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Shifting Towards Smart, Connected Products: A Business Model Innovation Perspective

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Preface

This master thesis is one of a series of papers and reports published by the Center for Service Innovation (CSI). Centre for Service Innovation (CSI) is a coordinated effort by NHH to focus on the innovation challenges facing the service sector and involves 15 business and academic partners. It aims to increase the quality, efficiency and commercial success of service innovations and to enhance the innovation capabilities of its business and academic partners. CSI is funded through a significant eight year grant from the Research Council of Norway and has recently obtained status as a Centre for Research-based Innovation (SFI).

Abstract

Our everyday products become more and more digitally connected. From home appliances to toys to paper notebooks, products become embedded with sensory devices that allow them to provide more value than their predecessors. For firms, this often means to venture into activities that lie outside their core competencies. The re-orientation of some elements such as value proposition, key activities or key partnerships can instigate business model innovation. Thus, in this master thesis, we aim to give advice to managers who are challenged with the complexities that arise from the integration of smart, connected products (SCP) into their offering. Hereby, we address two pressing gaps in extant business model literature. Firstly, we investigate the opportunities and challenges that firms face when commercializing smart, connected products (SCP) and develop propositions regarding the effects of SCP on BMI. Secondly, based on three in-depth case studies of SCP sellers, we find that external partnerships, complex value chains, and new marketing strategies are common characteristics of BMI under the SCP commercialization. Further, our results indicate the necessity for firms to leverage on dynamic capabilities in order to bridge organizational challenges brought about by the integration of SCP. Finally, we find that firms seem to undergo a more radical BMI when the SCP represents a thorough change with respect to the overall product offering, and the firm does not yet have an established ecosystem of competencies to develop this new product. We suggest that an increase of radicalness of the BMI has to be supported by more agility and adaptability of the firms' processes. Based on these findings we propose a framework, which explains SCP-driven BMI along the dimensions of agility and adaptability as capabilities of the specific firm. Finally, we offer managerial recommendations on how firms can effectively deal with the sourcing of digital know how in different way: an outsourcing, a full cooperation and an ecosystem approach.

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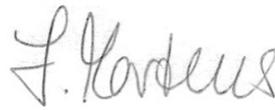
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Secondly, we would like to thank the interviewees participating in our study, for giving their valuable time and insights, and for taking the effort to clarify and validate our case transcripts. Their inputs have given us unique views into fascinating company projects and have allowed us to gain a more practical understanding on our topic. We would particularly like to thank Federica Dogliani from Moleskine for her efforts to involve more of her colleagues in order for us to gain a broader perspective. Furthermore, we would also like to thank our interviewee from DentiStrong for not only being extremely helpful with describing their case to us, but also for sharing further hints to other input on the topic and for altruistically going beyond of what we asked to help us in our research. We also would like to thank our interviewee from TechyToy for her willingness to participate in our research on rather short notice.

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Table of Abbreviations

BM	Business model
BMI	Business model innovation
IIoT	Industrial Internet of Things
IoT	Internet of Things
P-S transition	Product- service transition
PSS	Product service systems
SCP	Smart, connected products

1. Introduction

1.1 How Smart, Connected Products are Changing the Rules of the Game

The advances in new technologies have caused the world economy to drastically change over the course of three IT-driven transformation waves occurring since the 1960s (Porter and Heppelmann, 2014). Technological innovation, enabled by computer-aided automation, new ways of data capture and the internet, has allowed firms to standardize, coordinate across the whole globe, and integrate across industries and supply chains. Now, the ability to capture and analyse large quantities of data through sensors and innovative software is actuating the latest transformation wave, which has a large impact on firms' way of doing business. In fact, at this point "technology and society are evolving faster than businesses can naturally adapt" (Solis, 2015, p.1) and the new technologies are challenging the status quo of doing business. As a result of this, new business models keep emerging, in an effort of industry players to stay in the market (Solis, 2015).

In this fast-paced environment, even a solidly established business model does not guarantee a permanent success. Therefore, incumbent firms need to reconsider their business models (Chesbrough, 2010), in order to successfully link innovative technologies with the core elements of the business (Zott, Amit & Massa, 2011). For firms operating in today's technology-intensive markets, it is therefore important to continuously evaluate and redesign their business models, in order not to be swiped out of the competitive landscape.

The main challenge is for managers to efficiently develop and implement new business models that take advantage of emerging technologies (Chesbrough, 2012). This can be difficult, as managers often struggle to grasp the challenges and opportunities that new technologies bring forth and to understand how integrating a new technology might alter the existing business model's architecture.

The architecture of a firm's business model refers to the linkages between the business model components, i.e. the firm's "value proposition and market segments, the structure of the value chain required for realizing the value proposition, the mechanisms of value capture that the firm deploys, and how these elements are linked together in an architecture." (Saebi, Lien & Foss, 2017, p.567) Given these linkages and the complementarities that arise, altering an existing business model becomes a difficult, uncertain and complex task (Foss & Stieglitz, 2015; Foss & Saebi, 2017). This, together with the risks incurred, leads to a generalized

organizational inertia, meaning that change is often highly dependent on previous choices and rather slow (Hannan, 1984; Teece, Pisano & Shuen, 1997).

Smart Connected Products (SCP) are an emerging technology that requires managers to rethink their way of doing business. We define SCP as those *physically manufactured products that have the ability to connect to networks, exchange and analyse data autonomously, that can communicate and interact with the physical environment, and that can be remotely controlled and personalized*. Estimations say that by 2020 there will be more than 200bn devices in the market (Russo, Marsigalia, Evangelista, Palmaccio, & Maggioni, 2015) and these products have the potential to fundamentally disrupt entire industries.

For example, companies such as Moleskine have recently moved into technological product markets to stay competitive in an ever-digitizing world (Dodson, 2017). The company did so by introducing a smart pen, which digitalizes writing on paper with the help of a camera and synchronizes the notes directly to the computer (“Moleskine - Smart Writing Set”, n.d.). Previously, Moleskine was operating solely in the traditional stationary market, selling paper notebooks. Similarly, the subsidiary of the utility provider Électricité de France, Edison Energia S.p.A., has recently introduced a “Smart living box” to the market, which allows consumers to control their home appliances through their smartphones (“Edison Offerte e Servizi”, n.d.). Other home appliance firms, such as Samsung and LG now offer all-encompassing smart-home systems, rather than individual appliances, and the Google home assistant likewise taps into home networks in order to control home appliances (“The easiest way”, n.d.; “Home as a new hub”, n.d.; “Get More Done”, n.d.; “Hands-free help”, n.d.). As such, these products are revolutionising a whole market. Inspired by such examples and after having reviewed the existing literature, we noted we could fill in two important research gaps by:

- 1) systematically collecting the main opportunities and challenges coming from the commercialization of SCPs
- 2) exploring the implications of such commercialization on the architecture of an existing business models.

With regards to the first research gap, only a handful of studies have pointed towards the business opportunities that the commercialization of SCP offers (e.g. Dawid et al., 2017; Allmendinger & Lombreglia, 2005; Smith, Maull, & Ng, 2014; Vendrell-Herrero, Bustinza, Perry, Georgantzis, 2016), however these insights are highly fragmented and scattered throughout various literature streams. Similarly, other researchers point at some recurring challenges coming from the introduction of a smart product, but do not address these

challenges in a systematic way (e.g., Bilgeri & Wortmann, 2017; Allmendinger & Lombreglia 2005; Dawid et al., 2017; Vendrell-Herrero et al., 2016; Chesbrough, 2007). To address this research gap, we thus provide a critical review of the literature and identify the main challenges and opportunities that are associated with the introduction of SCP.

With regards to the second literature gap, reviewing previous research led us to conclude that the introduction of SCP, with its challenges and opportunities, can fundamentally change the way the company creates, delivers and captures value. The question thus arises how exactly the introduction of SCP alters the incumbent's business model, that is, how are the individual components affected. Literature on this issue is scant. In this thesis, we have identified a handful of studies that explore the link between technological innovation and business model change. These studies, however, do not look at the commercialization of this new technology within smart products, but mainly focus on the employment of the technology within the firm, such as in production lines (e.g. Kiel, Arnold & Voigt, 2017; Onar & Ustundag, 2018) or in the digitization of processes. Hence, even though the scholarly discussion on Business Model Innovation (BMI) and related fields such as servitization and digitization is rich, there is a clear literature gap with respect to the peculiarities of shifting into the smart products industry. Most notably, Onar and Ustundag (2018) coined the term smart and connected business models, but only few others describe the BMI dynamics with the introduction of SCP. Yet, given the challenges and, more importantly, the opportunities of smart, connected products, an assessment of the process of business model innovation in this context is desirable. Therefore, this thesis aims at closing these two literature gaps to simplify managerial choices and to advance the theoretical understanding of how the introduction of new technologies, such as smart, connected products (SCP), affects incumbents' existing business models.

1.2 Research Questions

To address the first research gap that we identified, we aim to shed light on the following question:

- (1) *What are the challenges and opportunities faced by companies that attempt to introduce smart, connected products into their offering?*

This will allow us to collect, from the reviewed literature, a synthesized and comprehensive overview of the most cited challenges and opportunities for businesses associated with the introduction of SCP.

Building on this newly gained insight, we take a closer look at the business models of those companies which introduced smart, connected products in their already established offering. At this point, literature has focused either on effects of technology on business models when employed within the firm, such as in the production line (e.g. Kiel et al., 2017; Onar & Ustundag, 2018), or on the emergence of digital marketplaces and e-commerce (e.g. Mezger, 2014). However, the repercussions of smart connected technology embedded in consumer products are scarcely researched. Therefore, secondly, we will answer the question of:

(2) How does the introduction of smart, connected products affect the company's original business model architecture?

To address this question, we chose a qualitative approach, purposefully selecting companies which did not originally commercialize tech-products. This enables us to highlight potential difficulties emerging from the commercialization of a tech-product. Throughout the work we will refer to these companies as smart, connected product *sellers* to distinguish them from manufacturers of technological components, as well as companies which employ smart technologies in their production line.

1.3 Outline of the Work

We will first review the relevant literature about business model innovation and smart, connected products, and then arrive at the necessary working definitions for terms where consensus is missing in the literature thus far. The literature review also establishes the required connections between the aforementioned academic research fields in order to provide a theoretical underpinning for the relevancy and interpretation of the case study.

Towards the end of our literature review, we will summarize and systematically collect the opportunities and challenges related to the commercialization of smart, connected products. To do so, we will deduct opportunities and challenges from relevant studies investigating the relationship of digital devices with features of the Internet of Things (IoT), smart, connected products (SCP), and servitization, with business models. With this step, we will be able to already answer the first research question, while starting to build a working

ground to close the second literature gap by identifying particular areas of interest to be explored in our case studies. In order to answer the second research question, and to untangle the complex interdependence between a technological innovation such as that of SCP and business model innovation, we will first collect the relevant data through in-depth interviews, which are presented in Chapter 4. Then, based on a combination of the literature review and the analysis of case studies of companies with SCP in their product portfolio, we will compare our findings of recurrent challenges and opportunities faced by the case firms with the challenges and opportunities suggested by literature. At the same time, we will use the case studies to try to assess which of the business model components are most commonly affected by the introduction of SCP. Furthermore, given the existence of a certain degree of complementarity among the different elements of the business, we will attempt to establish how the architectural components might change with the introduction of the smart, connected product.

By the end of this work, we aim to have explored the effect that a newly commercialized smart, connected product is having on the process of BMI and to provide a basis for future exploratory studies on smart and connected business models.

1.4 Contributions and Research Limitations

By answering these questions, we contribute to the literature on BMI, by looking at the specific pathway which involves the commercialization of a technological product. We are therefore enriching a rather limited research field regarding the effects of technology on BMs. Moreover, we show how opportunities stemming from the commercialization of smart, connected products are mirrored by challenges, which require managerial attention. This finding is of extreme relevance for practitioners from different industries. Since the success of SCP ventures will highly depend on the capability of capturing value from all the opportunities, while dealing with their challenging aspect, we are introducing a tool of analysis for their innovation projects. With our discussion, in fact, we are warning managers and entrepreneurs venturing into this particular technological innovation of the double-edged facets of the commercialization of SCPs. In particular, we have identified organizational inertia and other organizational challenges as opposing the opportunities arising from new market positioning. When analyzing themes highlighted by the literature in our case studies, we found the organizational processes and dynamic capabilities are of particular importance to firms when undergoing BMI driven by the commercialization of smart, connected products.

Our cases particularly highlighted the need for agile project management teams and adaptability of processes. This is reflected in the practical framework which we provide in order to dimensionalize the different capabilities which the firms employ in order to deal with BMI in their particular situation. Managers can henceforth use this framework as a starting point to assess the nature of their own SCP development project. Of particular importance in this regard are the complexity of the partnerships emerging from SCP production, the creation of a more flexible supply chain, the need to rethink marketing campaigns to provide the customer with the right understanding of the product and the market creation stemming from the servitization of the value proposition.

With the use of some successful case studies and the aforementioned framework we have therefore contributed to the discussion on smart and connected business models, which could lead to the reconceptualization of the ways of doing business in a plethora of industries.

Despite our thorough analysis of the qualitative data available for this discussion, we deem it necessary to highlight that our research is presented with some boundaries. First and foremost, we carried out an exploratory study which assesses the BMI in their ex-post nature without analysing the causality mechanism that could have led to a particular change. Based on the reviewed literature, we explored some propositions by analysing the before and after pictures of some case companies. However, our understanding is specific and limited to the particular sample of companies at stake. Therefore, our findings are not generalizable, and the boundary of our work is drawn at providing suggestions for managers which particularities of their business are likely to be affected when venturing into SCP.

2. Business Models: Definitions, Complementarities and the Missing Link to Technological Innovations

The purpose of this and the following chapter is to provide a thorough analysis of the concepts and frameworks which will set the theoretical base for our dissertation. We will proceed first with a review of the business model and business model innovation concepts. We will also provide an overview of previous studies undertaken with regards to technological innovation and its interplay with business models. This will lead to us pointing at the gap in the existing literature and explain our choice to narrow down the analysis of BMI to the context of smart, connected products in Chapter 3.

Thus, the main goal of the first chapter of the literature review is not only to provide a solid theoretical underpinning for the approach and analysis of this study, but to justify the relevance of this thesis by clearly identifying missing pieces in literature so far. The analysis of the research gap is performed in paragraph 2.4, where the gap on the commercialization aspect in the BMI literature is addressed. In Chapter 3 the research gap is further narrowed down to the SCP context.

2.1 What are Business Models and why are They Important?

“A business model describes the rationale of how an organization creates, delivers, and captures value.” - Osterwalder & Pigneur, 2010

The effort companies exude to unlock value from new technology has enriched the research regarding business models (Teece, 2010; Wirtz, Pistoia, Ullrich, & Gottel, 2016). In particular, Chesbrough and Rosenbloom (2002) refer to the role of the business model as an intermediary element of transforming technical inputs into economic outputs. Therefore, the business model allows access to the value potential embedded in a new technology and consequently shapes the market outputs. Teece (2010) agrees by claiming that without a well-developed business model, innovators will not succeed in either delivering or capturing the value behind their innovations. In addition, Zott et al. (2011) point out that business models act as connecting ground between the firms' innovative technology, the target consumers, and key company resources. Therefore, to develop the proper business model is deemed as a

necessary step for the successful commercialization of innovations (Teece, 2010; Chesbrough & Rosenbloom, 2002). Moreover, a strong business model can be seen as a source of competitive advantage (Zott, et al., 2011). When a business model is correctly used, it forces managers to rigorously think about their business (Magretta, 2002) by identifying its core activities, partners and processes. Indeed, it is through a good business model that the consumer is provided with a compelling value proposition and that the entrepreneur is led to capture a portion of the value created (Teece, 2010).

The initial development of a business model for new ventures is extensively discussed in the literature (Morris, Schindehutte, & Allen, 2005; Petrovic, Kittl, & Teksten 2001; Teece & Linden, 2007; Linder & Cantrell, 2000). For the purposes of this master thesis however, we will mainly focus on companies which have already developed a business model and have faced some ex post restructuring of its components. In fact, the architectural challenges of a business model are not a one-time-only obstacle for companies, as the development of a viable business model is a continuous task. Hence, for a business to sustainably capture value over time, fundamental differences vis à vis competing firms have to be constantly reinforced. BMI is the most effective way to decrease the chance of imitation as it provides differentiation in the way the company will structure its value creation, delivery and capture mechanisms (Teece, 2010; Teece & Linden, 2017; Linder & Cantrell, 2000).

The term business model was first used by Bellman, Clark, Craft, Malcolm, & Ricciardi in 1957 (Osterwalder, Pigneur & Tucci, 2005). Few years later, it appeared for the first time in the abstract of a paper in the Accounting Review where Jones (1960) discussed the relevance of computer technologies in the field of business sciences for the decision-making practices. Afterwards, “business model” as a concept started to be more and more used in the 1980s, when business analysts, encouraged by the diffusion of IT tools, used the concept to model costs and revenues of any proposed business (Saxona, Doodhar, & Ruohonen, 2016). With the internet boom, the term “business model” was one of the most popular buzzwords (Magretta, 2002) and gained wider popularity in the mid-1990s and early 2000s with the rise of e-business ventures. In that period, academics started to define the concept and create proper taxonomies for e-business models (Timmers, 1998).

In their literature review, Zott et al. (2011) further identify three silos of research on the topic of business models. The first emerged from the reconceptualization of doing business in the dot-com era and therefore mainly refers to e-business and the use of information technology in the organizations. A second branch of literature discusses the strategic issues as

value capture and value creation, firm performances and competitive advantage. The third - perhaps most relevant for our discussion - looks at business models as a unit of innovation.

Before narrowing the attention to business model innovation, we would first like to pick a working definition of business models. Table 1 presents a collection of business model definitions and underlying components proposed by various scholars.

Table 1: Selected BM Definitions and Related Components

Author	Definition	Components identified.
Hamel (2000)	[A] business model is simply a business concept that has been put into practice. [...] comprises [of] four major components: Core Strategy, Strategic Resources, Customer Interface, Value Network. [...] There are four factors to consider in determining the wealth potential of any business concept: [...] efficient [...] unique [...] fit of the elements of the business concept [...] and] profit boosters.	<ul style="list-style-type: none"> - customer interface - core strategy - strategic resources - value network <p>In his visualization,</p> <ul style="list-style-type: none"> - customer benefits - configuration - company boundaries <p>act as links between the 4 main business model components.</p>
Osterwalder and Pigneur (2010)	A business model describes the rationale of how an organization creates, delivers, and captures value.	<p>Business model canvas is a tool of 9 building blocks used to describe the BM:</p> <ul style="list-style-type: none"> - value propositions - customer segment - channels - customer relations - key activities - key resources - key partners - cost structure and revenue stream
Wirtz et al. (2016)	“a business model is a simplified and aggregated representation of the relevant activities of a company. It describes how marketable information, products and/ or services are generated by means of a company's value-added component. In addition to the architecture of value creation, strategic as well as customer and market components are taken into consideration, in order to achieve the superordinate goal of generating, or rather, securing the competitive advantage.”	<p>Spectrum of the components:</p> <ul style="list-style-type: none"> - Strategy - Resources - Network - Customers - Market offering (value proposition) - Revenues - Service provision - Procurement - Finances
Saebi, Lien, and Foss (2017)	“the firm's value proposition and market segments, the structure of the value chain required for realizing the value proposition, the mechanisms of value capture that the firm deploys, and	<p>In the general architecture of the Business model the following are identified:</p> <ul style="list-style-type: none"> - value proposition - market segments it addresses - structure of the value chain - mechanism of value capture

	how these elements are linked together in an architecture.”	
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As Table 1 illustrates, no generally accepted definition of the term “business model” has emerged. Notwithstanding the lack of a general agreement, it is now possible to identify some common themes in the literature on the topic:

- business models are emerging as a new unit of analysis
- business models are used in a holistic approach to explain how firms “do business”
- firms’ activities play an important role in the conceptualization of business models
- there is much more emphasis on the value creation aspect, than on value capture, when reviewing business models.

Moreover, according to Foss and Saebi (2017), despite the differences across studies, the most recent definitions tend to be consistent with Teece’s (2010, p.172) definition of a business model as the “*design or architecture of the value creation, delivery and capture mechanism*” of a firm.

Given their nature of the unit of analysis, business models are frequently expressed by subordinate components. Several authors attempted to map the business model literature along the business model (BM) component dimensions (Wirtz et al., 2016; Shafer, Smith, & Linder, 2005; Morris et al. 2005). In their paper, Saebi et al. (2017) conclude that the literature is converging in the recognition of “*the firm’s value proposition and market segments the structure of the value chain required for realizing the value proposition, the mechanisms of the value capture that the firm deploys, and how these elements are linked together in an architecture*” (p. 568).

For the operational purposes of this work, it is important for us to have both a working definition and a set of components of BM, since we want to explore the impact of changes on a specific component on the overall model. We believe Osterwalder and Pigneur’s (2010) component selection provides a straightforward yet complete picture of business models. It is possible to identify the key core business elements around the central value proposition, and, at the same time, grasp the financial sustainability of the venture, all in a clear architecture. Therefore, we will from now on refer to this specific conceptualization of BM both for the definition and the components’ identification.

2.2 The Importance of Business Model Innovation

The introduction of new technologies, such smart, connected products are likely to affect the existing business model of incumbent firms. Chesbrough and Rosenbloom (2002) highlight that only in some instances a new innovation can fully be employed in a business model already familiar to the firm. In most cases the business model will need some restructuring in order to comply with the new circumstances brought in by the technological innovation.

Hamel (2000) claimed that with the modern economy, the unit of analysis of innovation is rather found in a business concept than in a product or technology per se and that the business concept innovation is the main determinant of competitive advantage. As a matter of fact, “the same idea or technology taken to market through two different business models will yield two different economic outcomes” (Chesbrough, 2010, p. 354). Therefore, the extreme relevance of business model innovation stems from the idea that even a small change in the business model can have a major impact on profitability (Linder & Cantrell, 2000). The benefits stemming from such innovation are superior to those of other innovations, especially when looking at the advantages related to imitation. There is indeed much more complexity in the imitation of a BMI set of activities than in product imitation. Nevertheless, the potential added value behind business model innovation is often an underutilized source of value (Verma & Bashir, 2017). A clearer understanding of the dynamics behind BMI could help ventures to take on their rivals. To this end, a clear conceptualization of what BMI entails is essential – see Table 2 for an overview of key BMI definitions.

Table 2: Selected BMI Definitions

Authors	Definition
Mitchell and Coles (2003, p.17)	“By business model innovation, we mean business model replacements that provide product or service offerings to customers and end users that were not previously available. We also refer to the process of developing these novel replacements as business model innovation.”
Johnson, Christensen and Kagermann (2008, p. 64-65)	“1. The opportunity to address through disruptive innovation the needs of large groups of potential customers who are shut out of a market entirely because existing solutions are too expensive or complicated for them. [...] 2. The opportunity to capitalize on a brand-new technology by wrapping a new business model around it (Apple and MP3 players) or the opportunity to leverage a tested technology by bringing it to a whole new market (say, by offering military technologies in the commercial space or vice versa).

	<p>3. The opportunity to bring a job-to-be done focus where one does not yet exist. That's common in industries where companies focus on products or customer segments, which leads them to refine existing products more and more, increasing commoditization over time. A jobs focus allows companies to redefine industry profitability. [...]</p> <p>4. The need to fend off low-end disruptors. [...]</p> <p>5. The need to respond to a shifting basis of competition. Inevitably, what defines an acceptable solution in a market will change over time, leading core market segments to commoditize. [...].”</p>
Gambardella and McGahan (2010, p. 263)	“Business-model innovation occurs when a firm adopts a novel approach to commercializing its underlying assets.”
Casadesus-Masenell and Zhu (2013, p. 1)	Business Model Innovation is “the search for new logics of the firms and the way to create and capture value for its stakeholders; it focuses primarily on finding new ways to generate revenues and define value proposition for customers, suppliers and partners”
Khanagha, Volberda, and Oshri (2014, p. 324)	“Business model innovation activities can range from incremental changes in individual components of business models, extension of the existing business model, introduction of parallel business models, right through to disruption of the business model, which may potentially entail replacing the existing model with a fundamentally different one.”
Foss and Saebi (2017, p. 201)	Business Model Innovation as “designed, novel, non-trivial changes to the key elements of a firm’s business model and/or the architecture linking these elements”

However, the lack of a unanimous definition of business model is rendering the conceptualization of BMI difficult (Foss & Saebi, 2017). Ultimately, we concur with Foss and Saebi’s (2017) definition of BMI as “*designed, novel, non-trivial changes to the key elements of a firm’s business model and/ or the architecture linking these elements*” (p. 201). We do so for two reasons. First, the definition is in line with prior literature that conceptualizes BMI is a more holistic form of organizational innovation (Foss & Saebi, 2017; Voelpel, Leibold, & Tekie, 2004) and thus is distinct from the traditional forms of process and product innovation (Verma & Bashir, 2017). Second, the conceptualization of business model as an architecture of linked elements serves the purpose of our study, i.e. to assess which architectural BM components change with the introduction of smart, connected products. The architecture of a firm’s business model refers to the linkages between the business model components and thus leads to the issue of complementary, which we will discuss in the next section.

2.3 The Problem of Complementarity in BMI

In our thesis we aim to explore how the introduction of a new technology affects the existing business model; that is, how it alters the components and linkages between, which leads to BMI. Thus, the complementarity among the different BM components is key in the process of BMI. Therefore, we need to understand how different degrees of complementarity among the components can impact the overall BMI process. For this purpose, we refer the work by Foss and Stieglitz (2015) who dimensionalize BMI along the dimensions of depth and breadth of change – see Table 3. The resulting four types of BMI imply different levels of complementarity, which we will explain in more detail below.

Table 3: Dimensionalizing BMI (adapted from Foss & Stieglitz, 2015)

Breadth of BM changes \ Depth of BM changes	incremental	radical
modular	continuous BMI	ambidextrous BMI
architectural	evolutionary BMI	revolutionary BMI

The authors' starting point is that the complex architecture of BM is fundamentally supported by a system of complementarities between the constituting elements. Such complementarities can therefore constrain BMI to different levels. Here, depth of BM refers to changes along a more incremental or radical spectrum, while breadth of changes indicates whether the changes are modular (contained to one element) or architectural (affecting the BM in its entirety). As a result, 4 main types of BMI are identified.

- 1) a continuous BMI will be related to incremental changes in some specific components of an existing BM. The value proposition and core elements of the BM do not undergo any substantial change, but the modular component at stake evolves towards superior levels of efficiency and performances.
- 2) an ambidextrous BMI is a radical change which happens within the boundaries of a specific modular component of the BM. It is therefore possible to witness changes at a value proposition or a target consumer level which obviously have their repercussions on the modular components changed.

- 3) an evolutionary BMI is incremental in that it does not affect the key company value proposition or the customers segments but being architectural in nature it impacts the value creating and capturing activities.
- 4) a revolutionary BMI sees the most radical revolution of a BM in that implies new business models with new sets of activity systems which were not part of the previous way of doing business of the company.

For the purpose of our case studies, we intend to use this typology by Foss and Stieglitz (2015) in order to dimensionalize the BMI of the different cases companies accordingly.

As a matter of fact, from the various definitions of BMs and the components' identification, we can deduct that the degree of complementarity among the different elements presents challenges when it comes to innovating. The severity of such challenges depends on the degree of innovation the BM will undergo (Table 3). Arguably, the challenges become more severe as depth and breadths become larger. For example, coordination becomes more critical when the breadth of changes is predominant, while learning and experimentation are necessary capabilities when the depth of innovation invalidates prior knowledge (Foss & Stieglitz, 2015).

Therefore, the problems of complementarity in the context of BM gives rise to managerial and organizational challenges when it comes to BMI. First and foremost, the complexity and intertwining of BM components makes it hard to forecast the effects of changes. Hence, the impossibility to make ex ante predictions of results further builds uncertainty. Business models can be seen as architectures where maintaining coherence to let the different elements fit together and realize potential is a complex task (Santos, Spector & Van der Heyden, 2009). We will therefore refer back to this section when examining the case studies to see how different degrees of depth and breadth of BM changes in our cases led to different outcomes.

Related to the problem of complementarity is inertia, which is mentioned in the literature as detrimental for the success of any innovative process (Hannan, 1984). In fact, the degree of inertia, which characterizes business models, is caused by the existing set of complementary elements in the established business model. This is also referred to by Teece et al. (1997) as *stickiness*, namely a firm's choice towards a certain organizational and managerial setup, which influences their future ability to change. Change might not be possible immediately and changes are always connected to a slowing down in efficiency, the more so the more drastic the changes. The rationale of such contrasting force stems from the success

of the current model and the uncertainty coming from changes. Moreover, in order to achieve the non-trivial changes characterizing BMI, sporadic innovation will not suffice.

On top of this, the accountability of innovation is another challenging element of BMI. Foss and Stieglitz (2015) discuss how the massive organizational change of BMI has implications on the role of managers, too. Chesbrough (2007) identifies the *leadership gap* as one of the complications of BMI. Indeed, oftentimes there is no specific management figure at a corporate level with the authority and the capability to innovate the business model. At a top management level, most of the actors have reached their current position and level of responsibility by executing within the current business model. For this reason, the incumbent BM represents a familiar architecture for them. All in all, this contributes in the nature of inertia being detrimental for BMI. In a later paper, Chesbrough (2010) suggests that conferring authority within the hierarchy for experimentation can rejuvenate traditional business models and help overcoming some barriers to BMI.

All of these challenges which appear in the process of BMI can be overcome when there are the right capabilities to approach innovation and change.

2.4 Business Model Innovation and Dynamic Capabilities

The degrees to which venturing into BMI will result in a success and to which different areas of the business model are affected depend on a specific set of capabilities the firm owns. According to Teece et al. (1997), the possession of dynamic capabilities is a critical success factor to implement BMI. For this reason, in the following we will elaborate some key points of the dynamic capabilities perspective. This will provide a more drilled down view-point on processes and activities within the business model perspective. While addressing our case studies, we will look at how companies which are in possession of the right capabilities might more promptly engage in BMI.

The dynamic capabilities perspective puts forward the argument that a firm's management needs to have certain capabilities to use the firm's resources and assets to their full potential. Indeed, dynamic capabilities help cast a holistic view onto competitive advantage (Teece et al., 1997). In contrast to the classical resource-based perspective by Barney (1991), where resources act as the sole prerequisite for comparative advantage, dynamic capabilities are here the driver of competitive advantage. Teece et al. (1997) further elaborate by saying that succeeding firms have "timely responsiveness and rapid and flexible product innovation, coupled with management capability to effectively coordinate and

redeploy internal and external competences” (p.515), in addition to resources. The dynamic capabilities view thus provides the appropriate angle in order to analyze the more intangible underlying mechanism *within* the firm, which allow for successful changes to business model.

Teece et al. (1997) argue that managerial and organizational processes, consisting of business routines, are what defines dynamic capabilities. They further identify three main roles of these processes, which can be summarized in a simplistic way as:

- **coordination/ integration** (managerial coordination of internal & external business activity)
- **learning** (employment of systems for collaboration between individuals)
- **reconfiguration & transformation** (sensing of need for asset structure reconfiguration and subsequent efficiency in adopting new processes and technologies)

Teece (2007) later developed this into what is now the most commonly accepted framework of dynamic capabilities, with capabilities consisting of “the capacity to (1) sense and shape opportunities and threats, (2) to seize opportunities, and (3) to maintain competitiveness through enhancing, combining, protecting, and, when necessary, reconfiguring the business enterprise’s intangible and tangible assets.” (p.1319). This also shows the emphasis on exploiting the benefits of opportunities, which is contrasting the otherwise commonly held perception of opportunism as a risk (Leih, Linden & Teece, 2015).

In our work, we will investigate the case study firms’ capabilities along the three pillars and point out what role capabilities versus resources play in the commercialization of technological innovation.

There are quite a number of authors and articles which analyze firms through the application of Teece’s framework and try to point out the particular and more distinct nature of the organizational processes (e.g. Kindström, Kowalkowski, & Sandberg, 2013; Achtenhagen, Melin, & Naldi, 2013; Boly, Morel, & Camargo, 2014; Mezger, 2014). For example, Mezger (2014) applies the dynamic capabilities view on a study in the German publishing industry, where technological change has brought about a rapid change in the value creation and capture structures of the market. Boly et al. (2013) even generate and quantitative indicator of the innovation capacity of firms, based on the idea of dynamic capabilities.

Scholars seem to agree that when a firm is able to efficiently manage these organizational processes, it will have success in implementing business model innovation (Teece et al.,1997). In other words, firms with dynamic capabilities are “adept at anticipating

and exploiting the opportunities created by technological innovation” (Day & Schoemaker, 2016, p.59). The elaboration of dynamic capabilities has been important to provide a theoretical structure to unravel the capabilities companies need to have in order to tackle this deep innovation to their organization and activities.

2.5 Technological Innovations and Their Influences on Business Models: Previous Studies and Literature Gap

Few authors have undertaken studies to evaluate the influence of technological innovation on business models specifically. A search on Web of Science and Ebsco Business Source Complete generated a total of 127 articles when searching for the key words “business model” and “technological innovation”; with combinations of “methodology” and “explorative study” as indicators to filter out mere literature reviews or theoretical works. The further filter settings were:

- Document type: Article
- Category: Management, Business, and Operations Research Management Science
- Language: English
- Year: 2000 - 2018.

The last filter was chosen because, when talking about technological innovation in today’s sense, we are looking at what Porter and Heppelmann (2014) call the third wave of IT-driven innovation, which started with the rise of the new millennium. This type of technological innovation is about “embedded sensors, processors, software and connectivity in products, coupled with a product cloud” (Porter & Heppelmann, 2014, p.3). This list of articles was further streamlined by checking for relevance by reading titles, abstracts and conclusions, filtering most importantly for studies that were looking at effects on business models of incumbent firms primarily. This then left us with a list of just 11 articles of which we could retrieve the full text (the full list and summary of these articles can be found in Appendix A).

The articles identified in this manner look at business model innovation from a number of different angles and perspectives. For example, some have looked at different types of innovation and their influences on a ventures success or failure. The importance of business model innovation, much rather than the innovation of technology itself, was found to be determining the success of the venture (Tongur & Engwall, 2014). Moreover, there is an argument for viable business models to be based on technological innovation and service innovation in conjunction (Tongur & Engwall, 2014). Unfortunately, this particular study

focuses on a very specific type of firm and fails to convincingly make generalizations of technological implications that go beyond the specificity of the studied industry. The service innovation element is also found in a study where the case companies were purposefully engaging in BMI to uncover revenue opportunities from servitization (Raja, Frandsen, & Mouritsen, 2017). When moving to the service-based approach, there is the emergent need of utilizing organizational capabilities, because companies are engaging in activities that lie outside of their core activities.

In some of the other articles we found explanations of BMI from the perspective of both technical innovation (Calia, Guerrini, & Moura, 2007; Sainio, Ritala, & Hurmelinna-Laukkanen, 2012) and organizational innovation (O'Connor & Rice, 2013; Mezger, 2014; Karimi & Walter, 2015; Sainio et al., 2012).

For example, technology-oriented companies, which are usually dealing with product innovation more often, are keener to develop a deep BM radicalness, which is comparable to the capability to move towards BMI (Sainio et al., 2012). A thorough change of BM can also happen if the company engages in innovation leading to drastic changes in the key partners and relationships. In this case, change in the BM is brought about by entering a technology innovation network of partners, which will provide new resources and competences to the firm (Calia et al., 2007). Therefore, joining innovation networks is a possible driver of BMI (Mezger, 2014).

On the side of the discussion on BMI led by innovation at an organizational level, dynamic capabilities seem to play a major role. A study on the publishing industry illustrates the importance to first align a company's organizational elements before engaging in BMI. In particular, the effects the specific technology was found to have on the existing BM demanded specific organizational processes and routines to support the BMI transformation, which ultimately led to organizational restructuring (Mezger, 2014). It goes without saying that managerial choices and processes are fundamental in the development of a BM which can support the introduction of breakthrough technologies (O'Connor & Rice, 2013). Therefore, especially when facing digital disruption, the management has to be ready to intervene and employ dynamic capabilities to face the challenge of the drastic digital change (Karimi & Walter, 2015).

Another stream of articles focuses on the difference in BM development when particularly innovative technologies are involved (e.g., see Dmitriev, Simmons, Truong, Palmer, & Schneckenberg, 2014; Flammini, Arcese, Lucchetti, & Mortara, 2017; Wu, Ma & Shi, 2010). For instance, the linear BM development, in which there is first a design phase and

then an implementation phase, is insufficient in the case of commercialization of innovation. Indeed, the peculiarity of a partially digital product implies that BM development should happen through iterative and cyclical phases (Dimitriev et al., 2014). The cyclicity of iterations is also required in the specific case of commercialization of new disruptive technologies (Flammini et al., 2017). Moreover, such technologies can give an advantage to latecomer firms, which decide to engage in what they call a secondary business model innovation. From an already developed business model, companies can therefore innovate and tailor their business model to fit a different customer segment (Wu et al., 2010).

The peculiar technology of the Internet of Things (IoT) is also assessed for its implications on industrial production (Kiel et al., 2017). In this case, the IoT is more narrowly defined as Industrial Internet of Things (IIoT) and it can give a productivity boost to the BM of established manufacturing companies. This new technology applied to production lines gives rise to recurrent challenges and opportunities for these manufacturing companies. Moreover, some BM components are particularly affected by the introduction of these IIoT products, which are comparable to what we will discuss in this work as smart, connected products. Therefore, it has already been established that this technology affects value proposition, key activities, key resources and customer relationships when introduced on the production side of a firm.

The few articles discussed in this chapter are looking at business model innovation caused by technological innovation, however, there is still a lack of understanding of the business model innovation processes which follow the attempt to commercialize innovation. Even though there are sporadic studies undertaken in this respect (e.g. Dimitriev et al. 2014; Flammini et al., 2017), most business model literature looks at technological innovation disregarding the commercialization viewpoint.

In parallel to the stream of literature in this paragraph, where the link between technological innovation and BMI is explored, we found articles following the discussion on how IoT and SCP (Porter & Heppelmann, 2014) are reshaping competitive dynamics and leading to BMI. This same technology is also discussed in the stream of literature on the Industry 4.0¹ such as the study by Kiel et al. (2017), who also point out how this technology

¹With the term Industry 4.0 we are referring to the current industrial transformation through the utilization of automation, data exchange, cloud computing, IoT and semi-autonomous processes which speed up the processes of manufacturing and give birth to smart industries. For further reading, please refer to the introductory chapters of Onar and Ustundag (2018).

is reshaping the production side of BM. By further researching the combination of topics (BMI, SCP and IoT) we discovered few more articles pointing to the same direction (Ehret & Wirtz, 2017; Tesch, Brillinger, & Bilgeri, 2017). Still, just like with the previously reviewed 11 articles, we did not find literature assessing the commercialization aspect of this technological dimension.

Whilst this trend towards implementing digital components into the product offering has been recognized in descriptive literature (e.g. Porter & Heppelmann, 2014) explorative studies have yet to be undertaken to properly understand BMI in this particular commercialization context.

We have therefore decided to focus on the specific technology highlighted here to understand how its commercialization affects business models, in order to fill in this literature gap. On the one hand, we will contribute to the literature on BMI by exploring the effect of introducing a new technology to the underlying architecture of a firm's existing business model. On the other, our findings will result in beneficial advice to those companies upgrading their BM and trying to unlock value from a new technology, such as SCP. To properly introduce the concept of smart, connected products, the following chapter discusses some commonly found descriptions on this type of products in the literature, and the used terminology. We then provide an exploration of SCP as a driver for BMI, as well as a collection of associated opportunities and challenges.

3. Commercializing, Smart Connected Products: Opportunities, Challenges, and Their Effect on Established Business Models

In Chapter 3 we will establish why we have decided to look at SCP commercialization as a particular driver of BMI. First and foremost, in section 2.5 we found that extant literature has not sufficiently addressed the effect of technological innovations on incumbents' existing business models. To understand this effect, we focus on the example of smart, connected products because comparable technologies have been already assessed for their effect on the production side of a BM, but not on the commercialization side. To this end, we will firstly define this new product category (see 3.1.1). Secondly, to understand the effect of SCP on BM, we also need to draw on the intertwined literature concepts of digitalization and servitization. This review allows to gain a better understanding of the peculiar aspects that incumbents need to consider when venturing in the SCP industry and the opportunities and challenges that SCP implies for incumbents (see 3.2). In particular, we will try to clarify the intersection between business model innovation and smart, connected products literature, which is also called *smart and connected business models* by Onar and Ustundag (2018). Lastly, as there is a significant lack of academic research on the link between introducing and commercializing SCP and business models, we develop theoretically driven propositions on how the introduction of SCP is likely to affect certain components of the BM (see 3.3). We will use these propositions later on in our exploratory study.

3.1 Defining Smart, Connected Products

So, what are smart, connected products? Currently there are many corresponding and related terms used in the literature, describing similar phenomena, but yet scholars are not quite arriving at consensus, using some overlapping and exchangeable definitions. This is not surprising, as the accumulated literature in the field is only just growing alongside the constantly turning wheel of smart, connected product innovations. However, it is important to be clear about the definition, as different features and capabilities of products provide grounds for a variety of different implications on the underlying business model.

A search conducted via Web of Science (as of September 2017) revealed only three articles containing *smart, connected products* in their title, two of which were sister articles by Porter and Heppelmann (2014, 2015), published in the Harvard Business Review. Far more commonly used terms are smart products (118 articles), connected products (92 articles), and

the internet of things (1,620 articles). An overview of selected definitions is provided in the following table (Table 4).

Table 4: An Overview of Used Definitions on The Internet of Things, Smart Products, and Smart, Connected Products

Author (Year)	Term used	Definition / Description
Porter and Heppelmann (2014)	smart, connected products	<ul style="list-style-type: none"> • Smart, connected products have three components, reinforcing each other's capabilities and value: physical, smart and connectivity components. • 4 categories of abilities, of which products can possess just one or up to potentially all four. Each category requiring the previous one as a premise: <ul style="list-style-type: none"> ○ Monitoring (can alert to changes in circumstances or performance) ○ Control (remote control and algorithms for executing actions) ○ Optimization (use historical data to improve output, utilization, and efficiency) ○ Autonomy (eg. autonomous product operation, self-diagnosis, or adapt to user preferences)
Rijsdijk and Hultink (2009)	smart products	<ul style="list-style-type: none"> • smart products are products that contain IT, and therefore are able to collect, process and produce information, and "think" for themselves. • products possess one or more of a range of abilities, referred to as "product smartness": autonomy, reactivity, multifunctionality, ability to cooperate, human-like interaction, personality
Mani and Chouk (2017)	smart products	<p>smart products have</p> <ul style="list-style-type: none"> • sensors (collect data about the environment) • actuators (activate an action, controlled by some other entity) • network connectivity (eg. wifi, bluetooth or RFID)
Kortuem et al. (2010)	smart objects	autonomous physical / digital objects augmented with sensing, processing and network capabilities
Kortuem et al. (2010)	internet of things	loosely coupled, decentralized system of smart objects
Allmendinger and Lombreglia (2005)	connected products	<p>connected products can</p> <ul style="list-style-type: none"> • capture and report on operation, performance and usage • self-optimize or allows for monitoring, troubleshooting, repairing and maintaining • be upgraded through upgrade applications • coordinate the sequenced activity of several devices • monitor variations in location, culture, performance, usage and sales of a device • monitor consumption and buying patterns of the end user • track and optimize the service support system
Adams (2017)	internet of things	<ul style="list-style-type: none"> • networks of networks • devices can autonomously communicate within these networks and other devices for functions such as gathering and analyzing data

Hoffman and Novak (2015)	smart products	products that interact and communicate with themselves and each other, and with humans on an ongoing basis by sending and receiving data through the internet that is stored and organised in a database
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While reviewing the different definitions we have noticed how certain expressions might lead to confusion. Take for example, the *Internet of Things*, or in short, IoT. It seems to be the best-established term in the field of smart and interactive devices. Most of the literature referring to the IoT focuses on the interconnectedness of products through a network, as well as the consequent collection, exchange and analysis of data (e.g. Perera, Ranjan, Wang, Khan, & Zomaya 2015; Kortuem, Kawsar, Sundramoorthy, & Fitton, 2010), as the word “internet” would suggest. Some definitions of the IoT, however, go beyond mere data analytics. They add attributes like intelligence and even personality to the definition of the IoT (e.g. Russo et al. 2015; Rijdsdijk & Hultink, 2009).

We would like to argue that products possessing these additional components make up an entirely new generation of products. Porter and Heppelmann also specifically claim that the two terms of the IoT and smart, connected products cannot be assumed synonymous, because the capabilities of smart, connected products far exceed a mere connectedness over the internet and have a major impact on competition (Porter & Heppelmann, 2014).

When trying to separate these terms, it becomes apparent that product capabilities are where the true difference lies. One of these capabilities is *E-diagnostics*. It refers to a collection of data which serves as an additional business opportunity to extend services around the products to consumers in the aftermarket (Lee, 2003). For Allmendinger and Lombreglia (2005), the core of E-diagnostics is the prevention of a product’s failure through the inherent ability of the product to capture and communicate data by itself. The authors use the terms *smart service* and *connected device*, pointing towards how digital extensions of products can be understood as services. Just a year after the article by Allmendinger and Lombreglia (2005), Rijdsdijk and Hultink (2009) already have a much closer understanding of the smart, connected product to the one Porter and Heppelmann (2014) will later describe.

Rijdsdijk and Hultink (2009) define product *smartness* to describe the capabilities which set smart products apart from non-smart products. In their study on consumer’s perception of smart products, *smartness* was defined by one or more of seven product abilities: “autonomy, adaptability, reactivity, multifunctionality, ability to cooperate, humanlike interaction, and personality” (Rijdsdijk & Hultink, 2009, p.3). In this framework, a product is classified as possessing smartness, if even one of these abilities is present. Some of these features clearly

constitute service features that replace human administered services. For example, abilities such as autonomy and reactivity imply some sort of programmed intelligence, which enables the product to act independently from immediate human instruction. Abilities such as human-like interaction and personality even act as a proxy for a real person and can be found in recently popular assistant devices such as Amazon's Echo ("Das neue Amazon Echo", n.d.) or the Google Home ("Hands-free help", n.d.).

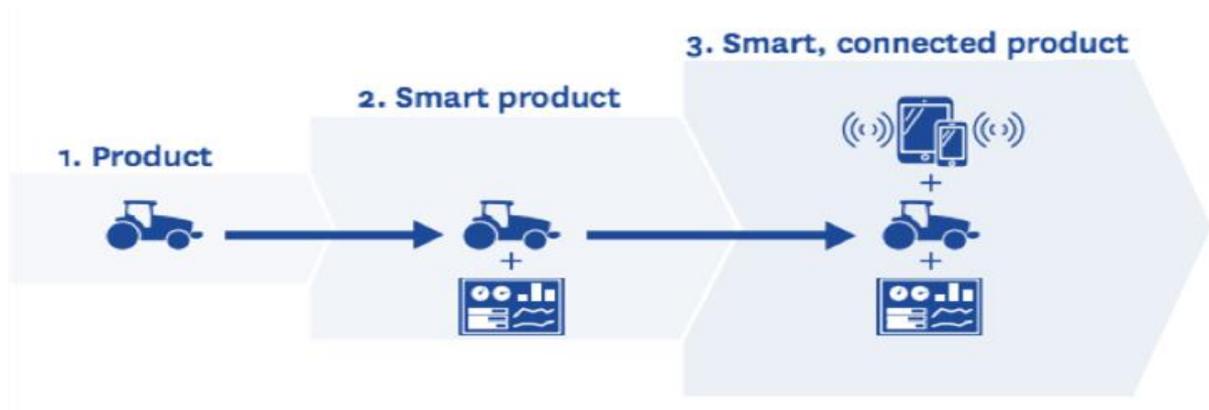
Kortuem et al. (2010), similarly to Porter and Heppelmann (2014), use the term *smart objects* to describe products which have sensors and connectivity to networks, and can process things autonomously. Autonomy is here established through the analysis of data performed by the product. The authors also find these smart objects to be the building blocks of the Internet of Things. This is consistent with Porter and Heppelmann (2014), who show how multiple smart, connected products can act together as product system or system of systems, and hence can be understood as synonymous to the Internet of Things.

The differences in approach of Lee (2003) and Allmendinger and Lombreglia (2005) versus Rijdsijk and Hultink (2009) and Kortuem et al. (2010) show how different authors place different emphasis on either the *smartness* or the *connectivity* components. However, for Porter and Heppelmann (2014) both are essential to the smart, connected product in their own right. The authors also acknowledge how smart and connectivity components of such products are distinctive features, which increase the value of the physical product. They find "smart components amplify the capabilities and value of the physical components, while connectivity amplifies the capabilities and value of the smart components and enables some of them to exist outside the physical product itself." (Porter & Heppelmann, 2014, p.5). This is illustrated in their article as shown in Figure 1. The tractor stands for the simple, non-smart, non-connected product, i.e. a product without any of the abilities described by Rijdsijk and Hultink (2009). In contrast, a smart product might just as well possess all of the abilities that they mention, as long as they are achievable through sensors and software within the product itself. In Porter and Heppelmann's (2014) view however, the absence of connectivity will drastically limit the scope of the product's abilities. The difference lies in the products' ability to communicate with other devices or the cloud, symbolized in Figure 1 by the tablet and smartphone surrounded by signals. The consequent data exchange is what enables a whole new range of abilities. Hence, there seems to be an important difference between smart products and smart, connected products.

This clear distinction is not yet shared among scholars. Some authors like Mani and Chouk (2017) arrive at a similar product definition after citing Porter and Heppelmann

amongst others. Their definition of products includes sensors, actuators and network connectivity, yet they call them just “smart products”, despite including the connectivity aspect.

Figure 1: Components of Smart, Connected Products. Adapted from: Porter and Heppelmann, 2014



Porter and Heppelmann (2014) also offer a classification of abilities which they attribute to smart, connected products. Namely, the authors establish four categories: monitoring, control, optimization, and autonomy abilities (see Table 4 on p.21). These four ability types exist in a strong dependency relationship. As can be seen in Figure 2, the monitoring ability is the only one which does not require other abilities as facilitator. The abilities of control, optimization and autonomy build upon each other and can be thought of as levels of abilities. With this scheme Porter and Heppelmann allow for smart, connected products to just be equipped with monitoring capabilities (similar to the e-diagnostics and maintenance concepts by Lee, 2003, or Spring and Araujo, 2017) but at the same time acknowledge that smartness and connectivity can be exploited for a much larger range of abilities.

Figure 2: Four Ability Categories of SCPs. From: Porter and Heppelmann, 2014.



The previous discussion shows how, over just the course of ten years, the idea of smart products and their abilities has evolved drastically. This consistent change in terms used

reflects this and also shows how responsively the literature had to readjust and distinguish between the quickly arising differentiation of different product functionalities.

We can observe a shift of focus in the terms. In the late 90's to early 2000s the emphasis laid on the ability of products to gather data in order to support and improve the way firms provided services in the aftermarket. The then arising term of the IoT drew focus to the products ability to interconnect with each other. Now, a larger focus lies on the product's ability to analyse, and sometimes act, autonomously- the so-called product smartness - which takes connectivity as a premise. The terms chosen by the authors are, however, sometimes misleading and used almost interchangeably.

Based on this analysis of literature we found that Porter and Heppelmann (2014) have the most wholesome idea of what smart, connected products constitute. In our working definition, we therefore want to stay close to that definition. We remain at the stance that smart, connected products must have physical, smart, and connectivity components. Different from Porter and Heppelmann's (2014) definition however, we argue that products must at least be equipped with the ability-level of control from Porter and Heppelmann's taxonomy of abilities, in order to be considered smart and connected. We still see the abilities of optimization and autonomy as optional, in line with Porter and Heppelmann. We can therefore arrive at the following working definition:

Smart, connected products are physically manufactured products that have the ability to connect to networks, exchange and analyse data autonomously, that can communicate and interact with the physical environment, and that can be remotely controlled and personalized.

3.2 SCP as a Driver of BMI

In the last 30 years we witnessed a shift in firm's focus with respect to their offering. Many firms started to put more emphasis on service components and the importance of the physical product sales went down in their overall revenue structure (Smith et al., 2014; Cook, Bhamra, & Lemon, 2006). This process is called "servitization". Vandermerwe and Rada (1988), who first coined the term, saw it as the process of adding services to products. Baines, Lightfoot, Benedettini, and Kay conclude in their 2009 literature review on servitization that it "*is the innovation of an organisation's capabilities and processes to shift from selling products to selling integrated products and services that deliver value in use.*" (Baines et al.,

2009, p.563). An almost identical perspective within the servitization literature focuses on so called “product-service systems” (PSS), which embody a hybrid between products and pure service offerings, where traditional product and service jointly create value (Cook et al., 2006). In this field, servitization is also called product-service transition, or for short, P-S transition (Smith et al., 2014). An article by Tukker (2004) shows that the rise of product-service systems is very much connected to newly emerging business models, which allow the capturing of value and competitiveness. This is so because product-service systems allow for an orientation towards integrated customer solutions, the building of closer customer relationships and a subsequent capability to innovate faster.

More recently, this shift in firm’s value offering has been spurred by the emergence of new digital technologies. In fact, the term ‘digitalization’ refers not only to the shift from analogue to digital products but describes the more fundamental effects on the ways in which firms can create value (Hagberg, Sundstrom, & Engels-Zandén, 2016). Thus, some authors use the term ‘digital servitization’ to refer to the embedding of digital services within a tangible product (Vendrell-Herrero et al., 2016). They point out that smart, connected products are essentially the vehicle through which firms can embed digital services into their products. However, for firms setting out onto the process of servitization or digitization it will quickly become evident that this process comes at the price of adding a lot of complexity to the business operations. Therefore, it becomes clear how smart, connected products are very much an instigator of BMI.

Allmendinger and Lombreglia (2005) find that connected products can set in motion the development of completely new markets. Porter and Heppelmann similarly argue, in their 2014 and 2015 papers in the Harvard Business Review, that SCP “reshape industry boundaries” and “alter the nature of competition”, which asks for a “new set of strategic choices related to how value is created and captured” (Porter & Heppelmann, 2014, p.4). The gathering of large quantities of data, which needs to be managed and regulated, is an instigator of changes in the company. However, it is not the only trigger, as all the business functions are affected by SCP (Porter & Heppelmann, 2015). Lee (2003) especially emphasizes the necessity of reviewing the business model in order to improve customer solutions. Smith et al. (2014) similarly find that firms must adjust underlying operational processes when moving towards the establishment of product-service systems. This clearly calls for companies to review their business model when they move through the digital servitization process.

While it has largely been established that innovation is considered a main necessity for sustaining competitive advantage (Porter, 1990), SCP are “raising the bar in terms of best

practices” (Porter & Heppelmann, 2014, p.14), and therefore engaging in the digital servitization transition constitutes a much higher degree of change in the business model than just engaging in innovation activities with regards to technological development. Therefore, smart, connected products provide an interesting and dynamic environment to study BMI in. However so far, literature is lacking a detailed view of the linkages between SCP and BMI. Even though there is a recognition of the relevancy of smart, connected products within the servitization field, scholars such as Spring and Araujo (2017) fail to consider the repercussions that offering other service features in products can have on business models as a whole.

What we do see is an open discussion on topics such as the Industry 4.0 and the Internet of Things, where scholars have started devoting attention to linkages between business model innovation and digitalization (Onar & Ustundag, 2018). In particular, there is a branch of the literature which focuses on the analysis of the impact of the Industrial Internet of Things (IIoT) on business models (Ehret & Wirtz, 2017). In this case, the focus is on the transformations which occur in the manufacturing pipelines due to the introduction of the IIoT. As a matter of fact, the worldwide connection of the IIoT transforms manufacturing from a stand-alone activity to a connected and integrated system of activities. A further step on the assessment of the effect of the IIoT on business models of established manufacturing companies is taken by Kiel, et al. (2017). Their business level analysis takes a sample of 73 German manufacturing companies and examines the most relevant changes on the BM components as identified by Osterwalder and Pigneur (2010). Kiel et al. (2017) build a relational model between the different business model components to show how the effect of the IIoT has consequences on the different BM elements of the tested firms. Results show that, at least from an IIoT perspective, value proposition, key activities, key resources and customer relationships are the most affected elements following the introduction of the IIoT in the manufacturing lines. With the model by Kiel et al. (2017), the BMI is seen from the perspective of the companies which introduce smart products in their production line.

Even though the topic of IIoT is largely discussed and of great relevance in current markets, and its influence on business models has started to be investigated (e.g. Porter & Heppelmann, 2014; Kiel et al., 2017; Ehret and Wirtz, 2017), what is still lacking is a clear understanding of the BMI dynamics when companies want to embed SCP in their offering, rather than in the back-end of the firm.

As more and more firms decide to utilize digital innovation in traditionally non-digital end-consumer products, this topic deserves similar attention in the literature as the IIoT and the Industry 4.0, for which this thesis is meant to provide a starting point. In the following

chapters and paragraphs, we will therefore lay out a basis for the discussion of SCP's effect on business models by identifying opportunities and challenges for firms in the field, as well as discussing the changes in components of the business model architecture apparent in our case study firms.

3.3 The Opportunities and Challenges of Introducing SCP

Given that innovating a business model is a challenging task (e.g. see sections 2.1 to 2.3), we want to clarify what opportunities the introduction of SCP into an existing business model might entail but also which challenges it implies. That is, does it make sense for an incumbent firm to adopt SCP into its business model? To be able to assess the most recurrent opportunities and challenges, we have collected and evaluated the most perseverative issues from the literature and synthesized relevant concepts mentioned by more than one scholar. We provide a full overview of the opportunities and challenges identified in the literature in Appendix B and summarize the key insights in the section below.

Interestingly, we found that for each identified opportunity coming from the SCP commercialization there is a mirroring challenge. Hence, we have summarized these dichotomies in the following table (Table 5).

Table 5: Mirroring Opportunities and Challenges at the Introduction of SCP

Opportunities	Challenges
Establishing new markets/ strengthening the market position	Process ownership (leadership gap)/ organizational inertia
Relationship beyond point of sale	Privacy concerns and the need to have a common standard
Gaining customer insights	Develop data analytics for customer insights
Value co-creation: closer customer relationship	Value co-creation: customer value awareness
Amplification of the value proposition through servitization	Intricacy of the supply chain: new partners & activities
New pricing models	Setting the optimal pricing strategy

The first opportunity we identified in the compiled literature is the possibility to establish new markets or strengthening the market position (Dawid et al., 2017). This is possible via the fundamental change in value proposition, which occurs with the servitization and the direct interaction with the customer. SCPs deeply change the rule of engagement with the consumer and for this reason unveil new market segments. Take for example Google's new series of home assistants (Google Store, n.d.). Google's mission, to manage the world's information and make it universally accessible and useful ("Our company", n.d.), is now enhanced by the home assistants. The consumer can now talk to a device to get access to the world's information, and this has opened up a completely new market of home appliances. The challenging element emerges from the idea that entering new markets or strengthening the market position is an opportunity companies will not be able to take if not capable of overcoming two main organizational challenges: organizational inertia (Hannan, 1984; Teece, et al., 1997; Chesbrough, 2007; Allmendinger & Lambreglia, 2005) and the leadership gap (Chesbrough, 2007). As far as the former is concerned, processes of organizational change are path-dependent and slow. Managers, comfortably working with a well-functioning BM, might fail in supporting the risky changes that a jump into a digital segment imply. The latter, the leadership gap, stems from the fact that managers will have to take a vast array of decisions, with far-reaching implications for the entire organization, even in the case in which there is lack of clear responsibility and establishment of process ownership (Bilgeri & Wortmann, 2017; Dawid et al., 2017). Both challenges can be highlighted as a further obstacle to commercialize SCPs.

Secondly, while with the traditional commercialization of a product the seller loses direct access to the item at the point of sale, with smart, connected products there is a stretch of business opportunities for the seller that goes beyond the sale (Dawid et al., 2017). Companies can take advantage of monitoring the product life in order to offer maintenance and replacement services, or alternatively monitor the patterns of product use. The challenges related to this issue are mainly concerning privacy and the lack of a shared regulatory framework and standard for these new digital services (Dawid et al., 2017). Regulations tend to geographically differ hence the biggest SCP sellers will have to lobby for the creation of a common ground of regulations to deal with these challenges.

Thirdly, with the never-ending stream of data that these devices collect, businesses can gain insights into their consumers' preferences and habits. This allows to further streamline R&D activities and to obtain almost instantaneous feedback (Allmendinger & Lombreglia,

2005; Spring & Araujo, 2017; Porter & Heppelmann, 2014). The relevance of data is predominant in that it decreases the information asymmetry between the consumer and the seller, enabling firms to have much more predictive and bargaining power (Vendrell-Herrero et al., 2016). The drawback lies in the lack of competencies in data-mining these companies might have. The huge quantity of unstructured data - the Big Data - a SCP collects, requires sophisticated data analysis and electronic intelligence, which the company has to acquire or develop (Bilgeri & Wortmann, 2017; Allmendinger & Lombreglia, 2005; Sprig & Araujo, 2016).

Fourthly, the controversial topic of value co-creation is addressed in literature (Allmendinger & Lombreglia, 2005; Smith et al., 2014). On the one hand, the interaction that occurs even after the sale between the company and the consumer enables the firm to get feedback on the products and enhance the possibility to fine-tune the value creation with the customer need (Vendrell-Herrero et al., 2016). On the other, Smith et al. (2014) underline how the company delivers a product that has an inner value. However, this value is not realized until the consumer properly uses the product. Therefore, the value co-creation stems from the value in use. Similarly, Dawid et al. (2017) highlight how bridging the interface gap between a less visible technology of SCPs and the user's unawareness of its potential applications is the largest challenge for SCP sellers.

Fifthly, the servitization sphere allows to amplify the value proposition (Allmendinger & Lombreglia, 2005; Spring & Araujo, 2017). The service dimension given to the physical products enhances the experience (e.g. by providing for capabilities in routine maintenances, or by offering services on demand). Most of the services are provided via applications for digital devices and are often reliant of the support of third-party providers (Dawid et al., 2017; Allmendinger & Lombreglia, 2015). Therefore, it is highly likely to face the challenge of a very intricate supply chain (Bilgeri & Wortmann, 2017; Vendrell-Herrero et al., 2016; Dawid et al., 2017). New activities and new partners emerge with the SCP commercialization as a direct consequence of the digital and service element which enriches the value proposition. Much more interdisciplinarity emerges in R&D activities (Allmendinger & Lombreglia, 2005) and companies often tend to partner with suppliers or developers which do not necessarily belong to the same industry (Dawid et al., 2017).

Lastly, companies can experience the opportunity to engage in new pricing models (Dawid et al., 2017). For instance, a twist to the business model can be given by adding value capturing opportunities via premium services available as download. We can exemplify by referring to an insurance company which via smart, connected cars can customize the

insurance premium to the driving habits of the specific client. The not so obvious challenge stems from the difficulties faced in achieving an optimally efficient pricing strategy. We have already mentioned the potential lack of customer's value awareness (Dawid et al., 2017). In the same way a customer might not realize the value in use, she might fail to see the customer surplus and consequently lack the right willingness to pay for the SCP. Yet, the company, faced with the additional costs of development and production, will want to give a premium price to its SCPs (Vendrell-Herrero et al., 2016, Dawid et al., 2017).

With a clear and comprehensive picture of the challenges and opportunities, we now have the foundations to map our expected findings for the case studies.

3.4 Propositions: The Effect of SCPs on BMI

Based on our review and discussion of extant literature, we found no single study that clearly delineates how the introduction of a novel technology, such as SCP, effects the components and underlying architecture of incumbents' business model. However, by synthesizing the various insights, we develop five propositions on how SCP is likely to affect BMI. Later on, we will use these propositions as starting point of investigation in our case studies (Chapter 5). In the Discussion section (Chapter 6), we will compare the case-study evidence with the expectations we formed by reviewing the literature.

3.4.1 The Servitization of the Value Proposition

Many studies and articles in the reviewed literature assume changes in the business model to be largely set in motion by a change in value proposition, which stems from the extension of the physical product through digital components (e.g. Dawid et al., 2017; Dmitriev et al., 2014; Porter & Heppelmann, 2015). Firms must pay attention to how they communicate the benefits of the digital extension of the product in a way that makes the customers realize its value. The new value is usually not encapsulated with the old value proposition, which causes an alteration of it (Porter & Heppelmann, 2015). Furthermore, since there is a new value provided, new customers may be attracted and new market segments might be formed. This can be seen, for example, in the emergence of the connected home systems, which connect multiple home appliances in one network. In such new market, consumers shop for all-encompassing home systems providers, rather than individual

appliances. The first proposition that we would like to investigate and compare with our case studies is therefore:

Proposition 1: The introduction of SCP facilitates the development of new value propositions, which can lead to the opening up of new consumer segments and markets.

3.4.2 A Different Nature of Customer Relationship: The Double-Edged Sword of Value Co-Creation

A number of authors point towards the deeper interaction with the consumer stemming from opportunities of increased consumer data, which pushes businesses to rethink their rules of engagement with the target group (Dawid et al., 2017; Vendrell-Herrero et al., 2016; Allmendinger & Lombreglia, 2005). Value co-creation, as well as the involvement of consumers in the product development processes, are named repeatedly as a possible outcome of such a reshaping of business-consumer relationships (Allmendinger & Lombreglia, 2005; Smith et al., 2014, Mezger, 2014). In section 3.2 we have seen how value co-creation, intended as correct realization of the value in-use, can also represent a challenge for the company. Indeed, there is some hardship in enabling the customer to properly use the SCP. Businesses are stuck in the middle between the opportunities coming from the customer involvement, with the feedback this activity enables, and the challenge to let the customer achieve the right value in use, which requires a much more involved communication of product specificities from the company side. Businesses are prompted to face the challenges of involving consumers, collecting their feedback and constantly update the production process with such information.

Proposition 2: The introduction of SCP enables the company to establish a feedback loop and a closer, more involved relationship with their consumers. Value is co-created provided that the customer is fully aware of the product potential.

3.4.3 The Intricacy of the Supply Chain

This constant customer feedback loop is proposed by the literature to increase the speed at which market insights can be transferred to be of use for R&D departments. Hence, the traditional product development becomes more dynamic. The supply chain has to be more flexible to leave space for upgrading the product components and the R&D teams are subject to higher interdisciplinarity (Dawid et al., 2017). Furthermore, on many occasions, companies

have to cooperate with players in unrelated industries and engage in completely new key activities which were not part of their previous core business.

Proposition 3: The introduction of SCP demands changes in the value chain with regards to R&D processes and external sourcing.

3.4.4 Revised Revenue Model and Cannibalization Concerns

Moreover, as suggested by Dmitriev et al. (2014), the commercialization of technology innovations can lead to revised revenue models. Other authors have pointed out how, in the case of SCP, this mainly manifests in new revenue sources after the point of sale (Dawid et al., 2017). In addition, changing the offering of an established venture by means of SCP can actually impact the profitability of the previous line of business. For example, Greenstein (2010) mentions how SCP can threaten to cannibalize traditional products by delivering superior digital services. When a company decides to introduce a smart, connected product offering in parallel with the non-smart products it already has in the market, the demand for the latter might be significantly affected.

Proposition 4: The introduction of SCP opens up new sources of revenue and pricing strategies. In some cases, cannibalization concerns have to be taken into account.

3.4.5 Organizational Learnings/ Dynamic Capabilities

Lastly, as the business experiences changes during the transition towards smart, connected products, managers need to be able to adapt alongside. This can be a challenge, especially for more senior management (Allmendinger & Lombreglia, 2005), for whom the previous *modus operandi* has produced good economic results. This problem of inertia is also addressed by Teece et al. (1997), and Hannan (1984).

Moreover, the BMI dynamics push towards fundamental changes in core resources used. Specifically, Kiel et al. (2017) address in their study the changes occurred in the knowledge resources as an effect of the industrial internet of things, particularly referring to data as a new core resource. Mezger (2014) makes a similar observation but keeps it more general when identifying technology knowledge as the new key resource. Since this concept highlights how knowledge that is already present in the firm gains relevancy as it is utilized throughout the BMI process, this idea is linked to the concept of dynamic capabilities. One

element of this is the idea of adapted organizational processes and learning. Hence, BMI in the face of SCP seems to be enabled by dynamic capabilities, rather than resource superiority. With respect to all these issues highlighted in the literature, we can pose the following proposition:

Proposition 5: Successful and efficient BMI in the face of commercializing SCP stems from the firm's ability to leverage their dynamic capabilities.

These propositions posed in this chapter act as guidelines for our case studies and will be either supported or weakened by the following analysis of the interviews in Chapter 5.

4. Methodology

In this section, we provide a description of how we decided to structure our research. We first describe the purpose of the thesis and the consequent choice of the research method. Then we explain our research strategy by presenting the main steps of analysis: literature review, building case studies, and lastly, the case study analysis. As a last step in this chapter, we will assess the validity, generalizability, reliability and ethics of our research method.

4.1 Purpose of the Thesis and Choice of Methodology

Our thesis aims to answer the questions of *What are the challenges and opportunities faced by companies that attempt to introduce smart, connected products into their offering?* and *How do these challenges and opportunities affect the company's original business model architecture?* We thus aim to explore the innovation to the business models of established companies, which introduce a smart, connected product.

Given the nature of our research questions, it is more suitable to broadly investigate and discuss the relevant research fields, rather than to attempt to apply quantitative measurements. Following the guidelines by Saunders, Lewis and Thornhill (2009) we have found that the purpose of answering our questions is best met by an exploratory qualitative study. Indeed, we aim to research new insights within the boundaries of BMI literature and find out which are the repercussions of embedding of SCP in the BM architecture.

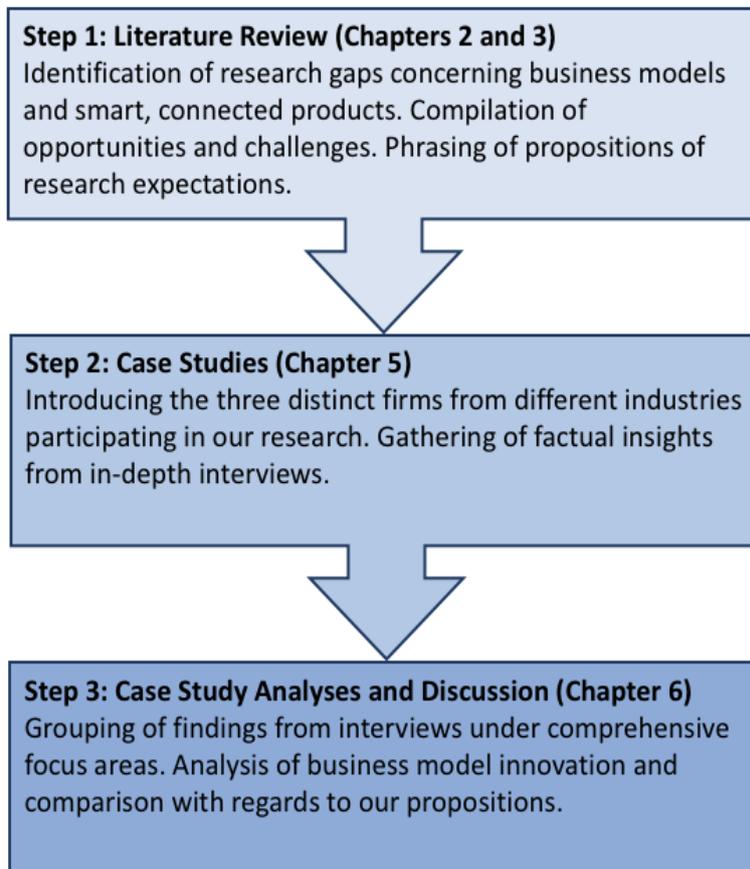
As far as our research strategy is concerned, we combined a thorough literature review with qualitative case studies. We did so as case studies are widely found in qualitative studies because they are versatile and allow for adaptation to conditions (Guest, Namey & Mitchell, 2012). This choice of approach is also particularly suitable to our research since with our first research question we want to uncover the related contextual conditions of each case and with our second question we explore *how* a particular innovation impacts the BM architecture. Moreover, we will not be able to manipulate the behaviour of individuals participating in our study, since we will examine their decisions *ex-post*. Lastly, the phenomenon of BMI is, in this case, so intertwined with SCP introduction that it is hard to set clear boundaries between the context and the phenomenon, which also makes a case study approach the most suitable (Yin, 2003).

We collected primary data by interviewing experts on the subject matter, as suggested by Guest et al. (2012), who identify in-the depth interview as a main data collection tool for

case studies. Acquiring data from multiple sources is a choice which follows Robson's (2002) definition of case studies, where the author outlines how multiple sources of evidence are required to enhance the legitimacy of the findings. This is called 'triangulating sources', which helps to reach a higher level of reliability in our qualitative study (Saunders et al., 2009).

4.2 Main Steps of the Research Process

Figure 3: Main Steps of the Research Process



A structured process of our research strategy is visualized in Figure 3. The first step consisted of the literature review, which served to gain an understanding of the research already conducted in the related contexts and to highlight those recurrent challenges and opportunities related to BMI in the case of the commercialization of SCPs. This will ultimately lead to the formulation of expectations on our research phrased in a few propositions. This literature review can be found in

Chapters 2 and 3 of this thesis.

In step 2, we explored three company projects by means of in-depth interviews in order to build the specific case studies.

At last, in step 3 the findings of the case studies have been analysed and confronted with the initial expectations we had formed via the propositions coming from the literature review. The similarities or discrepancies of the findings will help us to highlight some focus areas in the BM architecture for SCP sellers. In the following we provide a more detailed description of the individual steps.

4.2.1 Literature Review

Prior to designing our research questions, we needed a clear understanding of the existing literature on business model innovation. As a first step, it was important to (a) deeply understand business models and business model innovation as concepts, and to (b) gain an overview of already existing research on the effects of technological innovations on business models. We discovered that there is no relevant literature on the pathways of business model innovation in the case of technology commercialization. Given the comparability of the Industry 4.0 technologies and smart, connected products (Russo et al., 2015), we decided to investigate the impact of their commercialization on existing BM.

Once the research question was articulated as in section 1.2, we expanded our literature review in a second step to include articles which provided a taxonomy of what constitutes smart, connected products. The literature review was conducted mainly utilizing *EBSCO Business Source complete*, *Web of Science* and *Google Scholar*. Based on the review of these pillars of literature we were able to derive working definitions for *business model* (BM), *business model innovation* (BMI), and *smart, connected product* (SCP). We were also able to identify multiple studies of different types of technology, other than smart, connected products, bringing about changes in business models.

Building on these studies, we collected the opportunities and challenges of SCP commercialization in one organic discussion. We first collected evidence of the discussion on the subject and then reviewed the works for the most recurrent arguments and classified them in a table as in Appendix B. This step was meant to answer the first research question in section 1.2 and to set the basis of identification of some focus areas in our case studies.

With a clear understanding of the available literature on the topic and a clear picture on challenges and opportunities, we drew some propositions as in section 3.3. The propositions were meant to guide us in the exploratory work.

4.2.2 Case Studies

Interview Guideline and Proposition Testing

An interview guideline was developed and send to the interviewees in advance. In line with the pertinent methodology suitable for on in-depth interviews, questions have been formulated to be open-end in order to give the interviewee the chance to elaborate and therefore, to really reach content depths with their answers. The interview guideline was developed based on a review of relevant studies, which informed the formulation of research

propositions. According to Maxwell (2012), stating propositions about a research subject, whilst constructing the analysis, is common practice in quantitative research.

The propositions guided the formulation of the different question blocks in the interview guideline. The questions were developed to support or weaken the propositions.

Criteria for Choosing Companies & Experts

Criteria for selecting companies for an initial invitation to join our study were:

- a) they provided a product consistent with our definition of smart, connected products
- b) their product offering had developed from being non-smart to smart, connected (i.e. we excluded companies that started out as sole providers of smart, connected products).

These criteria were chosen in order to secure the same situational environment for all chosen subjects, so to be able to draw conclusions. Companies befitting these criteria were found online. Search strategies included to screen the exhibitor lists of recent technology fairs (for example, CES 2018) and to visit websites of long-established companies expected to engage in smart, connected products (this has mostly been applied to home appliance brands).

Conducting the Interviews

We contacted potential interview partners by emailing via the professional network site LinkedIn. After introducing our project in this way, we explained how the in-depth interview would have taken place and we attempted to schedule some. Given the length of the interview, finding senior managers who were willing to lend us their time was challenging, hence in the end we managed to schedule interviews with 3 companies and build three case studies. The companies interviewed for our case studies were Moleskine, DentiStrong, and TechyToy. In the case of DentiStrong and TechyToy a fictitious company name was chosen in order to protect the companies' identity. Case companies belong to different industries: stationary & leather accessories, consumer healthcare products and games & entertainment. Our interviewees were managing respective SCP commercialization projects within these firms. Managers were chosen for their particular insights and larger perspective on issues which might arch over multiple departments, which is crucial for the nature of our questions on changes in the business model. An overview of these details can be found in the following table (Table 6).

Table 6: Interviews Overview

Company	Interviewee	Role in the company	Interview length
DentiStrong	n.a. (under NDA)	Associate Director R&D and Engineering	90 min
Moleskine	Federica Dogliani	Digital Specialist	45 min + extra time for follow up questions (15 min)
TechyToy	n.a. (under NDA)	Previous Marketing Manager	60 min

The interviews were conducted as semi-structured phone interviews. Given the goal of maximising the depth of responses, the interviews were characterized by use of inductive probing, taking the answers of respondents as base for new questions. Therefore, deviations from the interview guideline were not only appropriate but purposefully engaged in.

4.2.3 Case Study Analyses

The preliminary step of our interview analysis was to transcribe the audio file from our interviews. Despite following a rather unstructured flow of questions during the interviews, we restructured the answers according to the interview guidelines to better discuss certain topics. In this way, all the transcripts have the same structure and enhanced comparability. The draft of the transcription was then sent to the managers for approval.

After receiving approval of the interview transcript from our interviewees, we proceeded with the analysis of the findings from our interviews by assessing the impact of the SCP commercialization onto:

- value proposition
- customer closeness
- core resources and external partnerships
- revenue streams and cost structure
- organizational processes and learnings.

We focused on reporting the facts as stated during the interviews and we created a case study with the relevant details for each company.

Only at a later stage, in Chapter 6, we moved to the phase of integration and discussion. In this chapter, we refer back to the case studies, integrate and compare the different business

scenarios, as well as confront the case study findings with the relevant literature discussed in the Chapters 2 and 3.

4.3 Evaluation of the Research Method

4.3.1 Validity

Validity describes the concept of findings really being caused by the apparent and described causes, and not to be confounded by underlying, unrecognized reasons (Saunders et al., 2009). In our case, threats on validity existed mainly with regards to content validity and construct validity.

In our work, content validity is established by carefully and thoroughly reviewing the relevant literature, and then deriving our interview questions from recurring topics from the literature. This way we make sure that the premise of content validity - to adequately cover what the research questions are trying to answer (Saunders et al., 2009) - is fulfilled. Furthermore, we have made an effort to ask multiple questions to shed light on the same issue from different angles, so to make sure to definitely uncover any possibly relevant information on it.

To ensure construct validity, we made sure that our interview guideline is formulated in such a way that the average respondent should be familiar with all terms. We also provided explanations of terms either with the material attached to the guideline, or via verbal explanations and clarifications during the interview, in order to warrant that answers to our interview questions actually refer to the construct which we wanted to measure. The risk of having the interviewee interpreting our questions in a different way than we meant them should be very limited, as we immediately clarified and rephrased questions as soon as misinterpretations from the interviewee's side became apparent during the interview. Furthermore, causal relations between findings and the suggested causes have not been tested specifically, and do not aim to stand against a validity test, since we are not trying to answer any research questions on "why" or trying to identify underlying causes for the findings. Discussions on why some firms might exhibit different characteristics from others are much rather a suggestion to be investigated in further research.

4.3.2 Generalizability

By nature, generalizability of our study is limited, because we only examined three case studies, and therefore it is not possible to deduct generalizable notions as it would have

been when working with larger sample sizes. Whilst our case studies can point towards certain topics and occurrences that might be of interest, within the scope of our work it is not possible to prove against external influences on our case participants which might make them an exception, rather than the rule. Furthermore, we did not work in a “sterile” environment, where an attempt was made to sample firms that only operate within the same conditions, which means that deductions made on differences between the case study firms are for the most part speculative. In this sense, this study does not claim generalizability.

4.3.3 Reliability

Reliability refers to how consistent the findings of our thesis are with regards to data collection and analysis, if undertaken on different occasions or reproduced by other researchers (Saunders et al., 2009). There are four main threats to reliability: participant error, participant bias, observer error and observer bias.

To minimize the threat of participant error (i.e. when a participant gives inconsistent answers due to their emotional state (Saunders et al., 2009), we targeted the interview questions towards facts rather than emotions or opinions. Nonetheless, as we have only interviewed one person per company, the answers might have been biased by a certain subjectivity of the interviewee.

To decrease the risk of participant bias, we offered full anonymization and refusal of answers to the interviewees, so to ensure that participants can answer freely and honestly. Participant bias can occur when this is not given, for example out of fear of retaliation of their superiors (Saunders et al., 2009). Hence, in our interviews participants received full disclosure about the purpose of our thesis, and we tried our best to make them feel comfortable with our questions. Further insights on this is given in the following paragraph on ethics.

We hedged our work against observer error, which refers to systematic errors made by researchers (Saunders et al., 2009), by utilizing a consistent interview guideline for all interviews conducted. We also made records of the conducted interviews from notes and audio recordings alike, which made sure that the interpretation of the interviewees’ statements were not biased by expectations on their answers.

Furthermore, we provided detailed descriptions of our interview findings, to limit observer bias, which is caused by the tendency of researchers as human beings to interpret findings in a certain way, especially with regards to expected or wanted outcomes (Saunders et al., 2009). The detailed descriptions are directly stemming from the interview transcripts provided in the appendix. By first noting down the findings in a factual way, we ensured a

more removed view on the cases, before accumulating them into interpretations and implications. Based on the transcripts and the case description, the reader of this study will be able to clearly comprehend the deduction of interpretations. This is in order to provide transparency on how the raw data has been used to arrive at the findings. Furthermore, since the written interview notes have been sent to the interviewees for checking afterwards, we have employed the tool of informant verification (Saunders et al., 2009) in order to avoid misunderstandings and misinterpretations of their verbal answers.

Reliability is also increased by the cross-checking of analyses and findings between the two students conducting this work, rather than a single person deducting findings on their own, and hence reducing observer bias. Furthermore, observer bias is addressed by discussing and questioning alternative interpretations of our findings in Chapter 5, which sheds light on the reasoning behind interpretations.

4.3.4 Ethics

Lastly, the ethics of conducting this thesis need to be considered. In this regard, we made sure that all interviewees were fully informed about the purpose of the interview, from the first introductory mail onwards, and asked full permission for any audio recordings made and the disclosure of any company names or the names of the individuals interviewed. Furthermore, interviewees had the chance to familiarize themselves with the interview guideline prior to the interview, which allowed for them to prepare and decide which information they felt comfortable sharing. The interview guideline (Appendix C) sent included example questions as well as categories of questions.

Interviewees were also reminded that they should feel free to refuse an answer if they felt that this information would be too sensitive to disclose in a master's thesis. This allowed interviewees to scrutinize the disclosure of information, even for questions that deviated from the interview guideline. The participation of interviewees was fully voluntary.

Upon completion of the interviews, we send the interview notes (as to be published in the appendix of our thesis) to the interviewee for review, to give them the chance to correct or further elaborate on answers given. This ensured also that any misunderstandings were eradicated.

5. Analysis and Findings: Introducing our SCP Sellers

In this chapter we present the cases of three companies defined as SCP sellers. All case study firms currently commercialize a smart, connected product, which has a precedent non-digital version. The BMs in analysis witnessed an innovation, driven by the expansion of the product offering in the SCP field. In the following, we aim to introduce the companies and investigate their BMI by looking through the lens of SCP. For this reason, we will explore the SCP commercialization from the idea to the commercialization and assess the implications on different business model components.

All the data reported in the following section were gathered through interviews, which have been conducted with managers, who are currently, or have been previously, in leading project management roles for such products. Before moving to understanding the details of the different commercialization processes, we will provide an overview of the findings in the following table (Table 7).

Table 7: Summary of Analysis and Findings

	DentiStrong	Moleskine	TechyToy
Value proposition	Value proposition stays the same but extended via the digital components.	Digital components integral to radically new value proposition.	Digital components integral to radically new value proposition.
Customer closeness	Data is not collected. Change in communications on product functionalities. Customer involvement in development phase.	Monitoring of app-usage patterns. Change in communications on product functionalities.	Data is not collected. Change in communications on product functionalities. Independent online community.
Core Resources/ external partnerships	IT-knowledge as fundamental resource. Reliance on already existing network of partners for development of digital component.	Reliance on newly established partner to source digital component. Dedicated digital innovation team to bridge external and internal know-how.	New establishment of partnership triangle with two external partners, who provided digital components. Partnership as Achilles' heel of the project.

Revenues/ cost structure	No major shift. Increased prices due to higher production cost.	No major shift. Increased prices due to higher production cost.	No major shift. Increased prices due to higher production cost.
The processes and learnings	Higher involvement of IT department. Changed processes to align analog and digital product development.	Rethinking of marketing to achieve value in use. Align production cycles of analog and digital components. Small project team.	Superior project management via a small in-house team. Matching process speeds of analogue and digital components.

5.1 Elevating the Teeth-Brushing Experience: A Large Player in Consumer Healthcare

5.1.1 DentiStrong²: The Trusted Brand for Oral Care

The brand has been around for over half a century and is today part of a large consumer goods conglomerate. As such, it is a globally active brand with its mother company's revenues ranging in the multiple billions. The brand offers a range of non-digital oral hygiene products, however is more well known for their more technical applications in that area.

5.1.2 Smart Toothbrushes: Expanding the Experience to the Digital World

The brand has been marketing electric toothbrushes for decades and has in the recent years introduced electric toothbrushes endowed with elevated sensor systems which connect to an app on users' smartphones. The app allows users to monitor their brushing technique and thoroughness. Users can track how much and how often they brushed their teeth, set goals and challenges, or select personalised programs with respect to their individual needs. Users are also given instructions through the app whilst brushing, such as which areas to focus on or to adjust the pressure on the brush, and they can share the information on their oral care habits with their dentist.

² DentiStrong is an arbitrarily chosen fictitious name in order to provide anonymity to the participating company.

The following paragraphs refer to insights gained from an interview, which has been conducted with a high-level manager who has been part of the project management team from the R&D and engineering side on the smart, connected toothbrush pilot project. The interview transcript can be found in Appendix D.

5.1.3 DentiStrong's BMI

Value Proposition

The value proposition of the electric toothbrushes has not been replaced but extended to include the digital and connectivity element. What is still at the core of the value proposition is the superior quality of the brushing mechanism and the brush itself. Whilst the user will be more immersed into the act of tooth brushing as an experience, rather than a chore, the true value added through the toothbrush smartness comes only from a correct use of its functionalities. In fact, the app communicates educational messages to increase knowledge on how to use the product correctly to bring out the full potential of the quality product. By increasing the compliance habit of the consumer, the use and product life of the non-digital components could be prolonged. Therefore, the digital element was never meant to be the core value of the product, but to enhance the value of the non-digital elements. The value proposition of the smart, connected toothbrushes can therefore be seen as an extension of the value proposition of the non-connected electric toothbrushes.

Consumer Closeness

The company did not experience a shift of consumer closeness, or gain particular consumer insights stemming from feedback data, as it was a conscious choice not to collect the data from user's phones. This was mainly due to the risk of consumer sensitivity with regards to data, and also difficulties of compliance with regards to differing data laws across countries.

However, DentiStrong was particularly concerned with getting the consumer's feedback for the development of the product. For this, they involved digital natives from within their company to test the prototypes and track their usage, but also involved their traditional user for feedback, in order to make sure that this particular consumer group saw the benefit of the new product. They also involved digital natives from outside the company, who were able to provide early and valuable feedback particularly because of their familiarity with other smart, connected product systems. This way, these consumers could provide insights on

what they expected from smart, connected products in terms of features, which were then taken into consideration to be transferred to the electric toothbrush app.

In the initial phase of commercialization, DentiStrong experienced a shift in who their consumer was, namely mainly early technology adopters and digital natives, but they did manage to take into account the mass-consumer needs in order to keep successfully marketing to the mass market.

Even though there is no increase of consumer communication to the firm through the product usage, the communication of the firm towards the consumer has gained a new facet through the introduction of the app. The inclusion of educational material and instructions for the consumer make better use and preserve their electric toothbrush adds an extra service element. The provision of extra material to prevent diseases even links in with counselling services usually provided by health care professionals.

Core Resources/ External Partnerships

For the development of the new product, the company relied on a combination of in-house and external expertise, provided by partners. For this project, they needed a partner to provide the software and programming component to the product, namely the app development. The other technological hardware parts were developed by the firm in-house. For finding the software provider, DentiStrong relied on an already existing, extensive ecosystem of partners. Since the business relationships were already developed, and no new partnerships were required for this project, the process of establishing all the necessary organizational components to the product development was very efficient. The company also collaborated with dentists, to provide insights for the enhancement of the digital product. They also relied on dentists and hygienists as influencers and endorsers of the product.

Even though DentiStrong drew on the existing ecosystem of partnerships, they experienced a clearly noticeable shift in importance of IT-knowledge in their organisation. To some extent, knowledge about cloud systems, connectivity, data integrity and safety was much more significant to the firm than before, as this dimension became embedded in the entirety of the product life. For this reason, it was also important to educate the employees of all the departments involved in the product commercialization. For instance, the marketing teams now needed some know-how on software and IT tools, in order to communicate the right message to the customers on the latest digital developments and the new services.

Revenue/ Cost Structure

The company incurred the increases in production cost that naturally occur from the production of the connectivity hardware. DentiStrong rolled over some of those costs onto pricing, which led to the new toothbrushes being priced at a premium point. However, there were steps taken by the firm to diminish the cost increase for the consumer, such as alternating what is included in an individual stock keeping unit, for example by including fewer replacement brush heads. Generally, however, the brand felt that their consumers understood the added value provided by the digital element and received the price well, in the sense that they were willing to pay for it and did not consider the connectivity element as a “gimmick”.

In terms of revenue, the smart, connected toothbrushes have brought higher growth and better profitability, which allowed the brand a certain flexibility with regards to cost structures.

5.1.4 The Relevance of the IT Knowledge and the new Pace of Product Development

Overall, the smart, connected toothbrushes pilot project was handled like any other project within the firm. New processes were only implemented as learnings from the project onto following projects, after the pilot was completed.

The regular approach within the firm therefore dictated to have a team of representatives from R&D, Marketing and Industrial Design, who in part already knew each other from previous projects. The most significant change in team composition lay in the heavy involvement of the IT department. The company also established an “IoT boot camp” as a result and one of the pilot project’s key learnings, to transfer knowledge from the IT department to the other functions involved in the development process. The IoT boot camp teaches topics such fundamentals on digital electronics, cloud architecture and programming in a seminar format.

With regards to processes, it is especially interesting to point out the increased speed of product development in terms of the digital components, which the company experienced. Because of shortened iteration and improvement cycles, DentiStrong was able to cut down prototyping and testing cycles to four weeks, which was a significant decrease compared to the physical products. Even though there was initial discomfort from certain management functions because the previously established 5-step program management process could not be employed in this particular project, the company managed to align the processes between the faster development of the digital apps and the longer lead-time on traditional physical

product components. This ultimately allowed establishment of a lean innovation process, which was afterwards scaled to many other projects within the organization.

Other learnings include how to test, release and certify software updates for the product after the point of sale, the utilization of new due diligence processes and new quality and global requirement documents in consecutive projects, and the implementation of new lifecycle management tools.

To conclude the case of DentiStrong, we highlight the major ‘before and after’ changes in a simplified visualization of the Osterwalder canvas. Elements marked in light blue indicate major changes to the existing business model (Figure 4).

Figure 4: DentiStrong Canvas: Before and After the Smart Toothbrush.

<p>Key partners</p>  <p>BEFORE: the company has an extensive network of partners to support the key activities</p> <p>AFTER: no need to add other partners. The technological components needed are sourced/ developed by the partners in the network.</p>	<p>Key activities</p> <p>BEFORE: the R&D and production of innovative - high quality solutions for oral care.</p> <p>AFTER: no shift.</p>	<p>Value proposition</p>  <p>BEFORE: Dentistrong offers superior quality & technology for the oral hygiene which make the difference in the brushing experience.</p> <p>AFTER: No drastic change, but the experience is enhanced by the digital elements: the app to optimize performances and the cloud to share data with the dentist.</p>	<p>Customer relationship</p> <p>BEFORE: limited interactions typical of consumer goods.</p> <p>AFTER: stronger interaction to teach the consumer how to use the product at its best (educational relationship).</p>	<p>Customer segment</p>  <p>BEFORE: electronic brushes are meant for a predominantly adult target, who demands for a premium brushing experience.</p> <p>AFTER: in the early phase the digital natives were the most responding segment, but with time the electronic brush segment and the smart brush segment became identical.</p>
<p>Cost structure</p> <p>BEFORE: Given the complexity of its world-wide operations Dentistrong has a cost structure comprehensive of R&D costs, production costs, marketing cost, logistics costs, distribution costs.</p> <p>AFTER: no significant shift in the cost structure is highlighted.</p>		<p>Revenue stream</p> <p>BEFORE: The product is priced in a “razor-razorblade” fashion. The electronic toothbrush comes in a starter-pack with the essentials and requires the purchase of replacement components. There are different product lines sold at different price points depending on the product functionalities.</p> <p>AFTER: The smart toothbrush sells at a premium price point with the same “razor-razorblade” model. The app is free.</p>		

5.2 Bridging Digital and Analog to Satisfy a Customer Need: The Smart Writing Set

5.2.1 Moleskine: A Legendary Notebook With a Digital Kick

As a relatively young company, born in 1997 from the efforts of Francesco Franceschi and Maria Sebregondi (Raphael, 2014), Moleskine has evolved quite significantly over the years, moving from being “the notebook company” to having a diversified portfolio offering, which flanks paper products with leather travel accessories and a growing category range of digital products. With its headquarters in Milano, Moleskine Srl acquired the worldwide trademark rights for the brand in January 2007. Given the modest global workforce of 450 employees, it is impressive to see that the Moleskine Group also includes Moleskine America, Inc. (established in 2008); Moleskine Asia Ltd (est. 2011), which controls Moleskine Shanghai and Moleskine Singapore; Moleskine France (est. 2013) and Moleskine Germany (est. 2013) (Moleskine, n.d.).

The original idea behind the brand was to bring the legendary notebooks used by artists and thinkers of the past two centuries, such as Vincent van Gogh, Pablo Picasso, Ernest Hemingway, and Bruce Chatwin back to life. Today, the company’s value proposition is to use the Moleskine objects, both analog and digital to “*connect the owner to a heritage in art, literature and cultural and geographical exploration*”. These objects “*form an ecosystem of tools and services that provide for and connect the visionaries of the past and the makers of the future*” (Moleskine, n.d.). The company adventure in the digital environment already started back in 2012 with a collection released in collaboration with Evernote (McCarty, 2012). Since then, the company has taken a clear path with its *Moleskine+* category, towards smarter products which culminated in the introduction of the Smart Writing Set in 2016 (Davey, 2016).

For the following paragraphs, we are mainly referring to what we learned during an interview with Federica Dogliani. Federica is a digital product specialist for Moleskine and she is currently working in the team which leads the commercialization of the company’s digital product offering from the Milan headquarters. She joined the company in 2016, approximately at the launch of the 1st version of the Smart Writing Set. The interview is fully transcribed in Appendix E.

5.2.2 The Smart Writing System: From Separate Collections to an Ecosystem of Objects

It was in the early 2010s that Moleskine matured the understanding that the habit of taking notes was becoming more digital. Customers were more and more supporting their standard note-taking activities with digital devices and even for those pen and paper lovers, the need of digitalization started to emerge. This perceived need of switching between analog and digital devices was soon embedded in the company's offer. In fact, Moleskine currently sells in three product categories: the paper objects, the accessories and the Moleskine+ category.

The Moleskine+ category was born in 2012 to bridge the analog and digital dimension. The first collection of products in this category was realized in collaboration with Evernote, an app for the storage of notes in a cloud. The line of notebooks designed for Evernote granted access to a premium space on the app storage cloud, hence incentivizing the user to store his paper notes in a digital form by simply taking a picture ("Evernote", n.d.). This product is however quite far from the concept of SCP to which we are referring in this work.

The real innovation came in 2016 with the commercialization of the first Smart Writing Set, which our interviewee defined as the *climax of bridging analog and digital*. The set consists of a smart pen, a smart notebook resembling the shape of a tablet, and an app for digital devices. The first item can digitalize all the segments traced on the specific smart writing tablet. The tablet is a traditional paper notebook, which is endowed with a weft thread, almost invisible to the bare eye, capable of guiding the pen's camera whilst it digitalizes the image or text. The pen first reads what is written or drawn on the paper and then communicates with the app, where then all the notes are stored in digital format. Afterwards, they can be shared and moved seamlessly across other connected digital devices.

This launch represents a significant change for the company in that it not only allowed for truly bridging between analog and digital, but also, to set a change in the traditional seasonality of the products. In fact, the company traditionally only launched special editions of its staple coloured notebooks in collaboration with other well-known brands. With the introduction of the Smart Writing Set the company moved to a reconceptualization of their offer, which is no longer made of single objects, but is comparable to an ecosystem where the objects interact with each other to bridge the pen and paper feeling with the need of the contemporary user to have her creative projects in a digital format.

Since then, different product versions came to market and today, an entire product line is available for the Smart Writing Systems. In the following, we will discuss which changes were deemed necessary to successfully commercialize these products.

5.2.3 The Go-To-Market with a SCP: Moleskine's BMI

Value Proposition

The value proposition of the company has evolved to embrace a new digital element. On the one hand, Moleskine did not compromise on the essence of its value proposition. It was really important for the Italian brand to keep the paper and pen feeling, and all the lifestyle values and archetypes, which were distinctive of Moleskine. On the other hand, it was of essence to create a seamless solution to make the handwriting on paper collide with a potential digital version.

Moleskine wanted to be on the “warm” side of technology by letting the technological element into the analog creative process.

In practice, in order to generate this combination of analog and digital, the company currently offers smart notebook systems (paper product and pen), a series of different applications for digital devices and a series of services, such as a service of printing on demand, to support all the products in the category.

At a value proposition level, it is therefore possible to witness a significant improvement of the consumer experience. The solutions can be combined in multiple ecosystems and generate plenty of opportunities for the consumer.

Consumer Closeness

This wave of digitalization came to Moleskine as a direct consequence of an expressed need of their target customers. Indeed, no significant change happened to the customer group after the Smart Writing Set commercialization. The loyal customers, who were already keen on the brand, found the perfect solution to one of their manifested needs. Of course, the launch of a new product, which is so peculiar, also comes with some resonance in the group of non-customers.

The novelty comes from the two-fold exchange of information among the parties. On one side, the customers are in a much closer relation with the company since there is a monitoring of usage patterns through the products in use. The exchange of information and the data flow is much more significant than it was in the past. The company collects plenty of feedback from multiple sources, such as surveys after the purchase, online reviews of the

product functionality, feedback from the retail channels, however, data is collected also from the apps. On the other side, the company has to more extensively engage in the communication of the right marketing message to its consumers. The product is much more complex than its traditional paper version. Moleskine has to invest more time, effort and money into the right promotional campaigns to convey all the information related to the right use of the product. Similarly, salespeople had to be trained to be ready and assist the consumer in their very first encounter with the smart device.

Core Resources & Activities/ External partnerships

Moleskine has been traditionally cooperating with several well-known brands in the launch of the different yearly collections. With the wish to bridge analog and digital, the company needed partners beyond the pure design phase. A know-how was needed to engage in the digitalization process, which was beyond the “notebook company” core competencies.

As a first step, the company decided to devote a specific team to the Moleskine+ category of products. It was necessary to have dedicated specialists who could work in agility on the project management of a project which required the combination of two production processes belonging to two different industries: the technology of infra rays and the software deployment on one side, and the traditional manufacturing of paper products on the other.

The digital innovation team of Moleskine is a global team consisting of few members: a director of global operations, a manager, a digital innovation specialist in the Italian HQ, and an architect of the digital experience. The team roles are hard to put into simple job descriptions. The complexity of this product development requires them to be involved in all the phases of the product life: from the design to the post purchase monitoring. It is important to understand that the ideation and design is entirely carried out by Moleskine. The company takes care of analysing the data and inputs coming from the consumer and tries to prototype accordingly. Besides the notebook production in its entirety, the choice of materials, shapes and textures is still entirely Italian. However, the feasibility study, engineering and manufacturing of the pen is strongly driven by the key tech-partner, who also carries the software deployment for the apps.

Behind this digital element of the smart writing set is the Korean firm Neolab. The company is highly specialized in smart, connected products, which have different purposes (Neolab, n.d.). For the partnership with Moleskine, the company relies on what is called nCode technology for the functioning of the smart pen on the specifically designed Moleskine paper,

and on its know-how in software deployment to boost the customer experience with the software updates.

After the product has reached the market, it is Moleskine that takes care of monitoring and collecting data from its products after sales. Via the app and through dedicated feedback surveys for the customers, the company is capable of collecting the feedback and eventually propose new ideas for an update of the digital side of the product ecosystem. To perform this data mining, the company has not internally developed specific tools. They perform what is now a key activity by relying on the use of some software suits available in the market. With the data analysis it is possible to gain a clearer understanding of the customer usage patterns and evaluate some product performances. As a consequence, new ideas are generated and then exposed to Neolab, which evaluates the feasibility of the proposals and eventually tries to develop new updated versions of the app or the technology.

Revenues/ Cost Structure

The company did not undergo significant changes in its revenue stream. The digital products have been priced in alignment with the competitor brands and in line with the premium positioning of the brand. Moreover, also the partnership with the Korean Neolab has decreased the risks related to the cost of internal development. Therefore, no significant change occurred to the cost structure.

Despite the fact that there has not been any significant change in the target group, there has been no cannibalization of demand of the analog products. The smart writing set is oftentimes bought by people who still use their notebooks for different purposes, usually related to leisure activities, and purchase the smart writing set for those creative projects which will be shared with other people, in different occasions, with different devices and across long periods of time.

5.2.4 Selling an Experience and Achieving Supply Chain Agility

The introduction of a digital element in what is mainly a paper business still represents a process of learning and growth for Moleskine, which has been having a smart and connected business model for the past two years and a half. We spotted two main focus areas emerging from the interview with the company.

On the commercial side of the business model, the company had to rethink its marketing strategies. The complexity of the technology hidden by the simplicity of a notebook might mislead the customer and deteriorate her user experience. What the company found to

be a successful choice in this regard was the product positioning. In line with the value proposition which bridged digital and analog, but in contrast with most of the competitors, Moleskine did not sell a new technologic gadget. The Smart Writing System is an experience ready to be used. The ecosystem of pen, paper and app is not far from the user experience lived by the consumer prior to the commercialization, when they may have taken notes on paper, and use other external digitalization tools in a second step in order to digitalize them. What Moleskine did was seamlessly bridging all those elements in a single ecosystem which truly enhances the note taking experience.

On the production side, there is a partnership with a specialized company, which is first and foremost geographically distant, and with whom interaction happens on a daily basis. Moreover, the difficulty of combining two completely different production cycles complicates the picture. The digital development takes a few weeks for most of the products, but the time-to-market is slowed down by the activities related to the analog product supply chain, which are much longer. The dedicated team of digital innovation inside the company was the success factor on this matter. Their synergic effort on the product category and their holistic responsibility, which is not confined in a single task, have contributed to achieve the right agility needed to commercialize a SCP.

To conclude, the introduction of the smart writing set affected most of the elements of the company's existing business model. We illustrate these 'before and after' changes in the Osterwalder's Canvas below, where elements marked in light blue are the components that most significantly changed (Figure 5).

Figure 5: Moleskine Simplified BM Canvas: Before & After the Smart Writing Set

<p>Key partners</p>  <p>BEFORE: partners provide mainly the raw materials such as paper and leather material for the production of the analog objects.</p> <p>AFTER: The digital components of the smart product are produced and developed by the Korean company, NeoLab, which is specialized in the technological protocol of the Smart Writing Set.</p>	<p>Key activities</p> <p>BEFORE: Design is the core activity for the production of the paper and leather objects.</p> <p>AFTER: Incorporation of the customer feedback to update products.</p>	<p>Value proposition</p>  <p>BEFORE: Moleskine objects connect the owner to a heritage in art, literature and cultural and geographical exploration.</p> <p>AFTER: Analog and digital products form an ecosystem of tools and services that provide for and connect the visionaries of the past with the makers of the future.</p>	<p>Customer relationship</p> <p>BEFORE: Dedicated website and traditional forms of marketing communication.</p> <p>AFTER: Data collection, blog reviews, online forums, in store product try-out.</p>	<p>Customer segment</p>  <p>BEFORE: The lifestyle-passionate customer, who loves to use premium products for note-taking</p> <p>AFTER: The digital customer was an early adopter, but no change happened to the core customer segment.</p>
<p>Cost structure</p> <p>BEFORE: Moleskine bears the R&D, production, logistics and marketing costs.</p> <p>AFTER: There is an additional Cost of digital components bought from NeoLab.</p>		<p>Revenue stream</p> <p>BEFORE: revenues coming from the sale of the physical product.</p> <p>AFTER: No significant change to the revenue stream. The initial set contains all the elements needed for the smart writing activities. The customer will subsequently purchase refills for the digital pen ink and also new paper tablets when needed.</p>		

5.3 When Kids get Digital: Bringing Plastic to Life

5.3.1 TechyToy3: The Traditional Entertainment Adapts to the Generation Z

TechyToy is a very successful toy company that has been producing plastic toys for many decades. The brand offers multiple toy product lines for children of different ages and has started to also tap into the adult market with their more high-end products. Furthermore, in recent years they have expanded the toy experience through other media offerings and computer gaming. The company enjoys an extremely popular brand image and has been able to leverage this in building a whole fan-subculture.

5.3.2 Giving Toys a Smart Soul: Toy Story Made Real

In the last five years, the company has been following the dream of bridging the analogue and digital playing experience, as seen in the movie Toy Story, where the kids' toys come alive. Whilst they managed this quite well with their slightly older consumers, such as teenagers and passionate adults, they were still lacking such a product for younger children. From market research they knew however, that children at the age of seven are spending a significant part of their time playing with digital devices. As a consequence, they developed a product line of toy sets which can connect to an Ipad or mobile phone via an app and can through this app be individualized and controlled.

The following paragraphs refer to insights gained from an interview, which has been conducted with a high-level manager who has been part of the project management team from the marketing side on the smart, connected toy. The full interview transcript can be found in Appendix F.

³ TechyToy is an arbitrarily chosen fictitious name in order to provide anonymity to the participating company.

5.3.3 TechyToy's BMI

Value Proposition

The value proposition for TechyToy's new product line mainly stemmed from the kids dream to interact with their toys. Now they could make that dream come true, hence the gained value is the live interaction with the toy that is more than just the kid's imagination. TechyToy also had to communicate the value to parents, who are the actual shoppers of the products, as well as the toy retailers, who are TechyToy's direct customers. For this, they relied mainly on this analogy of having a toy come to life, since often retailers were not equipped with showrooms or screens that would allow for proper demonstration of the toy's capabilities.

The more traditional product of TechyToy offered a constant opportunity for reinventing the story played with the toy, since a multitude of sets in the market could be combined and mixed together at will. This offered a never-ending stream of fun for the child with the same toys. Now, with the new digital product line, this value offering gets expanded into the digital world, where the children can reprogram their toy in many different ways.

Consumer Closeness

For TechyToy, consumer closeness did not change much. Their more technical and digital products had traditionally a strong online community, which is independent from the firm's interaction. This community now grew via the platform designed for the younger target audience. However, data collection has always been a no-go for TechyToy, since the data is stemming from kids. Therefore, there is no additional feedback stemming from the in-use data of kids playing with their toys. Moreover, because of their very young target audience, they had to abstain from common digital testing grounds such as releasing a beta version, as small children would not be able to understand the concept of a beta version and rather claim its deficiency. Nevertheless, the company did rely on focus groups involving both the parents and the children in order to test the product. TechyToy also had to rethink the way they approached parents and retailers. The higher complexity of the product features made explaining the product more difficult, especially since it didn't lend itself to traditional 2D marketing channels. In the end, the decision was made to market the product as a tool box concept, which represented the idea in line with the value proposition of being able to build multiple toy ideas from one box set.

Core Resources & Activities/ External Partnerships

Whilst the product development was performed entirely in-house, TechyToy relied on two external partners for the smart toy components and the app development. These were new partners specifically sought out by TechyToy for this particular project and were chosen for their expertise in more complex coding. TechyToy specifically needed to build partnerships in this regard, since the time to market was quite short and the company would not have been able to develop or hire these capabilities in-house in time. Yet, TechyToy acknowledged the difficulty of working in a triangle of partners, where matching development procedures and know-how had to be guided by very superior project management. TechToy identified the partnerships as the Achilles' heel of the project.

Revenues/ Cost Structure

Overall, TechyToy's revenue streams stayed the same since the product is fully accessible through the initial purchase and does not rely on any subscriptions or in-app unlockings. They merely had an increased revenue from an increased price of the more technically complex product.

TechyToy also used this project as an advancement of their brand, and therefore did not shy away from high costs incurred. The product was not necessarily meant to bolster the profit structure of TechyToy, but primarily to promote the firm at the forefront of bridging analog and digital toys.

5.3.4 An Agile Project Management for Multiple Decision Streams

The new product project at TechyToy was characterized by the time pressure to get the product to market. Hence, the main team consisted only of three managers: a marketing lead, a design lead and a project lead. They were challenged with the task to create a similar, but better product to the more technical product for older children that was already in the market, but at a cheaper price point.

It has been pointed out by our interviewee that the critical success factors in this project really were the superior project management, which bridged the cooperation between TechyToy and its external partners, as well as the drive and will of the three internal project managers, who all took real ownership of the project, supported by the top management.

The matching of processes between the development of non-digital and digital components has been named as a challenge. In this case, this was mainly due to matching the blue-collar expertise of the plastic production managers with the white-collar expertise of the

software developers, which did not always understand each other's standpoint. The in-house production of the plastic components was subject to a much longer production planning cycle than the software development, which led to a lack of understanding of the external partners on why certain things could not be changed at a later stage.

Although these challenges did occur, iterations in the development process mainly stemmed from altering the value proposition, and how respectively the message to the consumer would change. This was however more a marketing issue, rather than an issue related to the development of product features.

TechyToy had to grow competences on digital products and develop a process which could bridge their previous activities and expertise with the newly relevant ones of digital product development. In this, TechyToy could rely on some learnings from previous products, which had established online platforms and communities. Furthermore, TechyToy developed a start-up mentality which drew from the drive and willpower of managers to make this project a success, as well as from the agility stemming from a small team.

Lastly, just like in the previous two cases, we proceed with the illustration of the most affected elements of the company's existing business model. We present these 'before and after' changes in the Osterwalder's Canvas below, where elements marked in light blue are the components that most significantly changed (Figure 6).

Figure 6: TechyToy Simplified BM Canvas: Before and After the Smart Toy Introduction

<p>Key partners</p>  <p>BEFORE: TechyToy has traditionally cooperated with other brands from the entertainment industry for the development of most of its playing stories.</p> <p>AFTER: With the smart product, two more partners emerge to scale and speed up the production of the smart toy components and to carry out the app development.</p>	<p>Key activities</p> <p>BEFORE: the design and ideation of the plastic toy, followed by the in-house production of the plastic playing sets.</p> <p>AFTER: no shift</p>	<p>Value proposition</p>  <p>BEFORE: a toy you never get bored of. Combine the different pieces and turn them in the exact toy you want to play with.</p> <p>AFTER: combine the different pieces and make your toy come to life.</p>	<p>Customer relationship</p> <p>BEFORE: Independent online communities and traditional marketing communication.</p> <p>AFTER: Tailored product communication but no data collection allowed given the young age of the target group.</p> <p>Distribution channel</p> <p>BEFORE: mainly toy shops.</p> <p>AFTER: toy shops and also tech shops selling entertainment.</p>	<p>Customer segment</p>  <p>BEFORE: kids of different age groups with the wish to create their own stories via their toy.</p> <p>AFTER: The kid of the generation Z, very keen on digital technologies. The parents who finance the purchase of the toy because they support its proposition.</p>
<p>Cost structure</p> <p>BEFORE: TechyToy has a cost structure comprehensive of R&D costs, production costs, marketing cost, logistics costs and distribution costs.</p> <p>AFTER: TechyToy did not shy away from the high cost incurred since the shift towards the smart toy was meant to significantly boost the brand awareness and the keep up with the competition.</p>		<p>Revenue stream</p> <p>BEFORE: The playing set is sold with all the pieces needed to play. There are different product lines available for different prices.</p> <p>AFTER: The smart toy has a premium price, which requires the support of the kid's parents to be purchased, still there is no significant shift in the revenue stream.</p>		

6 Integration and Discussion of the Case Study Findings

In this chapter, we propose an integrated discussion of the findings emerging from the case studies. Business model components, or blocks of components, will be assessed for the changes they have gone through given the decision of the companies at stake to commercialize a SCP. To further highlight the changes, we will first discuss the architectural components and the changes in processes and learnings the companies witnessed and then assess which typology of BMI can be witnessed in the different cases by using the Foss and Stieglitz (2015) typology.

The last section (section 6.7) will be a summary of the discussion.

6.1 The Servitization of the Value Proposition

What has been strongly emergent from the literature (section 3.3.1) reviewed in this work was the viewpoint of a change in value proposition as major catalyst of BMI in this context (Dawid et al., 2017; Dmitriev et al., 2014; Porter & Heppelmann, 2015). This led to us strongly expecting a change in this regard, hence we posed the *Proposition 1: The introduction of SCP facilitates the development of new value propositions, which can lead to the opening up of new consumer segments and markets.*

In the case of DentiStrong we have found however, that the value proposition has not fundamentally changed, but was merely extended by the digital element, whilst the core benefit of clean and healthy teeth via a mechanically superior toothbrush has stayed the same. This is somewhat in line with our expectations, since this precisely fulfils the servitization notion of adding a non-physical value to the physical product (Allmendinger & Lombreglia, 2005; Spring & Araujo, 2017). However, the expected effect and repercussions on other business model components is not apparent. One often identified effect of the extended value proposition is a development of new customer segments (Dawid et al., 2017). DentiStrong has not experienced a recognizable change in its consumer base or market. Even though it has been pointed towards an initial increase in attention from the digital natives, DentiStrong put large efforts into purposefully retaining their old consumer segment. The fact that the finer changes in value proposition do not have large repercussions on these business model components for DentiStrong could, in our interpretation, be attributed to the fact that they are

part of a large conglomerate which “washes out” the positioning of the individual brand segment.

Differently, Moleskine’s value proposition clearly underlines a new digital component, which enables the creation of an ecosystem of tools and services (Moleskine, n.d.). The change in value proposition is not just an enhancement in the customer experience, but it is a much more conscious choice of the company to bridge the digital and analog tools of note-taking in a seamless solution. Moreover, differently from DentiStrong, Moleskine did gain new customers through the introduction of the smart writing set. Furthermore, the company also made the step to become a multi-category company. As a consequence, Moleskine entered new market segments with both the accessories and the Moleskine+ category. In that sense, we do in fact see a change in value proposition have effects on other elements of the business model, and, as expected (Dawid et al., 2017), particularly on new consumer segments and markets.

Along the line of a more radical change to the value proposition is also TechyToy. The necessity to communicate the digital dimension to the diverse stakeholders (retailers, parents and kids) required to conceptualize a fully new value proposition that clearly explained the digital dimension behind the plastic shell to all of them. We would not claim, however, that the company saw, as a consequence of the change in value proposition, a change in the customer segment per se. Kids have always been the main target for the company. However, the company took on the challenge of entering the market for a digital toy targeted to an extremely young consumer. Products of similar sophistication were in the market, but with a target of young adults and passionate gamers. To enable kids to play with a combination of digital devices and plastic toys at the age between 5-10 years old is the innovative proposition of TechyToy. From these three cases, we find support as well as opposition to our first proposition. As elaborated, an explanation could lie in the different size of the firms. DentiStrong, being part of a consumer products giant, will not feel changes from moving into SCP so strongly, as they are integrated with other brands of the network that were already active in the digital product market. Moleskine and TechyToy instead had to face the complexity of significantly re-conceptualizing their proposition, since they only operated in rather specialized industry segments before and do not have the backing of a conglomerate, nor an extensive network. Both companies, in comparison to DentiStrong’s mother-conglomerate, had a rather narrow focus prior to opening themselves up to the digital category.

6.2 The Different Nature of Customer Relationship

When looking at the effect of SCP commercialization on consumer closeness, what we would expect from the extant literature (e.g. Dawid et al., 2017; Allmendinger & Lombreglia, 2005) is for firms to leverage on increased insights gained from data collected by the SCP in order to establish faster feedback loops and intensify the relationship to the consumer, which is reflected in our *Proposition 2: The introduction of SCP enables the company to establish a feedback loop and a closer, more involved relationship with their consumers. Value is co-created provided that the customer is fully aware of the product potential.* The results on this point were different for our case companies.

As far as the data exchange which would enable the feedback loop is concerned, DentiStrong has particularly emphasized their strategic decision not to utilize data collection from the SCP applications, out of their customer's privacy concerns. The company feared the sensitivity of data exchanged would have irked the customer and result in negative externalities on their brand image. Similarly, TechyToy does not collect data from their digital toys since collection of data from children is legally restricted. On the contrary, Moleskine does monitor the patterns of usage of its smart product via the app. Moreover, they actively engage in other more traditional sources of feedback collection, such as questionnaires and other feedback collection mechanisms which their specialized retailers perform. Afterwards, the company analyses the data and plans for product improvements with the Korean partner.

The inclusion of consumer feedback in R&D processes is in fact another component which we expected to find in our case studies, based on the discussed literature (e.g. Mezger, 2014; Smith et al., 2014). While for Moleskine and TechyToy it is an ongoing process (both companies rely on feedbacks collected from online forums and platforms), for DentiStrong it was a step related only to the development phase. Indeed, the firm tried to leverage on the digital early adopters' knowledge on digital features in their prototyping phase. Moreover, DentiStrong had established channels for customer feedback before the commercialization of the SCP, and just added the specific customer segment as a further channel for responses.

When looking at the challenging side of the value co-creation, coming from the consumer's understanding of the product functionalities (Smith et al. 2014; Dawid et al., 2017), all three companies manifested a similar approach. The three firms have experienced the need to change the interaction with their consumer. DentiStrong and Moleskine focused in particular on much more educational marketing, informational material distributed through different channels and a specifically trained salesforce in order to convey the full extent of the

value provided by the digital component of the SCP. TechyToy also mainly was challenged by explaining the product, but they mainly opted for communication at the point of sale. However, since buyer and user of the product are in this case two separate groups, the children's understanding of the product at the point of sale was less important. The marketing message was therefore less educational, but more an attempt to transport the value proposition in a concise, simplified way. These findings again fall in line with our expectations.

We can argue that, given their monitoring activities, Moleskine saw a much stronger change of its customer relationship with the clients, which has an impact also on the development activities. Instead, the change for DentiStrong and TechyToy is less evident since the opportunity of engagement with the product and the customer after the point of sale is not exploited due to privacy and brand image concern or legal restrictions. In all cases however the companies had to rethink some of their marketing activities.

6.3 The Intricacy of the Supply Chain

Two more important points established by the literature are the need for flexible R&D processes and the push towards establishing partnerships with technology providers (Dawid et al., 2017). Mezger (2014) also suggests a capability-based conceptualization of BMI, whereby the network effects, which enable companies to gain resources and capabilities, play a major role in determining the dynamics of BMI.

We found support of our guiding *Proposition 3: The introduction of SCP demands changes in the value chain with regards to R&D processes and external sourcing.*

In the case of DentiStrong, the company was already embedded in a network of technology providers with whom it had established previous collaboration for different projects. Being embedded already in such an ecosystem meant having neither the need to change the suppliers nor the need to establish and work on new partnership and alliances. Differently, Moleskine and TechyToy both had to enter a technologic network where the company acquired the right knowledge needed to scale up its project without incurring in the lengthy and expensive process of developing the technology in house. Moleskine managed via the partnership with the Korean NeoLab to outsource complexity and rely on an established know-how. TechyToy also formed a small network of partners by bringing on two external partners to the project, who provided know-how that TechyToy could not efficiently build in-house.

Regarding the complexity of the supply chain which stems from these partnerships, the main finding concerns the alignment of the development process of the digital and analog components. The processes related to the software deployment or the development of digital components are much shorter than the product development of the analog parts. Also, the feasibility of dynamically changing the digital components during the development is not a shared feature in the analog parts. Hence, the two production lines have to be merged, despite the significant apparent structural differences. This difficulty is shared by all the companies interviewed, which have stressed that skills in terms of project management, coordination and communication are necessary to achieve a satisfactory result in this regard.

Overall, the supply chain of these companies is much more intricate in that we do see more dynamic R&D processes and higher interdisciplinarity. However, this does not stem, as previously described in other literature (e.g. Dawid et al., 2017; Allmendinger & Lombreglia, 2005), from consumer feedback, but from the nature of the digital product component and the requirements of its production.

6.4 Revised Revenue Model and Cannibalization Concerns

Our guiding proposition in this regard was *Proposition 4: The introduction of SCP opens up to new sources of revenue and pricing strategies. In some cases, cannibalization concerns have to be taken into account.*

All three companies in analysis did not undergo any evident change in their revenue model. Despite Moleskine offering some services on demand through their applications for mobile devices, there is no significant change the traditional revenue collection. Also, our concerns regarding the cannibalization of demand on other product lines caused by the SCP was not shared by our interviewees.

In the case of DentiStrong, the company highlighted that the different price point of the smart toothbrush, together with the lack of change in terms of value proposition, has not significantly shifted the customer preferences towards the smart version. It is important to underline that the company's core business comes from the sales of consumer goods, where we expect significantly higher volumes sold per year. It is our opinion, that even the prior electronic version of the toothbrush still represents a niche segment with respect to the overall market.

Moleskine, as a lifestyle brand, already targets a niche of customers. The loyalty towards the brand is such that customers often purchase different tools for different usages.

However, the majority of volumes sold come from the analog segment more than the digital one.

For TechyToy, the source of revenue also remains with the initial product sale. Even though their technologically enhanced products started to be responsible for large parts of TechyToy's revenue, the revenue model has not changed. Whilst prices might be higher than in other products, due to the higher production cost of the digital components, the pricing strategy itself remained the same.

Therefore, in all the analyzed cases, we did not find evidence of cannibalization, as suggested by Greenstein (2010), nor did we see changes in the revenue model, as pointed out by Dmitriev et al. (2014) and Dawid et al. (2017). Our forth proposition therefore has not found supporting evidence from our case studies.

6.5 Organizational Learnings/ Dynamic Capabilities

Our case studies show that firms engaging in SCP commercialization do, in fact, find that this affects certain organizational processes, as also addressed in the studies by Allmendinger and Lombreglia (2005), Kiel et al. (2017), and Mezger (2014).

All three of our case firms address the organizational challenge faced when developing a product that consists of physical as well as digital components, which stems from the differences in the development cycle lengths. In particular, for DentiStrong, this challenge came also in the form of managerial inertia because managers had difficulties to let go of a previously established development process. The old process, consisting of 5 steps, did not match the new product development cycle, especially in its more agile digital component. This problem of inertia was expected from the reviewed literature.

In the case of TechyToy, the matching problem was more prevalent at the intersection of working with external partners, since the responsibility for the digital components lay with the external partner, whilst the responsibility for the plastic components stayed internal. Similarly, Moleskine curated the design and commercial side of the Smart Writing Set and had to coordinate and align with the Korean NeoLab in order to successfully complete its go-to market strategy. This difficulty of increased complexity stemming from managing partnerships was also an expected find.

We also found our expectations confirmed with regards to how the introduction of SCP facilitates a shift in importance of affected resources. DentiStrong saw an increase in the IT-departments involvement in the product development processes, and as a supporting function

charged with educating the entire organization in IT knowledge, which was suddenly a prerequisite for other departments as well. Therefore, it can be argued that the importance of IT-knowhow as a resource has increased.

With regards to the dynamic capabilities exhibited in our case studies, we see firms specifically leveraging on the capabilities of reconfiguration and transformation.

In all case companies, a new team was formed, which was in charge of digital innovation. For Moleskine and TechyToy, this team was purposefully kept small, in order to guarantee the necessary agility throughout the product development processes. As such, a leadership gap as described by Chesbrough (2007) has been avoided by all case firms, as ownership of the process transformations was given, which is in line with Bilgeri and Wortmann (2017) and Dawid et al. (2017).

Yet, we do not detect a more grander approach to restructuring processes purposefully, with BMI as an end goal, prior to the project commencement. DentiStrong at first exhibited a limited capability of reconfiguration and transformation, because of their organizational inertia. Nonetheless did the firm reconfigure and transform their processes throughout the course of the project and afterwards, most notably by establishing lean innovation processes and new due diligence processes. Again, changes in business model components have stemmed from a necessity throughout the project, rather than being purposefully seized. TechyToy also did not purposefully address BMI prior to the project, however, the start-up mentality and agility adopted by the managers hints at large transformative capabilities which were critical to the project's success.

In terms of how the firms in our case studies leverage on coordination and integration of processes, Moleskine really adapted themselves in this regard. Their ability to sense the need to address the consumer expectation of digitalized products, combined with the ability to form an effective partnership with a Korean technology firm, helped them to successfully transform their BMI. As already mentioned, TechyToy found themselves in a very comparable situation, wanting to satisfy a customer need, which was tackled through the formation of effective partnerships. For DentiStrong however, these capabilities were of less importance, as the conglomerate ecosystem and partnership network allowed them to achieve product digitalization through their capabilities of reconfiguration alone, because the know-how was already existent in the business ecosystem. Furthermore, their size and market power make them less dependent on the need to sense opportunities and threats.

DentiStrong however is now particularly leveraging on establishing institutionalized learning processes within their firm via their IoT Bootcamp for employees.

Overall, we can say that *Proposition 5: Successful and efficient BMI in the face of commercializing SCP stems from the firm's ability to leverage their dynamic capabilities* finds support from all our case studies.

When trying to answer the dispute between the concepts of the dynamic capabilities literature and the resource-based view (cf. Teece et al., 1997; Barney, 1991) we can see that in the case of SCP oftentimes BMI is more driven by the exploitation of dynamic capabilities than technological superiority. Even though the development of digital components is not insignificant, usually these products do not contain new-to-the-world technology. What makes them unique is the employment of already existing technology into already existing products to create a new kind of experience and elevate what the product can do. To do so, the companies rely on managerial capabilities and adaptation of processes in order to align their product development processes with the demands of the new products.

6.6 The Complementarity of the BM Components and the Foss and Stieglitz Typology for the Case Study Firms

In our literature review, we highlighted the problem of complementarity of the BM components as a challenge in the processes of BMI. In particular, we would like to refer back to the Foss and Stieglitz (2015) typology of BMI and assess alongside which in dimensions the BMI happened for DentiStrong, Moleskine and TechyToy.

As far as DentiStrong is concerned, we would argue that a continuous BMI is identifiable. Referring back to Figure 4 (Chapter 5) we identified mainly modular changes related to consumer closeness and key resources. As a consequence of the SCP introduction, the company had to rethink their interaction with the consumers, making it more educational in scope. Moreover, DentiStrong had to place more importance on the IT-knowledge as a resource for the company. Furthermore, the depth of BM changes is, in our opinion, incremental in nature. The company was already commercializing electronic appliances for the oral healthcare. The introduction of the sensor system and the services provided via the app represent an incremental evolution of the product sophistication. However, there is neither substantial change in the core elements of the BM architecture, nor at a value

proposition level. Nevertheless, the digital element is source of superior levels of efficiency and performances.

The case of Moleskine has a radical nature in our understanding. We argue that the company radically changed its business model starting from a reconceptualization of the value proposition. If, on the one hand, it is true that the company did not compromise on the core values and lifestyle features behind its offering, then on the other, it is evident that the act of bridging the digital with the analog was a radical change for a company previously selling only paper notebooks. Indeed, such decision brought the company to change multiple BM components, hence achieving an architectural breadth of BM change. The system of activities related to the digital products and the service dimension were not part of the previous way of doing business of the company.

In the case of TechyToy we would also claim that a radical BMI happened. Both on the production and commercial side of the BM the company saw some changes. The company purposefully revolutionized its core deliverable in the gaming experience and made it possible to give life to the plastic components. As a consequence of this, the architecture of its operations changed both on the production side, demanding for the outsourcing of some activities, and on the commercialization side, deeming it necessary to de-facto penetrate a new market of digital toys meant for truly young digital gamers.

6.7 Overview

Overall, we can say that our propositions have largely found support from our case studies, which means our expectations build from literature were met. An overview of our expectations in comparison with our actual findings are presented in Table 8.

Table 8: Comparison of Expectations from Literature and Actual Findings

Proposition	Expectation	Findings	Support for Proposition
1	Facilitation of new value propositions. New consumer segments and markets.	Value propositions are either <ul style="list-style-type: none"> radically changed to bridge the analogue and digital experience, with effect on consumer base and markets tapped or merely extended through a digital element, rather than fundamentally changed. No 	inconclusive

		radical effects on new consumer segments or markets.	
2	Closer customer relationships due to insights from data. Value co-creation when product potential is communicated effectively.	Changes in customer relationships stem from a different communication with them (firm to customer), not from data collection. Value co-creation is indeed harnessed through the thorough explanation of the product value.	partially
3	Changes in the value chain with regards to R&D processes and external sourcing.	All firms incurred changes in R&D processes, in particular when aligning the development of digital and non-digital components. External sourcing played an important role for all companies, whether these were previously established or newly formed.	yes
4	New revenue streams and pricing strategies. Cannibalization concerns.	No particularly new revenue streams or pricing strategies. Prices merely increased due to higher production cost. Cannibalization concerns were not supported.	no
5	Leveraging of dynamic capabilities for successful and efficient BMI.	Particularly relying on capabilities of reconfiguration and transformation. Relying on managerial capabilities, in particular project and process management.	yes

Our Propositions 3 and 5 seem to be fully supported by our case studies, in that all case characteristics presented themselves as expected from literature. As expected, firms experienced an increase in complexity of their value chain through the inclusion of external competencies in their projects. However, R&D processes were mainly affected by the challenge of matching the development cycles of physical and digital product components, which seems to be a far more pronounced and common problem when commercializing SCP than what literature led us to foresee. Furthermore, our expectations have been met with regards to firms' utilization of dynamic capabilities in order to address their BMI.

Our case firms also fulfilled our expectations with regards to changing customer interaction. Firms indeed harness value from value co-creation. This is however established pre-sale through a more educational and informative interaction with the customer, much rather than post-sale via the superior information gained from data. Hence, our second proposition finds at least partial support.

With regards to Proposition 1 we found supportive as well as contradicting characteristics in different cases. Whilst two out of our three studies did indeed develop quite radical changes in value proposition, one case company, namely DentiStrong, did not see its value proposition affected on a larger scale. Therefore, we argue that this difference is caused by circumstantial factors, such as a firm's size and/ or its embeddedness into a larger value creation network.

Merely our fourth proposition on new revenue models did not find support in our particular cases. Therefore, we can conclude that existing literature on the effects of technology on existing business models does provide a general direction on what can be expected in the case of commercializing smart, connected products, in certain cases there might however be peculiarities which need further exploration. This will be addressed in Chapter 7.

7. Conclusion & Implications

The aim of our thesis has been twofold. Firstly, we identified recurrent challenges and opportunities faced by companies engaging in the commercialization of SCP. Secondly, we have explored the BMI journeys of three companies playing in different industries to assess how the introduction of a SCP has been a driver of BMI. In the following, we will conclude on our main findings and contributions, and discuss theoretical as well as managerial implications. Lastly, we will address the limitations of this work and provide possible angles for future research.

7.1 Conclusion

Based on our thorough literature review, we noticed that extant studies remained fragmented regarding the possible benefits and challenges of commercializing SCP. To address this gap, we thus synthesized the existing literature in Chapter 3, and found that for each opportunity stemming from the SCP introduction there was a mirroring challenge. Most importantly we were able to show that the seizing of opportunities which stem from stronger market positions or better consumer relationships require deeply rooted organizational capabilities to overcome organizational inertia and leadership gaps. Other opportunities, which are more linked to the product's capabilities themselves, such as collecting data, providing services, or allowing for integrating more complex revenue models after the point of sale, likewise require organizational capabilities in order to deal with the emergent complexity and know-how gap within the organization. Hence, companies venturing into the direction of integrating SCPs in their offering might face severe implications when failing to take not only the opportunities but also the challenges into account. This could lead to lost opportunity cost from not capturing all of the created value, or even the damaging of the entire brand image.

Further, we investigated *how the introduction of smart, connected products affects the company's original business model architecture* based on our case study descriptions and discussion in Chapters 5 and 6, guided by our propositions developed in Chapter 3. We found that our expectations were predominantly met with a few exceptions on pricing strategies, which might also be related to the limited number of interviewed companies as explained in the methodology (section 4.3) and the limitations of this work (section 7.3). Most notably, we found all case studies supporting our expectations on (i) increased complexities in the value chain because of differently paced development cycles, (ii) the importance placed on external

partnerships in such projects and (iii) the firms' leveraging on dynamic capabilities to bridge organizational challenges. Also prevalent in all cases was the firms' need to rethink the way they communicate the product's value to the consumer.

Moreover, by utilizing the BMI typology of Foss and Stieglitz (2015), we concluded that firms seem to undergo a more radical BMI when introducing SCP, when the SCP represents a more significant change to the overall product offering, and the firm does not yet have an established ecosystem of competencies to develop this new product.

These are novel findings with important implications for management as well as academia, which we will discuss in detail below.

7. 2 Implications

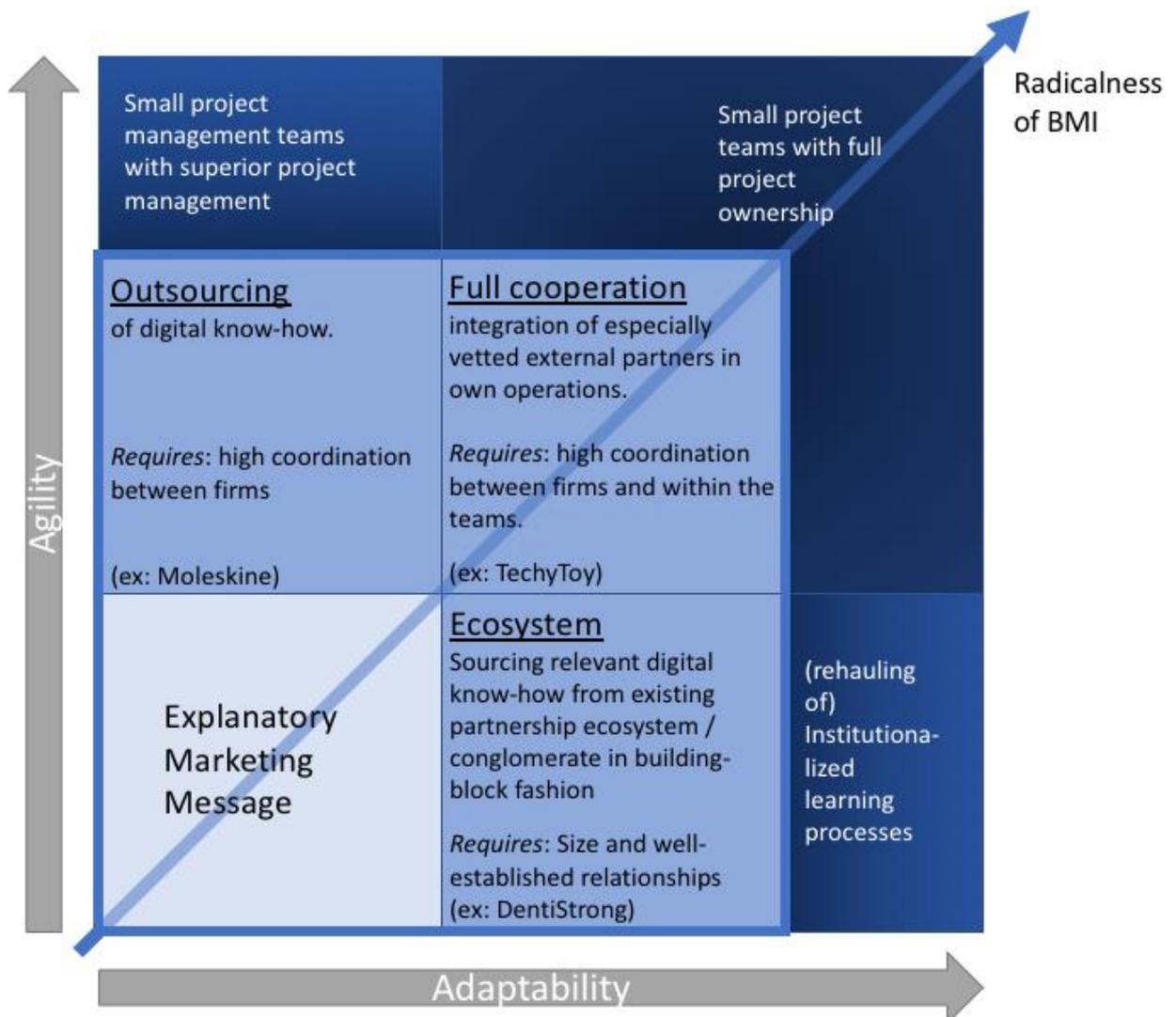
7.2.1 Managerial Implications

The findings of this study are particularly targeted at a specific group of managers, namely those working in a traditionally non-digital industry that face the challenge of keeping up with a constantly innovating market. The digitalization of today's world implies changes in customer needs that evolve in their complexity. Thus, our study contributes with a clear understanding of the challenges and the opportunities stemming from the introduction of a digital element, such as SCP, in a BM. Through the opportunities, we made clear that keeping a competitive advantage by innovating the BM is possible via SCPs as they allow for new market creation and open up for new ways of engaging the customers via servitization. We also made our managers aware of the organizational challenges they will face (e.g. inertia, leadership gap) and gave them the insights that allow for the creation of a case-specific scorecard for the change management which is required before engaging in BMI.

Our study furthermore contributes a practical exploration of cases of companies that innovated their BM in this direction. The companies in our case study captured a need in the market and they were, despite their rather traditional operations, capable to stay competitive in the market because they leveraged on adding a digital side to their products to match a relevant customer need. Our focus on non-technologic companies was meant to highlight the difficulties coming from the newly embedding of a tech element in an established business model and the expedients of innovation taken by our case companies.

From combining the analysis of the findings from these cases, it is possible to identify different degrees of BMI radicalness and different approaches towards the procurement of digital know-how, which are graphically explained in a tangible framework (Figure 7).

Figure 7: SCP-Driven BMI Framework



So how do companies successfully engage in SCP-driven BMI? Our framework shows that companies tend to rely on two organizational capabilities to achieve this:

- **Agility:** The capability to swiftly implement new organizational requirements in a lean management fashion, with high decision power in project teams.
- **Adaptability:** The capability to change (institutionalized) processes in a situation-based manner to fit the project at hand.

We would argue that for SCP-driven BMI-cases where the BMI is not needed to be particularly radical, an adaptation of the marketing message might suffice for firms, since the creation of a more explanatory marketing message was universal to all cases regardless of the level of agility and adaptability. However, with increasing BMI-radicalness, adaptability and agility become relevant as the sourcing of digital know-how from external partnerships becomes crucial. Depending on the nature of the collaboration, firms might have to rely on adaptability and agility to a different extent, and the way they achieve agility and adaptability might also differ.

In the case in which adaptability is high and agility is low, which in our study was DentiStrong, the relevance of some resources can change. In particular, at least inside the dedicated team, the digital- and IT knowledge becomes relevant for all the members regardless of their function. The firm relied on adapting the resources drawn from the existing partner ecosystem, rather than vetting completely new partners, and matched the right ones for the particular project from the existing pool of partners. The learnings from the project were then applied to the conglomerate as whole, and the sourcing from only existing partners meant that certain capabilities and knowledge had to be grown in-house. Learnings were institutionalized after the project was finished to be used in subsequent projects, rather than ad-hoc implementation of learnings. As such, the size of the firm in this case caused a slower learning process, and a less radical BMI was achieved over the course of one project. This approach is however only recommended for much larger firms that can rely on their foothold in the market to allow them the time for step-by-step learnings.

In the case of Moleskine, we saw the company relying on high agility, whilst adaptability was not relied on to a large extent. Because the company was dealing with external partners that are not part of a long-established ecosystem, it was advisable to have an agile team in charge of BMI projects. Decisions are to be taken interdisciplinary and sometimes in collaboration with the external partners. For this reason, more conventional teams with specific departmental knowledge are not suitable to deal with this complexity. We suggest the creation of small, dedicated managerial teams that could operate in a start-up fashion, regardless of the traditional decision-making processes of the core business. Agility is also needed to deal with complex process management in the development phases of the products. The short development processes of digital components need to be coupled with longer processes of analog parts. The project manager has to be able to make both ends meet and clearly align the expectations of all the project stakeholders. If the digital knowledge is outsourced,

this often means superior project management and production planning is the critical factor to align the work that falls at the different responsibilities between the firms.

In a full cooperation, there are both high levels of agility and adaptability required. Through the case of TechyToy, it was evincible that the responsibilities of who produces the digital and analog parts tend to blur. This requires firms not only to react to the requirements made by the external partner, but to also adapt processes internally. In such cases, we recommend project teams to have larger freedom of action, and to establish a fully committed team that is not shy to take ownership.

Ultimately, we recommend managers to consider how radical the product innovation is in relation to their previous offering, and to think about whether this transition can be achieved with sourcing knowledge from existing networks or whether it is better to introduce new partners and processes all together. If a more radical BMI is needed, agility is crucial, however, large organisations often lack this agility due to organizational inertia.

7.2.2 Theoretical Implications

The journey towards answering the two research questions started with a careful review of the literature. The first implication is the contribution concerning the link between new technologies and BMs. In fact, the novelty of our approach towards the topic of BMI stems from the narrowing down of our focus on the specific case of the commercialization of a technologic item. We wanted to stress that the nature of certain digital product technologies is such that it gives new shapes even to very consolidated and established ways of doing business. There are several steps of this specific BMI that required further investigation.

Surprisingly enough we saw that, despite the large growth in the market for SCPs, the research on the topic lacks a certain formality, perhaps for the relative novelty of the products. Therefore, we contributed with a definition that helps distinguishing this particular group of products from a vast array of technologies under the umbrella of the IoT. In this definition we highlighted those facets that make a product smart, as well as connected, and that have the potential to change ways of doing business. The capabilities of interacting with the surrounding environment are those enabling the servitization of thousands of industries.

Moreover, from our analysis of case studies, it seems to appear that the servitization of the offering, and consequently of the value proposition, does not have the same effects on all types of businesses. The complexity stemming from the combination of a digital and service element has different managerial implications depending on the heterogeneity and size of

network of partners and customers to which the company is exposed. Hence, differences will emerge on the production and commercial side of the BM.

Given these complexities, topics such as the intricacy of the supply chain and the value co-creation, as discussed in Chapters 5 and 6, require further attention.

The managerial challenges stemming from partnerships and collaboration are not new in the management discussion. The novelty lies in the coordination among partners on product development processes that do not share common features but need to result in a single merged outcome. Also, one could expect the consumer to be embedded in the process of value creation together with the company and its partners. This could happen in two different ways. In the development phase, there is an interaction customer-company to identify the actual customer need in the most accurate way. Later, when the product is brought to market, the value hidden by the analog shell of the product has to be unveiled by the customer in-use. On the marketing side, companies struggle in communicating SCP because their appearance resembles traditional analog products but does conceal a digital plethora of new functionalities. There has to be a joint commitment of company-customer in communicating and learning the proper product use. Lastly, with usage, companies might decide to incorporate more complex feedback in their development activities. This choice will eventually depend on privacy concerns, as mentioned in the section on managerial implications.

In general, despite a rather limited current discussion on smart and connected business models, we believe that, given the size of the market for these products, the vast array of applications and the effect on BM, this field of literature will develop in the near future. We therefore contributed with a first qualitative exploration of some success cases and opened up the floor of further discussion and quantitative studies on the subject matter.

7.3 Limitations and Future Research

In the process of writing this thesis we actively tried to maintain a rigorous approach to the methodology as described in Chapter 4. For this reason, we want to assess the limitations of our work. The main points of discussion will be related to the case study firms. Given the narrow specificities of the topic we were researching in the companies and our limited time framework, we managed to draw only three case studies. Oftentimes we got in touch with companies which we ultimately had to exclude because their products could not be classified as smart and connected by our definition. This has helped us building accuracy in the findings, while limiting the number of interested companies we managed to reach.

Moreover, we could have achieved a better case development by interviewing multiple stakeholders in the 3 BMI projects. This would have allowed to have multiple points of view on the processes and increased the complexity and the completeness of our findings, while decreasing the subjectivity and other potential biases of our interviewees.

Given the qualitative nature of our study we could not measure the potential casualties in changes of BM architecture stemming from a particular modular component. Our initial intention was to build a model to assess patterns of BMI given a change in one of its components. This would require a rigorous quantitative approach and the creation of a significantly larger sample of companies willing to share data with the research group. In this regard, we have to highlight that given the novelty of this technology, companies are not yet ready to share quantitative measures. Indeed, as seen in our cases, many want to keep their identity hidden to be protected from the competition.

This said, we believe the opportunity for further research on this topic is vast. Starting from the just mentioned model generation, to generally approach the topic in a more quantitative way, there are several points to be further researched. The stream of literature concerning smart and connected business models is currently in need of several clarifications. Firstly, the definition of these products is not yet unanimous and this implies confusion. Whilst with our working definition we aim to start solving some of this confusion, further research into the characteristics of products and their meaning for market players and consumers could further help to form uniformly comprehensive, logical terms and definitions. Furthermore, the connections and relations with the customers could be further explored in light of the different regulations on data privacy and the lack of a common international framework of action in this regard.

Further studies working with larger samples could try and explain why in some of our cases our propositions have not been met. Especially with regards to the effects of SCP-driven BMI on value propositions, quantitative studies on larger samples could uncover the exact factors that cause repercussions on value proposition. Whilst we suspect there to be a difference in our cases due to the fact that one of the firms is part of a large conglomerate, exact research on this might shed light on other possible factors that could be of vast managerial implications. Furthermore, it could be interesting to investigate why we did not see a change in revenue models, against our expectations. Even when refraining from data collection, apps present an opportunity to employ a razorblade model by locking features or content at the initial sale. Yet, none of our case firms have chosen to make use of this.

Another point for future research presents itself in trying to understand the specificities of the managerial processes that are adopted by firms to successfully manage SCP-driven BMI. Despite our study already pointing at the necessity of skilful project management, small, agile project teams, and the ability to bridge between different development cycles and internal viewpoints, there is large potential to provide a more detailed guide and strategies to managers as to how to handle such projects. Our study merely managed to scratch the surface of what happened in terms of operational processes within these firms. More detailed case discussions could yield more insights.

8. References

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9. Appendices

Appendix A: Studies related to IoT, Smart Products, and Smart, Connected Products with a Business Model Perspective

Author and Year	Title	Main focus
Calia, R. C., Guerrini, F. M., & Moura, G. L. (2007)	Innovation networks: From technological development to business model reconfiguration.	<p>The article answers the following question: "In which manner did the technological innovation network enable the metallurgy company with the business resources and relationships required to innovate the company's business model?"</p> <p>We are presented with a case study on a mid-sized family-operated metallurgy company in a developing country. Thanks to new relationship structures, innovation typology and innovation network dynamics, the company went through a process of BMI which led to internationalization and company growth.</p> <p>In this article, it is the technological innovation network which leads to BMI. It was indeed the set of resources coming from the network which enabled the BMI.</p>
Dmitriev, V., Simmons, G., Truong, Y., Palmer, M., & Schneckenberg, D. (2014).	An exploration of business model development in the commercialization of technology innovations.	<p>In this study, the authors were aiming to explore business model development during the commercialization of innovations through a case-based qualitative study. This was driven by the need to better understand the mechanisms and dynamics in business model development.</p> <p>The authors argue that the linear ex ante model of business model development, in which the business model is first designed and then implemented, is insufficient. They argue that instead, business model development happens in a cyclical manner in iterating steps.</p> <p>In order to build their cases, the authors build a conceptual model of the ex post business model development process and test it with cases of technology innovation commercialization projects in four different firms, which include three start-ups and one technological spin-off.</p> <p>They find that indeed, business model development processes are circular.</p>

<p>Flammini, S., Arcese, G., Lucchetti, M. C., & Mortara, L. (2017).</p>	<p>Business model configuration and dynamics for technology commercialization in mature markets.</p>	<p>The authors of this article developed a framework from extant literature, which analyses the business model innovation cycles associated with the exploitation of emerging technologies. They then conducted a single case study to test this framework and integrated the findings. They mainly contributed to the literature in showing how new entrants in established markets innovate, and how they develop their business model for the commercialization of a new, disruptive technology. Their main findings were a) that new businesses can also engage in business model reconfiguration, a process which can run in parallel to business model development, and b) that firms can be in interim explorative stages where they employ two business models at the same time until they have identified the more suitable one.</p>
<p>Karimi, J., & Walter, Z. (2015).</p>	<p>The role of dynamic capabilities in responding to digital disruption: A factor-based study of the newspaper industry.</p>	<p>This study focuses on the newspaper industry and investigates the role of dynamic capabilities in firms' performance in the face of digital disruption. Using self-reported data from 143 newspapers in the United States, the authors ran a correlation between resources, processes and values, and found that dynamic capabilities stemming from changing, extending or adapting resources, processes and values are positively connected to performance and what they call digital platform capabilities in a response to digital disruption. The contribution lies in providing the most promising factors for managers to focus on when the goal is performance or digitization.</p>
<p>Kiel, D., Arnold, C., & Voigt, K. I. (2017).</p>	<p>The influence of the Industrial Internet of Things on business models of established manufacturing companies—A business level perspective.</p>	<p>The authors studied 76 German manufacturing companies to verify how the Industrial Internet of Things (IIoT) influences business models of established manufacturing companies. Moreover, the article contains a collection of recurrent challenges and opportunities faced by these manufacturing companies. Their analysis further enables the identification of those BM components which are the most affected by smart, connected product introduction in the manufacturing lines. Indeed, the article features a relational model between the different business model components to show how the effect of IIoT has consequences on the different BM elements of the tested firms. Results show that, at least from an IIoT perspective, value proposition, key activities, key resources and customer relationships are the most affected elements following the introduction of IIoT in the manufacturing lines. This article gives answers which are comparable to the one we are discussing in our work. The difference stems from the fact that SCP are assessed for their introduction in the production lines and the consequent implications of BMI.</p>

Mezger, F. (2014).	Toward a capability-based conceptualization of business model innovation: insights from an explorative study.	<p>The article tries to answer the question of how firms systematically and purposefully engage in BMI. It does so from a dynamic capabilities perspective. The author uses an explorative case study approach on six German publishing firms.</p> <p>The main finding is the understanding of BMI as a distinct (higher order) dynamic capability, which consists of a firm's capacity to sense business model opportunities, seize them through the development of valuable and unique business models, and reconfigure the firms' competences and resources accordingly.</p> <p>The study shows that BMI is not only rooted in product innovation, but also takes place on an organizational level. Firms also consider the value proposition to customers, revenue models, or value network and partners, which all together form the business model.</p> <p>The author also highlights shifts in firm's focus with regards to competences, technological competences become much more important, whilst before the focus was mostly on content. Furthermore, they recognize network effects on which firms leverage for gaining technological resources.</p> <p>They also point at the importance of purposefully undertaking changes in business models and analyzing competitors business models on a constant basis.</p>
O'Connor, G. C., & Rice, M. P. (2013)	New market creation for breakthrough innovations: Enabling and constraining mechanisms.	<p>This article belongs to a series of longitudinal research studies on the management processes associated with Breakthrough Innovation (BI). In particular, the paper examines the business model development and new market creation activities for BIs in large established firms.</p> <p>The work shows that market creation for BI should require as much time as the technical development in itself. Moreover, it is highlighted how BM development plays a fundamental role in the commercial infancy of a BI. In particular, the fit of a breakthrough innovation in the organizational structure of a company will determine the degree of complexity of the BM development and market creation. To evolve a mature BI commercialization competency, a firm must recognize and address the implications for managerial processes, for personnel recruitment, for setting leadership expectations, and for developing appropriate performance metrics for those responsible for market creation that go beyond technical discovery and engineering development.</p> <p>In this article, the management processes are highlighted as fundamental in the development of a BM for breakthrough innovations (BIs).</p>
Raja, J. Z., Frandsen, T., & Mouritsen, J. (2017).	Exploring the managerial dilemmas encountered by	<p>The authors look at manufacturers of advanced analytical equipment and the challenges they encounter when expanding their business to a more service-based approach in order to uncover new sources of revenue. Their study is based on three case firms. All three companies had intent to change their business model purposefully.</p>

	<p>advanced analytical equipment providers in developing service-led growth strategies.</p>	<p>Overall, they address three trajectories that firms venture to, when trying to expand their service offerings:</p> <ol style="list-style-type: none"> 1. Serviceability and the dilemma of closeness, scalability and the dilemma of technological simplification, and 2. solutions and the dilemma of organizational capabilities. <p>Findings include a shift of focus from hardware to software and services capabilities, and an increased evaluation of risk with regards to changes in business model.</p> <p>Furthermore, the dilemma of consumer closeness is mentioned with regards to the intent to expand service offerings, which is created by a mismatch of the need to collect consumer data in order to gain insights for convincing R&D, and the reluctance of consumers to supply such data.</p> <p>Also, products have to meet new requirements (focus more on running smoothly than sophistication).</p> <p>The authors also establish the point of the need for different organizational capabilities to generate new solutions and address the idea of organizational inertia, when they pose the question of how much the new capabilities should be allowed to influence, or be influenced by, the existing business.</p>
<p>Sainio, L. M., Ritala, P., & Hurmelinna-Laukkanen, P. (2012)</p>	<p>Constituents of radical innovation—exploring the role of strategic orientations and market uncertainty</p>	<p>This work aims to investigate the role of technology orientation and customer relationship in promoting or preventing the emergence of radical innovations.</p> <p>The authors look at BM radicalness as a dimension to explain how a firm's BM has to adapt to radical innovations.</p> <p>They suggest that the degree of newness of the innovation in relationship to the existing business practices is relevant in determining the span of adaptation needed.</p> <p>Technology-oriented firms may be better at pursuing radically new ways of operating, since they are used to invest and understand those technologies which have the power to change BM and value propositions.</p> <p>Moreover, the customer relationship orientation may improve the capacity to achieve high BM radicalness. The higher the customer relationship orientation, the higher is the business model radicalness of the firm's innovations.</p> <p>Hence, both technological orientation and customer orientations are seen as drivers of deep BM radicalness and towards what we have defined in our work as BMI.</p>

Tongur, S., & Engwall, M. (2014).	The business model dilemma of technology shifts.	This work examines how technological innovation can cause the need for business model changes by means of an extensive qualitative case study on a project of an incumbent truck manufacturer. In that, the findings are not necessarily generalizable, but they do make an interesting point: successfully managing technology shifts is not just a matter of either technology innovation (as implied by literature on innovation) or service innovation (as implied by servitization literature), but of both in conjunction. Moreover, business failure can often be accounted to a failure to innovate the business model, rather than a failure to innovate technology. Therefore, the authors propose a transformation of the value proposition to include the products into product service systems as an alternative to investing in R&D to transform the technological core competence.
Wu, X., Ma, R., & Shi, Y. (2010).	How do latecomer firms capture value from disruptive technologies? A secondary business-model innovation perspective.	This article studies how latecomer firms can still build an advantage from disruptive technologies. In that context, the authors build case studies, and conclude that latecomer firm's might be able to compete by engaging in what they call secondary business model innovation, which relies on changing the basis of competition and tailor the business model to fit a different consumer segment. They also emphasize the establishment of the right value proposition as well as leveraging on partnerships.

Appendix B: Table for Opportunities and Challenge

Name	Type	Description	Sources
Opportunities			
Relation beyond POS	SCP	The connection between the company and its products does not stop at the point of sale (POS). The company can keep direct access to its products after they have been bought by the customers, via the connectivity elements of the sensors and the apps. For this reason, the company is pushed forward in the product life cycle, beyond purchase and installation into the ongoing use. Thanks to this opportunity it is possible to offer services of monitoring, remote diagnostics and maintenances. The most significant share of opportunity stems from owning, controlling and integrating the data streams stemming from the product usage, since this data offers a thorough understanding of the users' habits and needs.	Bilgeri and Wortmann (2017); Dawid et al. (2016); Allmendinger and Lombreglia (2005); Spring and Araujo (2017)
Gaining customer insights	SCP	Customers insights can be gained by monitoring usage patterns and also by collecting feedback. In both cases, the SCP sellers gain an unprecedented quantity of insights that can be immediately embedded in R&D processes to generate future greater value. From a customer segmentation perspective, getting user insights means to be able to segment the customer base on usage patterns and consequently configure offerings to different customers in a much more tailored fashion.	Allmendinger and Lombreglia (2005); Spring and Araujo (2017); Porter and Heppelmann (2014)
Value co-creation: closer customer relationship	SCP	The establishment of information flow between the customer and the company enables the creation of a closer customer relationship. The feedback loop might start already in the pilot phases of SCP project, determining a new customer role of involvement in the value creation. Some steps of the commercialization are therefore enhanced by a clearer understanding of the value to be delivered to the final user.	Vendrell-Herrero et al. (2016); Allmendinger and Lombreglia (2005)
Amplification of the value proposition through	SCP	The capability of SCPs to sense and interact with the surrounding environment have granted the opportunity to add a service dimension to the physical product, which enhances the user experience. SCPs create service opportunities which space from maintenance services to on-demand offers etc.	Allmendinger and Lombreglia 2005; Spring and Araujo (2017)

servitization			
New pricing models	BMI/ SCP	Depending on the specific SCP context, it is possible to have new pricing models and capture value via the digital element. With the app, it is possible to extend the offering with premium feature available via download. Thanks to the monitoring option, new pricing models can be foreseen.	Dawid et al. (2017)
Establishing new markets/ strengthening the market positioning	BMI/ SCP	The extension of the value proposition and the new customer-company relationship are changing the "rules of engagement" for many market players. SCPs might therefore enable the creation of completely new markets (ex. home assistants)	Dawid et al. (2017)
Challenges			
Privacy concern & the need to have common standard	SCP	The industry of IoT & SCP is relatively young. In its early stage, there has been an underinvestment for the creation of common standards. In particular, it would be needed to have common solutions with regard to the digital interfaces, the legislation (in particular for privacy concerns), and even taxation.	Bilgeri and Wortmann (2017); Dawid et al. (2017)
Develop data analytics for customer insights	SCP	A system of electronic intelligence is needed to perform the analysis of the big data produced by the sensing dimension of SCPs. Firms need to either develop or buy the tools and know how to perform data analytics, if they want to harness the value coming from the constant flow of data between the products in use and the company.	Bilgeri and Wortmann (2017); Allmendinger and Lombreglia 2005; Sprig and Araujo (2016)
Value co-creation: Customer value awareness	SCP	The company selling an SCP delivers a product to the market with an inner value which is not necessarily known to the customers. The increase in the value of an SCP vs a standard product is realized only in the moment in which the customer fully understands how to properly use the product in all of its functionalities. The real value co-creation stems from the value in use of the SCP. The largest challenge in the commercialization of the smart products is to bridge the interface gap between the technologic element, which become more invisible, and the consumer who is less aware of the smart appliances. There is the need to share a clear message on how these appliances can be used, which information is collected, how they can be controlled, configured, taught and used.	Dawid et al. (2017); Smith et al. (2014)

Intricacy of the supply chain: new partners & activities	SCP	From a supply perspective, smart products challenge firms to apply more flexible supply chain strategies and to enter interdisciplinary research and development (R&D) collaboration with firms, which are oftentimes from unrelated industries.	Bilgeri and Wortmann (2017); Vendrell-Herrero et al. (2016); Dawid et al. (2017); Allmendinger and Lombreglia (2005).
Setting the optimal pricing strategy	SCP	There is a generally shared difficulty in setting the optimal pricing strategy. The customer might find it hard to quantify the added value in the technology and consequently have a distorted perception of its value, while the company necessarily has to position the product in a premium manner to cover the enhanced costs.	Vendrell-Herrero et al. (2016); Dawid et al. (2017)
Process ownership (leadership gap)	BMI	When it comes to BMI, it is hard to find a specific figure in charge of the process in the organization. Yet, the process involves managers in decisions which have far-reaching economic consequences for different areas of the business. Hence, the risks involved are therefore high. The lack of process ownership, or leadership gap, contributes to significantly slow down the process for many business realities.	Chesbrough (2007); Bilgeri and Wortmann (2017); Dawid et al. (2017)
Organizational inertia	BMI	Organizational change is often highly dependent on previous choices and rather slow. Oftentimes, managers of the organization reached their current level of responsibility by executing within the current BM, which represents a reassuring and familiar modus operandi. It is hard to get senior management reconsider the nature of the business model.	Hannan, 1984; Teece, Pisano and Shuen, (1997); Chesbrough (2007); Allmendinger and Lombreglia (2005)

Appendix C: Interview Guideline

Shifting Towards Smart, Connected Products: A Business Model Innovation Perspective

The following is a guideline containing example questions for a semi-structured interview. The purpose of the semi-structured interview is to build rapport between the interviewee and the interviewers, in order to create a conversation flow that naturally points towards the most relevant topics within each individual case. Hence, the below mentioned questions might not all be covered, and instead be replaced with other, more detailed questions based on the interviewees answers. Furthermore, the sections of the interview might be covered in a different order.

Introductions

- Can you tell us something about the first steps of the introduction of the smart, connected product?
- How did you come up with the decision to introduce these products? Who were the main stakeholders?
- What were the main drivers for this decision?
- Can you tell us about your role within the project?
- What was the goal of introducing these products (other than economic goals)?
- What would you say was the biggest gain the company got from it?

Deep dive into the BMI

Attached you can find the Business Model Canvas as designed by Alexander Osterwalder & Yves Pigneur in 2010. In order to tailor the interview to your specific case, we would like to get an understanding of your specific business scenario before and after the introduction of the smart, connected product.

- Did you target any changes in Business Model purposefully from project start? (Which ones?)/ Which business model changes occurred after the introduction of the smart, connected product?
- If not, is there any area where you see a particularly evident change?

Value Proposition

- How has your value proposition changed since the introduction of the smart, connected product?
- What was the goal/ reasoning of expanding the offering?

Consumer Closeness

- Did you experience a change in who your target consumer is? Any completely new customer segments?
- How did you engage with your customer before the existence of the smart, connected product? In which regards did the relationship to your consumers change after the introduction?
- Have you found new solutions/ pathways for customer feedback since the establishment of the smart, connected product?
- Has the introduction helped to better understand the market/ consumer?

Core Resources/ External Partnership

- Did you have the technology developed in-house, in a different division of the company, or sourced from an external supplier/ partner?
- Did you happen to enrich the number of suppliers?
- For changes in partnership structures, how was the process? Was it efficient? What about managerial flexibility in this regard?
- How has the role/ importance of technological know-how changed since the commercialization of the smart, connected product?
- How has the role/ importance of data changed since the commercialization of the smart, connected product?
- Would you argue there is more need for interdisciplinarity/ inter-departmental cooperation in such product development projects?

Revenue/ Cost Structure

- What has been the most significant change in the revenue stream?
- Did the introduction of the smart, connected product have any consequences in terms of volumes sold for the other product lines?
- Where there any unexpected costs incurred?

Deep Dive into Processes and Learnings

- Was there a specific team in charge of the project?
- How would you describe the role of managers within the project?
- Could you highlight the main steps you had to take?
- How long did the overall reorganization process take?
- Was this a straightforward, one-time process, or did you have to repeat certain steps?
- Would you say this process was efficient?
- What would you say was overall the biggest challenge for your firm during the course of this project?
- Which processes for learning did you implement during or after the commercialization of the smart, connected product?
- Did the relevance of some specific core-competence change before and after the introduction of the smart, connected product?
- Can you identify a change in routine that actually made the difference in the whole process? Which is the one that contributed the most to your success story?
- Was there any stakeholder that was uncomfortable with the change? Was it hard to move towards new processes and routines for a particular reason?
- Do you feel that teams were sceptical about the success of the venture in the beginning? How did you manage to deal with this obstacle?

Appendix D: Interview Transcript - DentiStrong

Preliminary scoping

What were the main drivers for this decision to start the pilot project on the new product?

It was a variety of factors. The idea came from different levels and functions, both R&D, marketing, brand management and the industrial design. These were the innovation leaders. In general, when it comes to product development, the company also relies on external partners that approach us with the open innovation spirit.

What would you say was the biggest gain the company got from it?

The biggest opportunity lies in providing added value via real time feedback to the consumer whilst she is using the product, together with the coaching and education features. Moreover, there was the possibility to achieve interactivity at a free price point because the consumers already have a smartphone. The high adoption rate of smartphones in recent years now unlocked this opportunity. Previously, it would not have been possible to have a remote control, or a HD display to achieve the same interaction results without incurring extremely high costs.

Deep dive into the Business Model Innovation

VALUE PROPOSITION

How has your value proposition changed since the introduction of the smart, connected product?

The core of the value proposition has not changed. It is still about delivering a product that has the same premium quality and the functionalities as in the past. The digital aspect is just an extension, a supplement, an enhancement of in-use experience, which improves compliance habit. But in this field the digital element it's not the core of the proposition, it's just a way to enhance the customer experience. With digitally enhanced products the aim should be to have enhanced performances and better experience of use for the consumer with respect to the standard non-digital product, but the original value proposition cannot be replaced by the digital element.

CONSUMER CLOSENESS

Did you experience a change in who your target consumer is? Any completely new customer segments?

Just like with all new-to-the-world innovations, there has been a particular shift of target in the initial phase of commercialization. Our early adopters were mainly digital natives. However, it was important to keep the traditional target group in focus too. They had to feel the involvement and value the innovation as useful. This could be achieved by involving them in the product development early-on. If this doesn't happen, it means that the focus on digitalization is too far from the actual mass-customer need.

How did you engage with your customer before the smart, connected product? In which regards did the relationship to your consumers change after the introduction?

In the development phase, during the prototyping, the company mainly relied on employee and small-scale consumer panels as testing group. Inside the different functions involved in the digital product development there are recent graduates, new hires and digital natives that are particularly keen on using such products. Key employees are mostly located in R&D, marketing and industrial design departments. We tracked the panel input and evaluations throughout the product prototyping and

testing.

Consumer involvement in product development with consumers from outside the company happens in two streams: the “standard” one, where the “classic” key target consumer is recruited like before; this is to ensure that the old market still accepts the product. The second stream focuses on getting feedback from digital natives who can provide early and very valuable feedback that even goes beyond the specific product to be tested, because they have experiences with other products and features from other digital and connected/ IoT devices which can be transferable.

In addition, we engaged with health care professionals, in our case dentists and hygienists, for early co-development and inclusion of their feedback and improvement ideas to our digital product enhancement. It is key to gain full support for professionals as recommenders and influencers to their patients.

The company has consciously decided not to engage in consumer data collection. All data stays with the consumer on their smartphone. This is mainly due to privacy reasons. There are different regulations even within Europe for privacy purposes, hence it is hard to come up with a single platform for all the customers which complies to local law.

Customers are reserved when it comes to health-issues. The customer can however share the data in the cloud with the dentist if they choose to do so and opting-in.

The company included educational material into the app to educate about the way in which the product should be used for best performance so to enhance the prevention of related diseases and also to provide informational material on the product line.

Have you found new solutions/ pathways for customer feedback since the establishment of the smart, connected product and the corresponding app?

There is little direct benefit to the customer relationship because of the choice not to collect feedback data.

Does your app have a feature which lets the consumer know when to exchange replaceable parts?

There is no additional intelligence provided for the replacement of the product component. This is mainly because maintenance in this case cannot be standardized and it depends on the habits and care of the different user.

CORE RESOURCES/EXTERNAL PARTNERSHIP

Did you have the technology developed in-house, in a different division of the company, or sourced from an external supplier/ partner?

It was a combination of internal experience enhanced with external collaboration. Our company has an established ecosystem of partners that especially provide software for internal purposes. There are already established partnerships with them, hence the specific skills needed came mainly from them and there was no need to establish new partnerships. Most of the technology was internally developed, the external partners were mainly used for their programming knowledge and app-development skills. This is a pattern that is found across many other companies.

Did you happen to enrich the number of suppliers?

This was not necessary in our case, because we had the possibility to leverage on existing partners. They were already in our pool of partners and they could provide us with the electronic components and chips we needed.

Were the changes in partnership structures efficient?

The process of finding the right partners would be described as very efficient, due to leveraging on the existing ecosystem of partners and our established open innovation system and processes.

How has the role/ importance of technological know-how changed since the commercialization of the smart, connected product?

The IT know-how became much more significant across all the functions. IT know-how became more important in two areas: 1) the IT knowledge in cloud systems, connectivity and the integrity of data, and ensuring that the data is not hacked, and 2) the general understanding of IT in all other functions needed to increase development of novel, future digital business and service models. Usually marketing people only use the software but are not on the side of understanding how software deployment works. In this case, it was necessary also for them to have a clear understanding of the IT tools.

Was there a particular process established to ensure this IT education of other departments?

There was no structured learning process or training for the people from non-IT departments initially. In the meantime, we have created a so-called IoT Bootcamp to teach fundamentals of digital electronics, cloud architecture and software programming in a hands-on seminar including own programming and prototyping of Arduino based modules including sensors and output actuators.

Would you argue there is more need for interdisciplinary/ inter-departmental cooperation in such product development projects?

R&D, marketing and industrial design all cooperated in the development phase. But that is normal and standard for all projects within the company. The main difference is the additional involvement of the IT organisation.

REVENUE/COST STRUCTURE

What has been the most significant change in the revenue stream?

There are slightly higher costs of production for such products to add the wireless connectivity. As a consequence, these consumer goods play at a premium price point. However, there are ways to mitigate the effect on the price increase, for example by providing a lower number of replacement components or accessories in the first purchase with respect to the standard electrical alternative, so we balance cost through alternating SKU packaging. Generally, the digital element has provided a higher growth point and better profitability structure and made cost structures more flexible.

Did the introduction of the smart, connected product have any consequences in terms of volumes sold for the other product lines?

Not in our case as we upgraded existing products and were able to build the IoT/ digital technology into existing product designs and manufacturing equipment. The premium line-up was converted and after a relatively short transition time all their products included the digital technologies like sensors and wireless technology.

Deep dive into Processes and Learnings

Was there a specific team in charge of the project?

It was a team spontaneously formed by people from R&D, marketing and industrial design, that in part already knew each other and had worked together on other projects, but also some new people, but not more than in other projects.

Was this a straightforward, one-time process, or did you have to repeat certain steps?

We developed the digital product in iterations and with agile methods. Digital products have shorter iteration and improvement cycles than traditional products. There is opportunity in being able to iterate code much faster than a physical product. Typically, it took us 4 weeks to iterate complete prototyping and testing cycles/ processes for the software of the app, and it usually requires much more time for the physical products. The iterations are much more agile. We also call this lean innovation or lean start-up. The lean development methods are a main learning from this pilot project and now scaled across many other projects and organizations.

What would you say was overall the biggest challenge for your firm during the course of this project?

Answering the questions of “What do you want to do?” and “Where do you want to play?”. The biggest risk was to get too excited with some technology option that would not serve a true consumer need, so the search for a meaningful solution was a challenge and team focus. Also, taking into account the risk that with a wrong move (esp. with regards to data) a complete brand image that has been built over decades can be ruined in just a couple of minutes.

Which processes for learning did you implement during or after the commercialization of the smart, connected product?

The main learning was from the adaptation of the app for the iOS and Android devices. It is hard to have a single code that works with the same degree of efficacy on the two different platforms. We also learned from new due diligence processes, quality and global legal requirements documents, which we will use for future projects.

Was there any stakeholder that was uncomfortable with the change? Was it hard to move towards new processes and routines for a particular reason?

In particular, there was significant discomfort within the traditional, multifunctional program management function due to the fast-paced development of digital apps and solutions vs. the longer lead-times and cycles in traditional physical product development. Our common, 5 step program management process has not been designed for the digital world and needed significant changes to accommodate the agility and speed of digital tool development. We also had to learn how to test, release and certify the new, connected devices in conjunction with the apps and digital solutions which require to be updated after the initial sale of the product in retail or e-commerce. New product lifecycle management tools had to be created and implemented in a relatively short period of time.

Appendix E: Interview Transcript - Moleskine

Preliminary scoping

Can you tell us something about the first steps of the Smart Writing Set introduction?

I joined Moleskine about 2 years ago, right after the launch of the product. So, I did not follow the project from its inception, but I was there at the launch around April 2016.

How did you come up with the decision to introduce it? Who were the main stakeholders?

What happened inside the company few years ago was that we realized that our customer needs were changing. People were not just taking notes on notebooks, but a lot of the times they had a computer next to them, their smartphones. So, there was the switch between an analog device and a digital device. So, the Moleskine+ category is the category inside the company that brings together the analog and the digital. The very first collection we created was the Evernote one. The application, which works with this notebook, is basically capturing images of the notes from the notebook and the customer can back up your notes in the Evernote. This was a very simple product proposition that evolved little by little and arrived in 2016 with the Smart Writing Set. So, the Smart Writing Set can be conceived as a climax of the bridging between analog and digital.

For us it was really important to keep the paper and pen feeling, so to keep the classic Moleskine notebook feeling. We really wanted to keep this feeling and to keep it consistent with the Moleskine values, but at the same time we wanted to achieve the combination of analog and digital. This is the atmosphere from which the Smart Writing Set was born.

What were the main drivers for this decision?

The Moleskine+ category was born to create seamless solutions to bridge the analog and digital element so to follow the need of the Moleskine user.

Can you tell us about your role within the project?

I am a digital innovation specialist. In particular I take care of the operational marketing and the marketing development for the Moleskine+ category. This category has multiple products in its portfolio, which could be arranged in 3 sub-categories:

- So, we are talking about *smart notebooks*, maybe you have seen the Evernote collection. Here belongs the Smart Writing System, of which the Smart Writing Set was the very first product.
- Then we have the *applications*, like TimePage, Actions and all the apps to be used with the notebooks.
- Besides this, there are the *digital services*. For instance, at the moment we have a print on demand service. There are services offered for all the categories in the company.

What was the goal of the project (other than economic goals)?

Moleskine wanted to be on the warm side of technology. Which does not mean analog versus digital. I think one of very first ideas that our founder had was that analog vs digital were not one against the other, but they were both part of the same creative process. Take for instance an artist who starts his creative process on paper and then has to switch to Illustrator or another Adobe software. Or a professional, who drops down notes quickly on a notebook and then has to write an email, which is on a computer. So, we are not talking about putting analog vs digital, but we are talking about the evolution of needs, in order to follow the creative processes of our consumers.

What would you say was the biggest gain the company got from undertaking this project?

Of course, there are economic gains. But I believe that for sure giving a new product proposition to our consumers and reaching new targets were the biggest gains. There is a group of prospect consumers that could get to know the brand through this specific product. But it is also a gain in terms of brand and company. Moleskine is a company which is evolving and does not stop at the notebook itself. It's almost like a lifestyle brand. So, we are evolving with the contemporaneity, with the consumers' need. In terms of keeping pace with the changing environment and needs, it's a big lesson for the company itself to be anchored with the contemporaneity and not just keep on doing the same thing.

Deep dive into the Business Model Innovation

Is there any area of the business model canvas where you now see a particularly evident change? Which changes to your business model occurred after the introduction of the Smart Writing Set in your offer?

I would say that we are becoming a multi-category company (Paper, Bags and Accessories, Moleskine+). Before we just a "notebook company", with very few categories and now we are expanding to multiple categories. That I would say is the biggest change for the company overall. If I have to think about the specific Moleskine+ category, I would say the biggest change was from the thinking in terms of collections to the focus on an ecosystem of objects, which are connected among each other in an integrated way.

VALUE PROPOSITION

How has your value proposition changed since the introduction of the Smart Writing Set?

There is an improvement of consumer experience. At this point we are not only offering a single solution. There is plenty of opportunities in terms of notebooks and pens which are enlarging the offering not only physically but also digitally. So, the customer has many opportunities and an improved experience.

CONSUMER CLOSENESS

Did you experience a change in who your target consumer is? Any completely new customer segments?

Yes, in the sense that for sure it's a new useful product, we have found new customers. But at the same time our loyal customers, who like the brand and its products, have found the perfect solution in the Smart Writing Set for their analog-digital use and the possibility to switch from the fully analog to the digital side, also.

How did you engage with your customer before the Smart Writing Set? In which regards did the relationship to your consumers change after the introduction of the Smart Writing Set?

Before the launch I don't think [there was any involvement of the consumer in the prototyping], but I wasn't there. We definitely already had experience from the launch of the smart pen in the market. So, we had the right momentum to start.

Have you found new solutions/ pathways for customer feedback since the establishment of the Smart Writing Set?

Of course, you find reviews and commentaries on the internet, but now we also try to stay in contact with the customers. We have created surveys for people, who purchase the product, or try to understand patterns from the app usage. So, you can monitor on the application for the product usage. We also have the retail [stores], so clients come to our retails and they ask for new products and from them we collect information for future development.

Is there a different message brought to the digital consumer, compared to the analog consumer?

Yes, there is. The smart writing set is a more complex product, so we try to communicate it in a different way and we give more details on the functionality and the different usages. And we explain it better than a normal notebook.

Is there a difference in your marketing interaction then (external communication)?

A notebook doesn't need many explanations. It's simple to use and it's intuitive. The Smart Writing set is not so simple. It's intuitive, but since it is a partially technological product, it implies the need for much more explanations. You have to be very clear on the product proposition, you have to provide video tutorials and leaflets to the public and really have a clear communication of the product on the market, otherwise people will not understand it. They would not understand the needs that the product covers.

CORE RESOURCES/EXTERNAL PARTNERSHIP

Did you have the technology developed in-house, in a different division of the company, or sourced from an external supplier/partner?

It's totally outsourced there is nothing in-house. In-house we basically have the digital innovation team only. All the tech key activities are executed by a Korean company called Neolab. Their core business is the production of the technology of the pen and the app development. We work in really close partnership with them, I talk to them every day.

For changes in partnership structures, how was the process? Was it efficient? What about managerial flexibility in this regard?

I was not there when the partnership was created. I can tell you that it's complicated. The main obstacle is that if you are a company that makes a paper product you have a certain production phase, while the partner mainly works on the app, so mainly a software product, and the pen which again has a totally different production process. You have to make sure you are aligned with the timings, and the all the processes between the companies are aligned.

How has the role/ importance of technological know-how changed since the commercialization of the Smart Writing Set?

We are involved 100% on everything, in terms of the digital innovation department. So, to give you an idea: in December, we have launched a new pen. Moleskine takes care of the design of the pen. The Korean company made the hardware, but the design is kept in-house. For the notebooks instead, everything is still in-house, we coordinated everything. For the application, it is more driven by the Korean company. We can give them insights in terms of what the consumers would like to have, but they will ultimately determine the feasibility of our requests. For most of the things it's 50-50%. All the design components and paper components are for Moleskine to take care of, whereas the digital component is Neolab-driven.

How has the role/ importance of data changed since the commercialization of the Smart Writing Set?

For the application, we use software which are out there for data analysis.

Would you argue there is more need for interdisciplinarity/ inter-departmental cooperation in such product development projects?

We have created the digital innovation department, which is separate in order to be more agile on the product development in general. Of course, all departments are aligned, but I would say they don't follow the project from the beginning but rather get involved only at certain points.

For instance, our IT department is never involved in our product development, since it is an IT department in the traditional sense of taking care of CRM and business intelligence.

Of course, we get in touch with the product marketing team and with the sales team a lot as well.

REVENUE/COST STRUCTURE

What has been the most significant change in the revenue stream?

For sure with the product launch there has been an increase in revenues. The pricing was really well received from the consumer, we never had harsh feedback from the consumer saying it was overpriced or under-priced. The product is priced in line with the prices on the market and our Moleskine brand price list.

Did the introduction of the Smart Writing Set have any consequences in terms of volumes sold for the other product lines?

The introduction of the Smart Writing Set did not cause our consumers to purchase more of the paper notebooks. In general, our core business, which is the paper business of the notebooks and planners was already very strong, it did not need a push from the digital side.

Do you think there was any cannibalization with the other product lines?

Given the different price points, there is also a different positioning, so there is no cannibalization. We have customers still using both paper and smart writing, depending on the use they have to make of the notes. Maybe they use the smart set on the job only, so there is no cannibalization at all.

Where there any unexpected costs incurred?

Given the outsourcing, we purchase the pens and that's it.

Deep dive into Processes and Learnings

Was there a specific team in charge of the project?

There is the specific digital innovation team. This a global department. Milano is our HQ, and we coordinate with the teams in Asia and New York. In the team, there is the digital innovation specialist, which is me, there is my boss who is the digital innovation manager, and there is a department director, and then there is the user experience architect (a guy whose focus is the digital experience). Then everything else is outsourced. Basically, me and my manager are very focussed on product marketing, project management and all the coordination needed.

The digital innovation professions are less defined than in other departments. In our department, everybody has to know a bit of everything because of the relationship between products I told you about, it's an ecosystem. So, we do a bit of everything.

What would you say was overall the biggest challenge for your firm during the course of this project?

The introduction of a new "tech" product in a mainly paper business.

Was the product commercialisation a straightforward process or did you have to repeat and re-iterate certain steps?

It's a still ongoing learning process but distribution and communication of the product were partially new (Ex: how to enter the consumer electronics channel)

Did the relevance of some specific core-competence change before and after the introduction of Smart Writing Set?

No, not really.

Can you identify a specific key activity that contributed the most to the Smart Writing Set success story?

I think how the product proposition was created determined the success of the product. We didn't place the Smart Writing Set as a gadget or tech product like smart pens are usually positioned, but as an experience ready to be used (smart pen + paper support all in one). Moreover, the fit with the brand was key, as we had a pen and paper experience in mind which was "digitized" like the classic note-taking activity with the Moleskine notebook.

Was there any stakeholder that was uncomfortable with the change? Was it hard to move towards new processes and routines for a particular reason?

I think, in this case, it is a still ongoing learning process. You have to get the whole company used to a new product, which is much more complex than a simple notebook.

Do you feel that teams were sceptical about the success of the venture in the beginning? How did you manage to deal with this obstacle?

Yes, in the sense that all the Digital Innovation products are a bit of a "risk". You may have an idea of how they will go, but you are not sure until the market launch. The scepticism has been overcome by the success of the product in the market.

Which processes for learning did you implement during or after the commercialization of the Smart Writing Set?

I would say that first of all the smart writing set has to be communicated in a very different way. We had to understand that before [the launch] we were only selling a product, a notebook which is really simple, now we are selling a more complex product. We had to invest a lot into training the people in-store, the people inside the company, and training the consumer. We had to explain the product and showing it and knowing it A to Z. The on-boarding process is much more complex and you have to be ready for it.

Second takeaway is also that the analog side has a different production than the digital side, so there has to be an alignment. On the digital side, it takes weeks to do an update, on the analog side it takes months for the production, preparation, logistics etc.

Another takeaway is to listen your consumer, but this is rather normal.

Appendix F: Interview Transcript - TechyToy

Preliminary scoping

Can you tell us something about the first steps of the introduction of the smart, connected product?

There was already a comparable product which had adults as target customers. This product was really on the forefront of the digital-physical play experience offers. It's the classic plastic product but with some digital components. Traditionally our product does not have any intelligence, but if we add technology we can bring it to a higher level, and you can connect it to an iPad and interact. That was the intent of our team: how can we bring this kind of product to kids, a product which is in some way intelligent and interactive, so it can actually challenge the kids back?

How did you come up with the decision to introduce these products? Who were the main stakeholders?

The push came from the management, in particular, there was a memo from the senior vice president, who wanted to have a product comparable to the one we had already in the market but for a different consumer. The company wanted a product that could be used by the main target group, namely kids. As a consequence, it also had to come to the market at a cheaper price.

What were the main drivers for this decision?

It was a combination of knowledge from the market, the dream of bringing this technology down the road, and to create a seamless experience between the non-digital toys for younger kids and the digital toys we already had for the older, more advanced and "techy" audience. So mostly teenagers and young adults were fond of the already existing product, which is 80% of our business, and we wanted to bridge this technology into other products.

Our consumers, the kids, are getting "older" at a younger age. Already at the age of seven they go fully digital. They are more and more exposed to technology through iPads and phone games, and the playing with physical games is going back.

As a company, we had a digital intelligence group following the relevant trends in the entertainment industry and the technology scene, for example, what is happening in Korea or Japan. We also participated in the relevant fairs, such as the Nürnberg Toy Fair, the New York Toy Fair, the Las Vegas Consumer Electronics Fair, etc. to see the trends.

Can you tell us about your role within the project?

As a marketing leader, I was part of the group which lead the product development of the smart toy.

What was the goal of introducing these products (other than economic goals)?

The goal was to satisfy the market need we had identified.

What would you say was the biggest gain the company got from it?

The company gained a lot of notoriety with the product success. The reputation of the brand and PR grew even stronger.

Deep dive into the Business Model Innovation

VALUE PROPOSITION

How has your value proposition changed since the introduction of the new product?

We realized, as a preliminary step, that in order to successfully launch this product, we needed to address three different target audiences: the consumers, which are the kids, the shoppers, which are the parents who actually buy this rather expensive product, because the kids can't themselves afford it with their pocket money, and the customers, which are the retailers. The latter led to the question: how can we promote this product in the stores? Therefore, the value proposition had to be a combination of elements understandable to all 3 target audiences. We found out the idea that the toy could come alive was the value proposition: "I can make my toy come alive". The idea was as in the Toy Story movie, the kids' dream of having their toys come to life. When we started this product development journey we had this bigger picture in mind.

CONSUMER CLOSENESS

Did you experience a change in who your target consumer is? Any completely new customer segments?

Actually, younger than expected kids were able to use the products and in the end, parents buy this product from their kids down to the age of 5.

For us, the customers are the retail stores, and I'm not sure if we managed to expand to reach new ones through the introduction of the new product.

How did you engage with your customer before the existence of the smart, connected product? In which regards did the relationship to your consumers change after the introduction?

The complexity of the product demands a really clear communication from our side. We could not have lengthy communication between the company and our target audience about the functionalities, hence we had to find a way to make it really simple so that it could easily be understood.

How can you sell something which is both digital and physical on a flat piece of paper? It was really hard to decide how we wanted to present this. In the specific case, you need to clearly communicate a new story, a new solution, that your customer is not familiar with. We first wanted to create a story attached to the product we wanted to commercialize, but we did not manage to do it in a one box offer. Then we tried with the option of a tinker box, the idea of a tool box with a lot of things you can do. We picked this option in the end to communicate a message which was closer to the actual value proposition.

Given the traditional orientation of toy retailers, it was particularly important to adapt some features of the sale process to communicate correctly what the product could do, especially since many of these stores are not necessarily equipped with screens, which would lend themselves best to communicating the product value. The dream would have been a similar setup as in an apple store.

We did not open up for kids before the launch. We used focus groups though, in which we had both groups of parents and groups of kids. There were also some testing setups. We had this interaction to see if we were getting in the right direction. But we could not put demos on the market, because the software has to be completely finished when you introduce something for a very young target audience, because they do not understand the meaning of a beta version and they just want to play.

Have you found new solutions/ pathways for customer feedback since the establishment of the smart, connected product?

There is interaction among users on forums, where people share the code lines they are working on. We do not interfere with that as a company.

However, we are not allowed to collect any data from kids, but we have a social media platform for the specific product. Still, the social media platform requires a minimum age of 13, which is older than the target user of the new product. Therefore, we don't collect any data there.

CORE RESOURCES/EXTERNAL PARTNERSHIP

Did you have the technology developed in-house, in a different division of the company, or sourced from an external supplier/partner?

The steering of the app development was definitely internal. For the product technology embedded in the game, we had two external partners for the technology of the smart component of the toy and for the app development technicalities. The external partners were certified by the company.

Did you happen to enrich the number of suppliers?

Yes, as mentioned before. The intelligent app had a complex coding component, so we need two different partners for two different competences to scale up the development. We did not even have such a long time to finish the product in our schedule. Hence, the software to be put in the physical plastic component, the mind of the toy, had to be obtained pretty fast. For this reason, we had to get the external partners in.

For changes in partnership structures, how was the process? Was it efficient? What about managerial flexibility in this regard?

The tender went really smooth. But it's an Achilles' heel if you don't find the right partner because you don't have time to do it all over. It is very much about competences and trust, especially since this is a cooperation among 3 players working together. You need to have a very oriented steering and also openness about what is going on.

We knew everything about making plastic toys, but to steer through such a complex programming and digital task was quite difficult.

How has the role/ importance of technological know-how changed since the commercialization of the product?

Our core expertise was the knowledge of the why and how we wanted to achieve the commercialization of that particular product. But in terms of what needs to be done, we were relying on the external partners. However, we did have within our company some very skilled people already, and a few new people we hired for that purpose within the group. I think that was why we succeeded.

How has the role/ importance of data changed since the commercialization of the smart, connected product?

We follow trends and we analyse the sales data. But we do not ask for any data information without permission.

Would you argue there is more need for interdisciplinary/ inter-departmental cooperation in such product development projects?

There were many instances of the decision-making process in which people with different competencies had to come together and decide what was right to make all the components work in a seamless manner.

REVENUE/COST STRUCTURE

What has been the most significant change in the revenue stream?

The revenue stream is the same as for the standard product, with the difference that you now have a physical component, a digital component and some other maintenance features, hence a different price. There is no subscription idea behind the app. You only pay the box and you get access to all the digital features.

When setting the price there is both a psychological component and a portion of costs that necessarily has to be covered. There is also a component of price setting which is both internal and external, hence you need to see what is there in the market offered by the competition, talk to your sales people etc.

Where there any unexpected costs incurred?

I cannot really say, but there were high costs incurred. The project was pushed to the market to increase the value of the offering, not primarily to boost our profits.

Deep dive into Processes and Learnings

Was there a specific team in charge of the project?

Yes, there was a team of 3 people, a locked triangle of members working closely together, a marketing, design and project lead. Underneath us were supporting functions in marketing and design. Me, the marketing lead, and my 3 colleagues had to design a perfect go-to-market strategy. As a team, we really wanted to achieve this project together and this made the difference in our results, but the project lead had to make sure that all the functions involved in the product development phase were engaged and up to time.

The design task was to make sure that everything was clear to the consumer.

How would you describe the role of managers within the project?

There was support from the top management. There were few stakeholders at the top that really wanted this. We all wanted to set a new bar of what was possible to do from our side to make kids happy.

Could you highlight the main steps you had to take?

We had a vision board, with seven streams and different stage gates.

Was this a straightforward, one-time process, or did you have to repeat certain steps?

We changed things several times from the initial idea we had in mind. There can be budget issues. We also had to understand whether we had a male or female target. Since we wanted to go for both, we had to work a lot on the product development so that it could work well for both genders.

The iterations were mainly coming from the value proposition we wanted. If you want to communicate too many features, you don't reach the consumer.

Did you incur any difficulties when trying to match the different development cycles of the digital and non-digital components?

We were champions in the development of physical components, but how to do this with the digital components, where every 2 weeks you have a new update, was really tough to figure out. We had on one side our blue collars producing plastic components at their standard pace, and on the other the white collars, software development guys, with another. The latter did not always understand why we couldn't change the physical product components at a later point in time. While you can change the app until the very last moment, you just cannot do it in the toy! It has to stand in the market for at least some years.

It's two different machines, and there is not such a smooth understanding.

What would you say was overall the biggest challenge for your firm during the course of this project?

First, we were only focussed on plastic production before. This product development was efficient, for plastic! But we only had few people with experience on the other side of the digital. We had to develop

this understanding and incorporate all the interdependencies with the plastic components. We had to develop a process that could handle this complex product development. Second, from the moment the project starts to the moment you are able to scale up there is a big temporal gap with many challenges.

Which processes for learning did you implement during or after the commercialization of the smart, connected product?

There were some learnings coming from the previous commercialization of comparable products. Related to that particular product, we had already an established digital platform of gamers we could follow.

I think we needed to develop a start-up mentality within a huge machine, and I think the burning desire to make it happen was what made the difference. Also, our team was kept small on purpose in order to be more agile. With the agility, we were able to come up with solutions and decide what to do with the challenges.

You need to escalate when things are getting too complicated.

Can you identify a change in routine that actually made the difference in the whole process? Which is the one that contributed the most to your success story?

The greatest contribution to the success story was a good project management.

Was there any stakeholder that was uncomfortable with the change? Was it hard to move towards new processes and routines for a particular reason?

There were many challenges and there were some sceptical people. We were not enough people in the beginning and it took a long time to get the right people on board and be able to scale up.