

BLESSING OR CURSE: DOES DIGITALIZATION FOSTER BUSINESS MODEL INNOVATION? EVIDENCE FROM A QUANTITATIVE EMPIRICAL STUDY

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Abstract

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This study analyses whether and how digital transformation affects business models. Digitalization influences businesses regardless of size, industry, and structure. Thus, companies are often forced to rethink their value architecture in order to remain competitive and not vanish from the business world. Therefore, deepening the understanding of the relationship between digitalization and business models is of utmost importance for both practice and academia. We examine the interdependencies of the utilization of digital technologies and the execution of a digital strategy on business model innovation, and the extent to which the digitalization level is influencing this relation. Furthermore, we depict the results from a quantitative study among a sample of 166 German companies. The results indicate that business model innovation is positively influenced by a higher pursuit of digital technologies and the adoption of certain digital strategies. The digitalization cluster further stresses the importance of digital actions for the companies' sustainability.

Keywords: Digitalization, Business Model, Innovation, Digital Strategy, Technology, Digitization Level

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1. INTRODUCTION

With new digital technologies disrupting businesses (Nambisan, 2017) all over the world, mastering the digital transformation is a challenging endeavor for companies of all sizes, industries, and structures. According to Berman (2012), every company is affected by digitalization and its consequences. While at the beginning of the digital transformation mostly products and processes became ever more digital (Yoo, Henfridsson, & Lyytinen, 2010), we are now in the era of "smart-just-about-everything" (Zott & Amit, 2017, p. 19) with the "Internet in our pockets" (Hendrix, 2014, p. 149). Even new terms

such as "datification" (Galliers, Newell, Shanks, & Topi, 2015; Newell & Marabelli, 2015) developed with the digitalization trend. Among the drastic consequences of this development are an increasingly fast-moving world, shorter product lifecycles, and the obsolescence of extant business models (Pateli & Giaglis, 2005; Zott & Amit, 2017). This leads to the emergence of new businesses, business models, and even digitally-driven industries (Alexopoulos, Sipsas, Xanthakis, Makris, & Mourtzis, 2018; Hoffmeister & von Borcke, 2015). Among these changes, platform business models (Evans & Gawer, 2016; Gawer & Cusumano, 2014; Tiwana, 2013), ecosystem architectures and

environments (Mäntymäki & Salmela, 2017; Peltoniemi & Vuori, 2004; Sussan & Acs, 2017), and new industries such as blockchain (Belle, 2017; Tapscott & Tapscott, 2016) can be named as some examples of these new developments. Therefore, one of the greatest challenges is to create management tools and a corporate culture that fosters innovation and dynamic flexibility (Tapscott, 1996).

However, digitalization, as a major technological trend, has many positive implications for companies. Hence, digitalization aims at optimizing existing processes, supports increasing the overall efficiency and quality of products and services, and reduces transaction costs for transforming activities (Berman, 2012; Nambisan, Lyytinen, Majchrzak, & Song, 2017; Vendrell-Herrero, Parry, Bustinza, & Gomes, 2018). According to Pisano and Verganti (2008) and Ireland, Hitt, Camp, and Sexton (2001) digitalization is one way to reduce costs for innovative ideas and the execution of innovative initiatives.

Driven by the enormous success of tech giants such as Amazon, Google, Facebook, and several other digital leaders, digital innovation and the rise of new business model types propelled the debate about how digitalization effects business models. Uber and AirBnB are at the forefront when it comes to exploit unused or underutilized resources to generate value. According to Cohen and Levinthal (1990), the organizations' ability to leverage knowledge inside the company is a valuable resource for innovation. This is especially true in an interconnected world, where data and knowledge about how to use and transform data into a powerful competitive tool is striving. The digitalization leads to changes in strategic firm decisions and is deemed important as a strategic influencing factor (Davis, 2016). Thus, the digitalization puts new demands on firm-level dynamics and business model innovation initiatives. Empirical studies are relatively scarce to today's point of time.

Value creation and capture mechanisms change dramatically in times of digitization (Bharadwaj, El Sawy, Pavlou, & Venkatraman, 2013). Both concepts strongly focus on the value perspective (value proposition, value creation, and value capture) and contribute to new value prospects for the customer (Baden-Fuller & Haefliger, 2013; Berman, 2012; Clauss, 2017). "BMI appears even more important as digitalization is placing substantial stress on firms" (Gassmann, Frankenberger, & Sauer, 2017, p. 45). Especially, the intertwined relation between digitalization and business model innovation is rather underexplored in current literature and opens new perspectives in current entrepreneurship and management research (Nambisan, 2017). A hitherto existing research gap in the linkage between these two concepts is detected and must be filled with sophisticated research findings. We seek to address this gap by combining digital strategies with the most appropriate BM type and link this relation to firm performance.

Thus, we ask the following research question:

Does digitalization foster business model innovation considering the utilization of digital technologies and specific digital strategies?

To capture a holistic picture, we use a quantitative approach and derive results from

a study among 166 German companies. The remaining paper is structured as follows: Section 2 explains the main theoretical foundations and further deepens the understanding of the relation between digitalization, the utilization of digital technologies, the pursuit of a digital strategy, and business model innovation initiatives. Based on the theory, in Section 3 the hypotheses are derived which need to be tested. The methodology of the underlying study is explained in Section 3 with seamless linkage to the results in Section 4. We conclude with a discussion in Section 5 and give some suggestions for future research in Section 6.

2. THEORETICAL FOUNDATIONS & LITERATURE REVIEW

Although the relationship between digitalization and business models is of great importance in practice, the topic is still in its infancy in academic research. However, a number of studies contributed to contemporary research. Most studies enhance the general perception that digitalization is primarily a trigger or impulse for business model adaptations or changes (Boyd & Crawford, 2012; Birkinshaw & Ansari, 2015; McAfee & Brynjolfsson, 2012). Further, some studies find evidence for a positive and reinforcing relation between digitalization and business models (Kurti & Haftor, 2015). The relatively small amount of papers examining this explicit relationship, compared to increasing studies in the entrepreneurship, business model, or similar research strings, suggests this specific research field to be a rather pertinent and evolving one.

2.1. Digitalization

"Digitalization" is more than only a buzzword in today's fast-changing environment. Digitalization is a megatrend which is disrupting markets, societies, and company behavior (Bressanelli, Adrodegari, Perona, & Sacconi, 2018; Iansiti & Lakhani, 2014). Unfortunately, a paradigmatic showcase example of how to best master the digital transformation in enterprises does not exist yet (Bughin & van Zeebroeck, 2017). Simply put, digitization describes the technical transformation of analog information and processes into digital ones (Negroponte, 1995). As research emerged, digitalization is more than only the technical perspective, but rather includes the changes in patterns and innovative nature targeting economy, society, and further aspects in life (Loebbecke & Picot, 2015). Moreover, this topic has even become an important research stream (Tsatsou, 2016). The high practical orientation and the interrelation to major research areas in management, such as digital entrepreneurship (Aldrich, 2014; Obschonka & Fisch, 2018), market boundaries and competition (Cattani, Porac, & Thomas, 2017), corporate strategy (Arora, Belenzone, & Rios, 2014) and resources and capabilities (Berger & Kuckertz, 2016; Dy, Marlow, & Martin, 2017; Teece, 2018) drive the interdisciplinary. Therefore, digitization opens up new opportunities for innovative and disruptive exploitation among business architecture (Baesens, Bapna, Marsden, Vanthienen, & Zhao, 2016; Newell & Marabelli, 2015). Digital embeddedness has the power to not only

transform business models on an internal level but also businesses in total and even complete industries (Bleicher & Stanley, 2017).

Another term often used in connection with digital strategies is digital transformation. Digital transformations as one form of diversification and innovation have been shown to have an immense impact on firm performance (Wade & Hulland, 2004; Westerman & Bonnet, 2015). A rather recent definition for the digital transformation comes from Bou   and Schaible (2015) and presents it as networking architecture among all economic sectors and participation of stakeholders to the new standards regarding the digital affordances. According to this definition, the inherent transformation of strategies, business models, and overall value structures due to digital technologies shall be expressed. According to prevalent literature, digitalization has a predominantly positive effect on the economy (Bloom, Sadun, & Van Reenen, 2012; Guerrieri, Luciani, & Meliciani, 2011; Van Reenen et al., 2010).

2.2. Digital technologies

At the heart of the digital transformation are digital technologies that trigger the transformation of the business landscape. Dating back to the advent of the internet and the birth of the digital revolution, a considerable number of digital technologies emerged. Digital technologies are basically external facilitators promoting the evolution of new ventures (von Briel, Davidsson, & Recker, 2017) and simultaneously disrupting existing and incumbent businesses (Svahn, Mathiassen, & Lindgren, 2017). Digitization embodies the transformation of businesses brought by the mass introduction of digital technologies (Katz & Koutroumpis, 2013). The usage of digital technologies does not only lead to advanced products and processes but also change the service offerings to the customer (Ardolino et al., 2018). Our online time rocketed in the last years, with the Internet as primary technology and other digital technologies are approaching (Keegan, 2012). Big data as "the focus on very large, unstructured and fast-moving data" (Davenport, 2014, p. 10) together with the Internet of Things and Machine Learning are basically data-driven with the focus on high connectivity between objects and their interactive environment (Leminen, Westerlund, Rajahonka, & Siuruainen, 2012).

Completely different is the social media trend with high connectivity and new communication forms among people (Shih, 2009; Smith & McKeen, 2011; Vaccaro & Madsen, 2009). This progress has led to fundamental changes in consumer consciousness and the question, how companies are dealing with their customer on a frequent basis (Edelman & Singer, 2015). Digital technologies are therefore not only the necessary tools needed to tackle the digital transformation challenge, but also objects and mutually exclusive research avenues. Yet, digital technologies are not easy to analyze per se, because of their high level of dynamism and high dependency upon further determinants (Tsatsou, 2016). Moreover, the power of digital technologies as a competitive factor should not be underestimated (Weinmann & Euchner, 2015). Among the most popular digital technologies range the Internet of

things (IoT), big data, and cloud computing (Bressanelli et al., 2018; Chen, Kazman, Sch  tz, & Matthes, 2017). IoT is known as digital equipping physical objects with sensors, etc., in order to connect them to the Internet, where objects can communicate with each other (Dijkman, Sprenkels, Peeters, & Janssen, 2015). These IoT applications are primarily used in monitoring activities and help to optimize processes with the least effort in installing systems (Dijkman et al., 2015). Big data applications show similar characteristics (Chen et al., 2017). According to Seggie, Soyer, and Pauwels (2017), big data fosters information transparency, allows for target and customer segmentation and speeds up processes by using information data and making tailored decisions.

2.3. Digital strategies

Additionally, the formulation of a dedicated digital strategy is a key to incorporate digital technologies and achieve a competitive advantage (Ross, Sebastian, & Beath, 2017). According to Berman (2012), every company needs a digital strategy. Henderson and Venkatraman (1993), as well as Bharadwaj et al., (2013), years later further postulate that digital strategies cannot be understood as part of the overall firm strategy, but rather need to be seen as a dedicated strategy to master the digital era. New technologies and advances in the IT sector combined with new standards arising from the digital transformation movement are altering prevalent business strategies (Kohli & Grover, 2008; Rai, Pavlou, Im, & Du, 2012; Tanriverdi & Venkatraman, 2005). The underlying paper uses the working definition by Bharadwaj et al. (2013) and claims a digital business strategy to be an "organizational strategy formulated and executed by leveraging digital resources to create differential value" (p. 472). It is of utmost importance to precisely distinguish between an IT and digital strategy. Digital strategies must be clearly formulated and executed transparently (Ross et al., 2017). At the most general level, IT strategy has a superordinate position with many sub-decision and strategic alignments for the digital technologies that are being used (McDonald, 2012). Digital strategies expedite a value perspective and include customers next to the technological side (McDonald, 2012). The main enablers of this digital strategy are the utilization of digital data as well as a networking perspective.

Hence, there are several technology applications that need to be aggregated in one network, which is characterized by (Rysman, 2009). Thus, this multi-sided dimension call for the implementation of several technological applications and enablers (Pagani, 2013; Seggie et al., 2017). Among the digital strategies the "rebundling and customizing" has to be mentioned. Among the business model elements that are most affected by the digital transformation are the value proposition and the channels. The digital strategy "digital distribution channels" is addressing the new path to the customer by digitizing the distribution channel. One of the most pushing technology trends are cloud-applications that lead to a possible increase in income when applied as well as increased loyalty and lock-in effects (Berman, 2012; Zott & Amit, 2017).

Following the contribution by Bharadwaj et al. (2013), cloud computing is upon the main key digital resources. The advantages of cloud computing applications are rapid network access, self-service opportunities, virtual resources between an open-innovation network, and high service quality (Bharadwaj et al., 2013). When digitizing the channels, the customer is put into the forefront of strategic decisions and high flexibility, speedy delivery, and high-quality standards are among the most common characteristics (Bressanelli et al., 2018).

2.4. Business models and business model innovation

Companies often struggle when they are confronted with innovations (Alegre, Sengupta, & Lapeidra, 2011). Despite the inherent merits that can be generated through innovation, such as competitive advantage, increased firm performance, and the company's sustainable survival (Mansury & Love, 2008), the execution of this strategy is anything but trivial (Seggie et al., 2017). Still, the decisive factor of many brilliant company success stories is business model innovation (Taran, Boer, & Lindgren, 2015). Traditional innovation formats clearly receded into the background and made room for new and modern vicissitude (Zott & Amit, 2008). With the emergence of the internet and "with the new millennium and the hype of [new] businesses a new movement was created that still gains momentum: business model innovation" (Freiling, 2015, p. 3). Business models and their innovations have become an increasingly sophisticated topic, especially since new information and communication technologies entered the debate (Osterwalder & Pigneur, 2004). Since then, business model innovation has attracted great attention both in theory and in practice (Spieth, Schneckenberg, & Ricart, 2014) and foremost among the strategic management discipline (Ireland, Hitt, & Sirmon, 2003; Zott & Amit, 2008). Likewise, the topic has experienced a rapid increase in interest and contributions over the past two decades (Amit & Zott, 2012; Casadesus-Masanell & Ricart, 2010; Osterwalder, Pigneur, & Tucci, 2005; Spieth et al., 2014; Teece, 2010; Teece, 2018).

According to Zott and Amit (2010), which is one of the most popular definitions, a business model depicts "the content, structure, and governance of transactions designed so as to create value through the exploitation of business opportunities" (p. 511). A more recent and up-to-date alternative definition by Teece (2018) describes a business model as "an architecture for how a firm creates and delivers value to customers and the mechanisms employed to capture a share of that value" (p. 40). The formation of a unity among all three value elements (value proposition, value creation, value capture) is the highest goal for a company's transforming their BM (Shafer, Smith, & Linder, 2005). An effective business model is further described as the core enabler of firm performance (Taran et al., 2015). Throughout history, the term experienced many meaningful changes. The most significant shift came with the alteration from the operational modelling term and process level perspective to the strategic management circle in companies. In the meantime, business model innovation is claimed to be the "cornerstone" for

sustainability and competitiveness for firms (Gassmann et al., 2017). Despite the increasing attention of BMI in practice and academia, the lack of consensus concerns a uniform definition, the elements of a business model and their inherent impact on firm success. However, as Teece (2018) describes, a company's success depends decisively on the design of its business model and its further implementation, based on the right usage of technologies and tangible as well as intangible assets.

2.5. Digitalization and business model innovation

In practice, the relationship between the two terms becomes apparently evident: the digital transformation affects almost all areas of a company, leads to changes in industry structures, and forces companies to innovate their business model in order to stay or become more competitive and sustainable in the long run (Bharadwaj et al., 2013). Both terms are used frequently and ambiguously. This almost inevitably leads to the disruption of traditional business markets as well as redesigned strategies and business models (Rai et al., 2012; Saraf, Langdon, & Gosain, 2007). Toward seeking to better understand the linkage between business model innovation and digitalization, we argue and show that there are some commonalities between the two concepts.

Further, the disruptive nature and implicit degree of novelty when executing both, business model innovation and digital transformation efforts, has to be mentioned (Schneider & Spieth, 2013). Another common denominator is found in the high complexity and effort in execution connected to both, business model innovation and digitalization (Tripsas & Gavetti, 2000; Mezger, 2014). Eventually, both phenomena require the utilization of resources upon the transformation process (Kiel, Arnold, Collisi, & Voigt, 2016). Therefore, the term "digital business model" has been receiving importance and increased prominence in the last years. Digital business models are "[...] business models[s] whose underlying business logic deliberately acknowledges the characteristics of digitization and takes advantage of them; both in interaction with the customers and business partners, and in its internal operations" (Bärenfänger & Otto, 2015, p. 18). As new digital technologies are entering the market ever faster, it is initially difficult to find the right business model right away (Teece, 2010). The extant literature in information systems (IS) and its related fields exemplifies the importance of the business model concept to the success of companies (Al-Debei, Al-Lozi, & Al-Hujran, 2015; Drnevich & Croson, 2013). The convergence of these technologies is enabling mobile users to communicate richer information with unprecedented levels of flexibility and convenience (Al-Debei et al., 2015).

3. RESEARCH METHODOLOGY

3.1. Hypotheses development

In this section, we derive the main hypothesis that will be subject to empirical testing in the upcoming chapters. Digital technologies are combinations of different technological trends such as

communication, information, connectivity, and computing processes which are transforming business processes, structures, strategies, and business models (Bharadwaj et al., 2013). Thus, it is important to understand the interrelation between digital processes and its effect on the business model architecture. We, therefore, follow the view by Osterwalder and Pigneur (2004) to understand the institutional structure of an organization as triadic consisting of an overall business strategy, the business model as a mediator between the strategic and operational unit, and the operational processes as further mechanisms. If this construct is linked to the digitalization, with “digital” being the new attribute for highly technological processes, a company is in need of a dedicated digitalization strategy, which is transmuted in several digital business model elements and implemented in practice through the utilization of digital technologies (BarNir, Gallagher, & Auger, 2003). Thus, we argue that the utilization of digital technologies may not be arbitrarily executed but calls for a structure and well-organized control organ, which might be a dedicated, written digital strategy. We, therefore, propose the following hypothesis:

H1: The increased utilization of digital technologies positively affects the pursuit of a dedicated digital strategy.

Digital technologies are upon the most important elements in the digital transformation. The term “e-business” is already depicting the connection between business model architecture and the usage of digital technologies (Chang & Li, 2003). Generally speaking, digital technologies are instruments or toolbox to successfully master the digital transformation that is currently taking place in most companies. The use of digital technology can contribute to performance improvements and exploits the full potential across a company’s value network (Bowersox, Closs, & Drayer, 2005; Westerman, Calm ejane, Bonnet, Ferraris, & McAfee, 2011). This is strongly linked with the value architecture of business model elements, such as value creation, capture, and delivery (Teece, 2010).

It can be concluded that research on digital transformation and BMI is still rather scattered and sometimes lacks an in-depth understanding of what business model innovation implies, what its antecedents are, and how it affects firms’ performance and innovativeness (Bouwman, Nikou, Molina-Castillo, & de Reuver, 2018). Thus, we hypothesize that:

H2: The increased utilization of digital technologies positively affects the pursuit of business model innovation.

In order to find gain an even more fine-grained view about the types of digital technologies used and their effect on business model innovation, we further distinguish between the four technology clusters: “Digital data”, “Automation”, “Digital customer access”, and “Networking” provided by Bou e and Schaible (2015). For this reason, the following hypotheses were formulated:

H2a: The increased utilization of digital technologies belonging to the “Digital data” cluster positively affects the pursuit of business model innovation.

H2b: The increased utilization of digital technologies belonging to the “Automation” cluster positively affects the pursuit of business model innovation.

H2c: The increased utilization of digital technologies belonging to the “Digital customer access” cluster positively affects the pursuit of business model innovation.

H2d: The increased utilization of digital technologies belonging to the “Networking” cluster positively affects the pursuit of business model innovation.

Following the path of Krstov and Krstov (2011), business models are the “interface between the organization strategy and e-business applications” (p. 639). The ongoing debate about the relation between strategy and business models is becoming more and more clear and distinct, with the majority of research proving that the overall business strategy is the strategic plan for the innovation of business models (Mahadevan, 2000; St ahler, 2002) to keep pace with environmental changes. Thus, the strategic orientation in the direction of business model adaptations as well as the digitization of business processes is an important task to include in management decisions (BarNir et al., 2003). Strategic orientation in times of digitalization means obtaining information about market conditions, competitors, and access to valuable resources and capabilities (Armbrust et al., 2010; Hoffman, Novak, & Chatterjee, 1995). The digitalization and internet-based capabilities facilitate these activities due to the high efficiency and reduced transaction costs connected to digitalization (Brynjolfsson & Smith, 2000; Tapscott, Ticoll, & Lowy, 2000). Based on this view, we suggest the following relationship between a digital strategy and business model innovation:

H3: The implementation of a digital strategy positively affects business model innovation.

We consciously dive one level deeper into the subject matter and combine different digital strategies derived by Bughin and van Zeebroeck (2017) to business model innovation. This might help to strengthen the relation between unique kinds of digital strategies with business model innovation. Hence, we formulate the following hypotheses:

H3a: The implementation of the digital strategy “Platform play” positively affects the pursuit of business model innovation.

H3b: The implementation of the digital strategy “New marginal supply” positively affects the pursuit of business model innovation.

H3c: The implementation of the digital strategy “Digitally-enabled products and services” positively affects the pursuit of business model innovation.

H3d: The implementation of the digital strategy “Rebundling & customizing” positively affects the pursuit of business model innovation.

H3e: The implementation of the digital strategy “Digital distribution channels” positively affects the pursuit of business model innovation.

H3f: The implementation of the digital strategy “Cost efficiency” positively affects the pursuit of business model innovation.

We further opt for testing the interaction effect of the utilization of digital technologies and the pursuit of a digital strategy on business model

innovation. This connection is again linked to the triadic relation between strategy, digital technologies, and the business model as a mediator between these two factors. We therefore suggest:

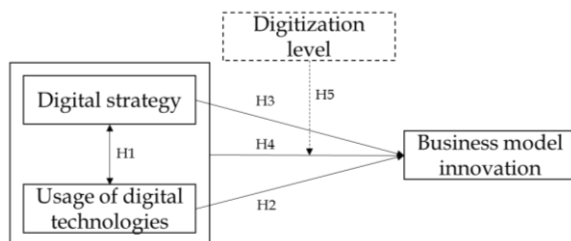
H4: The utilization of digital technologies and the simultaneous pursuit of digital strategy have a positive effect on business model innovation.

Our last hypothesis further distinguishes the digitization level and its effect on the interaction of digital technologies and a digital strategy on business model innovation. We proclaim that companies whose digitization level is already very high, a rather motivated to invest in business model innovation, because the level of disruption and change internally in the company is already strongly influencing the existing business model architecture. We argue that a high level of digitization within the company leads to the replacement of already obsolete business models and fosters strategic flexibility (Loebbecke & Picot, 2015; Weill & Woerner, 2013). Furthermore, the implicit innovation potential of digitalization efforts pushes towards the adaption to the upcoming change. Lingnau, Müller-Seitz, and Roth (2017) propose that the logical consequence of this development is a paradigmatic shift towards innovative initiatives, especially concerning the business model. Thus, we hypothesize that:

H5: The higher the digitization level - the more does it influence the interaction between digital technologies and digital strategy on business model innovation.

In summary, our full conceptual model is focusing on the linkages between the utilization of specific digital technologies, dedicated digital strategies, and their effects on business model innovation in regard to the firm's individual digitization level. We thus propose the following research framework:

Figure 1. Overview of the research model



The following sections deal with the methodology used for the underlying study and the results of the hypothesis testing.

To capture a holistic picture, we use a quantitative approach and derive results from a study among 166 German companies. Reviewing existing literature, empirical studies examine the effect of digitalization on business models is rather scarce, especially concerning quantitative studies. To close this gap, we chose a quantitative empirical study to suit best for the underlying context. The framework presented in Section 3 was tested by empirical analysis. In the analysis of the utilization of digital technologies and the pursuit of a digital strategy and business model innovation, we used a one-sample t-test for mean differences.

3.2. Sample size and survey data

To test our hypotheses, we conducted an empirical quantitative study based on an online survey among German companies. The data of the study originate from the database Nexis of German companies. We have sent the questionnaire link electronically to a stratified random sampling amount that originally consisted of 22993 firms. We were unable to reach all of the randomly selected firms, due to unavailability in the fieldwork. Since smaller companies often do not have the means and resources available for innovation and digitalization endeavors, we purposely decided to only include companies with at least 50 employees to ensure comparability.

The questionnaire was pre-tested and discussed with four independent experts. We also conducted two expert interviews that served as a reliability test for the variables we used in the questionnaire. The pre-test revealed that it takes approx. 20 minutes to answer the questions and complete the questionnaire. The survey was conducted from July to September 2018. Eventually, 192 companies took part in the survey. Unfortunately, a further 26 had to be excluded due to missing or incomplete data sets. Therefore, the final sample consists of 166 full data sets, which results in a response rate of 0.7 percent. Compared to similar studies the response rate is rather low. One explanation might be the difficulties of the questions concerning rather technical and digital attributes and the fact that the digital transformation in Germany is still a challenge, especially for small and medium-sized companies.

Table 1. Structural sample data

Characteristics	Sample
Sample size	166
Mean of employees (size)	4789,4
Mean company years (age)	53,5
Respondents	85 percent CEO or top-level management
Industries present in the study	43 percent manufacturing, 7 percent retail, 50 percent services

3.3. Variable development and measures

3.3.1. Dependent variable

In testing our conceptual framework, we employ business model innovation as a dependent variable. The measurement of business model innovation is not trivial and demands for sophisticated measurement (Schneider & Spieth, 2013; Spieth et al., 2014). Hereby, the problem arises that due to the "fuzziness" of the concept (DaSilva & Trkman, 2014, p. 388), operationalization is rather limited. Clauss (2017) was one of the first ones to derive a first potential scale based on the elements suggested by Osterwalder and Pigneur (2010) and the business model canvas. As we base our definition of business models on Zott and Amit (2008) we decided to use a different measurement scale for business model innovation. Therefore, we based our scale on the elements of business models that need to be

innovated. An analysis by Morris, Schindehutte, and Allen (2005) proved that there is no general decision about how many elements a business model incorporates and reveal a number that ranges between four and eight. One very common definition and framework comes from Lindgardt, Reeves, Stalk, and Deimler (2009) who incorporate five distinctive business model elements. These elements are repeatedly mentioned in the literature, why we choose to use these elements as objective measures for business models. The answers were measured on a five-point Likert scale from 1 = "not innovated at all" to 5 = "innovated in a high extent". The final measure consists of a binary score, equaling 0 if the business element is not or only slightly innovated and 1 if the element is highly or fully innovated.

3.3.2. Independent variables

We operationalize digital technologies by a comprised Likert scale item measuring the usage of a range of different digital technologies from 0 = "not used at all" to 5 = "fully used". The digital technologies are based upon the research results of Bouéé and Schaible (2015) who determine four enabler clusters, which incorporate digital applications or technologies supporting the digitalization of business models. The four enabler categories describe clusters of diverse technological applications. "Digital data" demonstrates a bundle of technological applications with the aim to collect and analyze data and includes technologies such as big data, Internet of things, wearables, data-based routing, demand prediction, and predictive maintenance. "Automation" mainly refers to intelligent technologies that simplify and standardize work processes, which in addition to a lower error rate and more speed can also lead to lower costs. This enabler incorporated technologies such as additive manufacturing, robotics, drones, autonomous automobiles, and intelligent processes. "Digital customer access" enables a new and unique way to address the customer with a high level of transparency among the distribution channel and includes social networks, apps, mobile internet, E-commerce, digitalization of customer relationships, and infotainment. The fourth enabler labeled "Networking" facilitates and accelerates communication within value networks with multiple stakeholders and implies cloud computing, broadband, sensor technology, pure digital products, platforms, remote maintenance, and smart factory.

Because a comprehensive measure for the utilization of digital technologies has not yet been introduced, we decoded the variables into a standardized binary score. The score for the individual digital technologies equals 0 if the technology is not or barely used and 1 if the technology is highly utilized. This process led to distinct quantitative measures of the digital technology variables. For more consistent we have added another variable "Sum of used digital technologies" that considers the utilization of all queried digital technologies in total.

For an adequate illustration of the digital strategy, we used the six derived digital strategies by Bughin and van Zeebroeck (2017). The digital

strategy "platform play" embodies the platform idea that experienced increased attention in the latest literature. It incorporates architectures based on a network perspective in which several actors work together to achieve value among one value chain. The "new marginal supply" strategy focuses on the utilization of digital technologies to open up new markets at the lowest possible transactional costs, often in combination with the platform idea. The "Digitally-enabled products and services" strategy is one of the most used digital strategies, where products and services are equipped with technical and digital features to make the value proposition more attractive and functional and propose new value to the customer. "Re-bundling and customizing" is understood as the concentration on core competencies and resources and serve the current customer base with more sophisticated solutions. "Digital distribution channels" act on changing the traditional delivery system to the customer, make it more efficient, flexible, and expedite. The "cost efficiency" digital strategy relies on the revenue- and cost-mechanism perspective and has the aim to achieve excellent operational performance with an advanced cost- and revenue structure. The digital strategy of "new marginal supply" has likewise implemented the platform idea but focuses on opening up new sales opportunities at the lowest possible transaction costs (Bughin & van Zeebroeck, 2017; Rong, Lin, Shi, & Yu, 2013). Characteristic for this type of digital strategy is above all the innovative customer access, which is to be supported primarily by means of digital technologies in order to favor low transaction costs, high flexibility, and a high level of customization (Richter, Kraus, Brem, Durst, & Giselbrecht, 2017; Weill & Woerner, 2013). The third digital strategy anchors digital technology with the establishment of new products and services (Matt, Hess, & Benlian, 2015). In times of increasing competition, it is no longer sufficient to simply bringing new products or services onto the market. Only solution providers who provide "complete packages" or the "overall solution" have the chance to gain competitive advantages and lock-in effects that bind customers to the company (Øiestad & Bugge, 2014). Finally, the sixth digital strategy is dealing with "cost efficiency". Hereby, the thriving digital trend arising in the automotive industry, the usage of electronic vehicles comes into the center of attention (Bohnsack, Pinkse, & Kolk, 2014). In this case, the investments needed at the beginning of the lifecycle are relatively high and need to be compensated by customer value and an increase in value throughout the lifecycle (Kley, Lerch, & Dallinger, 2011). We applied the same methodology as described for the utilization of digital technologies. Thus, the score for the individual digital strategy equals 0 if not applied and 1 if applied in the company.

3.3.3. Control variables

Firm age

We purposely controlled for firm age. Incumbents and firms with a long company history tend to establish routines and standards which might

expedite organizational inertia (Tushman & Romanelli, 1995). We asked the respondents to indicate the year in which their company was founded. The difference between the current year and the year of foundation results in the variable age.

Firm size

We further controlled for firm size to analyze if the firm size might influence the utilization of digital technologies, the implementation of a digital strategy as well as business model innovation initiatives. According to Damanpour (1996) firm size is one of the most decisive factors in organizational activities. We used the logarithmic value of the firm's number of employees.

Industry

We included a dummy variable for companies operating in the manufacturing industry equalling 1 and other industries as 0. Shepherd and Wiklund (2005) proved that industry features influence the performance of firms.

Degree of digitization

We further operationalize the degree of digitization the company has already obtained. Hence, we asked the respondents to indicate the subjective degree of digitization among the company in percentage. We clustered the results into three categories: digitization latecomers, digitization midfielder, and digitization pioneers. We used equidistant borders for the three categories originally measured by percentage from 1 to 100.

3.3.4. Environmental dynamism

As digitalization and innovation decisions are often related to a high degree of uncertainty and risk, we further controlled for environmental dynamism. Kirzner (1997) and Shane and Venkataraman (2000) assume that environmental dynamism has a decisive influence on the development of entrepreneurial potentialities. This leads to the revelation of new opportunities but makes strategy formulation and implementation more complex (Priem, Rasheed, & Kotulic, 1995) due to the external pressures. Since we are analyzing the effects of digital strategies on business model innovation is it worth including environmental dynamism as a control variable. In line with previous research (Castrogiovanni, 2002; Sharfman & Dean, 1991) environmental dynamism is constructed as a percentage of unpredictable change.

4. RESULTS

4.1. Descriptive statistics and correlation matrix

First, we did a factor analysis in SPSS with the usage of a component's extraction methodology including all final scales in order to define the number of factors that are present as well as the exact factor architecture of the measures (Hair, Anderson, Tatham, & Black, 1998). We further executed the

Harman single factor test in order to be sure that common method bias is not a problem (Craighead, Ketchen, Dunn, & Hult, 2011; Podsakoff, MacKenzie, Lee, & Podsakoff, 2003). The results show that one factor is explaining 30.757 of the variances, which is less than 50 percent and therefore such a bias should not be a problem for the underlying study.

We further examined the means, standard deviation, and correlations for all our variables from the study (Table 2).

All technology clusters are positively related to the digitalization strategy as well as to business model innovation. Business model innovation is also positively correlated with the pursuit of a digitalization strategy. Firm age and firm size do not correlate with the digital technologies, digitalization strategy, and business model innovation variables. The same is true for the industry variable, which leads to some surprise. Regarding the digitalization level, there is a negative correlation between "Latecomers" and the utilization of digital technologies, but not for the pursuit of a digitization strategy and business model innovation. The variable digitation level "Midfielders" does not correlate with the main variables. Whereas, digitization level "Pioneers" positively correlates with the pursuit of a digital strategy, with the utilization of digitalization strategies, and with business model innovation. It even negatively correlates with firm size and firm age.

4.2. Hypothesis testing

We tested our hypotheses by using linear regression models. We first conducted the regression for the predicted variables to test the hypotheses in the first step, and then entered the control variables in a second step. This results in a total of 31 regression models presented in Tables 3 to 7. According to Aiken and West (1991), and to reduce the effect of multicollinearity, we mean-centered the independent variables that were included in the interaction term. In order to avoid common method bias, we did a Harman single factor test. Alternatively, the use of logistic regression models would have been suitable for hypotheses testing.

Models 1 and 2 analyze the effect of the increased utilization of digital technologies on the pursuit of a dedicated digital strategy. Model 1 represented the pure results for this relation, and Model 2 contains all control variables. The results reveal the significant relationship between the utilization of technologies and the pursuit of a dedicated digital strategy ($\beta = 0.382$, $p < 0.001$), thus supporting *H1*. Interestingly, there is an effect of firm size on this relationship which suggests that larger firms that are longer operating in the market see the increased utilization of digital technologies as even more important for the effect of a digital strategy. Moreover, Models 3 and 4 show the relation of increased utilization of digital technologies and business model innovation. The results show significant results ($\beta = 0.385$, $p < 0.001$), and therefore, *H2* is supported. Surprisingly, Model 4 contains the control variables and shows no significant effects on the controls.

Table 2. Descriptive statistics and correlation matrix

		Mean	SD	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Digitalization strategy	3,131	1,969	1													
2	Utilization of digital technologies	7,783	5,385	0,382**	1												
3	Technology cluster "Digital data"	1,747	2,301	0,194*	0,601**	1											
4	Technology cluster "Automation"	0,59	1,211	0,261**	0,459**	0,182*	1										
5	Technology cluster "Digital customer access"	2,964	4,695	0,238**	0,398**	0,332**	0,053	1									
6	Technology cluster "Networking"	3,512	6,59	0,300**	0,221**	0,242**	0,014	0,625**	1								
7	Business model innovation	1,041	1,404	0,313**	0,385**	0,248**	0,200*	0,252**	0,275**	1							
8	Firm_age	69,468	60,604	-0,090	-0,113	-0,113	-0,072	-0,023	-0,092	-0,162	1						
9	Firm_size	5,865	1,882	0,145	0,107	0,004	-0,023	0,09	-0,024	-0,079	0,275**	1					
10	Industry	2,072	0,963	0,102	0,018	0,038	-0,099	0,072	0,12	0,104	-0,034	-0,287**	1				
11	Environmental dynamism	0,540	0,500	-0,132	0,023	0,088	0,181*	0,049	0,074	0,097	-0,084	-0,220**	0,014	1			
12	Digitization level_Latecomer	0,243	0,43	-0,024	-0,212*	-0,064	-0,043	0,083	0,012	0,05	0,191*	0,106	-0,049	-0,003	1		
13	Digitization level_Midfielder	0,472	0,501	-0,127	-0,036	-0,064	-0,127	-0,064	-0,06	-0,146	0,111	0,182*	-0,082	-0,207**	-0,536**	1	
14	Digitization level_Pioneer	0,257	0,438	0,201*	0,298*	0,179*	0,218**	0,011	0,072	-0,236**	-0,286**	-0,307**	0,147	0,242**	-0,333**	-0,556**	1

Notes: **. Correlation is significant at the 0.01 level (2-tailed);

*. Correlation is significant at the 0.05 level (2-tailed).

Table 3. Regression models 1 to 4

Model 1: Digital technology on digital strategy		
	Beta	Sig.
(Constant)		0,000
TECH_USE	0,382	0,000***
<i>Model fit</i>		
R ²	0,146	
Corrected R ²	0,141	
F (Model, global)	27,075***	
Model 2: Digital technology on digital strategy with controls		
	Beta	Sig.
(Constant)		0,376
TECH_USE	0,290	0,002**
INDUSTRY	0,058	0,498
FIRM_AGE	-0,061	0,490
FIRM_SIZE	0,182	0,057†
ENVIRON_DYNAMISM	-0,206	0,018
DIGI_LEVEL_LATE	0,146	0,485
DIGI_LEVEL_MID	0,012	0,959
DIGI_LEVEL_PIONEER	0,250	0,260
<i>Model fit</i>		
R ²	0,146	
Corrected R ²	0,141	
F (Model, global)	4,428***	
Model 3: Utilization of digital technologies on BMI		
	Beta	Sig.
(Constant)		0,189
TECH_USE	0,385	0,000***
<i>Model fit</i>		
R ²	0,148	
Corrected R ²	0,142	
F (Model, global)	25,381***	
Model 4: Utilization of digital technologies on BMI with controls		
	Beta	Sig.
(Constant)		0,502
TECH_USE	0,381	0,000**
INDUSTRY	0,047	0,600
FIRM_AGE	-0,077	0,405
FIRM_SIZE	-0,083	0,408
ENVIRON_DYNAMISM	0,033	0,710
DIGI_LEVEL_LATE	0,032	0,882
DIGI_LEVEL_MID	-0,108	0,655
DIGI_LEVEL_PIONEER	0,067	0,765
<i>Model fit</i>		
R ²	0,222	
Corrected R ²	0,165	
F (Model, global)	3,862***	

Note: † $p < 0.1$; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

Models 5 to 12 depict the results for the four individual technology clusters on the pursuit of business model innovation. The data shows significant results for all four *H2a* to *H2d*, proving that the increased utilization of digital technologies belonging to the “Digital data” cluster is positively affecting business model innovation ($\beta = 0.248$, $p < 0.01$) as well as *H2b* the “Automation” cluster ($\beta = 0.200$, $p < 0.05$), the “Digital customer access” ($\beta = 0.252$, $p < 0.01$) and “Networking” cluster ($\beta = 0.275$, $p < 0.01$). The results also reveal that the tech cluster “Digital data” is significantly higher among companies that belong to the digitization group “Pioneers” and are characterized as highly

digitized. Surprisingly, this is not significant for the other three clusters.

The results further reveal the highest effect in the networking cluster and the lowest effect, when comparing the four technology clusters in the automation cluster.

Models 13 and 14 analyze the influence of digital strategies on business model innovation. Model 13 does not include the control variables and shows significant results ($\beta = 0.313$, $p < 0.001$) supporting *H3*. However, Model 14 contains the control variables and the control variables do not have significant effects on the linkage.

Table 4. Regression models 5 to 12 (Part 1)

Model 5: "Digital data" cluster on BMI		
	Beta	Sig.
(Constant)		0,000
TECH_CLUSTER_DIGITAL_DATA	0,248	0,002**
<i>Model fit</i>		
R ²	0,061	
Corrected R ²	0,055	
F (Model, global)	9,545**	
Model 6: "Digital data" cluster on BMI with controls		
	Beta	Sig.
(Constant)		0,421
TECH_CLUSTER_DIGITAL_DATA	0,255	0,007**
INDUSTRY	0,043	0,645
FIRM_AGE	-0,074	0,442
FIRM_SIZE	-0,027	0,794
ENVIRON_DYNAMISM	0,019	0,841
DIGI_LEVEL_LATE	0,011	0,961
DIGI_LEVEL_MID	-0,073	0,770
DIGI_LEVEL_PIONEER	0,180	0,007**
<i>Model fit</i>		
R ²	0,169	
Corrected R ²	0,107	
F (Model, global)	2,746***	
Model 7: "Automation" cluster on BMI		
	Beta	Sig.
(Constant)		0,189
TECH_CLUSTER_AUTOMATION	0,385	0,000***
<i>Model fit</i>		
R ²	0,040	
Corrected R ²	0,033	
F (Model, global)	2,042***	
Model 8: "Automation" cluster on BMI with controls		
	Beta	Sig.
(Constant)		0,436
TECH_CLUSTER_AUTOMATION	0,158	0,112
INDUSTRY	0,065	0,495
FIRM_AGE	-0,116	0,236
FIRM_SIZE	-0,001	0,995
ENVIRON_DYNAMISM	0,018	0,848
DIGI_LEVEL_LATE	0,065	0,773
DIGI_LEVEL_MID	-0,013	0,959
DIGI_LEVEL_PIONEER	0,229	0,326
<i>Model fit</i>		
R ²	0,131	
Corrected R ²	0,067	
F (Model, global)	2,042*	
Model 9: "Digital customer access" cluster on BMI		
	Beta	Sig.
(Constant)		0,000
TECH_CLUSTER_DIGITAL_CUSTOMER_ACCESS	0,252	0,002**
<i>Model fit</i>		
R ²	0,064	
Corrected R ²	0,057	
F (Model, global)	9,918**	
Model 10: "Digital customer access" cluster on BMI with controls		
	Beta	Sig.
(Constant)		0,523
TECH_CLUSTER_DIGITAL_CUSTOMER ACCESS	0,225	0,015*
INDUSTRY	0,037	0,693
FIRM_AGE	-0,095	0,322
FIRM_SIZE	-0,022	0,831
ENVIRON_DYNAMISM	0,032	0,735
DIGI_LEVEL_LATE	0,054	0,808
DIGI_LEVEL_MID	-0,029	0,908
DIGI_LEVEL_PIONEER	0,236	0,296
<i>Model fit</i>		
R ²	0,158	
Corrected R ²	0,096	
F (Model, global)	2,536*	

Table 4. Regression models 5 to 12 (Part 2)

Model 11: "Networking" cluster on BMI		
	Beta	Sig.
(Constant)		0,189
TECH_CLUSTER_NETWORKING	0,275	0,001**
<i>Model fit</i>		
R ²	0,075	
Corrected R ²	0,069	
F (Model, global)	11,902**	
Model 12: "Networking" cluster on BMI with controls		
	Beta	Sig.
(Constant)		0,694
TECH_CLUSTER_NETWORKING	0,197	0,045*
INDUSTRY	0,061	0,514
FIRM_AGE	-0,099	0,309
FIRM_SIZE	-0,002	0,987
ENVIRON_DYNAMISM	0,056	0,559
DIGI_LEVEL_LATE	0,088	0,695
DIGI_LEVEL_MID	-0,019	0,939
DIGI_LEVEL_PIONEER	0,23	0,317
<i>Model fit</i>		
R ²	0,144	
Corrected R ²	0,080	
F (Model, global)	2,262*	

Notes: † $p < 0.1$; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

Table 4. Regression models 13 and 14 (Part 3)

Model 13: Digital strategy on BMI		
	Beta	Sig.
(Constant)		0,097
STRATEG_DIGI	0,313	0,000***
<i>Model fit</i>		
R ²	0,098	
Corrected R ²	0,092	
F (Model, global)	15,857***	
Model 14: Digital strategy on BMI with controls		
	Beta	Sig.
(Constant)		0,686
STRATEG_DIGI	0,282	0,004**
INDUSTRY	0,026	0,78
FIRM_AGE	-0,079	0,407
FIRM_SIZE	-0,053	0,607
ENVIRON_DYNAMISM	0,095	0,32
DIGI_LEVEL_LATE	0,029	0,896
DIGI_LEVEL_MID	-0,018	0,943
DIGI_LEVEL_PIONEER	0,195	0,386
<i>Model fit</i>		
R ²	0,176	
Corrected R ²	0,115	
F (Model, global)	2,888**	

Notes: † $p < 0.1$; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

Models 15 to 26 are further proving, which digital strategies have an effect on business model innovation. Hereby, *H3a* to *H3f* can all be supported due to significant results. *H3a* examines the effect of the digital strategy "Platform play" on business model innovation ($\beta = 0.146$, $p < 0.1$), *H3b* has examined the effect of the digital strategy "New marginal supply" on business models, proving significant results ($\beta = 0.250$, $p < 0.01$). The same applies to *H3c* the "Digitally-enabled products and services" strategy ($\beta = 0.191$, $p < 0.05$), the strategy "Rebundling and customizing" and *H3d* ($\beta = 0.220$, $p < 0.01$), strategy "Digital distribution channels" and *H3e* ($\beta = 0.221$, $p < 0.01$) and *H3f* with the digital strategy "Cost efficiency" ($\beta = 0.214$, $p < 0.01$). Again, the models which contain the control variables did not prove significant results. Overall, the digital strategy "New marginal supply" seems to have

the highest positive effect on business model innovation, when compared with the other digital strategies.

H4 surveys the interaction effect of simultaneous pursuit of digital technologies and a digital strategy on business model innovation which is depicted in Models 27 to 29. The results show significant effects ($\beta = 0.182$, $p < 0.05$), and thus *H4* can be supported.

The last hypothesis (*H5*) examining the effect of the digitization level of the interaction variable of digital technologies and digital strategy on business model innovation is not supported due to missing significant results.

The full model with all variables and the inclusion of control variables is depicted in the full Model 30.

Table 5. Regression models 15 to 26 (Part 1)

Model 15: Platform Play Strategy on BMI		
	Beta	Sig.
(Constant)		0,000
STRATEG_PLATFORM_PLAY	0,146	0,076†
<i>Model fit</i>		
R ²	0,021	
Corrected R ²	0,015	
F (Model, global)	3,187†	
Model 16: Platform play strategy on BMI with controls		
	Beta	Sig.
(Constant)		0,571
STRATEG_PLATFORM_PLAY	0,093	0,354
INDUSTRY	0,035	0,717
FIRM_AGE	-0,105	0,289
FIRM_SIZE	-0,002	0,983
ENVIRON_DYNAMISM	0,054	0,582
DIGI_LEVEL_LATE	0,079	0,73
DIGI_LEVEL_MID	-0,027	0,915
DIGI_LEVEL_PIONEER	0,289	0,210
<i>Model fit</i>		
R ²	0,118	
Corrected R ²	0,052	
F (Model, global)	1,803†	
Model 17: New marginal supply strategy on BMI		
	Beta	Sig.
(Constant)		0,000
STRATEG_MARGIN_SUPPLY	0,250	0,002**
<i>Model fit</i>		
R ²	0,062	
Corrected R ²	0,056	
F (Model, global)	9,695**	
Model 18: New marginal supply strategy on BMI with controls		
	Beta	Sig.
(Constant)		0,618
STRATEG_MARGIN_SUPPLY	0,225	0,015*
INDUSTRY	0,056	0,548
FIRM_AGE	-0,102	0,291
FIRM_SIZE	0,039	0,694
ENVIRON_DYNAMISM	0,044	0,905
DIGI_LEVEL_LATE	0,027	0,823
DIGI_LEVEL_MID	-0,056	0,349
DIGI_LEVEL_PIONEER	0,213	0,317
<i>Model fit</i>		
R ²	0,159	
Corrected R ²	0,096	
F (Model, global)	2,549*	
Model 19: Digital products and services strategy on BMI		
	Beta	Sig.
(Constant)		0,000
STRATEG_DIGI_PROD_SERVICE	0,191	0,020*
<i>Model fit</i>		
R ²	0,037	
Corrected R ²	0,03	
F (Model, global)	5,531*	
Model 20: Digital products and services strategy on BMI with controls		
	Beta	Sig.
(Constant)		0,590
STRATEG_PLATFORM_PLAY	0,176	0,079†
INDUSTRY	0,042	0,657
FIRM_AGE	-0,089	0,365
FIRM_SIZE	-0,034	0,749
ENVIRON_DYNAMISM	0,075	0,441
DIGI_LEVEL_LATE	0,084	0,708
DIGI_LEVEL_MID	0,008	0,974
DIGI_LEVEL_PIONEER	0,274	0,230
<i>Model fit</i>		
R ²	0,136	
Corrected R ²	0,072	
F (Model, global)	2,122*	

Table 5. Regression models 15 to 26 (Part 2)

Model 21: Rebundling and customizing on BMI		
	Beta	Sig.
(Constant)		0,000
STRATEG_REBUND_CUSTOM	0,220	0,007**
<i>Model fit</i>		
R ²	0,049	
Corrected R ²	0,042	
F (Model, global)	7,453**	
Model 22: Rebundling and customizing on BMI with controls		
	Beta	Sig.
(Constant)		0,564
STRATEG_REBUND_CUSTOM	0,218	0,019*
INDUSTRY	0,039	0,676
FIRM_AGE	-0,101	0,295
FIRM_SIZE	-0,011	0,913
ENVIRON_DYNAMISM	0,068	0,472
DIGI_LEVEL_LATE	0,014	0,949
DIGI_LEVEL_MID	-0,049	0,844
DIGI_LEVEL_PIONEER	0,241	0,288
<i>Model fit</i>		
R ²	0,155	
Corrected R ²	0,092	
F (Model, global)	2,474*	
Model 23: Digital distribution channel on BMI		
	Beta	Sig.
(Constant)		0,000
STRATEG_DIGI_DISTRIBUTE	0,221	0,007*
<i>Model fit</i>		
R ²	0,049	
Corrected R ²	0,042	
F (Model, global)	7,489**	
Model 24: Digital distribution channel on BMI with controls		
	Beta	Sig.
(Constant)		0,651
STRATEG_DIGI_DISTRIBUTE	0,160	0,085†
INDUSTRY	0,042	0,654
FIRM_AGE	-0,087	0,374
FIRM_SIZE	-0,001	0,993
ENVIRON_DYNAMISM	0,044	0,643
DIGI_LEVEL_LATE	0,065	0,775
DIGI_LEVEL_MID	0,013	0,958
DIGI_LEVEL_PIONEER	0,283	0,215
<i>Model fit</i>		
R ²	0,135	
Corrected R ²	0,071	
F (Model, global)	2,106*	
Model 25: Cost efficiency on BMI		
	Beta	Sig.
(Constant)		0,001
STRATEG_COST_EFFICIENCY	0,214	0,009**
<i>Model fit</i>		
R ²	0,046	
Corrected R ²	0,039	
F (Model, global)	7,012**	
Model 26: Cost efficiency on BMI with controls		
	Beta	Sig.
(Constant)		0,694
STRATEG_COST_EFFICIENCY	0,154	0,111
INDUSTRY	0,056	0,552
FIRM_AGE	-0,094	0,338
FIRM_SIZE	-0,001	0,989
ENVIRON_DYNAMISM	0,058	0,546
DIGI_LEVEL_LATE	0,042	0,852
DIGI_LEVEL_MID	0,008	0,976
DIGI_LEVEL_PIONEER	0,255	0,268
<i>Model fit</i>		
R ²	0,132	
Corrected R ²	0,067	
F (Model, global)	2,045*	

Notes: † $p < 0.1$; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

Table 6. Regression models 27 and 28

Model 27: Interaction tech and strategy on BMI		
	Beta	Sig.
(Constant)		0,000
MODER_TECH_STRATEG	0,182	0,027*
<i>Model fit</i>		
R ²	0,033	
Corrected R ²	0,026	
F (Model, global)	4,985*	
Model 28: Interaction tech and strategy on BMI with controls		
	Beta	Sig.
(Constant)		0,606
MODER_TECH_STRATEG	0,186	0,049*
INDUSTRY	0,019	0,842
FIRM_AGE	-0,119	0,220
FIRM_SIZE	0,041	0,683
ENVIRON_DYNAMISM	0,008	0,943
DIGI_LEVEL_LATE	0,099	0,659
DIGI_LEVEL_MID	0,039	0,875
DIGI_LEVEL_PIONEER	0,320	0,158
<i>Model fit</i>		
R ²	0,142	
Corrected R ²	0,079	
F (Model, global)	2,240*	

Notes: † $p < 0.1$; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

Table 7. Regression models 29 and 30

Model 29: Digitization degree in interaction variable		
	Beta	Sig.
(Constant)		0,389
INTERACT_TECH_STRATEG	0,172	0,048*
DIGI_LEVEL_LATE	0,087	0,699
DIGI_LEVEL_MID	0,065	0,797
DIGI_LEVEL_PIONEER	0,28	0,21
<i>Model fit</i>		
R ²	0,086	
Corrected R ²	0,057	
F (Model, global)	2,952*	
Model 30: Digitization degree on interaction variable with controls		
	Beta	Sig.
(Constant)		0,188
INTERACT_TECH_STRATEG	0,442	0,000***
DIGI_LEVEL_LATE	0,054	0,796
DIGI_LEVEL_MID	-0,064	0,784
DIGI_LEVEL_PIONEER	0,047	0,827
INDUSTRY	-0,003	0,97
FIRM_SIZE	-0,116	0,224
FIRM_AGE	-0,08	0,364
<i>Model fit</i>		
R ²	0,249	
Corrected R ²	0,203	
F (Model, global)	5,408***	

Notes: † $p < 0.1$; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

Table 8. Full regression model 31

Model 31: Full model		
	Beta	Sig.
(Constant)		0,593
INDUSTRY	-0,035	0,705
FIRM_SIZE	-0,114	0,257
FIRM_AGE	-0,059	0,518
ENVIRON_DYNAMISM	0,048	0,599
DIGI_LEVEL_LATE	0,000	0,998
DIGI_LEVEL_MID	-0,083	0,726
DIGI_LEVEL_PIONEER	0,054	0,808
STRATEG_DIGI_SUM	0,264	0,009***
TECH_CLUSTER_DIGITAL_DATA	0,202	0,025*
TECH_CLUSTER_AUTOMATION	-0,013	0,899
TECH_CLUSTER_DIGI_CUSTOM_ACCESS	0,170	0,058†
TECH_CLUSTER_NETWORKING	0,041	0,669
MODER_TECH_STRATEG	0,221	0,021*
<i>Model fit</i>		
R ²	0,297	
Corrected R ²	0,208	
F (Model, global)	3,344***	

Notes: † $p < 0.1$; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

5. DISCUSSION

In this paper, the initial goal was to describe the relationship of the utilization of digital technologies and the pursuit of a digital strategy on business model innovation. The interlinkages are important for academia and practice, due to the perceived effect of the digital transformation on the innovation of business model and the high level of change that is included in this overall architecture. Our study identifies that both digital technologies as well as a dedicated digital strategy are important mechanisms forcing the disruption of established business models. First, our study proves that the utilization of digital technologies and a digital strategy is positively connected. These results are in line with current literature results such as Rai et al. (2012) or Bharadwaj et al. (2013) who define digital technologies as a combination of different technologies that are affecting business strategies. In accordance with this view, digital technologies represent dynamic capabilities that are known as a key influencing factor for strategic decisions even under high environmental constraints (Pavlou & El Sawy, 2010). We found further proof for the reinforcing effect of the utilization of digital technologies on business model innovation. Digital technologies are not only the combination of different digitization structures but indeed the mechanisms for developments in the value architecture (Vendrell-Herrero et al., 2018). Digital technologies, depending on the degree of disruption, can strongly influence all elements of a value creation and capture processes. As business models are defined as value innovations changing value creation, capture, and delivery structures (Teece, 2010) it is worth putting some effort into the right choice of digital technologies to achieve catalytic effects in value creation.

The results also prove that independent of the digital cluster, all digital technologies have positive reinforcing effects on business model innovation. This might be true due to the fact that companies in order to high digital disruption and high velocity of environmental markets need to constantly keep pace and stay up to date to the competition. This orientation towards sustainability and long-term performance further intensifies the open mindset of companies towards change and disruption. It is therefore important to distinguish with a portfolio of different digital measures and to implement them profitably in the company. Digital data has a lot to do with data and the profitable acquaintance of data internally. Combined with automation, which might help to increase efficiency and effectiveness of processes and workflows, the increased focus on customer centricity and orientation on customer needs and the networking perspective with arising trends such as social media, crowd-based initiatives, and open innovation is key.

Thereby, the top management of a firm can play a decisive role to foster these initiatives and give incentives to implement transparency, innovative thinking, and digitalization among the overall company structure (Chesbrough & Vanhaverbeke, 2018). To this point, it remains unanswered whether at some point a certain saturation point will occur that indicates that no further digital technologies are to be used.

The linkage between a dedicated digital strategy and business model innovation is not as surprising, because there is an ongoing debate about the relation between strategy, business models, and operational processes in general. The contributions by Seddon and Lewis (2003) taught us that there is a diverse viewpoint on this relation, but the most prominent one depicts the business model as the implementation medium of strategic decisions.

Further, Osterwalder and Pigneur (2010) claim that business models, strategy, and operational processes are closely linked and need deliberately be bounded together. This matches the results of our study that digital strategies cannot be viewed separately, but the affordances of digital strategies are closely linked to changes in the corresponding business model. It is rather surprising that the digital strategy "Platform play" did not prove to be significant. Platform business models are experiencing increasing interest in academia in practice (Evans & Gawer, 2016; Mäntymäki & Salmela, 2017). One explanation might be that platforms are consistently changing the communication and interaction with the customer and bring customer relation to a completely new level (Bouwman et al., 2018). The big problem with platforms is that the turning point towards scaling and establishing a well-working ecosystem is protracted and comes together with high efforts, high resource endowment, and costs.

Most of the participants in our study were medium-sized companies that may not always be able to boast a high level of resources. This leads to the preference of other digital strategies that are easier to pursue and to convert. Following the digital strategy "New marginal supply", is positively affecting business model innovation. This strategy offers new opportunities to access new supply sources at marginal costs (Bughin & van Zeebroeck, 2017). This digital strategy is mainly connected to the improvement of customer distribution channels and the new source of the value proposition. Therefore, the main elements of a business model are addressed in combination with efficiency in costs. This might be a good way to grow organically without the risk of over-disrupting the company and putting too much pressure on the success of the digital transformation. The digital strategy of "Digitally-enabled products and services" is closely linked to the "Rebundling and customizing" strategy. Both digital strategies incorporate the recognition of digital resources, their efficient bundling, and the offering to the customer in an efficient and effective way (Bharadwaj et al., 2013). This is very important, due to the effect that companies suffer under resource scarcity and therefore have to concentrate on key capabilities and resources (Barney, 1991; Wernerfelt, 1984). This requires an appropriate and well-experienced resource management, especially for digital resources. The last two digital strategies are also closely linked. Digital distribution channels are characterized by reduced transaction cost and efficient ways to meet the customers' needs. Cost efficiency among the overall internal and external processes is of high importance for the company's profitability. Thus, it is important to digitize interfaces wherever possible, to achieve lean processes and address the customer as well as another stakeholder most efficiently.

The results have also proven that the increased utilization of digital technologies together with the simultaneous pursuit of a digital strategy is reinforcing the effect on business model innovation. Thus, digitalization is more of a blessing than a curse. This can in turn be expressed through the value triangle between strategy, business models, and operational (digital) processes in a company. Sticking to this viewpoint, a dedicated strategy formulation and execution might help to precisely and consciously adapt business model elements to current trends and affordances, which is ultimately implemented through digital operational processes.

6. CONCLUSION

The study is subject to some limitations. First, the sample size of 166 companies can be mentioned that calls for further research, such as a qualitative empirical study to further prove the reliability of data. A general problem in quantitative research is a common method and single informant bias. In fact, due to the new data protection regulations in Germany, which fosters data protection and privacy makes it increasingly difficult to reach a broad basis of companies. This could negatively influence the response rate and contributes to the sample size. Further, we purposely choose the subject of German companies to distinguish between their efforts in digital technology, the pursuit of a digital strategy, and the innovative performance in the case of business models. Further studies among other nations might help to increase compatibility among countries and gain further insights and distinguishing factors. At this point, we would also

like to mention some limitations in the data analysis. We opted for linear regressions with 31 models being analyzed in total. Due to the scales and item measurement, it might be meaningful to consider binary logistic regression analysis instead of linear regressions. This could be subject to further debate.

However, the research results prove some universal linkages and suggestions which need to be further developed in new research studies. Deep dive information about which digital technologies are most favorable at first for the definition and execution of a digital strategy as well as for business model innovation is still missing in research. This research gap could be closed by further qualitative case studies or interviews among companies of different sizes and industries. The same account for the specification of digital strategies and the development of a general definition of this term. This leads to another valuable research avenue that is connected to context factors influencing this overall construct. There might be some diminishing factors such as differences in industry, company size, family firms, or probably stock exchange listing that put forward changes in the specific digital structure. Moreover, it is necessary to work on some conceptualization of management tools and structures to successfully implement these results and successfully transform the inputs into value creation and capture mechanisms. We, therefore, encourage research from strategic management, innovation, and other research areas to use these results as a fundamental basis to put some more effort into this topic to gain even more fine-grained and detailed insights in the field of digital business models.

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