (2007), the selection of participants of different hierarchical levels supports a broader perspective on a complex issue and minimizes respondent bias.

In order to define the structure and settings of the interviews prior to this study, a guideline was prepared based on relevant literature on open innovation as well as business model design, its drivers and consequences (cf. Appendix E). The semi-structured character of the interviews gave the researcher the opportunity to clarify specific issues and follow up with questions. The

interviews lasted on average 61 minutes and were conducted by telephone between April and May 2020 due to the physical distance as well as the schedule and timely availability of interviewees. In all interviews, the same research protocol was followed, and extensive notes were taken due to the unwillingness of participants to have the conversations tape-recorded. Upon completion, the interviewing notes were transcribed in detail, and then shown and discussed with the research participants in order to ensure accuracy and completeness. The final version of the transcript was sent to the interviewees and written approval was obtained.

Table 4.3: Interviewees and position

Case Study	Information of Interviewee	Corporation	Interview Code
SHARE NOW *"Our mission is your personal freedom: To make it possible for you to drive in the city without breaking the bank – or the environment"* (corporate websites)	Executive Management, SHARE NOW	SHARE NOW	participant_sn_1
	Director of YOUR NOW Corporation Management	DAIMLER MOBILITY SERVICES GMBH	participant_now_1
	Executive Management, Digital & Mobility Solutions	DAIMLER MOBILITY AG	participant_dmo_1
	Managing Director of Finance	DAIMLER MOBILITY SERVICES GMBH	participant_dmo_2
REACH NOW *"Our mission is to help transform cities by providing the most convenient and sustainable mobility solutions."* (corporate websites)	Executive Management, REACH NOW	REACH NOW	participant_rn_1
	Director of NOW Cooperation Management	DAIMLER MOBILITY SERVICES GMBH	participant_now_1
	Executive Management, Digital & Mobility Solutions	DAIMLER MOBILITY AG	participant_dmo_1
	Managing Director of Finance	DAIMLER MOBILITY SERVICES GMBH	participant_dmo_2

The use of multiple data sources including primary and secondary data in this in-depth case study allowed for empirical triangulation during the analysis and increased the robustness of the findings (Jick, 1979). Following both Eisenhardt (1989) and Yin (1994), a within case analysis and a cross-case analysis were applied to ensure a thorough analysis and to unfold in detail the process of open business model innovation in the sustainability phase. In the first step, the within-case analysis, each of the two cases was analyzed individually in order to derive patterns for each case (Eisenhardt, 1989). The focus of the analysis rests on the business model

defined by Djelassi and Decoopman (2013), which is centered around the boundary-spanning activities of companies, and thus, links the business model design directly to the concept of open innovation. This linking allows one to gain further insights into the open innovation behavior of the mobility ventures with regards to the firms' new business models. The individual case analysis naturally included embedded elements of the business model concept, such as activities and goals, and resulted in unique patterns (Yin, 1994). The outcomes of the within-case analysis then functioned as input parameters for the following cross-case analysis with the intension *"to build a general explanation that fits each of the individual cases, even though the cases will vary in their details"* (Yin, 1994, p. 112). Hence, to generalize findings and obtain new knowledge from the data, case pairs were compared to identify both similarities within groups and difference across clusters (Eisenhardt, 1989). The iteration of theory and primary as well as secondary data is an efficient practice for the enhancement of new insights through in-depth case studies.

Moreover, this paper follows Yin's (1994) recommendations for ensuring validity and reliability of the research findings by using an approach that comprises multiple steps. As in all research, quantitative and qualitative empirical settings must consider internal validity, external validity, and construct validity as well as reliability (Yin, 1994). First, internal validity was secured with the aid of an analytical framework based on a systematic literature review of business model design and open innovation stemming from various areas such as strategic, technology and innovation management. Additionally, the analytic framework was extensively debated with scholars and industry experts familiar with the field of business model design and open innovation. Second, external validity was increased by using diverse information sources, such as multiple case studies including interviews as well as secondary data, because it supports the generalization of the findings (Eisenhardt & Graebner, 2007; Yin, 1994). Third, to ensure construct validity, the primary data gathered through interviews was triangulated with

secondary data sources and additionally, early findings of the research were distributed to the interviewees for validation (Yin, 1994). Fourth and finally, a formal case study protocol was developed to provide reliability, and thus, to ensure accuracy and alternative explanations as well as future replication of the results (Yin, 1994).

FINDINGS

THE CASE OF THE CARSHARING PROVIDER SHARE NOW

While the traditional business model of the German OEMs was centered around the development, production and the distribution of vehicles in large quantities, the car manufacturers have significantly expanded their product offerings over the past decades to increase the customer value proposition. Both firms have shifted towards a global financial and mobility service provider and have added several services including financing, leasing and the insurance of passenger cars and commercial vehicles (company websites). Considering the total investment required to purchase a car, these services have supported additional sales and have offered a greater number of customers access to their own vehicle (participant_dmo_1). However, car ownership still remains complex for people due to significantly high total costs and additional complexity, particularly in dense cities stemming from lack of parking, traffic jams, and congestion charges (participant_dmo_1). The traditional car ownership model is, under these circumstances, more a burden than prestige for many people (participant_dmo_1). Consumer habits are further altered by political associations such as the ‘car-free’ movement that a number of major cities have joined in order to lower CO_2 emissions and improve safety among residents (participant_sn_1). Daimler was the first German car manufacturer to make the move to become a broader provider for mobility by launching its carsharing service car2go in 2008 in order to protect and strengthen the market position (participant_dmo_1). BMW followed with its own carsharing service DriveNow a few years later (company websites).

In 2019, the German carsharing venture SHARE NOW was established from the merger of car2go and DriveNow (pr_20190222_dmo_2). Both previous services of Daimler and BMW were rather similar. However, car2go was using a 'free-floating' concept, while DriveNow was a so-called 'one-way' carsharing service (company websites), meaning, car2go enabled users to pick-up and drop-off vehicles at any location within a defined operational area. BMW's 'one-way' carsharing model, in comparison, did not provide the same level of flexibility, and the start as well as end point of a trip could either follow the 'free-floating' concept or be limited to traditional rental stations. To maximize the value offered to customers, the newly formed joint venture follows the 'free-floating' concept (participant_dmo_1, pr_20190228_sn_4). A mobile application allows the end user to identify the nearest vehicle and to reserve it for up to 20 minutes free of charge (company websites). Customers are only charged for every minute they actually use the vehicle including all additional costs such as insurance, refueling/recharging and even parking fees (participant_sn_1). Besides economic interest, the incumbent organizations anticipate additional value created through their novel business model ranging from environmental benefits due to fewer cars on the road and an increased use of electric vehicles (pr_20190228_sn_4) to organizational learning that stimulates new business models and supports the transition from a car manufacturer to a provider of mobility (pr_20180328_dmo_1).

VALUE CREATION AND CAPTURE IN THE SUSTAINABILITY PHASE

Value through business model design can be achieved in a variety of ways such as by decreasing opportunity costs of the value network or by increasing the maximum amount a consumer is willing to pay for goods and services (Brandenburger & Stuart, 1996). According to Zott and Amit (2010), an open business model is *"geared towards total value creation for all parties involved"* (p. 218) and ultimately determined by its design themes centered around novelty, lock-in, complementarities and efficiency. Hence, it is the value created through a

firm's business model that defines the size of the 'economic pie' and lays the foundation for the potential value captured by an enterprise (Zott & Amit 2010). The analysis of both case studies with the intention to provide an answer on the initial research question, allows one to group the sustainability phase of the business model innovation process into three stages: (1) evaluation and improvement, (2) efficiency and refocusing as well as (3) sustaining growth and scaling. The following sections examine in detail the main characteristics of each stage and explore in-depth the source of value creation and capture of the carsharing business model, SHARE NOW.

FIRST STAGE: EVALUATION AND IMPROVEMENT PHASE

The concept of Daimler's carsharing service was created in workshops about future mobility in urban areas back in 2007 (participant_dmo_1). During this time, it was an entirely new concept and there were no comparable offerings by competitors (participant_dmo_1). Nowadays, the carsharing service SHARE NOW has more than four million users and a fleet size of more than 20,000 vehicles (fs_20190222_dmo_1). The business model has proven that it has tremendous future potential in particular by considering both, to serve customers flexibility and convenience needs as well as to improve environmental and living standards (participant_dmo_1, pr_20180328_dmo_1).

Today, SHARE NOW fosters the transition away from car ownership towards renting or leasing a car, and thus, actively supports green mobility by reducing traffic congestion (participant_dmo_1, pr_20180328_dmo_1). While privately owned vehicles are used on average for only one hour per day, a vehicle of the SHARE NOW fleet today already replaces up to eight private cars due to a more efficient usage (participant_sn_1). Hence, the carsharing service supports the transition towards a world without traffic jams, frees up parking spaces in urban areas and further complements the strong public transportation system (participant_sn_1, pr_20190222_dmo_2). To ensure sustainability of the carsharing service, its business model

needs to be consistently evaluated (participant_dmo_1) and based on the market feedback of its users frequently adapted and gradually improved to provide at any point in time the best possible offer to its customers (participant_dmo_1). In this early stage of the sustainability phase, identified potentials for improvements tend to stem especially from 'novelty-centered' related business model elements.

A novelty-centered business model refers to the introduction of novel content, structure or governance of activities and thus provides a fresh approach to economic exchange (Zott & Amit, 2010). The carsharing service, SHARE NOW, has revealed that its business model, positioned between competing services such as car rental, taxi ride-hailing and micromobility, has some weaknesses that must be addressed by the focal firm in order to remain successful (participant_now_1). In particular, for commuting within urban areas, riders tend to prefer the more convenient service of taxi ride-hailing, as you don't have to deal with driving yourself and finding a parking space (participant_now_1). Furthermore, for short distances, micromobility such as scooters and bicycles offer cost-effective alternatives to the well-known carsharing service (participant_now_1). The highly competitive market environment combined with the necessity of high investments in the fleet management and maintenance of the firm's own vehicle fleet, lead to the need for a high utilization rate of each vehicle and makes the business model somewhat challenging (participant_now_1). These circumstances challenge SHARE NOW, at an advanced stage and thus after scaling the service, to redefine the business model. Ideally, *"you try out a business model, improve and optimize it based on market feedback, and once you've found an optimal business model you scale it"* (participant_now_1). However, the early focus on growth has helped SHARE NOW to tremendously gain experience and identify potential for future optimization of the service in a short amount of time (participant_now_1). Consequently, the carsharing venture SHARE NOW has slightly repositioned the business model by adding new content in order to stimulate profitable growth

among private and business customers (participant_now_1). Therefore, the expansion of the business model into the ‘car rental’ sector was of significant importance (participant_dmo_2, participant_now_1). This means that vehicles of the SHARE NOW fleet can be rented out not only for short distances on a per minute basis, but also for several days, weeks, or even months via an app. With the aid of ‘subscription models’ the service is priced attractively for customers (participant_dmo_2, participant_now_1). In addition, the service for long-term rentals might include, in the future, the delivery of vehicles to users’ homes in order to increase the aspect of convenience and to reduce the time and effort of customers to pick up and drop off rentals (participant_now_1). This service would further differentiate the business model of SHARE NOW from the service of traditional car rental firms.

Moreover, in another effort to increase the utilization rate of the fleet, the firm has recently introduced a service namely SHARE NOW *for Business* that offers employees of business partners a high degree of flexibility in using the car sharing service (participant_dmo_1). Business partners are eligible to use the service any time, for instance from the airport to the business meeting at the customer, and back to the office. While this service offers for SHARE NOW a new profitable business segment, it offers corporations a massive reduction of fixed costs in their company fleets as well as an opportunity to participate in a future-oriented mobility solution (participant_dmo_1). With SHARE NOW *for Business*, the carsharing vehicle becomes a company car whenever needed (participant_dmo_1).

SHARE NOW is also consistently updating its fleet and increasing its attractiveness to better meet the changing needs of its customers (pr_20180110_sn_1). Consumers are seeking maximum flexibility and convenience in the many areas of their lives (Nourinejad & Roorda, 2015). Mobility needs are no exception. The change of ideas for mobility in combination with a fundamental change of our transportation system due to the introduction of novel technologies and business models such as the ‘free-floating’ carsharing service, will lead to

new ownership models and mobility patterns (Hu, P. Chen, Lin, Xie, & X. Chen, 2018). Consumers already select their optimal mobility solution based on the situation. For example, the car that is rented by a person through SHARE NOW will depend on the specific purpose and will thus be different if the consumer drives to work or goes on vacation with the whole family (participant_now_1, participant_sn_1). Therefore, the company has added new and more comfortable 'Smart' models such as the 'Smart Fortwo', a cabrio as well as the latest model of the allrounder A-Class (pr_20180110_sn_1). Furthermore, new business model content to keep improving the service, especially customer satisfaction, in the near future might include 'image analysis' (participant_sn_1). This technology could help identify items that users may have left behind in the shared vehicle and help to detect whether the user handled the rental with the appropriate care. In the first situation, the technology can inform the customer about forgotten objects and block the vehicle for use until the article is retrieved, while the latter circumstance enables the firm to charge the customer for the necessary cleaning and encourages behavioral change, in compliance with the legislation in force and in full respect of the personal rights of the users (participant_sn_1).

Additionally, carsharing creates points of contacts with new technologies such as electromobility and thus reinforces awareness of the potential of *e*-mobility, possibly increasing its diffusion (pr_20181018_sn_2). This exposure links the new service to the core business of the OEMs, the production of vehicles, and improves their CO_2 balance sheets (participant_now_1). At the same time, it helps to satisfy the greater demand for *e*-vehicles for the carsharing community (pr_20181018_sn_2). Already 3,200 of 20,000 vehicles of the SHARE NOW fleet are equipped with an electric drive (fs_20190222_dmo_1). Based on the prediction of the car manufacturers, this number will be rising significantly in the upcoming years (pr_20190402_sn_5). The greater demand for *e*-vehicles also accelerates the need for a nationwide infrastructure for charging stations. Many cities, particularly in Germany, have

been enhancing electromobility in order to fulfill their emissions targets (pr_20181018_sn_2). Hence, the car manufacturers push many sub activities of sustainable mobility to third parties such as cities and municipalities. That approach allows the OEMs to keep their complexity and costs to a manageable level and paves the way for a large and profitable business.

Table 4.4: First stage elements and participant statements of SHARE NOW

First Stage: Evaluation and improvement phase		
Company	**Core Elements**	**Statements of Participants**
SHARE NOW *"Our mission is your personal freedom: To make it possible for you to drive in the city without breaking the bank – or the environment"* (corporate websites)	Monitoring and evaluating newly implemented business model	*The overall goal is to tailor the service to the customer in the best possible way and to find its ideal positioning between the competing mobility service offerings (participant_now_1).*
	Strong customer integration in the evaluation process	*The focus must be to further develop the firm's business model in the sense of maximizing the benefits for customers (participant_dmo_2).*
	Focus on introduction of new business model content	*Sustaining innovations play a vital role in continuously adapting the content of the firm's business model in order to meet changing customer needs at any point (participant_sn_1).*
	Redefining business model by implementing changes based on market feedback	*Ideally, you try out a business model, improve and optimize it based on market feedback, and once you've found an optimal business model you scale it (participant_now_1).*
	Communication strategy to encourage behavioral change	*Only very few people have a good understanding of the total costs of car ownership per minute including lease, insurance, service, gas, parking, and cleaning. Hence, they are very price sensitive. But carsharing is much cheaper than owning a car. This must be communicated to customers (participant_sn_1).*

Besides the introduction of new content, structure or governance of activities, focused communication from the firm that consistently illustrates the advantages of the carsharing service to encourage changes in the commuting behavior of people is of tremendous importance during the first stage in the sustainability phase (see Table 4.4). Customers are particularly price sensitive because *"very few people have a good understanding of the total costs of car ownership per minute including lease, insurance, service, gas, parking, and cleaning"* (participant_sn_1). But compared to the total costs of a private vehicle, the carsharing model of SHARE NOW is not only very competitive, but also cheaper (participant_sn_1). The many

positive effects of the service have to be actively communicated by the focal firm in order to foster continuous behavioral learning and the change process for consumers.

SECOND STAGE: EFFICIENCY AND REFOCUSING PHASE

Generally, there is a smooth transition between the first and the second stage which are both centered around the creation of additional value through the business model. But while the first stage is focused on the novelty of the content, structure and governance of the business model, the second phase is concerned with its 'efficiency' increase and to 'lock-in' customers in order to set the stage for sufficient value capture of the focal firm in the near future (see Table 4.5).

An efficiency-centered design comprises all business model activities aimed at increasing the efficiency of transactions through the reduction of costs (Zott & Amit, 2010). The focus of the construct relies clearly on transaction efficiency derived from aspects such as the reduction of complexity, information asymmetry as well as coordination costs (Zott & Amit, 2007). In order to increase the profitability, the efficient use of the firm's largest asset, its fleet of over 20,000 vehicles, is essential (participant_dmo_1, participant_now_1). The challenge in a 'free-floating' concept is to ensure that vehicles are staying in heavy usage areas in order to maximize the utilization rate of each vehicle (participant_dmo_1). Therefore, SHARE NOW has made significant investments in the automation of the internal fleet management system based on artificial intelligence methods. The complexity and importance of the fleet management, which was mainly carried out manually with the aid of 'Excel sheets', was underestimated, when car2go launched its service in 2008 (participant_sn_1). The necessity for the use of smart algorithms to handle and evaluate large amounts of data in real time for an efficient fleet management is obvious when one considers that on a daily basis 15,000 rides are handled via SHARE NOW in Berlin, Germany alone (participant_sn_1). Today, SHARE NOW is able to

determine the ‘average idle time’ of each vehicle in the fleet, depending on the address of the current location (participant_sn_1).

This determination in turn allows the company to create incentives for customers through flexible pricing and to decide when a vehicle should be cleaned or brought to service to minimize its downtime (participant_sn_1). The variable pricing system for carsharing includes a zone-based charge as well as a refund system that rewards users for driving vehicles back toward areas with a greater usage of the service and penalizes drivers for leaving the city centers (participant_sn_1). These steps aim to increase the utilization rate of vehicles, a key driver for the stimulation of revenue and return on assets (participant_dmo_1). To build a highly automated fleet management system in house requires a specific skill set that SHARE NOW has acquired by hiring suitable personnel with extensive expertise in the field of mathematics and information technology (participant_sn_1). Most of these people had no prior contact with mobility companies (participant_sn_1). To date, the efficient management system gives SHARE NOW a decisive competitive advantage and forms the company’s core competence (participant_sn_1).

In addition, existing offers from the car manufacturers in the area of leasing and financing might be used to efficiently expand and upgrade the carsharing fleet (participant_now_1). Nowadays, new cars are often leased and returned by the customers at the end of the leasing period of approximately three years. These vehicles are generally in great condition and could inexpensively be equipped with the required technology, and thus used for the carsharing service (participant_now_1). In carsharing, the focus is on the overall condition of vehicles rather than on whether it is the latest model (participant_now_1). This practice would allow SHARE NOW to take advantage of the dense dealership networks of the car manufacturers and to further decrease necessary investments into the maintenance and expansion of the fleet (participant_now_1).

But running a profitable carsharing business in a competitive landscape requires particularly good decision making on various levels; strategically, tactically, and operationally. Therefore, multiple steps have been effectively implemented during the new mobility joint venture that have fostered the efficiency of organizational processes. The decision to keep the carsharing venture separate from the parent companies guarantees that the team can develop their product with a high degree of freedom and autonomy like in an independent small-sized enterprise but with the fundamental difference of substantial financial support, additional technical expertise, and extensive distribution provided by the motherships (participant_dmo_1). Mature firms inherit the risk to limit the creative spirit of employees due to a certain degree of bureaucracy and standardization in business processes as well as a well-established cooperate culture (participant_dmo_1). According to Garvin and Levesque (2006), most new business models are associated with a high level of uncertainty that requires adaptive organizational environments to succeed.

The remaining efficiency-centered design elements aim to speed up transactions and improve their simplicity (Zott & Amit, 2007). For this purpose, the firm is consistently updating and improving its interface to its customers, the SHARE NOW app (pr_20191106_sn_7). The goal is to create an intuitive and easy-to-handle smartphone app that allows customers to conveniently start and end their trips as well as easily report incidents (participant_sn_1). The app uses a search radar that helps to locate vehicles within a pre-defined area and reserve them for up to 20 minutes free of charge (company websites). But the company is further considering increasing the maximum reservation period for customers, which is of particular interest for long-term rentals and meeting the specific customer need for a certain model or type of vehicle (participant_now_1). If there is no available car in the immediate vicinity, customers will then receive a push message on their mobile phones as soon as a vehicle becomes available. Furthermore, the app provides many more additional functions such as information about the

type of vehicle, exact location address, fuel or battery charge level and supports the customer in case of existing or new damage to the rental (company websites). SHARE NOW consistently gathers user feedback through the app and incorporates the suggestions to maximize customer satisfaction (participant_dmo_1).

Table 4.5: Second stage elements and participant statements of SHARE NOW

Second Stage: Efficiency and refocusing phase		
Company	**Core Elements**	**Statements of Participants**
SHARE NOW *"Our mission is your personal freedom: To make it possible for you to drive in the city without breaking the bank – or the environment"* (corporate websites)	Expand and refocus business model on profitable markets	*It is important 'not to do things half-way' when it comes to geographic expansions. An expansion must have a corresponding market weight in order to maintain relevance in the target market (participant _sn_1).*
	Efficiency increase of core activities to capture value in the foreseeable future	*At the beginning the complexity of the fleet management was completely underestimated and it was mainly carried out manually with the aid of 'Excel sheets'. Today, we are able to determine the 'average idle time' of each vehicle depending on the current location (participant_sn_1).*
	Increased openness to support efficiency and organizational learning	*To build in-house a highly automated fleet management system requires a specific skill set that we brought in by hiring suitable personnel with expertise in the field of mathematics and information technology. Most of these people had no prior contact with mobility companies (participant_sn_1).*
	Implementation of isolation mechanism to protect the novel business model	*The large number of tools, algorithms and calculations that run in the background to ensure an efficient fleet management represents internal Know-How that makes it difficult for competitors to copy (participant_sn_1).*

Besides increasing the efficiency of transactions, SHARE NOW has turned its attention in this stage to activities that increase value creation by implementing switching costs for consumers. A 'lock-in-centered' business model design makes it therefore more difficult for customers to move towards potential competitors and ensures their loyalty (Amit & Zott, 2001; Zott & Amit, 2010). The main goal of innovation is to positively influence profitability of a firm by creating value either through attracting new consumers or by stimulating the desire of existing users to increase their consumption (Markides, 2006). Business model activities designed to 'lock-in' customers tend to focus on the latter. Generally, lock-in effects can be

established on both, an industry and individual level. On an industry level, companies tend to create entry barriers through economic advantages or better availability of their services compared to competitors in order to generate competitive advantage (Karakaya & Stahl, 1989). The merger of the two well-established carsharing services car2go and DriveNow has led to a leading market position by pooling know-how and resources that sends a strong signal to its competitors (participant_dmo_1, pr_20190222_dmo_2) and creates competitive advantage due to the sheer size and financial strength of the venture and its parent organizations (participant_dmo_1).

On an individual level, in contrast, there are formal and informal ways in the design of business model activities to lock-in customers. Formal aspects comprise contract agreements (Mooi & Ghosh, 2010) while informal ways are manifold and may simply refer to personal preferences or acquired knowledge of an effective use of a new product (Murray & Häubl, 2007). In Germany, for instance, SHARE NOW is able to provide access to more than 7,000 BMW, Mercedes-Benz, Mini, and Smart models for its users (pr_20190228_sn_4). Hence, the merger has tremendously improved the selection of vehicle models as well as the number of locations and, therefore, the availability and accessibility of the carsharing service without switching between apps and services of different providers and in the knowledge that an experienced and trustworthy partner will be there to assist nationwide (participant_dmo_1). Furthermore, the promise to create a leading global game changer combined with the significant investment of both OEMs into the new carsharing venture establishes trust among current and future customers that the service will keep high quality standards (participant_dmo_1, pr_20190222_dmo_2) and aim to provide more energy-efficient and environmentally friendly mobility for better quality of life, particularly in big cities (pr_20190228_sn_4). The merger will actively support alternative modes of propulsion such as electromobility by offering electrified carsharing vehicles and will combine this service with

an integrated access to parking and charging options in order to provide a holistic solution for its customers (pr_20180328_dmo_1, pr_20190222_dmo_2).

THIRD STAGE: SUSTAINING GROWTH AND SCALING PHASE

During the third stage, SHARE NOW fosters activities focused on value capturing and sustaining long-term growth (see Table 4.6). Every company needs clarity on how to create a product or service that provides sufficient value to end consumers and simultaneously captures enough of that value for the business (Chatterjee, 2005). The pricing and cost structure of a product or service has to ensure appropriate value capturing and thus, allow the mobility provider to generate an adequate level of revenue and profits for its shareholders in order to guarantee a sustainable business and the long-term viability of the firm's product offerings (Teece, 2010).

Hence, costs are an essential element for a business model and play an important role in value appropriation (Shafer et al., 2005). The intention of both OEMs is to increase market share by merging their services (participant_sn_1, pr_20190115_sn_3, pr_20190411_sn_6) and gain economies of scale (participant_dmo_1, participant_sn_1) to become more profitable and to defend their market position (participant_dmo_1, pr_20180328_dmo_1). Indeed, with over four million registered users, over 12,000 electric journeys each day and a fleet of over 20,000 vehicles worldwide, including 3,200 electric cars, in 27 cities across North America and Europe, the car manufacturers have established the world's leading provider in the field of innovative mobility services (fs_201911_sn_1). However, SHARE NOW has recently announced its exit from the North American market as well three European cities, namely Florence, London and Brussels (company websites). These areas are highly volatile and show low adoption rates (participant_dmo_1).

This exit means the company needs to carefully weigh the potential advantages and disadvantages of geographical expansions. To date, mobility companies such as SHARE NOW

are not ‘cash cows’ and urban mobility is a difficult and demanding business sector (participant_sn_1). Therefore, the focus on well selected target markets is important to ensure profitability. Market assessments are mainly driven by efficiency measures such as population densities, car ownership statistics and political environments (participant_sn_1). But SHARE NOW has an ‘asset heavy’ business model (participant_dmo_1, participant_now_1) that requires high investments in its fleet to increase the geographic reach of the company. Hence, SHARE NOW may consider alternative concepts for regional expansions such as ‘franchising’ (participant_sn_1). By providing the necessary technology and service to franchisees, SHARE NOW can tremendously increase the range of its service, gain new customers, strengthen its market position and enhance its expense control (participant_sn_1). Consequently, franchising supports the transformation from an ‘asset heavy’ mobility company to a more efficient ‘asset light’ service provider.

Furthermore, the carsharing firm adjusted the charging structure of its service by introducing variable pricing (participant_dmo_1, participant_dmo_2). Under the new pricing system, the costs for the service will depend on the usage behavior of customers and thus, on aspects such as the length of a trip, time, location and day (participant_dmo_1, participant_dmo_2). While shorter trips tend to get more expensive under the guise of the new variable pricing system, day-length packages are actually cheaper (participant_dmo_1, participant_dmo_2). Studies have shown that most consumers use the service particularly for short-distance travel, and that the carsharing demand rises during peak hours and on weekends (Costain, Ardron, & Habib, 2012). Hence, the larger scale and reduced competition due to the merger allow SHARE NOW to adjust the pricing of its service in order to capture sufficient value and to support ambitious financial objectives set by the main shareholders, Daimler Mobility AG and the BMW Group.

Table 4.6: Third stage elements and participant statements of SHARE NOW

Third Stage: Sustaining growth and scaling phase		
Company	**Core Elements**	**Statements of Participants**
SHARE NOW *"Our mission is your personal freedom: To make it possible for you to drive in the city without breaking the bank – or the environment"* (corporate websites)	Optimizing the revenue model through pricing and cost structure in order to capture sufficient value	*SHARE NOW intends to use smart algorithms to create incentives for customers through flexible pricing and to decide when a vehicle should be cleaned or brought to service in order to minimize its downtime (participant_sn_1).*
	Identifying further revenue streams by considering all modes of open innovation activities	*Due to its 'asset heavy' business model, SHARE NOW needs to identify ways to scale the business in a cost-effective way. Therefore, the company needs to consider alternative concepts such as 'franchising' (participant_sn_1).*
	Leveraging strategic business alliances to sustain growth	*A key aspect for Daimler and BMW was to significantly increase the 'firepower' in the field of mobility services. In addition, economies of scale and cost saving potential were of enormous importance for both firms to make the carsharing business profitable (participant_dmo_2).*

Additionally, SHARE NOW has taken many and diverse measures for sustainable growth of the carsharing business model that can be grouped under the terminology of 'complementarity-centered' business model design. Generally, complementarity-centered business models occur at any time a bundle of activities generates higher value compared to the sum of individual activities' value (Amit & Zott, 2001; Zott & Amit, 2010). Complementarities can emerge on different levels. According to Chesbrough and Rosenbloom (2002), the *"value network increases the supply of complementary goods on the supply side, and can increase the network effects among customers on the demand side"* (p. 534-535), meaning, a greater number of users increases the value to each. The network effect of the business model becomes visible through the fact that carsharing leads to a better utilization of vehicles (participant_dmo_1) and thus positively influences the reduction of cars in cities (fs_201911_sn_1). As a result, carsharing can make cities a better place to live and help local governments to meet ambitious emission targets (participant_sn_1, pr_20190228_sn_4). Local government can then, on the other hand, further support the carsharing business model by

creating an ideal breeding ground through supportive policies that improves the service for its customers and the profitability for the provider (participant_sn_1).

But carsharing is a more powerful service when coupled with other modes of transportation (participant_dmo_1). The new mobility network of Daimler and BMW includes, besides carsharing, four other mobility solutions such as a taxi ride-hailing service, an innovative digital parking service, the world largest network of public charging stations, and a multimodal service (pr_20180328_dmo_1, pr_20190222_dmo_2). While these offerings are currently located in independent joint ventures, the OEMs have a clear vision: *"these five services will merge ever more closely to form a single mobility service portfolio with an all-electric, self-driving fleet of vehicles that charge and park autonomously and interconnect with the other modes of transport"* (pr_20190222_dmo_2). This interconnectivity will include various forms of public transportation such as trains, subways and buses which are already available through the multimodal platform of REACH NOW (participant_rn_1, pr_20190222_dmo_2). Therefore, customers will benefit in the future from a seamlessly, integrated sustainable mobility ecosystem that is unrivalled (participant_rn_1, pr_20190222_dmo_2). This comprehensive mobility approach of automotive pioneers shows that both organizations have realized the need for an increased openness in the field of mobility services that allows them to bundle resources and share costs to successfully transform their business models from simply manufacturing vehicles to a leading provider of innovative mobility services (participant_dmo_1, pr_20190222_dmo_2).

THE CASE OF THE MULTIMODAL PLATFORM PROVIDER REACH NOW

With REACH NOW, the car manufacturers extend their value chains and provide additional options, and thus, flexibility and convenience for customers for commuting from point A to B. The product portfolio of REACH NOW is built around a single multimodal platform that offers its users access to a broad spectrum of different mobility services

(participant_dmo_1, pr_20190222_dmo_2, pr_20190211_rn_8). The REACH NOW app brings together different forms of transportation such as public transportation, car-sharing, ride-hailing, and bike rentals, and breaks down the walls between these segments (pr_20190222_dmo_2, pr_20190211_rn_8). The use of one platform for different mobility modes creates transparency for customers, simplifies the payment process via an integrated customer account and avoids unnecessary switching between various apps (fs_20190222_dmo_1). The following section analyzes in detail the process of value creation and capture in the sustainability phase and explores the future potential of the Mobility-as-a-Service pioneer REACH NOW and its truly unique business model.

VALUE CREATION AND CAPTURE IN THE SUSTAINABILITY PHASE

As indicated earlier, the process of value creation through business models is influenced by the degree of four design parameters, namely novelty, efficiency, lock-in, and complementarities (Amit & Zott, 2001; Zott & Amit, 2010) as well as the open business model design elements of customer centricity, strategic resources, value proposition, and value network. The following sections present the analysis of the business model design themes and elements in each stage of the innovation process and links them to REACH NOW, a platform for individual urban mobility on demand.

FIRST STAGE: EVALUATION AND IMPROVEMENT PHASE

REACH NOW offers a fresh business model approach regarding its content, structure, and governance of activities. The new joint venture with its intelligent platform that seamlessly connects different mobility modes – including booking and payment – is another step for both car manufacturers to expand their business models beyond the mass production of vehicles. The future of mobility lies in environmentally friendly and personalized travel on demand with a maximum of convenience and flexibility (participant_dmo_1, pr_20180328_dmo_1). The

increase in urbanization, as well as the way people want to be mobile, is changing rapidly (participant_dmo_1). Large cities grow worldwide in size and the city councils as well as the citizens are seeking to create a better environment by reducing CO_2 emissions (participant_now_1, pr_20180328_dmo_1). The growing environmental awareness of people, together with high ownership costs for a vehicle, challenge OEMs to actively meet these shifting customer needs and to find solutions outside of their core business (participant_dmo_1). The car manufacturers realized that both public and private forms of transportation play a vital role in paving the way to the mobility system of the future (participant_rn_1, pr_20180328_dmo_1, pr_20181113_rn_6). There are numerous trends of mobility options ranging from carsharing and ride-hailing to *e*-scooters and public transportation, all with their specific strengths and weaknesses depending on the needs of consumers and the characteristics of the planned trip (participant_dmo_1, participant_rn_1). With this trend in mind and the fact that the potential market volume was large enough, Daimler established its subsidiary moovel, today known as REACH NOW, the first Mobility-as-a-Service platform in 2015 (company websites). The new business model creates transparency among all forms of transportation and provides different commuting options for the journey depending on the travel needs of customers (participant_dmo_2, pr_20190211_rn_8). This variety of options enables the riders to plan their trips and to travel in a more effective way (participant_dmo_2, pr_20190211_rn_8). This new business model approach allows the OEMs to further tap into the market of individual mobility (participant_dmo_1).

But the company has been struggling to convince cities, municipalities and mobility providers to commit to a 'third-party mobility platform' such as REACH NOW (participant_now_1). Instead, these players are striving to establish their own digital presence with their own mobility apps (participant_now_1). To date, the Mobility-as-a-Service provider still has a rather small number of active users (participant_now_1). Hence, REACH NOW has

to identify ways to position the company as a problem-solving partner for cities that is perceived as part of the solution for sustainable mobility in large cities and not as a competitor (participant_rn_1). This change would allow the company to expand the range of its service. Therefore, REACH NOW has adjusted its business model and broadened its product portfolio by offering its software and technology to other private and public mobility providers (participant_dmo_2, participant_rn_1) such as the Karlsruher Verkehrsverbund (KVV) and the Stuttgarter Strassenbahnen AG (SSB). This offering allows REACH NOW to establish close relationships with various mobility providers and introduce its technology with the long-term perspective to combine all mobility modes on its own platform (participant_rn_1). Moreover, it provides the company with an additional revenue stream and offers enormous growth potential, considering that the public transportation company KVV alone has over 150 million passengers per annum (participant_rn_1).

In addition, to increase the number of users in the short-term and to strengthen its financial situation, REACH NOW established cooperation with mobility providers in the field of micromobility (participant_dmo_1). The partnership with TIER Mobility, for instance, adds *e*-scooters to the product portfolio of REACH NOW and allows an additional eco-friendly and cheap option for customers to go the last mile (participant_dmo_1, pr_20190813_rn_13). The service can be easily booked and paid for through the REACH NOW app. As of the end of 2019, the *e*-scooter service is available in fifteen German cities (company websites). This cooperation is also another step towards a holistic mobility platform by merging the area of micromobility and public transportation.

Furthermore, to increase its product offerings and to complement the mobility service portfolio, the new venture recently joined forces with multiple players including the district of Karlsruhe, the Regionalbusverkehr Südwest (RVS) and the Karlsruher Verkehrsverbund (KVV) to launch a new service, namely MyShuttle (participant_dmo_1, participant_dmo_2,

pr_20190606_rn_12). The new real-time ridesharing service that uses electric mini-buses pairs the convenience of a private car with the efficiency of public transportation (participant_dmo_2). Intelligent algorithms pool travel requests with similar routes and books them into a single shuttle (participant_dmo_2, pd_201802_rn_2, pr_20190606_rn_12). Virtual bus stops stay on main routes and take riders quickly, cheaply, and in an environmentally responsible way to their final destinations (participant_dmo_2, pr_20190606_rn_12). Therefore, the service is an ideal extension of the public transport offer and supports the reduction of vehicles in cities due to a higher utilization rate compared to individual mobility (participant_dmo_1).

Table 4.7: First stage elements and participant statements of REACH NOW

First Stage: Evaluation and improvement phase		
Company	**Core Elements**	**Statements of Participants**
REACH NOW *"Our mission is to help transform cities by providing the most convenient and sustainable mobility solutions."* (corporate websites)	Monitoring and evaluating newly implemented business model	*REACH NOW is very customer-driven. Meaning, the firm consistently conducts customer surveys to ensure satisfaction with its service at any time and to adapt it frequently to changing customer requirements (participant_rn_1).*
	Strong customer integration in the evaluation process	*This may sound trivial, but it is the aspect of service quality and customer satisfaction that ultimately determines the success of a business (participant_dmo_2).*
	Focus on introduction of new business model content	*The gradual expansion of REACH NOW's business model aims to broaden the range of activities and thus to generate new revenue sources (participant_dmo_2).*
	Redefining business model by implementing changes based on market feedback	*Over time, REACH NOW has adapted its own business model several times based on market feedback and gradually developed into a software provider (participant_now_1).*
	Communication strategy to encourage behavioral change	*It requires accompanying communications with all market participants to illustrate the benefits of the service and to highlight that the company provides a meaningful supplement to individual mobility (participant_rn_1).*

Besides the integration of new partners and services to improve the value proposition for users and to strengthen strategic resources, REACH NOW's vision goes beyond an urban road infrastructure (pr_20180627_rn_3). The design project with the name 'Flights to Rome' uses

OpenStreetMap data as well as the worldwide flight network to realistically calculate the fastest route between different locations in different countries by combining air and road traffic (pr_20180627_rn_3). Hence, the mobility provider constantly introduces new content to its business model after implementation of the service and further improves the structure and governance of business model activities (see Table 4.7) to increase the value proposition for customers and to ensure a fresh approach to economic exchange (participant_rn_1). In addition, REACH NOW ensures accompanying communications with the market to illustrate the many benefits of its services and highlight that the mobility platform provides a meaningful supplement to individual mobility (participant_rn_1). REACH NOW does not seek to replace the traditional 'car ownership' model but intends to create a *"world without traffic jams"* (participant_rn_1).

SECOND STAGE: EFFICIENCY AND REFOCUSING PHASE

During the second stage, REACH NOW engages in various practices with the intention to gradually fine-tune all relevant business model activities, current offerings and resources of the company (see Table 4.8) in order maximize efficiency and to decrease transaction costs for all individuals involved (Zott & Amit, 2007, 2010). REACH NOW has recently introduced various innovations such as mobile ticketing (participant_dmo_2, pr_20180928_rn_5, pr_20181204_rn_7), fare connect (participant_rn_1, pr_20170515_rn_1) and mobility budget (pr_20190514_rn_9, pr_20190528_rn_11) that are speeding up transactions and improving simplicity for users.

'Mobile ticketing' is a convenient way to purchase one or multiple tickets for public transportation with no waiting time in a line at a ticket machine (participant_dmo_2, pr_20181204_rn_7). This procedure saves commuters tremendous time and guarantees sufficient flexibility through a variety of payment methods and an intuitive user interface for convenient use (participant_dmo_2). REACH NOW has utilized its expertise in the field of

mobile ticketing applications and provides its product to external partners such as Bay Area Rapid Transit (pr_20181204_rn_7) and Maryland Department of Transit Administration, one of largest multi-modal transit systems in the United States, to increase their operational efficiency (pr_20180928_rn_5). The firm has recognized the financial and strategic benefits of actively pursuing technology transactions (participant_rn_1). These collaborations will provide REACH NOW with an additional revenue stream and allow the firm to further improve their own mobility platform by increasing the number of embedded transit options which expands the service offerings (participant_rn_1).

Moreover, ‘fare connect’, a contactless mobile fare validation and calculation system, takes REACH NOW’s mobile ticketing software a step further by combining it with the simplicity and convenience of contactless technologies (pd_201802_rn_3). This new technology creates a flexible platform that simplifies the boarding procedure and makes it faster and more convenient (pr_20170515_rn_1). Looking several years ahead, one can certainly imagine further simplifications such as fully automated bookings that make the process of buying a ticket obsolete (participant_rn_1). REACH NOW is actively searching for such new ways to make travel more convenient for customers (participant_rn_1). In the end, it is these aspects of convenience that determine the success of the mobility provider (participant_dmo_2).

Furthermore, the ‘mobility budget’ makes it possible for riders to book and pay for different mobility options efficiently and conveniently via the REACH NOW app (pr_20190514_rn_9, pr_20190528_rn_11). Employers, for instance, can automatically allocate flexible monthly funds to the REACH NOW accounts of their employees, which can be then used daily to commute to work and for travels in their free time (pr_20190514_rn_9, pr_20190528_rn_11). The mobility budget includes various forms of transportation available through REACH NOW such as the carsharing service SHARE NOW, the taxi ride-hailing

service FREE NOW, buses and trains as well as rental bikes and *e*-scooters (pr_20190528_rn_11). Hence, with the mobility budget, corporations can go beyond a company car and offer their employees more flexibility through the Mobility-as-a-Service solution. This allows firms to reduce their private vehicle fleet, and thus, their fixed costs.

Table 4.8: Second stage elements and participant statements of REACH NOW

Second Stage: Efficiency and refocusing phase		
Company	**Core Elements**	**Statements of Participants**
REACH NOW *"Our mission is to help transform cities by providing the most convenient and sustainable mobility solutions."* (corporate websites)	Expand and refocus business model on profitable markets	*Scaling the business model is of tremendous importance for digital platforms such as REACH NOW. It is the active number of users that ultimately determines the success of the platform (participant _now_1).*
	Efficiency increase of core activities to capture value in the foreseeable future	*The firm has a clear vision of what an ideal mobility platform must look like and targeted acquisitions allow rapid progress and increases the efficiency of the service in a short time (participant_rn_1).*
	Increased openness to support efficiency and organizational learning	*REACH NOW has made several acquisitions and has collaborated with various companies to further develop content and efficiency of the firm's business model (participant_dmo_1).*
	Implementation of isolation mechanism to protect the novel business model	*The development rate plays a very important role for further enhancement of the business model and helps to strengthen and defend the market position (participant_rn_1).*

Besides the integration of efficiency-centered design elements the mobility joint venture ensures future profitability of the business by embracing activities that lead to loyalty of customers and locks them into the world of products and services of the company (Amit & Zott, 2001; Zott & Amit, 2010). For this purpose, REACH NOW acquired in 2019 a firm named, Validated (participant_dmo_2, participant_rn_1, pr_20190522_rn_10). This acquired company developed a technology platform that provides mobility incentives through loyalty programs (participant_rn_1, pr_20190522_rn_10). The new service gives mobility providers and public transit agencies the opportunity to build relationships with private users and local companies by offering incentives such as subsidized trips (pr_20190916_rn_14), which in turn allows, for instance, brick-and mortar stores to drive foot traffic by passing on these monetary

benefits and offering ride subsidies to their customers. Furthermore, the platform allows consumers to collect credits by shopping at local businesses which then can be used for trips on transit (pr_20190522_rn_10). The service also has the potential to reduce administrative costs due to the digitization of transit benefits of universities, employers and transit agencies that have used plastic passes and ticket books in the past (participant_dmo_2).

Additionally, to improve both the environmental and living conditions of inhabitants, REACH NOW has supported the capital of Baden Württemberg in Germany by issuing alarms when weather conditions cause atmospheric pollution (pr_20171012_rn_2). During this period, REACH NOW actively incentivizes citizens and visitors of Stuttgart, Germany to use public transportation through subsidized tickets or even by covering the entire cost of tickets for riders (pr_20171012_rn_2). Additional benefits for the company have been the increase in awareness of users of the REACH NOW mobility platform and the stimulation of deeper engagement of existing customers with the firm's services.

THIRD STAGE: SUSTAINING GROWTH AND SCALING PHASE

Besides value creation, every business model has to provide the company with sufficient value capturing (see Table 4.9), determined by the revenue sources in order to ensure a sustainable business (Shafer et al., 2005; Teece, 2010). REACH NOW drives disruption in the transportation industry and as a transit agency, links the different shared public and private transportation modes with their individual advantages and disadvantages, arranges the bookings of trips, and facilitates payments through a single platform (fs_20190222_dmo_1, participant_dmo_1). The main benefit the Mobility-as-a-Service provider REACH NOW has on its way to a profitable and sustainable business is an 'asset light' model similar to Uber and Airbnb (participant_dmo_1, participant_now_1, pr_20180918_rn_4). Hence, Mobility-as-a-Service might still be at an early stage, but a large number of individuals have already experienced such a concept in other industry sectors which likely facilitates adoption

(participant_dmo_2). People frequently take advantage of web-based travel aggregators to find the best flight options based on their preferences (participant_dmo_2). These providers allow the users to also add additional services such as car rental and hotels. Instead of using this service only once a year for a big trip, imagine people planning shorter trips multiple times a day by maneuvering through dense cities (participant_dmo_2). Hence, there is immense potential to scale the business in the future. Rapid scaling is of tremendous importance for the business model of REACH NOW in order to improve profitability. As a mobility platform, REACH NOW takes a brokerage fee for each successful order placement. Hence, by considering that *"ticket prices for the use of public transportation are relatively reasonable, one can imagine that by taking a small percentage as commission, scaling the business model and growing the company are essential for the business"* (participant_dmo_2). Consequently, the number of active users ultimately determines the success of the platform and allows for the advancement into new business areas (participant_dmo_2).

Table 4.9: Third stage elements and participant statements of REACH NOW

Third Stage: Sustaining growth and scaling phase		
Company	**Core Elements**	**Statements of Participants**
REACH NOW *"Our mission is to help transform cities by providing the most convenient and sustainable mobility solutions."* (corporate websites)	Optimizing the revenue model through pricing and cost structure in order to capture sufficient value	*By considering that ticket prices for the use of public transportation are relatively reasonable, one can imagine that by taking a small percentage as commission, scaling the business model and growing the company are essential for the business (participant_dmo_2).*
	Identifying further revenue streams by considering all modes of open innovation activities	*To increase the number of active users in the short-term and to strengthen the financial situation, REACH NOW joined forces with mobility providers in the field of micromobility (participant_dmo_1).*
	Leveraging strategic business alliances to sustain growth	*The market environment for mobility services is demanding and expensive and most of these services are not earning any profits yet. Hence, both OEMs intend to leverage synergies instead of creating competition (participant_now_1).*

Today REACH NOW offers two different payment options, 'pay-as-you-go' in which a trip from point A to B can be organized as a single trip but each leg has to be payed separately

by the users (participant_dmo_1) and a ‘monthly subscription’ in which specific transportation methods can be purchased in bulk by riders (pr_20180918_rn_4). However, the complexity involved in providing a platform that combines multiple modes of transportation from various providers under one umbrella that also allows the booking and payment through a single interface has hindered numerous transactions (participant_dmo_1). Many ticket schemas of external providers include a variety of rates and discounts such as zone and day tickets (participant_rn_1). These complex and often obsolete fare structures that differ among the various actors must be addressed and standardized to create transparency for users (participant_dmo_1). In the near future, standardization would allow REACH NOW to offer a payment system based on the already available ‘pay-as-you-go’ option but instead of paying separately for each leg of a trip from point A to B (pd_201809_rn_4), payment would be based on an integrated end-to-end version (participant_dmo_1). The customer would then see the costs of the whole trip and pay for it through one single transaction. Such an integrated and comprehensive payment system may also need to include a personal identification check to protect the riders and avoid fraud (participant_dmo_1). This integration would tremendously simplify the booking and payment experience for customers and provide the multimodal service firm with an increase in competitive advantage (participant_dmo_1).

However, this is a great challenge, but if REACH NOW succeeds in winning major customers and streamlines the payment procedure, it would immediately create market entry barriers for competitors and provide the company with a competitive edge in the marketplace (participant_rn_1). Generally, public mobility providers negotiate and sign long-term contracts and do not frequently change their ‘suppliers’ (participant_rn_1). The strengthened market position would then give REACH NOW a leverage in negotiations with other cities and municipalities and support the reduction of today’s fragmented mobility landscape (participant_dmo_2).

DISCUSSION

The findings of the present qualitative study have some major contributions for the existing business model research by providing fresh insights about the process steps in the sustainability phase of the business model innovation process, the importance and interdependencies of the design themes and elements in each proposed stage and the extent of openness required to maximize value creation and capture.

The first significant contribution is the proposition that after the implementation of the novel business model, the sustainability stage consists of three generic process phases (see Figure 4.2) with varying degrees of openness and differing emphasis of business model elements and design themes. The first stage provides in-depth knowledge of the importance of the monitoring and evaluation process of the business model. Following the implementation phase, several authors have suggested immediately scaling the business model and building up the required skill set in the corporation (e.g. Sosna et al., 2010). Instead, the findings indicate that after implementing a novel business model, it must first be consistently monitored and evaluated over a sufficient time period by gathering extensive market feedback from customers. This feedback is of significant importance, because after introducing a radically new business model innovation, consumers have to become familiar with it to be able to identify its additional value, and thus, to accept or reject it. Hence, before the implementation phase, companies can only predict preferences of potential consumers based on market research (Doganova & Eyquem-Renault, 2009) and develop the new business model accordingly.

The evaluation of the implemented business model provides an opportunity for a company to identify improvement potential based on actual market reactions and adapt and modify the business model innovation as a result. This process step is centered around market feedback, and thus, shows strong customer integration. The focus is clearly on the identification of concrete optimization potential in order to increase the value proposition for consumers. The

findings illustrate that, in this context, the design theme of ‘novelty’ and therefore, the adoption of new activities as well as new linkage and governance structures of these activities play a vital role in further increasing value creation through the business model. It is important to emphasize that the business model has to be tried and optimized until it is fully viable before it is scaled. Changing a business model, once it has already been rolled out and established in various target markets, is difficult, costly, time-consuming, and risks confusing customers.

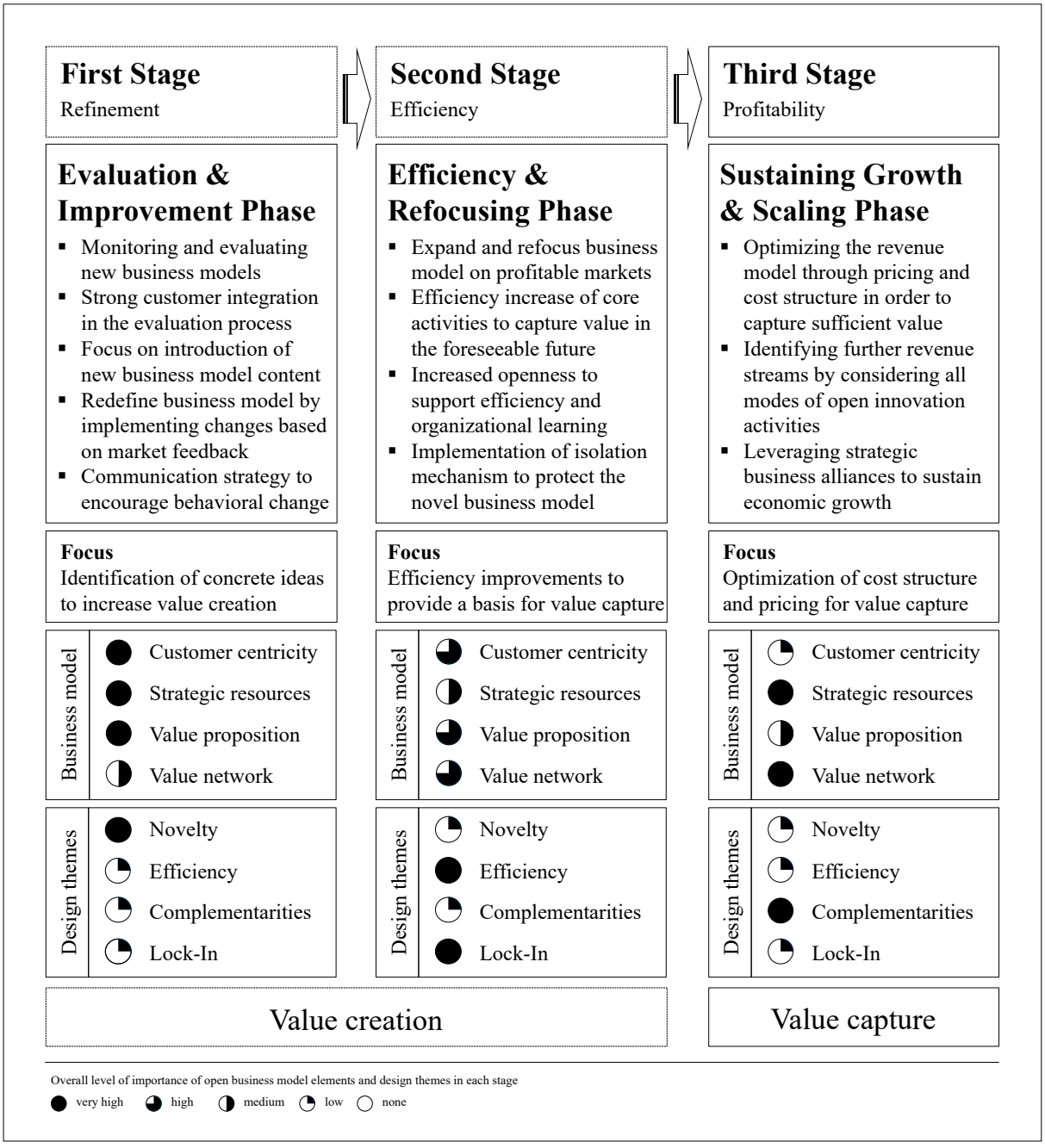

Figure 4.2: Three-stage process of open business model innovation

The findings regarding the second stage contribute to the business model literature by providing insights on how to turn a business model prototype into an efficient business model through organizational learning and openness towards the external environment. One important contribution of the study is that the increased competition challenges firms to further improve the efficiency of their business models, and thus, indirectly supports their evolution. Therefore, more competition does not always have to be a threat for corporations. Besides the efficiency increase, firms tend to focus on the design of 'lock-in' effects to establish switching costs derived from the content, structure and governance of the dominant value creation drivers. The intention of this stage of the business model innovation process is to pave the way for value capture in the near future and to increase the likelihood for strong financial performance and a sustainable business. Furthermore, firms need to ramp up the implementation of isolating mechanisms in this phase to protect the business model from imitators and substitute products (Teece, 2010). In this context the study reveals that informal appropriation mechanisms, particularly the design complexity of products and services as well as the rate for redefining and optimizing the novel business model, are of tremendous importance. In contrast, formal IP protection instruments such as patents, have clearly been given a subordinate role.

The analysis of the third stage provides researchers with a deeper understanding on how to effectively capture value through the business model by improving the revenue model and by further leveraging strategic business alliances to sustain growth. Findings also lead to insights on the important role of alliances in the business model functionality (Chesbrough & Rosenbloom, 2002; Zott et al., 2011). The firm's awareness of its own core activities in its business model, and therefore, of its own expertise, is tremendously important in identifying effective partnerships (Zott & Amit, 2010). Besides opening the business model innovation process, scaling becomes essential in this stage. However, the major challenge for enterprises that rapidly scale is that their business models experience greater exposure to the competitive

surroundings within a short time period, which requires frequent adaptation (Dunford, Palmer, & Benveniste, 2010). Moreover, the analysis reveals that to further foster the value capturing and to better protect the novel product and service offering from competition, organizations take advantage of 'complementarity' design elements by bundling business model activities in order to provide more value to customers and to create a more efficient and complex design structure.

The second significant implication for business model innovation research stems from the findings of differences in importance of the design themes with regard to timeframe. While prior academic work has uniformly pointed towards the existence of dominant value creation drivers (Zott & Amit, 2010; Zott et al., 2011), it does not precisely discuss in which stage an enterprise should emphasize which design theme, nor when to shift its focus. This study provides empirical evidence for the differing degrees of relevance for the four design themes, novelty, efficiency, lock-in, and complementarities, among the three process stages. Although there is a smooth transition between the proposed business model innovation process steps in the sustainability phase that makes it more difficult to accurately allocate activities to each stage without any overlaps, the aggregation of process step categories provides transparency and a thorough guideline for cooperation after successfully implementing the business model.

Finally, the insights from the in-depth case studies extend scholars' knowledge of the different emphasis of the open business model elements in each process phase as well as their interdependencies. Certain elements may become more dominant at a specific point in time within the configuration of an open business model (George & Bock, 2011). The element of 'value networks', for instance, and thus the decision for or against strategic alliances at defined periods of time, clearly determines the business model and its aspects of pricing, cost structure and value chain. Moreover, the financial strength of the parent companies made both business models, the carsharing service and the multimodal mobility platform, possible in the first place

and allowed the ventures to consistently develop their business models further, as well as to scale and to sustain them. Consequently, the high funding from the start of the ventures and particularly after the merger of the mobility services, reflects a significant effect on strategic resources. In addition, the value proposition on the other hand strongly determines the business model acceptance, and thus, the availability and pricing of the service. In other words, the core activities of the model and whether it grants, for instance, more independence for the user through car rentals provided by the operator (SHARE NOW), or greater flexibility (REACH NOW) for riders by combining multiple mobility solutions in a single, software platform, strongly predefines the required infrastructure and the amount of financial resources necessary for the service offering. Consequently, there are significant interdependencies between the four open business model elements with major consequences for the value creation and capture process of the business model.

LIMITATIONS

The present paper captures a complex and still fuzzy concept of open business models (Casadesus-Masanell & Zhu, 2013), which necessarily creates certain limitations that should be addressed in future studies. First, both analyzed companies, SHARE NOW for carsharing and REACH NOW for multimodal transport, have been developed within the German automotive industry. Although single-industry configurations are generally useful for the identification of universal organizational processes and patterns (Baum, Locke, & Smith, 2001), the specific industry settings of both in-depth case studies with a narrow focus on future mobility services creates some risk that the results lack generalizability (Yin, 1994). Therefore, the study results centered around the proposed three-staged open business model innovation process should be tested with the aid of further qualitative case studies outside the given settings in order to determine whether they are statistically significant or due to chance (Atieno, 2009).

Second, besides the single-industry configuration, both young companies have the support and backing of large enterprises with strong financial and human resources. This support gives the joint ventures additional opportunities and a much better platform to develop and redefine their business models as well as to achieve profitability compared to other startups. Hence, the findings should be confirmed by further empirical work in emerging and startup companies in technical as well as non-technical environments.

Third, even though the study uses multiple data sources that consist of primary and secondary data such as in-depth interviews, press releases, promotional documents, and information from corporate websites for empirical triangulation, the results might still be influenced by some recall bias (Zott & Huy, 2007). The interviews were conducted on average, about one year after both mobility joint ventures were established and some interview questions referred to the development of the business model since its implementation, and thus, before the joint ventures were formed. Hence, the time difference between interviews and actual events entails the general risk that certain information is not recalled entirely correctly by interviewees (Eisenhardt & Graebner, 2007).

Fourth and finally, it is possible that executives, who have been analytically trained, may report more successful rather than less successful events (Zott & Huy, 2007). As described previously, the multiple-case study approach applied in this paper uses many data sources to secure construct validity and improve the research findings (Yin, 1994).

CONCLUSION

This study provides a comprehensive perspective on the open business model process in the sustainability phase. After studying and comparing the business model process of the new mobility ventures of the German car manufacturers, it was possible to derive three broad process stages, which should be considered by practitioners when further developing radically innovative business models to ensure sustainable growth: (1) evaluation and improvement,

(2) efficiency and refocusing, (3) sustaining growth and scaling. Although the individual steps of the generic business model innovation process phases are partially overlapping, which leads to a certain impreciseness, the proposed three-stage model offers a detailed step-by-step process guideline for researchers and practitioners on how to optimize value creation and capture by integrating the competencies of external partners. However, the proposed innovation process steps are not a ‘one size fits all’ concept, and thus, have to be modified and tailored to suit the specific circumstances and needs of each corporation. Consequently, the field of business model innovation, in particular the adaptation requirements and differences of the open business model innovation process regarding situational and cultural aspects, provides an interesting agenda for future research.

CHAPTER 5
GENERAL CONCLUSION AND OUTLOOK

"In today's climate, it's best to assume that most business models, even successful ones, will have a short lifespan."

Osterwalder and Pigneur (2010, p. 248)

This dissertation project demonstrates the importance of open innovation for both the enhancement of business models and technological innovations. It further illustrates how closely related the concepts are and how important the right dynamic mix of open innovation practices as well as the resulting degree of openness is to foster innovativeness and to optimize the fit between business models and technological innovations under constantly varying conditions. For this purpose, an open innovation approach takes advantage of externally available innovation labor to open up the internal development and business model design process. While the first has been extensively discussed in the academic community, the latter is still in its infancy.

This research project with its multi-method essay approach set out to shed light on a complex construct and to expand the existing body of open business model literature with its adjacent fields of strategy and innovation management. To derive a framework that is as holistic as possible, the dissertation comprises three distinct studies, tackling their own specific research questions and following their own specific research methods with individually selected industries and data sources to achieve a high degree of methodological fit. The multiple methods applied in this dissertation project range from systematic literature review to qualitative and quantitative approaches. While qualitative techniques cover in-depth case studies, based on primary and secondary data sources for empirical triangulation of the

findings, quantitative methods are centered around a *k*-means cluster analysis with factor loadings obtained from a categorical principal component analysis as input variables. These algorithms take advantage of longitudinal data from the Mannheim Innovation Panel, a large-scale survey and top-quality data source, in order to capture the innovation behavior of German corporations. The final sample of the Mannheim Innovation Panel consists of more than six hundred firms from a number of different sectors and permits decoding the open innovation behavior of enterprises defined by their innovation focus. Furthermore, the multi-method essay approach allows for operationalizing the open business model innovation process after implementation of the model by considering the interaction as well as the degree of importance of both business model elements, defined as the main building blocks and design themes, described as the range of structural flexibility.

In order to derive a detailed and unifying understanding of the open business model framework among academics and to provide a basis for targeted future research, the first paper of this thesis examines closely the intersection of the related concepts of open innovation and business model design. In today's collaborative economies driven by globalization an increased openness with the ecosystem seems to be an absolute necessity for corporations. Hence, classifying a business model as closed, only when it does not perform collaborations would not do the job. Therefore, the study observes the degree of openness in business models in existing academic literature in order to derive a more fine-grained picture and a common definition of the concept among scholars. Moreover, this paper breaks down the open business model framework into its constituent elements of customer centricity, value proposition, strategic resources, and value network to derive deep insights into the main drivers of the corresponding innovation process.

In an effort to better grasp the innovation strategy of enterprises, the second study of this dissertation project is based on the evolutionary economic idea that innovation behavior

follows a dynamic pattern that is determined by the firm's innovation focus, defined as the degree of novelty of the technology and business model. The key takeaway from the empirical study is that the innovation strategy follows several patterns with different emphases and degrees of openness. Each cluster pays attention to very specific open innovation activities and shows differences regarding the firms' willingness to adapt their business models. Generally, a change in business models can be accomplished through several ways such as adjustments in the product line and the income generation or the organizational structure of an enterprise (Zott et al., 2011).

Furthermore, the initial framework of this dissertation project laid the foundation for a third study aimed to provide a comprehensive perspective on the open business model innovation process in the sustainability phase. It was possible to derive a generic three-stage process that presents a detailed step-by-step guideline for researchers and practitioners on how to optimize value creation and capture through a novel business model by taking advantage of open innovation practices such as external technology acquisitions and strategic partnerships. For this purpose, each process step provides detailed recommendations on the differing degree of relevance for the business model design themes and constituent elements, including the extent of openness. However, there is not a 'one size fits all' approach and the case studies have shown that successful business modelling is a form of art with a great deal of systematic nature.

Although this dissertation project covers a wide range of different areas within the open business model framework, its scope is still rather limited and various fields with potential to further enhance research had to be left out but should be shared to lay the groundwork for future academical work. First, more insights are required in defining the circumstances under which the focal firm has to adjust its open business model in order to remain competitive. In this context, particularly, cultural and individual characteristics are of importance that results in the

critical assessment of a firm's business model and market environment. Consequently, more empirical work on innovation and financial performance measures for the evaluation of an existing business model would be of great benefit for further research advancements in this area (Cheng, 2011). Second, more quantitative and qualitative research centered around the ideal organizational settings of companies to foster novel and even radically new open business models is needed. Third, considering the main functions of value creation and capture of an open business model, the latter is rarely covered by scholars and still not fully elucidated (Chanal & Caron-Fasan, 2010). This lack of attention is even more surprising, considering that the task of value capture defines the likelihood for strong financial performance and a sustainable business for the focal firm. Fourth and finally, different modes of partner motivation in business models with a high degree of openness regarding the firm's value network provides another promising area for research. Future contributions might also benefit from the integration of adjacent fields such as strategic network theory (Dyer & Singh, 1998), dynamic capabilities (Cheng, 2011; Teece et al., 1997), value chain analysis (Porter, 1985), and absorptive capacity (Soh & Roberts, 2005).

Undoubtedly, our collaborative economy offers many more thematic areas and real-world events than can be discussed at this point and that are worthy of examination to further complement the existing body of open business model literature. To give a sufficient answer to these and other related questions and to develop the concept of open business models into a vibrant research field that serves academics and practitioners, immense scientific efforts are required. But being successful in this challenge will support securing the long-term performance and competitive advantage of corporations.

APPENDIX A: COMMUNITY INNOVATION SURVEY

Community Innovation Survey

INBOUND OPEN INNOVATION: EXTERNAL KNOWLEDGE SOURCES

How important were each of the following information sources to your enterprise's innovation activities during 2010 to 2012, both for generating ideas for new projects and for completing existing projects?

Please mark one X for each line. Tick ‚not used' if no information was obtained from a source.

	Importance of information source			
	High	Medium	Low	Not used
Customers from the private sector / private households [a]	☐	☐	☐	☐
Customers from the public sector [a]	☐	☐	☐	☐
Suppliers of equipment, materials, software, etc	☐	☐	☐	☐
Competitors or other enterprises in your sector	☐	☐	☐	☐
Consultants and commercial labs	☐	☐	☐	☐
Universities or other higher education institutions	☐	☐	☐	☐
Public research institutes / Government [b]	☐	☐	☐	☐
Private research institutes [b]	☐	☐	☐	☐
Conferences, trade fairs, exhibitions [c]	☐	☐	☐	☐
Scientific journals, trade / technical publications [c]	☐	☐	☐	☐
Professional and industry associations [c]	☐	☐	☐	☐
Patent files [c]	☐	☐	☐	☐
Standards / Standardisation boards and documents [c]	☐	☐	☐	☐

COUPLED OPEN INNOVATION: COLLABORATION PARTNERS

Innovation co-operation is active participation with other enterprises or institutions on innovation activities. Both partners do not need to commercially benefit. Exclude pure contracting out of work with no active co-operation.

Please indicate the type of innovation co-operation partner by location. Tick all that apply.

	Germany		Europe	USA	China,	Other
	regional	national	excl. DE		India	countries
Suppliers of equipment, materials, software, etc [d]	☐	☐	☐	☐	☐	☐
Competitors or other enterprises in your sector [e]	☐	☐	☐	☐	☐	☐
Private research institutes	☐	☐	☐	☐	☐	☐

[a] The study does not differentiate between different types of customers and instead derives a comprehensive measure, determined by the highest value of importance of the respective information sources.

[b] The study does not differentiate between different types of research institutes and instead derives a comprehensive measure, determined by the highest value of importance of the respective information sources.

[c] The study does not differentiate between different types of 'other sources' and instead derives a comprehensive measure, determined by the highest value of importance of the respective information sources.

[d] The dataset of the Mannheim Innovation Panel distinguishes between suppliers in Germany and abroad. The study does not differentiate between different types of suppliers and instead derives a comprehensive measure, determined by the highest value of importance of the respective collaboration sources.

[e] The dataset of the Mannheim Innovation Panel distinguishes between competitors in Germany and abroad. The study does not differentiate between different types of competitors and instead derives a comprehensive measure, determined by the highest value of importance of the respective collaboration sources.

Community Innovation Survey

APPROPRIATION MECHANISMS

How effective were the following protection methods for maintaining or increasing the competitiveness of product and process innovations introduced during 2010 to 2012?

Please mark one X for each line.

	Degree of Effectiveness			
	High	Medium	Low	Not used
Patents [f]	☐	☐	☐	☐
Utility Patents [f]	☐	☐	☐	☐
Complex design of goods / services	☐	☐	☐	☐
Lead time advantage over competitors	☐	☐	☐	☐

RESEARCH AND DEVELOPMENT INTENSITY

Please estimate the amount of your enterprise's expenditure in 2012 for innovation activities A. and B. Please fill in "0" if no expenditure has been made in the respective field of activity in 2012.

A. In-house R&D (incl. capex specifically for R&D) [g] ca. .000 EUR

B. External R&D (R&D contracted out to third parties) [g] ca. .000 EUR

PRODUCT DEPENDENCY

Please state your enterprise's top-selling line of products / services in 2012 and its share in turnover. In case your enterprise only has one line of product / service, please state this one.

	Share in turnover
	%

FINANCIAL PERFORMANCE (RETURN ON SALES)

What was your enterprise's operating margin (i.e. profit before taxes on income as a percentage of turnover) in 2011 and 2012?

	Below -5%	-5% to -2%	-2% to 0%	0% to 2%	2% to 4%	4% to 7%	7% to 10%	10% to 15%	15% and more	No estimate possible
2011	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
2012	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

[f] The study does not differentiate between different types of patents and instead derives a comprehensive measure, determined by the highest value of importance of the respective IP protection sources.

[g] The dataset of the Mannheim Innovation Panel provides a comprehensive measure for the total R&D expenditure (internal and external R&D) as a share of turnover for each enterprise.

APPENDIX B: INDUSTRY SECTORS

Industry classification of the 2012 wave of in total 21 aggregated economic sectors based on the ZEW indicator report of the Mannheim Innovation Panel.

Sector	Description	WZ2008 (NACE Rev. 2)
1	Mining	5-9, 19, 35
2	Food / Tobacco	10-12
3	Textiles	13-15
4	Wood / Paper	16-17
5	Chemicals	20-21
6	Plastics	22
7	Glass / Ceramics	23
8	Metals	24-25
9	Electric equipment	26-27
10	Machinery	28
11	Retail / Automobile	29-30
12	Medical technology / Maintenance	31-33
13	Energy / Water	36-39
14	Wholesale	46
15	Transport equipment	49-53, 79
16	Media services	18, 58-60
17	Information Technology (IT) / Telecommunications	61-63
18	Banking / Insurance	64-66
19	Technical services / R&D services	71-72
20	Consulting	69, 70.2, 73
21	Firm-related services	74, 78, 80-82

APPENDIX C: CLUSTER DISTRIBUTION OF INDUSTRY SECTORS

Variable	Description [a]	WZ2008 (NACE Rev. 2)	Percent	Cumulative Percent
CLUSTER 1: SCIENCE-DRIVEN INNOVATORS				
1	Mining	5-9, 19, 35	4.7 %	4.7 %
2	Food / Tobacco	10-12	1.3 %	6.0 %
3	Textiles	13-15	0.7 %	6.7 %
4	Wood / Paper	16-17	4.0 %	10.7 %
5	Chemicals	20-21	5.4 %	16.1 %
6	Plastics	22	2.7 %	18.8 %
7	Glass / Ceramics	23	2.7 %	21.5 %
8	Metals	24-25	12.1 %	33.6 %
9	Electric equipment	26-27	12.1 %	45.6 %
10	Machinery	28	6.7 %	52.3 %
11	Retail / Automobile	29-30	4.7 %	57.0 %
12	Medical technology / Maintenance	31-33	4.7 %	61.7 %
13	Energy / Water	36-39	5.4 %	67.7 %
14	Wholesale	46	2.0 %	69.1 %
15	Transport equipment	49-53, 79	4.7 %	73.8 %
16	Media services	18, 58-60	5.4 %	79.2 %
17	Information Technology (IT) / Telecommunications	61-63	5.4 %	84.6 %
18	Banking / Insurance	64-66	2.0 %	86.6 %
19	Technical services / R&D services	71-72	7.4 %	94.0 %
20	Consulting	69, 70.2, 73	4.0 %	98.0 %
21	Firm-related services	74, 78, 80-82	2.0 %	100.0 %
CLUSTER 2: EXTERNAL KNOWLEDGE-DRIVEN INNOVATORS				
1	Mining	5-9, 19, 35	2.5 %	2.5 %
2	Food / Tobacco	10-12	2.5 %	5.0 %
3	Textiles	13-15	3.1 %	8.2 %
4	Wood / Paper	16-17	3.1 %	11.3 %
5	Chemicals	20-21	5.0 %	16.4 %
6	Plastics	22	5.7 %	22.0 %
7	Glass / Ceramics	23	4.4 %	26.4 %
8	Metals	24-25	9.4 %	35.8 %
9	Electric equipment	26-27	13.8 %	49.7 %
10	Machinery	28	3.8 %	53.5 %
11	Retail / Automobile	29-30	4.4 %	57.9 %
12	Medical technology / Maintenance	31-33	7.5 %	65.4 %
13	Energy / Water	36-39	2.5 %	67.9 %
14	Wholesale	46	3.1 %	71.1 %
15	Transport equipment	49-53, 79	2.5 %	73.6 %
16	Media services	18, 58-60	5.0 %	78.6 %
17	Information Technology (IT) / Telecommunications	61-63	3.8 %	82.4 %
18	Banking / Insurance	64-66	3.1 %	85.5 %
19	Technical services / R&D services	71-72	7.5 %	93.1 %
20	Consulting	69, 70.2, 73	2.5 %	95.6 %
21	Firm-related services	74, 78, 80-82	4.4 %	100.0 %

[a] The categorization of the industry sectors is based on the ZEW indicator report of the innovation panel.

Variable	Description [a]	WZ2008 (NACE Rev. 2)	Percent	Cumulative Percent
CLUSTER 3: PROTECTIVE COLLABORATORS				
1	Mining	5-9, 19, 35	2.1 %	2.1 %
2	Food / Tobacco	10-12	1.0 %	3.1 %
3	Textiles	13-15	5.2 %	8.3 %
4	Wood / Paper	16-17	0.0 %	8.3 %
5	Chemicals	20-21	7.3 %	15.6 %
6	Plastics	22	5.2 %	20.8 %
7	Glass / Ceramics	23	2.1 %	22.9 %
8	Metals	24-25	9.4 %	32.3 %
9	Electric equipment	26-27	18.8 %	51.0 %
10	Machinery	28	15.6 %	66.7 %
11	Retail / Automobile	29-30	5.2 %	71.9 %
12	Medical technology / Maintenance	31-33	5.2 %	77.1 %
13	Energy / Water	36-39	0.0 %	77.1 %
14	Wholesale	46	0.0 %	77.1 %
15	Transport equipment	49-53, 79	1.0 %	78.1 %
16	Media services	18, 58-60	0.0 %	78.1 %
17	Information Technology (IT) / Telecommunications	61-63	5.2 %	83.3 %
18	Banking / Insurance	64-66	0.0 %	83.3 %
19	Technical services / R&D services	71-72	10.4 %	93.8 %
20	Consulting	69, 70.2, 73	5.2 %	99.0 %
21	Firm-related services	74, 78, 80-82	1.0 %	100.0 %
CLUSTER 4: AD HOC INNOVATORS				
1	Mining	5-9, 19, 35	3.0 %	3.0 %
2	Food / Tobacco	10-12	3.3 %	6.3 %
3	Textiles	13-15	4.1 %	10.4 %
4	Wood / Paper	16-17	3.3 %	13.7 %
5	Chemicals	20-21	2.6 %	16.3 %
6	Plastics	22	4.1 %	20.4 %
7	Glass / Ceramics	23	3.0 %	23.3 %
8	Metals	24-25	6.7 %	30.0 %
9	Electric equipment	26-27	8.1 %	38.1 %
10	Machinery	28	7.0 %	45.2 %
11	Retail / Automobile	29-30	1.9 %	47.0 %
12	Medical technology / Maintenance	31-33	6.7 %	53.7 %
13	Energy / Water	36-39	6.3 %	60.0 %
14	Wholesale	46	2.6 %	62.6 %
15	Transport equipment	49-53, 79	8.5 %	71.1 %
16	Media services	18, 58-60	5.6 %	76.7 %
17	Information Technology (IT) / Telecommunications	61-63	6.3 %	83.0 %
18	Banking / Insurance	64-66	3.7 %	86.7 %
19	Technical services / R&D services	71-72	5.6 %	92.2 %
20	Consulting	69, 70.2, 73	4.4 %	96.7 %
21	Firm-related services	74, 78, 80-82	3.3 %	100.0 %

[a] The categorization of the industry sectors is based on the ZEW indicator report of the innovation panel.

APPENDIX D: SECONDARY DATA SOURCES

Document Code	Release Date	Title
SHARE NOW – PRESS RELEASES		
pr_20180110_sn_1	January 10, 2018	More user, more rentals: CAR2GO with successful financial year 2018
pr_20181018_sn_2	October 18, 2018	77% of car sharing customers prefer to be on their way electrically
pr_20190115_sn_3	January 15, 2019	Fourth electric city: CAR2GO launches in Paris
pr_20190228_sn_4	February 28, 2019	CAR2GO and DRIVENOW join forces: SHARE NOW to become the biggest free-floating car sharing provider worldwide
pr_20190402_sn_5	April 2, 2019	Focus on sustainable mobility: SHARE NOW to expand its electric fleet
pr_20190411_sn_6	April 11, 2019	SHARE NOW starts its free floating car sharing in Budapest
pr_20191106_sn_7	November 6, 2020	New app and website relaunch: SHARE NOW as a captivating new brand
SHARE NOW – FACT SHEETS		
fs_201911_sn_1	November 2019	SHARE NOW: facts and figures
DAIMLER MOBILITY AG – PRESS RELEASES		
pr_20180328_dmo_1	March 28, 2018	BMW GROUP and DAIMLER AG agree to combine mobility services
pr_20190222_dmo_2	February 22, 2019	BMW GROUP and DAIMLER AG invest more than €1 billion in joint mobility services provider
DAIMLER MOBILITY AG – FACT SHEETS		
fs_20190222_dmo_1	February 22, 2019	Fact sheet comprising five joint ventures

Document Code	Release Date	Title
REACH NOW – PRESS RELEASES		
pr_20170515_rn_1	May 15, 2020	Connect™, a mobile contactless fare platform designed to revolutionize the transportation industry
pr_20171012_rn_2	October 12, 2017	With the MOOVEL app and a bit of luck, you can travel on local public transport on particulate matter alarm days completely free of charge
pr_20180627_rn_3	June 27, 2018	MOOVEL lab visualizes mobility infrastructures on land and in the air with the design project 'Flights to Rome'
pr_20180918_rn_4	September 18, 2018	InnoTrans: Mobility-as-a-Service (MaaS) pioneer MOOVEL unveils digital marketplace for urban mobility ecosystems
pr_20180928_rn_5	September 28, 2018	MOOVEL and MDOT MTA power first mobile ticketing app for Baltimore region
pr_20181113_rn_6	November 13, 2018	'Making cities smarter': MOOVEL presents the latest digital mobility solutions at Smart City Expo World Congress in Barcelona
pr_20181204_rn_7	December 4, 2018	MOOVEL and BART to pilot new mobile ticketing app for airport trips
pr_20190211_rn_8	February 11, 2019	Mobility-as-a-Service pioneer MOOVEL : 6.5 million users, growth rate of 69%
pr_20190514_rn_9	May 14, 2019	Digital mobility budget: MaaS pioneer MOOVEL helps companies make employee mobility more flexible
pr_20190522_rn_10	May 22, 2019	MOOVEL acquires VALIDATED, a technology platform that offers mobility incentives through loyalty programs
pr_20190528_rn_11	May 28, 2019	Premiere: Mobility-as-a-Service pioneer presents 'Mobility Budget' at the Global Public Transport Summit (GPTS) in Stockholm
pr_20190606_rn_12	June 6, 2019	On-demand ridesharing offer 'MYSHUTTLE' starts on June 9 in Ettlingen: electric mini-buses can be ordered via KVV.mobil app
pr_20190813_rn_13	August 13, 2019	MOOVEL (becomes REACH NOW) integrates e-scooter from TIER MOBILITY into its MaaS platform
pr_20190916_rn_14	September 16, 2019	MOOVEL North America to preview new loyalty and rewards platform at APTAtech Conference
REACH NOW – PROMOTIONAL DOCUMENTS		
pd_201802_rn_1	February 2018	We bring the future to your city
pd_201802_rn_2	February 2018	Public transit's missing link
pd_201802_rn_3	February 2018	Fare Connect – Boarding made easy
pd_201809_rn_4	September 2018	A digital marketplace pioneer for urban mobility ecosystems

APPENDIX E: INTERVIEW SCRIPT

Interview Questions: SHARE NOW & REACH NOW (in English language)

Goals	1. What are the short, medium and long-term goals of your company? (e.g. growth, profit, sustainable mobility, strategic vs. financial goals)
Business model	2. How would you describe your business model and how does it differ from competing firms? (e.g. number of cars, availability of the service, payment options) 3. Has your business model evolved over time? *If yes:* What were the most significant adjustments? 4. How much does the success of your service depend on the chosen business model? 5. What were the biggest challenges by implementing (and adapting) your business model? (e.g. cultural differences between firms and/or the existing model) 6. Does your firm try to bring in external ideas (intellectual property) from other external sources to innovate the business model? *7. If yes:* Who in the company makes the decision *if*, *when* and *what* kind of external knowledge will be acquired? 8. Why does the firm include (or exclude) external knowledge in the business model innovation process? 9. What are the main difficulties and risks by bringing in external ideas and innovations?
Innovation process	10. Please describe in detail the innovation process in your company. What stages are included in the innovation process and who is involved?
Cooperation / Acquisition	11. Do you plan to acquire other competitors in order to expand your footprint in other markets (e.g. in China) or develop your service? What speaks for further acquisition vs. organic growth? 12. Could you imagine other technologies and firms in other areas or industries that might enhance your service and be potential takeover targets? 13. What were the main drivers for merging the competing mobility services of DAIMLER and BMW? (e.g. economies of scale, rising competition) 14. Why did both OEMs decide to keep their new mobility services separate from their motherships? (e.g. physical distance, new entity) 15. Do you consider to merge your business with currently competing mobility services of the NOW-family (FREE NOW, SHARE NOW, REACH NOW, PARK NOW, CHARGE NOW)?
Future development	16. How do you protect your business model from competition? 17. How do you analyze and review your business model in order to know when changes (innovations) are required? 18. What is your future scenario of an ideal mobility service and how does this impact your current service?

REFERENCES

Afuah, A. 2004. Business models: A strategic management approach. New York: Irwin/McGraw-Hill.

Ajzen, I. 2001. Nature and operation of attitudes. Annual Review of Psychology, 52: 27-58.

Alexy, O., Criscuolo, P., & Salter, A. 2009. Does IP strategy have to cripple open innovation? MIT Sloan Management Review, 51(1): 71-77.

Alexy, O., & George, G. 2013. Category divergence, straddling, and currency: Open innovation and the legitimation of illegitimate categories. Journal of Management Studies, 50: 173-203.

Amit, R., & Zott, C. 2001. Value creation in e-business. Strategic Management Journal, 22: 493-520.

Amit, R., & Zott, C. 2012. Creating value through business model innovation. MIT Sloan Management Review, 53(3): 41-49.

Antons, D., & Piller, F. T. 2015. Opening the black box of 'not-invented- here': Attitudes, decision biases, and behavioral consequences. Academy of Management Perspectives, 29(2): 1-25.

Argote, L., & Ingram, P. 2000. Knowledge transfer: A basis for competitive advantage in firms. Organizational Behavior and Human Decision Processes, 82(1): 150-169.

Armour, H. O., & Teece, J. D. 1980. Vertical integration and technological innovation. The Review of Economics and Statistics, 62: 470-474.

Arora, A., Fosfuri, A., & Gambardella, A. 2001. Markets for technology and their implications for corporate strategy. Industrial and Corporate Change, 10: 419-450.

Arora, A., & Gambardella, A. 1994. Evaluating technological information and utilizing it: Scientific knowledge, technological capability and external linkages in biotechnology, Journal of Economic Behavior and Organization, 24(1): 91-114.

Arundel, A., & Kabla, I. 1998. What percentage of innovations are patented? Empirical estimates for European firms. Research Policy, 27: 127-141.

Aschhoff, B., & Schmidt, T. 2008. Empirical evidence on the success of R&D cooperation – happy together? Review of Industrial Organization, 33: 41-62.

Assink, M. 2006. Inhibitors of disruptive innovation capability: A conceptual model. European Journal of Innovation Management, 9(2): 215-233.

Atieno, P. O. 2009. An analysis of the strength and limitation of qualitative and quantitative research paradigms. Problems of Education in the 21st Century, 13: 13-18.

Audretsch, D. B. 1995. Innovation, growth and survival. International Journal of Industrial Organization, 13(4): 441-457.

Audretsch, D. B. 1997. Technological regimes, industrial demography and the evolution of industrial structures. Industrial and Corporate Change, 6(1): 49-82.

Baden-Fuller, C., & Haefliger, S. 2013. Business models and technological innovation. Long Range Planning, 46(6): 419-426.

Barney, J. B. 1997. Gaining and sustaining competitive advantage. New Jersey: Pearson Education.

Baum, J. R., Locke, E. A., & Smith, K. G. 2001. A multidimensional model of venture growth. Academy of Management Journal, 44(2): 292-303.

Becker, G. S. 1964. Human capital. New York: Columbia University Press.

Becker, W., & Dietz, J. 2004. R&D cooperation and innovation activities of firms-evidence for the German industry. Research Policy, 33: 209-223.

Belderbos, R., Carree, M., & Lokshin, B. 2004. Cooperative R&D and firm performance. Research Policy, 33(10): 1477-1492.

Bellamy, M., Ghosh, S., & Hora, M. 2014. The influence of supply network structure on firm innovation. Journal of Operations Management, 32(6): 357-373.

Belsley, D. A. 1984. Collinearity and forecasting. Journal of Forecasting, 3(2): 183-196.

Björkdahl, J. 2009. Technology cross fertilization and the business model: The case of integrating ICTs in mechanical engineering products. Research Policy, 38: 1468-1477.

Boer, H., & During, W. E. 2001. Innovation, what innovation? A comparison between product, process and organizational innovation. International Journal of Technology Management, 22(1/2/3): 83-107.

Brandenburger, A. M., & Stuart, H. W. 1996. Value-based business strategy. Journal of Economics and Management Strategy, 5(1): 5-24.

Briggs, R. O., Vreede, G. D., & Nunamaker, J. F. 2003. Collaboration engineering with ThinkLets to pursue sustained success with group support systems. Journal of Management Information Systems, 19(4): 31-64.

Brouwer, E., & Kleinknecht, A. 1999. Innovative output, and a firm's propensity to patent: An exploration of CIS micro data. Research Policy, 28(6): 615-624.

Calia, R. C., Guerrini, F. M., & Moura, G. L. 2007. Innovation networks: From technological development to business model reconfiguration. Technovation, 27: 426-432.

Cantner, U., Joel, K., & Schmidt, T. 2011. The effects of knowledge management on innovative success: An empirical analysis of German firms. Research Policy, 40(10): 1453-1462.

Casadesus-Masanell, R., & Llanes, G. 2011. Mixed source. Management Science, 57(7): 1212-1230.

Casadesus-Masanell, R., & Ricart, J. E. 2010. From strategy to business models and onto tactics. Long Range Planning, 43(2/3): 195-215.

Casadesus-Masanell, R., & Ricart, J. E. 2011. How to design a winning business model. Harvard Business Review, 89(1/2): 100-107.

Casadesus-Masanell, R., & Zhu, F. 2013. Business model innovation and competitive imitation: The case of sponsor-based business models. Strategic Management Journal, 34: 464-482.

Cassiman, B., Perez-Castrillo, D., & Veugelers, R. 2002. Endogenizing know-how flows through the nature of R&D investments. International Journal of Industrial Organization, 20: 775-799.

Cassiman, B., & Veugelers, R. 2002. R&D cooperation and spillovers: some empirical evidence from Belgium. American Economic Review, 92(4): 1169-1184.

Cassiman, B., & Veugelers, R. 2006. In search of complementarity in the innovation strategy: Internal R&D and external knowledge acquisition. Management Science, 52: 68-82.

Cattell, R. B. 1966. The scree test for the number of factors. Multivariate Behavioral Research, 1: 245-276.

Cattell, R. B., & Jaspers, J. 1967. A general plasmode for factor analytic exercises and research. Multivariate Behavioral Research Monographs, 3: 1-212.

Cesaroni, F. 2004. Technological outsourcing and product diversification: Do markets for technology affect firms' strategies? Research Policy, 33(10): 1547-1564.

Chanal, V., & Caron-Fasan, M-L. 2010. The difficulties involved in developing business models open to innovation communities: The case of a crowdsourcing platform. Management, 13(4): 318-341.

Chatterjee, S. 2005. Core objectives: Clarity in designing strategy. California Management Review, 47(2): 33-49.

Cheng, C. 2011. Dynamic service innovation capability, radical service innovation and open business models. International Journal of Services Technology and Management, 16(3/4): 229-242.

Chesbrough, H. 2003. Open innovation: The new imperative for creating and profiting from technology. Boston: Harvard Business School Press.

Chesbrough, H. 2006a. Open business models: How to thrive in the new innovation landscape. Boston: Harvard Business School Press.

Chesbrough, H. 2006b. Open innovation: A new paradigm for understanding industrial innovation. In Open Innovation: Researching a New Paradigm, ed. H. Chesbrough, W. Vanhaverbeke, and J. West, 1-12. Oxford: Oxford University Press.

Chesbrough, H. 2007a. Business model innovation: It's not just about technology anymore. Strategy and Leadership, 35(6): 12-17.

Chesbrough, H. 2007b. Why companies should have open business models. MIT Sloan Management Review, 48(2): 22-28.

Chesbrough, H. 2010. Business model innovation: Opportunities and barriers. Long Range Planning, 43(2-3): 354-363.

Chesbrough, H., & Rosenbloom, R. S. 2002. The role of the business model in capturing value from innovation: Evidence from Xerox Corporation's technology spin-off companies. Industrial and Corporate Change, 11(3): 529-555.

Chesbrough, H., & Schwartz, K. 2007. Innovating business models with co-development partnerships. Research Technology Management, 50(1): 55-59.

Chesbrough, H. W., & Teece, D. J. 2012. When is virtual virtuous? In: Klein, D. A. (eds). The strategic management of intellectual capital. Waltham: Butterworth-Heinemann, 27-37.

Chiang, Y-H., & Hung, K-P. 2010. Exploring open search strategies and perceived innovation performance from the perspective of inter-organizational knowledge flows. R&D Management, 40: 292-299.

Christensen, C. 1997. The innovator's dilemma: When new technologies cause great firms to fail. Boston: Harvard Business Review Press.

Clauss, T. 2016. Measuring business model innovation: Conceptualization, scale development, and proof of performance. R&D Management, 47(3): 385-403.

Cohen, W. M., Goto, A., Nagata, A., Nelson, R., & Walsh, J. P. 2002. R&D spillovers, patents and the incentives to innovate in Japan and the United States. Research Policy, 31: 1349-1367.

Cohen, W. M., & Levinthal, D. A. 1989. Innovation and learning: The two faces of R&D. The Economic Journal, 99: 569-596.

Cohen, W. M., & Levinthal, D. A. 1990. Absorptive capacity: A new perspective on learning and innovation. Administrative Science Quarterly, 35: 128-152.

Cohen, W. M., & Levinthal, D. A. 1994. A fortune favors the prepared firm. Management Science, 40(2): 227-251.

Cohen, W. M., Nelson, R. R., & Walsh, J. P. 2000. Protecting their intellectual assets: Appropriability conditions and why U.S. manufacturing firms patent (or not). National Bureau of Economic Research Working Paper 7552.

Cole, R. 2001. From continuous improvement to continuous innovation. Quality Management Journal, 8(4): 1051-1056.

Colombo, M. G., Cumming, D., Mohammadi, A., Rossi-Lamastra, C., & Wadhwa, A. 2016. Open business models and venture capital finance. Industrial and Corporate Change, 25: 353-370.

Comrey, A. L. 1973. A first course in factor analysis. New York: Academic Press.

Coombes, P. H., & Nicholson, J. D. 2013. Business models and their relationship with marketing: A systematic literature review. Industrial Marketing Management, 42(5): 656-664.

Costain, C., Ardron, C., & Habib, K. N. 2012. Synopsis of users' behavior of a carsharing program: A case study in Toronto. Transportation Research Part A: Policy and Practice, 46(3): 421-434.

Cozzolino, A., Verona, G., & Rothaermel, F. T. 2018. Unpacking the disruption process: New technology, business models, and incumbent adaptation. Journal of Management Studies, 55: 1166-1202.

Cricelli, L., Greco, M., & Grimaldi, M. 2015. Open innovation actions and innovation performance: A literature review of European empirical evidence. European Journal of Innovation Management, 18(2): 150-171.

Criscuolo, C., & Haskel, J. 2003. Innovation and productivity growth in the UK: Evidence from CIS2 and CIS3. Working Paper. Centre for Research into Business Activity.

Crowther, D., & Lauesen, L. M. 2017. Handbook of research methods in corporate social responsibility. Northampton: Edward Elgar Publishing.

Dahlander, L., & Gann, D. M. 2010. How open is innovation? Research Policy, 39(6): 699-709.

Damanpour, F. 1991. Organizational innovation: A meta-analysis of effects of determinants and moderators. Academy of Management Journal, 34(3): 555-590.

Das, T. K., & Teng, B-S. 2000. A resource-based theory of strategic alliances. Journal of Management, 26(1): 31-60.

Davey, S. M., Brennan, M., Meenan, B. J., & McAdam, R. 2010. The health of innovation: Why open business models can benefit the healthcare sector. Irish Journal of Management, 30(1): 21-40.

Davey, S. M., Brennan, M., Meenan, B. J., & McAdam, R. 2011a. Innovation in the medical device sector: An open business model approach for high-tech small firms. Technology Analysis and Strategic Management, 23(8): 807-824.

Davey, S. M., Brennan, M., Meenan, B. J., McAdam, R., Girling, A., Chapman, A., & Lilford. R. L. 2011b. A framework to manage the early value proposition of emerging healthcare technologies. Irish Journal of Management, 31(1): 59-75.

De Brentani, U. 2001. Innovative versus incremental new business services: Different keys for achieving success. The Journal of Product Innovation Management, 18: 169-187.

De Meyer, A. 1991. Organizational leverage effect in innovation. European Management Journal, 9(4): 397-403.

Demil, B., & Lecocq, X. 2010. Business model evolution: In search of dynamic consistency. Long Range Planning, 43: 227-246.

Deslee, C., & Ammar, O. 2016. Transforming SNCF's business model through the evolution of participative innovation routine. European Business Review, 28(4): 467-485.

Djelassi, S., & Decoopman, I. 2013. Customers' participation in product development through crowdsourcing: Issues and implications. Industrial Marketing Management, 42(5): 683-692.

Doganova, L., & Eyquem-Renault, M. 2009. What do business models do? Innovation devices in technology entrepreneurship. Research Policy, 38(10): 1559-1570.

Dunford, R., Palmer, I., & Benveniste, J. 2010. Business model replication for early and rapid internationalisation: The ING Direct experience. Long Range Planning, 43(5/6): 655-674.

Dussauge, P., Garrette, B., & Mitchell, W. 2000. Learning from competing partners: Outcomes and durations of scale and link alliances in Europe, North America, and Asia. Strategic Management Journal, 21(2): 99-126.

Dutta, S., & Weiss, A. M. 1997. The relationship between a firm's level of technological innovativeness and its pattern of partnership agreements. Management Science, 43(3): 343-356.

Dyer, J. H., & Singh, H. 1998. The relational view: Cooperative strategy and sources of interorganizational competitive advantage. Academy of Management Review, 23(4): 660-679.

Edmondson, A. C., & McManus, S. E. 2007. Methodological fit in management field research, Academy of Management Review, 32(4): 1155-1179.

Eggert, A., Hogreve, J., Ulaga, W., & Muenkhoff, E. 2014. Revenue and profit implications of industrial service strategies. Journal of Service Research, 17(1): 23-39.

Eisenhardt, K. M. 1989. Building theories from case study research. The Academy of Management Review, 14(4): 532-550.

Eisenhardt, K. M., & Graebner, M. E. 2007. Theory building from cases: Opportunities and challenges. Academy of Management Journal, 50(1): 25-32.

Eisenhardt, K. M., & Schoonhoven, C. B. 1996. Resource-based view of strategic alliance formation: Strategic and social effects in entrepreneurial firms. Organization Science, 7: 136-150.

Eurostat. 2004. Innovation in Europe: Results for the EU, Iceland and Norway. Luxembourg: Office for Official Publications of the European Communities.

Fabrizio, K. R. 2006. The use of university research in firm innovation. In Chesbrough, H. W., Vanhaverbeke, W., & West, J. (eds). Open Innovation: Researching a new paradigm. Oxford: Oxford University Press, 134-161.

Feller, J., Parhankangas, A., & Smeds, R. 2006. Process learning in alliances developing radical versus incremental innovations: Evidence from the telecommunications industry. Knowledge and Process Management, 13(3): 175-191.

Ferreras-Méndez, J. L., Newell, S., Fernández-Mesa, A., & Alegre, J. 2015. Depth and breadth of external knowledge search and performance: The mediating role of absorptive capacity. Industrial Marketing Management, 47: 86-97.

Fey, C. F., & Birkinshaw, J. 2005. External sources of knowledge, governance mode, and R&D performance. Journal of Management, 31(4): 597-621.

Frankenberger, K., Weiblen, T., & Gassmann, O. 2013. Network configuration, customer centricity, and performance of open business models: A solution provider perspective. Industrial Marketing Management, 42 (5): 671-682.

Frankenberger, K., Weiblen, T., & Gassmann, O. 2014: The antecedents of open business models: An exploratory study of incumbent firms. R&D Management, 44(2): 173-188.

Freeman, C. 1991. Networks of innovators: A synthesis of research issues. Research Policy, 20(5): 499-514.

Fritsch, M., & Lukas, R. 2001. Who cooperates on R&D? Research Policy, 30:297-312.

Garcia, R., & Calantone, R. 2002. A critical look at technological innovation typology and innovativeness terminology: A literature review. Journal of Product Innovation Management, 19(2): 110-132.

Garvin, D. A., & Levesque, L. C. 2006. Meeting the challenge of corporate entrepreneurship. Harvard Business Review, 84(10): 102-112.

Gassmann, O., & Enkel, E. 2004. Towards a theory of open innovation: Three core process archetypes. Proceedings of the R&D Management Conference. Lisbon, July 6-9.

Gavetti, G., & Levinthal, D. 2000. Looking forward and look backward: Cognitive and experiential search. Administrative Science Quarterly, 45: 113-137.

Gemser, G., & Leenders, M. A. 2011. Managing cross-functional cooperation for new product development success. Long Range Planning, 44(1): 26-41.

George, G., & Bock, A. J. 2011. The business model in practice and its implications for entrepreneurship research. Entrepreneurship: Theory and Practice, 35(1): 83-111.

Ghezzi, A., Balocco, R., & Rangone, A. 2016. The open innovation – Strategy nexus: Findings from the mobile telecommunications industry. Management Research Review, 39(5): 569-598.

Giesel, F., & Nobis, C. 2016. The impact of carsharing on car ownership in German cities. Transportation Research Procedia, 19: 215-224.

Giesen, E., Berman, S. J., Bell, R., & Blitz, A. 2007. Three ways to successfully innovate your business model. Strategy and Leadership, 35: 27-33.

Ginsberg, A., & Venkatraman, N. 1985. Contingency perspectives of organizational strategy: A critical review of the empirical research. Academy of Management Review, 10(3): 421-434.

Girotra, K., & Netessine, S. 2013. Business model innovation for sustainability. Manufacturing and Service Operations Management, 15(4): 537-544.

Grant, R. M. 1996. Toward a knowledge-based theory of the firm. Strategic Management Journal, 17 (S2): 109-122.

Grimpe, C., & Kaiser, U. 2010. Balancing internal and external knowledge acquisition: the gains and pains from R&D outsourcing. Journal of Management Studies, 47: 1483-1509.

Grönlund, J., Rönnberg-Sjödin, D., & Frishammar, J. 2010. Open Innovation and the stage-gate process: A revised model for new product development. California Management Review, 52(3): 106-131.

Hair, J. F., Anderson, R. E., Tatham, R. L., & Black, W. C. 1995. Multivariate data analysis. New York: Macmillan Publishers.

Hall, B., Griliches, Z., & Hausman, J. A. 1986. Patents and R&D: Is there a lag? International Economic Review, 27(2): 265-284.

Hall, B., Helmers, C., Rogers, M., & Sena, V. 2014. The choice between formal and informal intellectual property: A review. Journal of Economic Literature, 52(2): 1-50.

Hamel, G. 2000. Leading the revolution. Boston: Harvard Business School Press.

Henkel, J. 2006. Selective revealing in open innovation processes: The case of embedded Linux. Research Policy, 35(7): 953-969.

Hetzel, R. D. 1996. A primer on factor analysis with comments on patterns of practice and reporting. In Thompson, B. (eds). Advances in social science methodology. Bingley: Emerald Group Publishing, 175-206.

Hienerth, C., Keinz, P., & Lettl, C. 2011. Exploring the nature and implementation process of user-centric business models. Long Range Planning, 44(5/6): 344-374.

Hollenstein, H. 2003. Innovation modes in the Swiss service sector: A cluster analysis based on firm-level data. Research Policy, 32: 845-863.

Holm, A. B., Günzel, F., & Ulhøi, J. P. 2013. Openness in innovation and business models: Lessons from the newspaper industry. International Journal of Technology Management, 61: 324-348.

Horbach, J. 2008. Determinants of environmental innovation – New evidence from German panel data sources. Research Policy, 37: 163-173.

Hu, S., Chen, P., Lin, H., Xie, C., & Chen, X. 2018. Promoting carsharing attractiveness and efficiency: An exploratory analysis. Transportation Research Part D, 65: 229-243.

Huang, H.-C., Lai, M.-C., Lin, L.-H., & Chen, C.-T. 2013. Overcoming organizational inertia to strengthen business model innovation: An open innovation perspective. Journal of Organizational Change Management, 26: 977-1002.

Huizingh, E. K. 2011. Open innovation: State of the art and future perspectives. Technovation, 31: 2-9.

Hung, K. P., & Chou, C. 2013. The impact of open innovation on firm performance: The moderating effects of internal R&D and environmental turbulence. Technovation, 33: 368-380.

Hurmelinna, P., Kyläheiko, K., & Jauhiainen, T. 2007. The janus face of the appropriability regime in the protection of innovations: Theoretical re-appraisal and empirical analysis. Technovation, 27: 133-144.

Jansen, J. J., Van den Bosch, F. A., & Volberda, H. W. 2006. Exploratory innovation, exploitative innovation, and performance: Effects of organizational antecedents and environmental moderators. Management Science, 52(11): 1661-1674.

Jick, T. D. 1979. Mixing qualitative & quantitative methods: Triangulation in action. Administrative Science Quarterly, 24: 602-611.

Johnson, M. W. 2010. Seizing the white space: Business model innovation for growth and renewal. Boston: Harvard Business School Press.

Johnson, M. W., Christensen, C. C., & Kagermann, H. 2008. Reinventing your business model. Harvard Business Review, 86: 50-59.

Kale, P., & Singh, H. 2009. Managing strategic alliances: What do we know now, and where do we go from here? Academy of Management Perspectives, 23(3): 45-62.

Karakaya, F., & Stahl, M. J. 1989. Barriers to entry and market entry decisions in consumer and industrial goods markets. Journal of Marketing, 53(2): 80-91.

Katz, R., & Allen, T. 1982. Investigating the not invented here (NIH) syndrome: A look at the performance, tenure, and communication patterns of 50 R&D projects. R&D Management, 12(1): 7-19.

Keinz, P., Hienerth, C., & Lettl, C. 2012. Designing the organization for user-driven innovation. Journal of Organizational Design. 1(3): 20-36.

Kim, H., & Park, Y. 2010. The effects of open innovation activity on performance of SMEs: The case of Korea. International Journal of Technology Management, 52(3/4): 236-256.

Kleinknecht, A., & Reijnen, J. 1992. Why do firms cooperate on R&D? An empirical study. Research Policy, 21: 347-360.

Klingebiel, R., & Rammer, C. 2014. Resource allocation strategy for innovation portfolio management. Strategic Management Journal, 35(2): 246-268.

Klomp, L., & Van Leeuwen, G. 2001. Linking innovation and firm performance: A new approach. International Journal of the Economics of Business, 8(3): 343-364.

Kogut, B. 1988. Joint ventures: Theoretical and empirical perspectives. Strategic Management Journal, 9(4): 319-332.

Kohler, T. 2015. Crowdsourcing-based business models: How to create and capture value. California Management Review, 57(4): 63-84.

Kortmann, S., & Piller, F. T. 2016. Open business models and closed-loop value chains: Redefining the firm-consumer relationship. California Management Review, 58(3): 88-108.

Kostova, T., & Roth, K. 2002. Adoption of an organizational practice by subsidiaries of multinational corporations: Institutional and relational effects. Academy of Management Journal, 45: 215-233.

Lambe, C. J., & Spekman, R. E. 1997. Alliances, external technology acquisition, and discontinuous technological change. Journal of Product Innovation Management, 14(2): 102-116.

Lassen, A. H., & Laugen, B. T. 2017. Open innovation: on the influence of internal and external collaboration on degree of newness. Business Process Management Journal, 23(6): 1129-1143.

Laursen, K., & Salter, A. J. 2006. Open for innovation: The role of openness in explaining innovation performance among UK manufacturing firms. Strategic Management Journal, 27: 131-150.

Laursen, K., & Salter, A. J. 2014. The paradox of openness: Appropriability, external search and collaboration. Research Policy, 43(5): 867-878.

Leiponen, A., & Drejer, I. 2007. What exactly are technological regimes? Intra-industry heterogeneity in the organization of innovation activities. Research Policy, 36(8): 1221-1238.

Leiponen, A., & Helfat, C. E. 2010. Innovation objectives, knowledge sources, and the benefits of breadth. Strategic Management Journal, 31(2): 224-236.

Levin, R. C., Klevorick, A. K., Nelson, R. R., & Winter, S. G. 1987. Appropriating the returns from industrial research and development. Brookings Papers on Economic Activity, 3(3): 783-820.

Levinthal, D. A. 1997. Adaptation on rugged landscapes. Management Science, 43(7): 895-1045.

Lin, B. W., & Wu, C. H. 2010. How does knowledge depth moderate the performance of internal and external knowledge sourcing strategies? Technovation, 30(11/12): 582-589.

Linting, M., Meulman, J. J., Groenen, P. J., & Van der Kooij, A. J. 2007. Stability of nonlinear principal components analysis: An empirical study using the balanced bootstrap. Psychological Methods, 12(3): 359-379.

Linting, M., & Van der Kooij, A. J. 2012. Nonlinear principal components analysis with CATPCA: A tutorial. Journal of Personality Assessment, 94(1): 12-25.

Luo, B. N., Lui, S. S., & Kim, Y. 2017. Revisiting the relationship between knowledge search breadth and firm innovation. Management Decision, 55(1): 2-14.

Magretta, J. 2002. Why business models matter. Harvard Business Review, 80(5): 86-92.

Mairesse, J., & Mohnen, P. 2007. A survey of innovation surveys: Taking stock of a growing literature. Banque de France Conference on Innovation, 1-16.

Malerba, F. 2005. Sectorial systems: How and why innovation differs across sectors. In: Fagerberg, J., Mowery, D. C., & Nelson, R. R. (eds). The Oxford handbook of innovation. Oxford: Oxford University Press, 380-406.

Mangematin, V., & Baden-Fuller, C. 2008. Global contests in the production of business knowledge: Regional centres and individual business schools. Long Range Planning, 41: 117-139.

Markides, C. 2006. Disruptive innovation: In need of better theory. Journal of Product Innovation Management, 23(1): 19-25.

Masaki, M. 2010. How to factor-analyze your data right: Do's, don'ts, and how-to's. International Journal of Psychological Research, 3(1): 97-110.

Massa, L., & Tucci, C. L. 2014. Business model innovation. In: Dodgson, M., Gann, D. M., & Phillips, N. (eds). The Oxford handbook of innovation management. Oxford: Oxford University Press, 420-441.

Mazzola, E., Bruccoleri, M., & Perrone, G. 2012. The effect of inbound, outbound and coupled innovation on performance. International Journal of Innovation Management, 16(6): 1-27.

McGrath, R. G. 2010. Business models: A discovery driven approach. Long Range Planning, 43: 247-261.

Mention, A. L. 2011. Co-operation and co-opetition as open innovation practices in the service sector: Which influence on innovation novelty? Technovation, 31(1): 44-53.

Mohnen, P., & Hoareau, C. 2003. What type of enterprise forges close links with universities and government labs? Evidence from CIS 2. Managerial and Decision Economics, 24: 133-146.

Monjon, S., & Waelbroeck, P. 2003. Assessing spillovers from universities to firms: Evidence from French firm-level data. International Journal of Industrial Organization, 21(9): 1255-1270.

Mooi, E. A., & Ghosh, M. 2010. Contract specificity and its performance implications. Journal of Marketing, 74(2): 105-120.

Morris, M., Schindehutte, M., & Allen, J. 2005. The entrepreneur's business model: Toward a unified perspective. Journal of Business Research, 58(6): 726-735.

Mowery, D. C., Oxley, J. E., & Silverman, B. S. 1996. Strategic alliances and interfirm knowledge transfer. Strategic Management Journal, 17: 77-91.

Murray, K. B., & Häubl, G. 2007. Explaining cognitive lock-in: The role of skill-based habits of use in consumer choice. Journal of Consumer Research, 34(1): 77-88.

Nakamura, M. 2003. Research alliances and collaboration: Introduction to the special issue. Managerial and Decision Economics, 24: 47-49.

Neely, A. 2008. Exploring the financial consequences of the servitization of manufacturing. Operations Management Research, 1: 103-118.

Nonaka, I., & Takeuchi, H. 1995. The knowledge-creating company: How Japanese companies create the dynamics of innovation. New York: Oxford University Press.

Nourinejad, M., & Roorda, M. J. 2015: Carsharing operations policies: A comparison between one-way and two-way systems. Transportation, 42(3): 497-518.

OECD/Eurostat. 2005. Oslo Manual: Guidelines for collecting and interpreting innovation data, The measurement of scientific and technological activities, Vol. 3rd Edition: OECD Publishing.

OECD/Eurostat. 2018. Oslo Manual: Guidelines for collecting, reporting and using data on innovation, The measurement of scientific, technological and innovation activities, Vol. 4th Edition: OECD Publishing.

Osborne, J. W., & Costello, A. B. 2009. Best practices in exploratory factor analysis: Four recommendations for getting the most from your analysis. Pan-Pacific Management Review, 12(2): 131-146.

Osterwalder, A., & Pigneur, Y. 2010. Business model generation: A handbook for visionaries, game changers, and challengers. Hoboken: John Wiley and Sons.

Osterwalder, A., Pigneur, Y., & Tucci, C. L. 2005. Clarifying business models: Origins, present and future of the concept. Communications of the Association for Information Science (CAIS), 16: 1-25.

Pavitt, K. 1984. Sectoral patterns of technical change: Towards a taxonomy and a theory. Research Policy, 13: 343-373.

Perkmann, M., & Spicer, A. 2010. What are business models? Developing a theory of performative representations. Research in the Sociology of Organizations, 29: 269-279.

Perkmann, M., & Walsh, K. 2007. University-industry relationships and open innovation: Towards a research agenda. International Journal of Management Reviews, 9(4): 259-280.

Peteraf, M., & Shanley, M. 1997. Getting to know you: A theory of strategic group identity. Strategic Management Journal, 18: 165-186.

Pfeffer, J., & Salancik, G. R. 1978. The external control of organizations: A resource dependence perspective. Stanford: Stanford University Press.

Pisano, G. P. 1990. The R&D boundaries of the firm: An empirical analysis. Administrative Science Quarterly, 35(1): 153-176.

Pisano, G. P. 2015. You need an innovation strategy. Harvard Business Review, 93(6): 44-54.

Pisano, G. P., & Teece, D. J. 2007. How to capture value from innovation: Shaping intellectual property and industry architecture. California Management Review, 50(1): 278-296.

Plessis, M. D. 2007. The role of knowledge management in innovation. Journal of Knowledge Management, 11(4): 20-29.

Poot, T., Faems, D., & Vanhaverbeke, W. 2009. Toward a dynamic perspective on open innovation: A longitudinal assessment of the adoption of internal and external innovation strategies in the Netherlands. International Journal of Innovation Management, 13(2): 177-200.

Porter, M. E. 1985. Competitive advantage: Creating and sustaining superior performance. New York: Free Press.

Powell, W. W., Koput, K. W., & Smith-Doerr, L. 1996. Interorganizational collaboration and the locus of innovation. Administrative Science Quarterly, 41(1): 116-145.

Rigby, D., & Zook, C. 2002. Open-market innovation. Harvard Business Review, October 2002: 80-89.

Rogers, E. M. 2003. Diffusion of innovations. New York: Free Press.

Romero, D., & Molina, A. 2011. Collaborative networked organisations and customer communities: Value co-creation and co-innovation in the networking era, Production Planning and Control, 22: 447-472.

Saebi, T., & Foss, N. J. 2015. Business models for open innovation: Matching heterogeneous open innovation strategies with business model dimensions. European Management Journal, 33: 201-213.

Schmidt, T. 2010. Absorptive capacity – One size fits all? Managerial and Decision Economics, 31(1): 1-18.

Seelos, C., & Mair, J. 2007. Profitable business models and market creation in the context of deep poverty: A strategic view. Academy of Management Perspectives, 21: 49-63.

Sethi, R., Smith, D. C., & Park, C. W. 2001. Cross-functional product development teams, creativity, and the innovativeness of new consumer products. Journal of Marketing Research, 38(1): 73-85.

Shafer, S. M., Smith, H. J., & Linder, J. 2005. The power of business models. Business Horizons, 48: 199-207.

Shaheen, S. A., & Cohen, A. P. 2007. Growth in worldwide carsharing: An international comparison. Transportation Research Record, 1992(1): 81-89.

Short, J. 2009. The art of writing a review. Journal of Management, 35(6): 1312-1317.

Simon, H. A. 1955. A behavioral model of rational choice. Quarterly Journal of Economics, 69: 99-118.

Soh, P.-H., & Roberts, E. B. 2005. Technology alliances and networks: An external link to research capability. IEEE Transactions on Engineering Management, 52(4): 419-428.

Song, M. X., & Montoya-Weiss, M. M. 1998. Critical development activities for really new versus incremental products. Journal of Product Innovation Management, 15(2):124-135.

Sosna, M., Trevinyo-Rodríguez, R. N., & Velamuri, S. R. 2010. Business model innovation through trial-and-error learning: The Naturhouse case. Long Range Planning, 43(2-3): 383-407.

Spieth, P., & Schuchert, S. M. 2018. Business model innovation alliances: How to open business models for cooperation. International Journal of Innovation Management, 22(4): 1-26.

Teece, D. J. 1986. Profiting from technological innovation: Implications for integration, collaboration, licensing and public policy. Research Policy, 15(6): 285-305.

Teece, D. J. 2007. Explicating dynamic capabilities: The nature and microfoundations of (sustainable) enterprise performance. Strategic Management Journal, 28(13): 1319-1350.

Teece, D. J. 2010. Business models, business strategy and innovation. Long Range Planning, 43(2/3): 172-194.

Teece, D. J. 2018. Business models and dynamic capabilities. Long Range Planning, 51: 40-49.

Teece, D. J., Pisano, G., & Shuen, A. 1997. Dynamic capabilities and strategic management. Strategic Management Journal, 18(7): 509-533.

Tether, B. 2002. Who co-operates for innovation, and why: An empirical analysis. Research Policy, 31: 947-967.

Thompson, V. A. 1965. Bureaucracy and innovation. Administrative Science Quarterly, 10: 1-20.

Timm, N. H. 2002. Applied multivariate analysis. New York: Springer.

Tödtling, F., Lehner, P., & Kaufmann, A. 2009. Do different types of innovation rely on specific kinds of knowledge interactions? Technovation, 29(1): 59-71.

Tomer, J. F. 1987. Productivity through intra-firm cooperation: A behavioral economic analysis. Journal of Behavioral Economics, 16(1): 83-95.

Tsai, K. H., & Wang, J. C. 2009. External technology sourcing and innovation performance in LMT sectors: An analysis based on the Taiwanese technological innovation survey. Research Policy, 38: 518-526.

Tyler, B. B., & Steensma, H. K. 1995. Evaluating technological collaborative opportunities: A cognitive modeling perspective. Strategic Management Journal, 16 (S1): 43-70.

Un, C. A., Cazurra, A. C., & Asakawa, K. 2010. R&D collaborations and product innovation. Journal of Product Innovation Management, 27(5): 673-689.

Urban, G. L., & Von Hippel, E. 1988. Lead user analyses for the development of new industrial products. Management Science, 34(5): 569-582.

Utterback, J. M. 1994. Mastering the dynamics of innovation. Boston: Harvard Business School Press.

Utterback, J. M., & Abernathy, W. J. 1975. A dynamic model of process and product innovation. Omega, 3(6): 639-656.

Van de Ven, A. H. 1986. Central problems in the management of innovation. Management Science, 32: 590-607.

Van de Vrande, V., Lemmens, C., & Vanhaverbeke, W. 2006. Choosing governance modes for external technology sourcing. R&D Management, 36: 347-363.

Van Maanen, J. 1982. Introduction. In: Van Maanen, J., Dabbs, J. M., & Faulkner, R. R. (eds). Varieties of qualitative research. Newbury Park: Sage Publications, 11-29.

Vanhaverbeke, W. 2006. The inter-organizational context of open innovation. In Chesbrough, H., Vanhaverbeke, W., & West, J. (eds). Open innovation: Researching a new paradigm. Oxford: Oxford University Press, 205-219.

Veugelers, R. 1997. Internal R&D expenditures and external technology sourcing. Research Policy, 26(1997): 303-315.

Veugelers, R., & Cassiman, B. 1999. Make and buy in innovation strategies: Evidence from Belgian manufacturing firms. Research Policy, 28: 63-80.

Visnjic, I., Neely, A., & Jovanovic, M. 2018. The path to outcome delivery: Interplay of service market strategy and open business models. Technovation, 72: 46-59.

Von Hippel, E. 1988. The sources of innovation. New York: Oxford University Press.

Von Hippel, E. 2005. Democratizing innovation. Cambridge: The MIT Press.

Waldner, F., Poetz, M. K., Grimpe, C., & Eurich, M. 2015. Antecedents and consequences of business model innovation: The role of industry structure. In Baden-Fuller, C., & Mangematin, V. (eds). Business models and modelling. Advances in Strategic Management, 33: 347-386.

Weiblen, T. 2014. The open business model: Understanding an emerging concept. Journal of Multi Business Model Innovation and Technology, 2(1): 35-66.

Wernerfelt, B. 1984. A resource-based view of the firm. Strategic Management Journal, 5(2): 171-180.

West, J., & Bogers, M. 2014. Leveraging external sources of innovation: A review of research on open innovation. Journal of Product Innovation Management, 31(4): 814-831.

Whyte, W. F. 1984. Learning from the field. Newbury Park: Sage Publications.

Williamson, O. E. 1975. Markets and hierarchies, analysis and antitrust implications: A study in the economics of internal organization. New York: Free Press.

Williamson, O. E. 1985. The economic institutions of capitalism. New York: Free Press.

Winter, S. 1984. Schumpeterian competition in alternative technological regimes. Journal of Economic Behaviour and Organisation, 5(3/4): 287-320.

Yildizoglu, M. 2002. Competing R&D strategies in an evolutionary industry model. Computational Economics, 19(1): 51-65.

Yin, R. 1994. Case study research design and methods. New York: Sage Publications.

Yun, J. J., Won, D., Park, K., Yang, J., & Zhao, X. 2017. Growth of a platform business model as an entrepreneurial ecosystem and its effects on regional development. European Planning Studies, 25(5): 805-826.

Yun, J. J., Yang, J., & Park, K. 2016. Open innovation to business model: New perspective to connect between technology and market. Science, Technology and Society, 21(3): 1-25.

Zhao, Y., & Karypis, G. 2004. Criterion functions for document clustering: Experiments and analysis. Machine Learning, 55(3): 311-331.

Zobel, A.-K., Lokshin, B., & Hagedoorn, J. 2017. Formal and informal appropriation mechanisms: The role of openness and innovativeness. Technovation, 59: 44-54.

Zott, C., & Amit, R. 2007. Business model design and the performance of entrepreneurial firms. Organization Science, 18(2): 181-199.

Zott, C., & Amit, R. 2008. The fit between product market strategy and business model: Implications for firm performance. Strategic Management Journal, 29(1): 1-26.

Zott, C., & Amit, R. 2010. Business model design: An activity system perspective. Long Range Planning, 43(2/3): 216-226.

Zott, C., & Amit, R. 2013. The business model: A theoretically anchored robust construct for strategic analysis. Strategic Organization, 11(4): 403-411.

Zott, C., Amit, R., & Massa, L. 2011. The business model: Recent developments and future research. Journal of Management, 37(4): 1019-1042.

Zott, C., & Huy, Q. N. 2007. How entrepreneurs use symbolic management to acquire resources. Administrative Science Quarterly, 52(1): 70-105.

ABSTRACT

NEW PERSPECTIVES AND INSIGHTS ON THE INTERSECTION OF BUSINESS MODEL DESIGN AND OPEN INNOVATION: A MULTI-METHOD APPROACH

by

ALEXANDER HERMANN TOBIAS HAGENMEYER

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Advisor: Dr. Ratna Babu Chinnam

Major: Industrial Engineering

Degree: Doctor of Philosophy

Today's fast-moving economy, characterized by uncertainty, rapid change and highly competitive landscapes, challenges firms to innovate effectively, which requires them in turn to increasingly innovate openly. The key idea of the notion of open innovation is that "not all the smart people work for you". Instead, useful ideas and knowledge are spread over firms of all sizes in many parts of the world. But at present, even the use of external knowledge sources to stimulate innovativeness is no guarantee for business success any longer. Increasingly, corporations realize that innovation must go beyond novel products and processes and also be applied to the firms' underlying core logic and strategic choices of doing business and thus to their business models. The open business model concept, in which the focal firm utilizes externally available capabilities and resources, has been rapidly gaining importance in the business and academic environment. But extant research of the emerging concept falls short in providing a clear definition and relevant insights into the innovation process.

The objective of this paper-based dissertation is to complement the existing body of scholarly research and its knowledge on achieving business model openness. The thesis consists of three individual articles, each with its own specific research focus and based on an appropriate methodology and data source. The first paper establishes the theoretical

groundwork by providing a common understanding of the interdependencies between both concepts, open innovation and business model design, and identifying their antecedents and consequences. The remaining two papers then use the developed structure to study insights of innovation behavior and business model innovation by providing answers to the following research questions: (1) How does the innovation focus of an enterprise determine the combination of open innovation practices and how is an ideal innovation strategy defined? (2) How is the open business model innovation process in the sustainability phase characterized and how does open innovation influence the value creation and capture? By examining these key issues, this dissertation hopes to make a meaningful contribution to the existing literature and to serve both, academics and business practitioners.

AUTOBIOGRAPHICAL STATEMENT

Alexander Hagenmeyer has been an engineer and business executive in the automotive industry for almost a decade. He is German and holds a Diploma in Engineering Management from the Esslingen University of Applied Sciences and a Master of Science in Industrial Engineering from the Technical University of Dortmund. Alexander is experienced in providing leadership and project management, with a strong international background and work assignments in countries like England, China, and the United States. In the past three years, before joining the doctoral program in the department of Industrial and Systems Engineering at Wayne State University in Detroit, Michigan, he was working for GETRAG FORD Transmissions and was granted extended insights in layout and material flow management. Towards the end of that period, key responsibilities included both the optimization and redesign of production areas in multiple facilities worldwide and the performance of training workshops on layout and factory planning.

No longer with the automotive industry, Alexander co-founded THI Investments, a Private Equity investor with offices in Stuttgart, Germany and London, England. The company, an active investor with experience of building businesses internationally, is driven by creating lasting value for shareholders, partner companies and the communities and economies where it operates. Alexander believes that positively embracing change leads to success and a positive future.