R&D MANAGEMENT

Two archetypes of business model innovation processes for manufacturing firms in the context of digital transformation

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The digital transformation is forcing manufacturing firms to innovate beyond new products and services and to develop their digital business model innovation (BMI) processes in order to stay competitive. This study explores how the innovation processes of manufacturing firms can be designed in order to develop novel business models to address the challenges of digitalization. The study uses a multiple-case study approach, where data on BMI processes was collected in six manufacturing firms. The results show that the design of BMI processes in the digital age differs conceptually between B2C and B2B manufacturing firms. While BMI processes in B2C firms follow a semi-structured approach that considers experimentation, process models in B2B firms show similarities with a new product development (NPD) hybrid model comprising stage-gate methods and agility. This new typology aims to structure the heterogeneity of BMI process models described in the literature. Finally, this study proposes two archetype process models for digital BMI for B2C and B2B firms with specific digital process characteristics that manufacturing firms could consider when designing a BMI process in the context of digital transformation without reinventing the wheel over and over again.

1. Introduction

Manufacturing firms in the digital age operate in an environment marked by the emergence of digital technologies and blurred industry boundaries (Porter and Heppelmann, 2014). Startups and high-tech firms such as Uber or Google are threatening existing industry structures (Kagermann, 2015), and established firms are seeing their traditional business models challenged and at risk (Bharadwaj et al., 2013; Christensen et al., 2016). Business Model Innovation (BMI) has been identified as a promising approach to provide firms with a sustainable competitive advantage, particularly in times of high environmental volatility (Wirtz et al., 2016). Research shows that although manufacturing firms have a lot of experience in exploring technologies and products, 'they often have little if any ability to innovate the business

models […]' (Chesbrough, 2010, p. 354). This explains why BMI is often viewed as the task of startups, 'who are less constrained by path dependencies and inertia than more established firms' (Zott and Amit, 2007, p. 182). Unsurprisingly, the same applies for digital business models, which are mainly associated with successful former startups such as Airbnb (Sorescu, 2017; Tesch and Brillinger, 2017). However, innovating digital business models is not only the task of startups, but of incumbent firms as well (Burmeister et al., 2016), although these firms often struggle to apply the new logic of innovation that may deviate from existing knowledge (Remane et al., 2017). Hence, aside from new technologies and product innovations (Tesch and Brillinger, 2017), manufacturing firms encounter significant challenges when developing new business models (Koen et al., 2011).

The design of innovation processes can reduce innovation complexity through methodological abstraction (Bucherer et al., 2012). While innovation processes in manufacturing firms (Svahn et al., 2017) mostly follow a New Product Development (NPD) Stage-Gate® approach (Cooper, 1990; Burmeister et al., 2016), digital innovation researchers claim that BMI processes in the digital age should follow a discovery-driven (McGrath, 2010), agile, and rapid development approach instead (Fichman et al., 2014; Brock et al., 2020). Thus, incumbent manufacturing firms need to develop new digital innovation capabilities (e.g., Svahn et al., 2017). The question of whether BMI processes should follow a linear, chaotic, or iterative approach is a much debated topic in BMI research (e.g., Frankenberger et al., 2013; Wirtz et al., 2016). Although the BMI process is an important topic in the BMI literature, empirical research on BMI processes and specific process models remains limited (Wirtz and Daiser, 2018). Extant research is particularly concerned with the design of BMI processes and the associated organizational challenges of BMI in established firms as the journey of BMI from idea to implementation is a process of uncertainty and challenges. From an organizational perspective, and unlike in NPD research, specific routines and knowledge for developing BMI are often nonexistent (Björkdahl and Holmén, 2013) and the structure of BMI process models described in the literature appears to be heterogeneous and case-specific or completely context insensitive and generic (Wirtz et al., 2016; Wirtz and Daiser, 2018).

Thus, this paper addresses three critical shortcomings in the extant BMI process literature. First, researchers lament the overall lack of research, in particular with reference to the digital transformation (Fichman et al., 2014; Hüsig and Endres, 2019), on BMI processes as well as comprehensive and structured empirical BMI process models (e.g., Frankenberger et al., 2013; Schneider and Spieth, 2013). Second, while existing BMI literature associates popular iterative and startup-related concepts such as the lean startup and design thinking (Brown, 2008; Ries, 2015) with BMI in the digital transformation (e.g., Weiblen and Chesbrough, 2015), critical context factors such as organizational structures and the NPD-related path dependency of established manufacturing firms (Cavalcante et al., 2011; Burmeister et al., 2016) related to digital innovations (Svahn et al., 2017) have so far been neglected in BMI research (Tesch et al., 2017). Third, extant research claims that BMI processes in the digital transformation need to follow a more iterative, experimental and rather semi-structured approach (McGrath, 2010; Burmeister et al., 2016). However, there is a lack of understanding on how agile methods are integrated into BMI processes (Burmeister et al., 2016; Tesch et al., 2017). Furthermore, research needs to explore how incumbents employ their ecosystem and collaboration (Svahn et al., 2017) in their BMI processes. Finally, researchers agree that the scalability of digital BMI plays a key role in defining its success (e.g., Stampfl et al., 2013; Tesch et al., 2017). Yet, the relevance of scalability of BMI processes in B2B and B2C firms remains underexplored. To address these research calls in the existing BMI literature, we explore *how the BMI process of established manufacturing firms is designed in the digital transformation with respect to critical context factors*.

In order to address this research question, this study uses a multiple-case study approach, where data on BMI processes were collected in six manufacturing firms based in Germany. Our findings show that the design of BMI processes in the digital age differs conceptually between B2C and B2B manufacturing firms. While BMI processes in B2C firms follow a semi-structured approach that considers experimentation, process models in B2B firms show similarities with a new product development (NPD) hybrid model comprising stage-gate methods and agility. This new typology aims to structure the heterogeneity of BMI process models described in the literature. We theorize that there is NPD-related path dependency, considering the history of NPD processes in manufacturing firms and the fact that requirements on specific digital process characteristics are factored in. Finally, this study proposes two archetype process models for digital BMI for B2C and B2B firms with specific digital process characteristics that manufacturing firms could consider

when designing a BMI process in the context of digital transformation without reinventing the wheel over and over again.

2. Preliminary theoretical framework

2.1. BMI process models and traditional NPD and NSD process models compared

While BMI research often deals with the differences between BMI and traditional process models (e.g., Wirtz et al., 2016), this study follows the approach of Bucherer et al. (2012) by considering potential transferable insights and empirical knowledge for the BMI research. Hence, a comprehensive comparison of different process models (Frankenberger et al., 2013) from BMI, NPD, and NSD research is conducted in order to derive a BMI process model (Bucherer et al., 2012; Frankenberger et al., 2013). What all three literature fields have in common is that they recommend a structured innovation approach (Cooper, 1990; de Jong et al., 2003; Wirtz et al., 2016).

In addition to the identified BMI processes, this paper includes NPD process models of Booz et al. (1982), Cooper (2014), and Rothwell (1994), which have been shown to be relevant in innovation research (e.g., Johne and Storey, 1998; Kahn et al., 2006; Frankenberger et al., 2013). Furthermore, the NSD process models of de Jong et al. (2003) and Johnson et al. (2000) are analyzed. These frameworks characterize service-specific, non-linear and NPD-differentiated NSD process models (Johnson et al., 2000; Kindström and Kowalkowski, 2014). Figure 1 provides an overview of the process models of the three literature fields. As a baseline, this study applies the generic process model of Wirtz and Daiser (2018). In order to follow a structured comparison approach, two heterogeneity characteristics of innovation processes are considered: sequence and set of performed activities (see Tesch et al., 2017).

Concerning the sequence, a heterogeneity between the three process model types can be identified. NSD models characterize a flexible and non-linear sequence, while BMI and NPD models follow a linear process. This, however, excludes the model of Frankenberger et al. (2013), which incorporates some iterations between the stages.

The comparative analysis also shows that BMI models and the NPD model of Cormican and O'Sullivan (2004) include some kind of 'analysis phase.' Activities such as analyzing the ecosystem and evaluating the current business model are exercised during the initial phase. Following that, almost all process models address the development of ideas in an ideation phase. Addressed as a separate phase in the NPD literature, the 'feasibility phase' allows for screening and the development of business cases. The comparative analysis, however, shows that the BMI process models consider

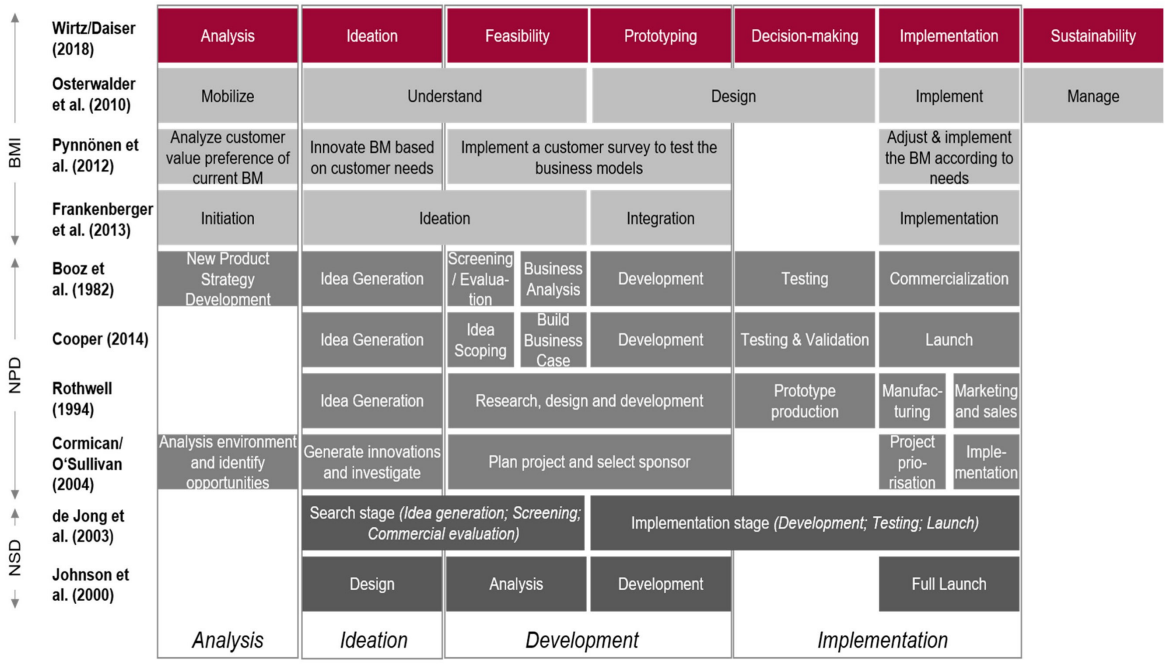

Figure 1. Comparison of BMI, NPD, and NSD process models. [Colour figure can be viewed at wileyonlinelibrary.com]

such activities within an ideation phase. A major difference between BMI and the traditional process models can be identified in the following two phases along the baseline model of Wirtz and Daiser (2018). While in the BMI process literature, a prototype is first carried out before the BM is developed, in NPD and NSD process literature the development of a product or service is completed before a prototype is created. Finally, all models show an 'implementation phase', in which the innovation will be launched.

Based on the comparative analysis, the breakdown of recurring phase patterns along NPD and NSD process models carried out by Eveleens (2010) needs to be adjusted. Rather than following an idea generation phase as starting point, (1) an analysis of the ecosystem and the customer problems seems necessary. Next, (2) an idea generation happens before (3) a prototype is created, and the innovation developed. Finally, (4) the BM will be implemented (see Figure 1).

2.2. *Organizational structure and path dependency of established manufacturing firms in relation to digital BMI activities*

Researchers show that organizational characteristics have an impact on the BMI process (Doz and Kosonen, 2010; Foss and Saebi, 2017), either through 'softer' dimensions (de Brentani and Kleinschmidt, 2004) such as organizational culture (Foss and Saebi, 2017) or through specific and tangible parameters related to the involvement of the senior management in innovation activities (Koen et al., 2011) taking on responsibilities in the innovation process governing innovation activities (de Brentani and Kleinschmidt, 2004). Such characteristics can be traced back to formal hierarchic organizational structures and innovation control systems (Goffin and Mitchell, 2017). Literature on NPD in manufacturing shows that senior management typically makes use of gates in product innovation processes to get involved and decide whether a project should continue or not (Cooper, 2008). Gates are an essential part of the 'Stage-Gate system' described by Cooper (2008) that forms a normative NPD process consisting of different stages (sets of activities) separated by gates (decision points). Gates are built of deliverables (expected outcome of a stage for the project team), criteria (how the innovation project is evaluated by the management), and outputs (expected decisions about the project by the management). Such a course of action follows a so called system of 'hierarchy of authority' (Jones, 2010) typically present in organizations involving management structures related to innovation processes (Crossan and Apaydin, 2010). While organizational attributes are present in the NPD literature factored in via gates (e.g., Cooper, 1990, 2014), Tesch et al. (2017) claim that such practices, particularly in regard to digitalization and the uncertainty associated with digital BMI, have so far been neglected by BMI process literature but can be identified at least in the context of Internet of Things (IoT) BMI projects to a limited degree.

By disregarding such organizational attributes in manufacturing firms, BMI literature overlooks the matter of history giving rise to the path dependency (e.g., Arthur, 1994) of established manufacturing firms in relation to digital BMI activities (Zott and Amit, 2007). 'The striking question nowadays is no longer if but rather how and to what extent history matters in organizations' (Schreyögg et al., 2011, p. 82). With respect to manufacturing firms, history means: product innovation and the practice of the NPD stage-gate-process (e.g., Cooper, 1990, 2014).

A different way of theorizing BMI processes in established manufacturing firms (Hollingsworth, 2006) is to consider developing a set of patterns that frequently lead to a so called 'lock-in' stage (e.g., Sydow et al., 2009), where 'one particular choice or action pattern has become the predominant mode; flexibility has been lost' (Schreyögg et al., 2011, p. 85). For the BMI process, this means that manufacturing firms might have difficulties abandoning NPD stage-gate activities when start-up-similar innovation approaches need to be applied at the same time to develop digital BMI (e.g., Burmeister et al., 2016). Such a setting of path dependent rigidity and possible inefficiency related to action patterns (Sydow et al., 2009) could explain why BMI might be more difficult in established firms than in start-up firms (Foss and Saebi, 2017).

2.3. *BMI process models in the digital transformation*

Digitalization is believed to be 'triggering a radical transformation of the manufacturing environment' (Kagermann, 2015, p. 32). Advances in digital technologies result in opportunities for BMI (Bharadwaj et al., 2013).

However, along the course of transformation to digital BM in the present age (Fleisch et al., 2014),

agile software development methods (Beck et al., 2001) replaced traditional waterfall approaches (Cooper, 2016). 'Agile and iterative development methods are best applied where things change quickly, where the market and needs are uncertain, and where speed is essential' (Cooper, 2017, p. 52). Similar preconditions can be identified in BMI in the digital transformation (McGrath, 2010, Tuulenmäki and Välikangas, 2011), which might explain the call for agile methods such as scrum (Beck et al., 2001) in BMI processes (Burmeister et al., 2016; Tesch et al., 2017). Taking agile values into account (Beck et al., 2001), researchers claim that BMI processes in the digital transformation need to follow a more iterative, experimental, and rather semi-structured approach (McGrath, 2010; Burmeister et al., 2016). Moreover, innovation process researchers have recently started associating iterative concepts such as design thinking (Brown, 2008) and lean startup (Ries, 2015) with agile development (e.g., Fixson and Rao, 2014), and are thus following principles similar to those for the iterative development of innovations (Tesch et al., 2017).

One way to support agile development is the development of rapid prototypes (e.g., Tuulenmäki and Välikangas, 2011; Nicoletti, 2015), which allows for an iterative innovation approach with customer and users. (Boehm and Turner, 2004; Trimi and Berbegal-Mirabent, 2012). Often associated with it is the lean start-up practice (Blank, 2013). It follows different maturity levels of prototypes in an innovation process with the goal to develop a 'minimum viable product' (MVP) containing fundamental business assumptions and hypotheses of a solution as a next development step (Blank, 2013; Ries, 2015). In the end, rapid prototyping supports a more customer-centered approach (Trimi and Berbegal-Mirabent, 2012), which seems very important in the digital transformation (Schallmo et al., 2017).

Moreover, researchers agree that the scalability of digital BMI plays a key role in defining its success (e.g., Stampfl et al., 2013; Tesch et al., 2017). According to Björkdahl and Holmén (2013, p. 217) 'a scalable business model refers to its ability to increase revenues faster than the corresponding cost base.' While BM scalability was already addressed in regard to e-commerce internet BM (Hallowell, 2001), the rise of platforms and data-driven services has seen the goal of scaling a digital BM and achieving success and growth raised to the next level (Evans and Gawer, 2016). The goal of digital BMI is not its implementation, as most existing BMI processes reveal (e.g., Wirtz and Daiser, 2018), but rather its scalability.

2.4. *Synthesis of the preliminary theoretical framework*

With regard to the preliminary theoretical framework, we consider gates as a characteristic of the influence of hierarchical structures and NPD-related past dependency of manufacturing firms, while agility and rapid prototyping, collaboration, and scalability represent specific digital process characteristics related to BMI in the digital transformation. Adapting the back end of the process to the fourth digital process characteristic, we preliminarily propose that the four generic phases – namely analysis, ideation, development, and scaling – form the structure of the BMI process framework in the digital transformation.

3. Methodology

3.1. *Research approach and case selection*

This research aims to explore the BMI processes of manufacturing firms in the digital transformation; however, 'the boundaries between the research object and its context are not clearly evident' (Laudien and Daxböck, 2016, p. 422) and can therefore not be predefined ex ante. In order to apply an appropriate research method, we employ a multiple case study approach (Yin, 2014). The use of multiple case studies allows for stronger robustness and analytical generalization (Gibbert et al., 2008) than evidence from single case studies (Yin, 2014).

The six cases were chosen by means of theoretical sampling in order to illuminate and extend relationships and logic among constructs. Thus, they offer theoretical insights for developing theory (Eisenhardt, 1989; Eisenhardt and Graebner, 2007). Moreover, the six cases include sufficient data points and provide alternative perspectives to develop theory (Eisenhardt and Graebner, 2007).

All cases originate from the German manufacturing sector and are large 'established firms' with headquarters in Germany, at least for the relevant business unit, in order to keep the institutional context constant. To ensure 'theoretical replication' (Yin, 2014, p. 57), the selected cases vary in terms of firm size, sub-sector allocation (i.e., aircraft, high-pressure cleaning equipment, automotive, and engineering), and business focus (B2B vs. B2C) (see Table 1). However, what all

Table 1. Overview of cases and data sources

Firm	Sector/Business	Digital business model	Semi-structured interviews			Other triangulation data sources
			Experts	Interviewees	Duration	
A	Aircraft (B2B)	Sensor-as-a-service: fleet performance management, IoT platform	1	Corporate Innovation	72 min	• Annual report • Homepage • Press releases • Case study
			2	Interior Innovation	46 min	
			3	Head of Corporate Innovation	44 min	
B	Cleaning equipment (B2B)	Sensor-as-a-service: fleet management, networked services	4	Portfolio Manager Digital Business Models	70 min	• Annual report • Homepage • Press releases • Case study • Internal documents
			5	Head of the Digital Hub	58 min	
C	Automotive (B2C)	Sensor-as-a-service: connected services, on-demand service	6	Business Innovation Lab	60 min	• Annual report • Homepage • Press releases
			7	Digital Business Strategy & Customer Experience	76 min	
			8	Innovation Service	62 min	
D	Automotive (B2C)	Sensor-as-a-service: connected services, car sharing	9	Head of Strategy & Innovation (Digital Unit)	51 min	• Annual report • Homepage • Press release
			10	Mobility Services	41 min	
			11	Digital Product & Services	38 min	
			12	Process Management	49 min	
E	Automotive (B2C)	Sensor-as-a-service: fleet management, car sharing	13	Head of Digital Transformation Office (Business unit A)	72 min	• Annual report • Homepage • Press release • Newspaper article
			14	Innovation Lab	52 min	
			15	Solution Consulting (Business unit B)	36 min	
			16	Head of Strategy (Business unit C)	54 min	
F	Engineering (B2C)[1]	Sensor-as-a-service: mobility solutions, IoT platform	17	Head of Sales & Marketing (Business unit A)	48 min	• Annual report • Homepage • Press release • Empirical studies • White Paper
			18	Head of Business Model	65 min	

[1]The main business focus of Firm F is the development of solutions for the B2B market. However, their BMI process was designed to develop digital BMI for the B2C market as digital technologies offer new opportunities for the firm.

cases have in common is that they offer sensor-as-a-service-based digital business models resulting mainly in a higher service-orientation as part of the digital journey. As a result, they need to develop new innovative business models while at the same time maintaining their traditional business model. Hence, the companies offer products as a service (Gassmann et al., 2017) such as pay-per-cleaned square meter or pay-per-use, while at the same time continuing to sell the product directly to the customer as part of the traditional business model. As a result, they have all implemented dedicated BMI processes and innovations units that aim to combine the exploration of digital business models with the exploitation of existing resources.

3.2. Data collection and analysis

In order to increase the quality of the findings, case study researchers should aim to use multiple data sources (e.g., Eisenhardt, 1989). With this in mind, this study uses annual reports, press releases, internal documents, published reports, and semi-structured interviews (Littig and Pöchhacker, 2014) as data sources (see Table 1). A total of 1,374 pages of annual reports, 61 pages of press releases, and 103 pages of reports (e.g., white papers, presentations, case studies) were analyzed.

In case study research, however, interviews are considered the most important data source (Eisenhardt and Graebner, 2007; Yin, 2014). In order to gain various perspectives on BMI processes, experts from different business units, organizational levels, and functional areas were selected (c.f. Eisenhardt and Graebner, 2007). For each firm, between two to four interviews were conducted, resulting in 18 interviews (see Table 1). The semi-structured interviews lasted between 38 and 89 min, resulting in a total of 994 min of interview recordings. In order to ensure a more precise account, each interview was recorded and transcribed, and then approved by the interviewees (Yin, 2014).

In order to analyze the data and to address the most important aspects in a descriptive way and look for specific patterns, the authors created case descriptions for each single-case study. They searched for cross-case patterns such as replications or differences and tried to find theoretical explanations for causal forces (Eisenhardt, 1989; Yin, 2014), thereby achieving the goal of 'theory building' (Eisenhardt and Graebner, 2007).

The use of multiple sources of data, the identification of operational measures from published articles, and the reviewing of the transcripts by the interviewees increased construct validity, while pattern-matching as well as explanation-building improved internal validity and the understanding of causal relationships. In addition, the use of a replication approach for exercising cross-case analysis increased external validity. In order to also ensure reliability, a case study protocol as well as a case study database were developed (Miles et al., 2014; Yin, 2014).

4. Cross-case analysis and discussion

4.1. Cross-case analysis

4.1.1. Structure of BMI processes and path dependency

The cross-case analysis shows that the degree of influence of organizational structures and path dependency reflected in the BMI processes of the six cases differs depending on whether the case firms are focusing on the B2C or the B2B market. Table 2 presents an overview of the findings and the cross-case pattern matching (Yin, 2014). Specifically, the BMI processes of Firms A and B show ***gates*** between ***every stage*** of their process (see Figures 2 and 3). The gates serve as a quality checkpoint for the management evaluating the progress and the results of the previous stage. Firm A assesses three gates in a four-stage process. A checklist was created for each stage, which enables the management to evaluate the previous process stage and decide whether there is potential for success. The second decision point is concerned with winning over internal customers and the management for a business model idea, while the 'go ahead for implementation' is permitted at the third gate.

Firm B, on the other hand, has five gates following the business model components of the business model canvas (Osterwalder and Pigneur, 2010). At the first gate, the management, based on a value creation and delivery analysis draft, decides whether the next stage is attainable. The value creation intention is substantiated by specifying the customer needs and value proposition in order to be able to enter the second gate. The purpose of the third gate is to evaluate the value creation impact extended by the infrastructure components, while value capturing is evaluated at gate four. The last gate is the most important one and includes members of the board of management in the 'innovation board.' They review the complete business model concept and decide whether it will be budgeted and implemented.

Table 2. Overview of the cross-case findings

Firm	Field of business	Variables			
		Gates (Nr.)	Agility and rapid prototyping	Collaboration	Process phases
A	B2B	3	'Hybrid' approach: 'Mini-sprints'/iterations within process phases; DT (workshops) and LS (MVP)	• Customer • Ecosystem approach (esp. startups)	1. Idea space 2. Conception 3. Elaboration 4. Qualification 5. Implementation
B	B2B	3	Hybrid' approach: 'Mini-sprints'/iterations within process phases; DT (Diamond) and LS (MVP)	• Customer • Ecosystem approach (esp. startups)	1. Ideation 2. Development 3. Validation 4. Implementation
C	B2C	1	Experimental agility across phases; 'build, measure, learn' approach/ LS (MVP)	• Customer • Ecosystem approach	1. Ideation 2. Screening 3. Scaling
D	B2C	1	Rather within-phase agility; rapid prototyping/MVP development	• Customer • Ecosystem approach (e.g., property developer)	1. Ideation 2. Development 3. Optimization
E	B2C	1	2-week sprints across phases/experimentation; rapid prototyping (e.g. wireframes)/MVP approach	• Customer/Co-creation • Ecosystem approach (esp. startups)	1. Ideation 2. Validation 3. Incubation 4. Scaling
F	B2C	1	Highly iterative/trial and error approach across phases; rapid MVP development	• Customer • Ecosystem approach (esp. startups)	1. Ideation 2. Preparation 3. Evaluation 4. Scaling

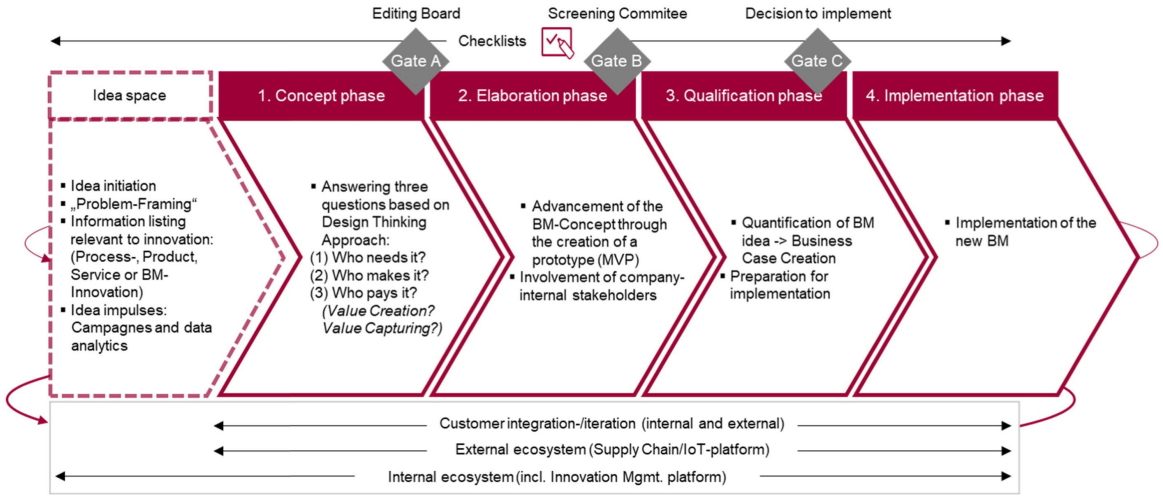

Figure 2. Firm A – Process model (B2B). [Colour figure can be viewed at wileyonlinelibrary.com]

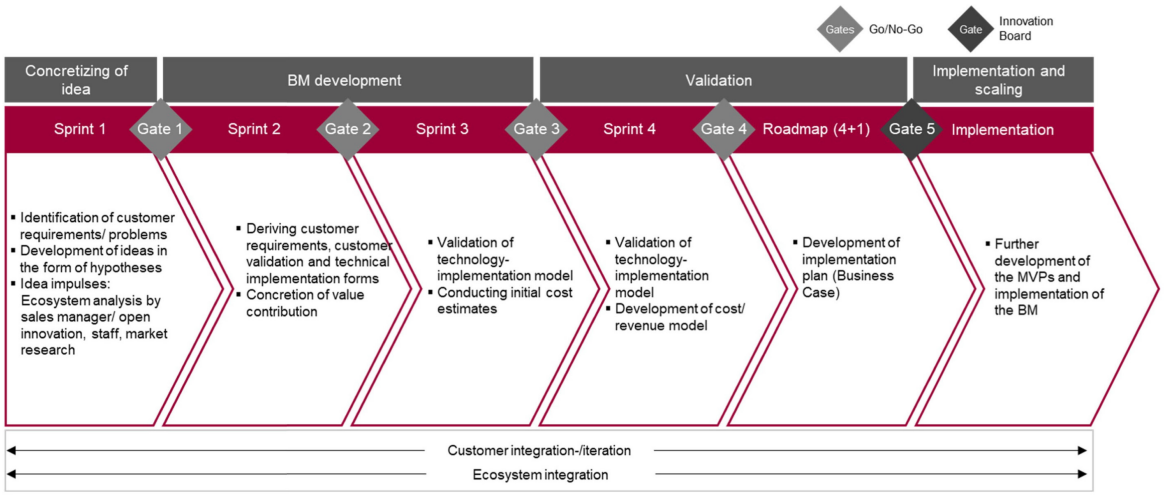

Figure 3. Firm B – Process model (B2B). [Colour figure can be viewed at wileyonlinelibrary.com]

BMI processes at B2C firms, however, do not show similar characteristics. Rather than involving the management between every stage, these gates are informal. Expert 6 from Firm C commented that 'certain gates are present. However, these gates are rather unofficial. This means that we decide based on gut feeling (see Figure 4).' Similar results were identified in the other three B2C firms (see Figures 5–7). Expert 14 from Firm E (see Figure 6), for instance, comments that in their BMI process, they have 'smaller gates,' which means that decisions are made rather spontaneously in project teams and not in official management meetings. The analysis, however, revealed one interesting finding amongst B2C firms: one main gate involving the management is established between the front- and back-end section of the BMI process. The gate serves as a decision point for whether a promising BMI concept requires a spin-off, the setup of a partnership, or the handover to the line-management. In relation to this, Expert 18 from Firm F (see Figure 7), for example, states: 'We developed a new business model idea associated with a new organizational unit and we consider making a spin-off. This can also be done setting up a partnership.' Particularly radical ideas or concepts that are not related to the core business or strategy of the firm need a different environment to scale successfully (e.g., Christensen and Raynor, 2003).

4.1.2. Digital process characteristics

Consistent with the findings related to gates in the previous section, ***agility and rapid prototyping*** are practiced differently in the BMI process models of B2B and B2C firms. The B2B cases indicate that agile approaches are applied between the gates. Expert 1 from Firm A states: 'I have always the

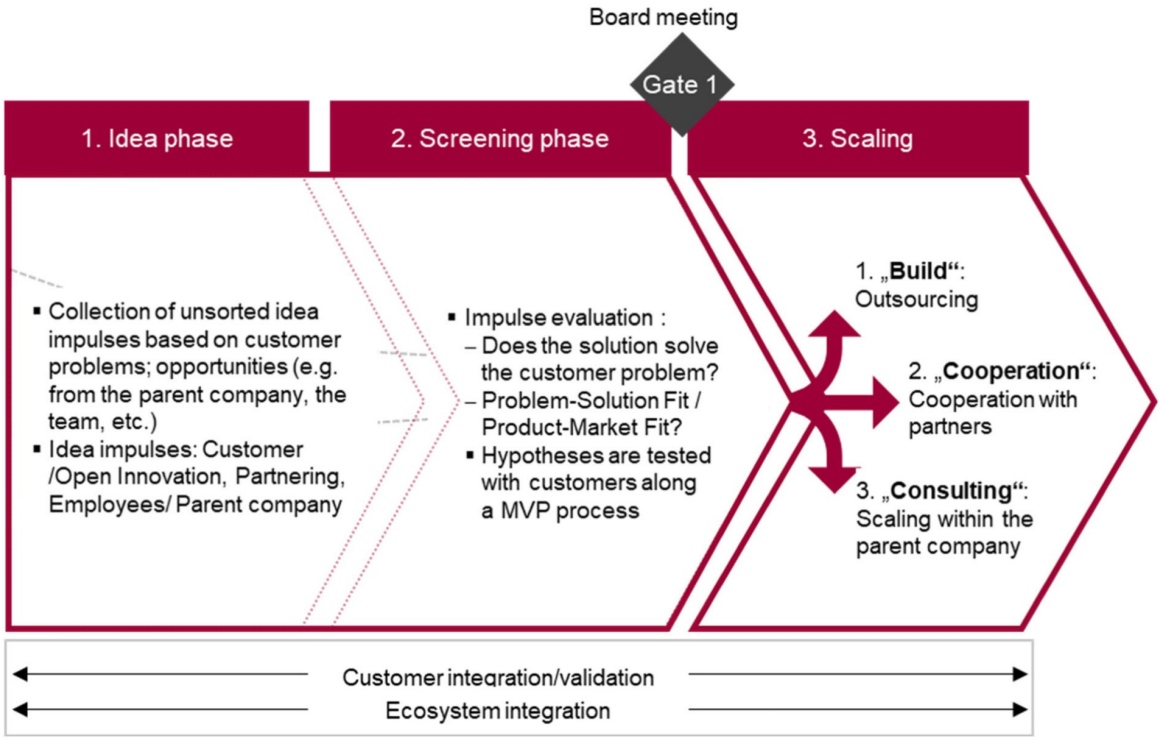

Figure 4. Firm C – Process model (B2C). [Colour figure can be viewed at wileyonlinelibrary.com]

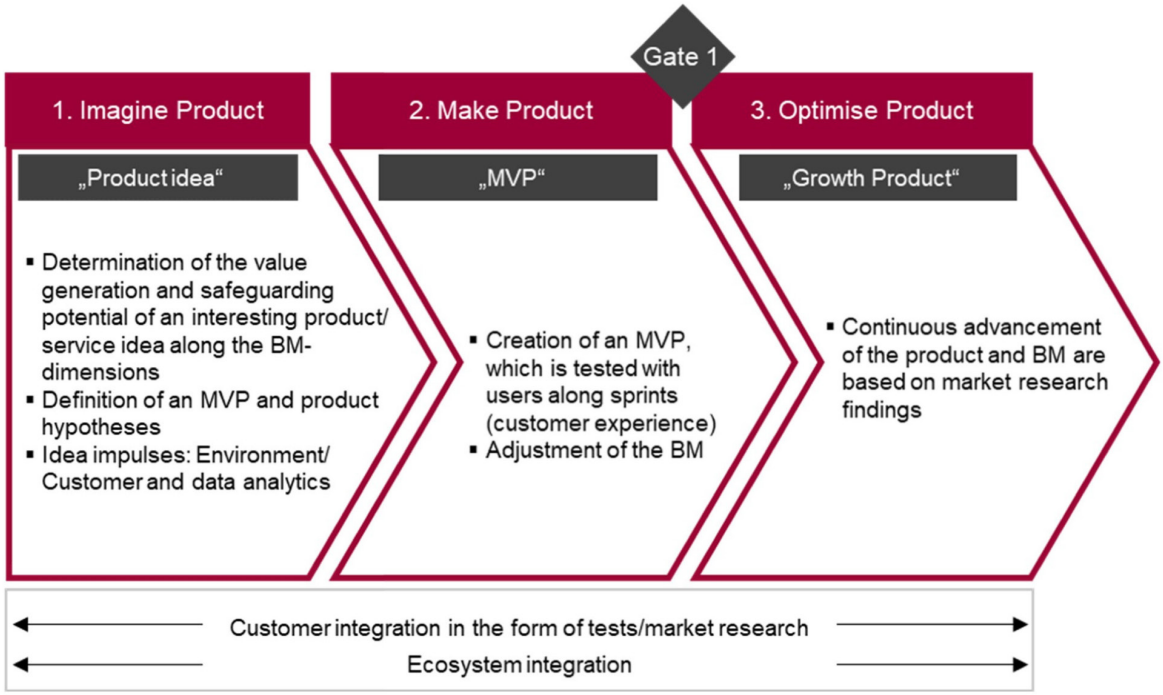

Figure 5. Firm D – Process model (B2C). [Colour figure can be viewed at wileyonlinelibrary.com]

opportunity to iterate within the stages taking a step backwards.' Firms A and B apply scrum-similar practices working in so-called 'mini-sprints' between the gates. In addition, the data reveal that the two B2B firms combine original practices from software-development such as scrum (e.g., Boehm and Turner, 2005) with agile-like methods such as design thinking and lean start-up. Moreover, the

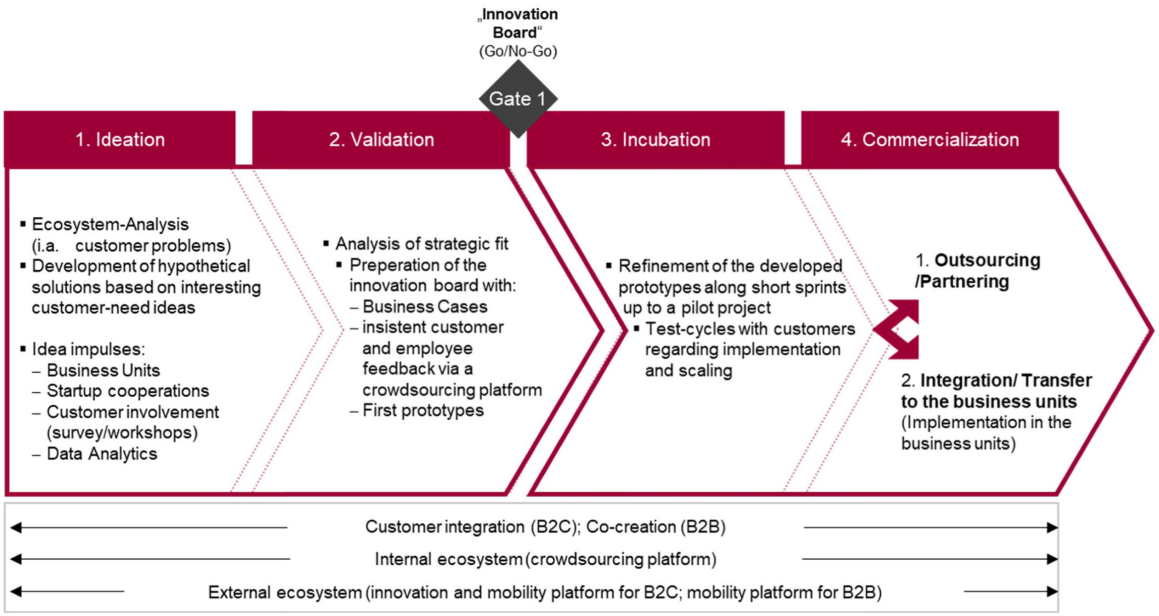

Figure 6. Firm E – Process model (B2C). [Colour figure can be viewed at wileyonlinelibrary.com]

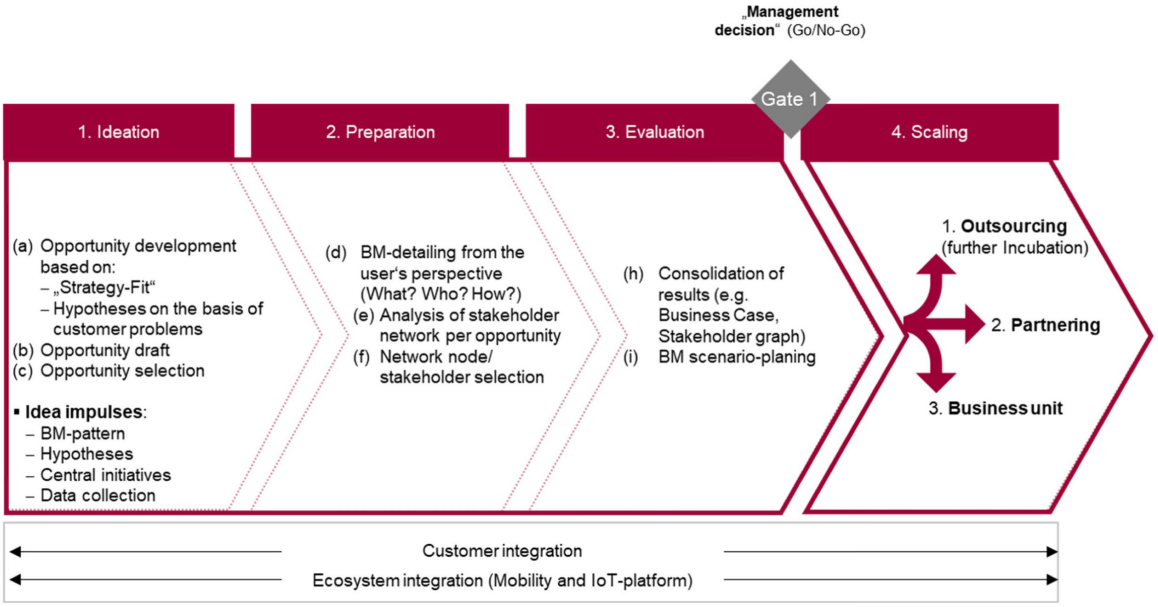

Figure 7. Firm F – Process model (B2C). [Colour figure can be viewed at wileyonlinelibrary.com]

data reveal that, consistent with the lean startup approach (e.g., Blank, 2013), rapid prototyping in the form of MVPs will be practiced early in the BMI process.

Although the findings regarding the B2B case firms reveal agile development and rapid prototyping in their BMI processes (see Cooper, 2014), a more experimental and flexibility-stimulating agile approach can be identified in the BMI processes of the B2C cases. Consistent with Boehm and Turner (2005), Expert 6, for instance, explains agile development on the basis of an ongoing project: 'We had a specific task and performed two sprints. After two sprints, nothing was left of the original idea because there is no existing customer problem. Following that, we went into a pivot (see Müller and Thoring, 2012) and analyzed what we could do differently.' Such an approach allows quick iteration with the customer to validate hypotheses and prototypes. The relevance of prototypes associated with an agile development approach is clearly pictured by Expert 12, for instance, who states that their

'innovation proceeding is mostly very agile – thinking mainly in MVPs, which means to directly test with the customer [in order to] receive feedback.'

Consistent with the data from the six case studies and the relevance of agile development identified in the previous paragraph, ***collaboration*** related to digital BMI is based upon *customer integration* in the innovation process. Expert 1 for example emphasizes: 'The point is to integrate the customer [in the BMI process].' Data source from Firm B shows that a successfully running digital BMI was developed 'together with a leading customer.' In contrast to B2B firms, end customers instead of business customers represent a major collaboration stakeholder in the BMI process of the four B2C case studies. The data reveal that customers are integrated into the BMI process and provide the firms with feedback on business model ideas. Expert 10 for example stated: 'Customer feedback is a more valid instrument than, for example, desktop research.' The results are in line with Nicoletti (2015), who accentuates the role of the customer in innovation processes in the digital transformation.

In addition, the data show that *collaboration with startups* plays a significant role in the BMI process of B2B and B2C firms. In the context of digital innovations, Firm B works closely with startups. Expert 4 also comments on this, explaining that missing dynamic capabilities in the organization related to digitalization represent a significant reason for collaborating with startups. This finding is consistent with the literature, as strong dynamic capabilities stimulate entrepreneurial actions and innovations in order to stay competitive in a dynamic environment (e.g., Teece, 2007).

The data reveal that beyond specific partners such as customers and startups, the whole ***ecosystem*** plays a significant role when considering cooperation in the BMI process. The development of an e-Scooter solution at Firm F, for example, was dependent on, amongst other things, the capabilities of a telecommunication firm and an insurance firm. Similar examples can be observed in the data of the other case studies. This relevance of the ecosystem for BMI in the digital transformation is consistent with the previous findings, as innovations are increasingly complex, making it unlikely that a single firm will own all necessary capabilities to implement an innovation successfully (Adner and Euchner, 2014), which implies that innovation activities involving the ecosystem need to be opened up (Adner, 2012).

For the last process stage, ***scaling***, the findings show that its relevance is considered in the digital BMI processes of the B2C firms, but not substantially in the B2B Firms A and B. Expert 4 from Firm B did indeed mention aspects of scalability in the context of their last process phase 'implementation and scaling.' The expert explains that while scaling should be kept in mind with regard to BMI, currently 'the scaling of solutions is still a minor aim.' Consistent with Lund and Nielsen (2018), the firms focusing on the B2C market link digital scaling with the milestone of fast growth of the BMI. Expert 9, for instance, states that the implementation of a business model itself is not enough for a BMI to be considered successful, but that effectual scaling of the business model is decisive for success. While the findings reveal that Firms C and F even named their ultimate process stage 'scaling,' all B2C firms aim for scalable BMI.

4.2. Discussion: design of BMI processes in the digital transformation in B2C and B2B firms

4.2.1. BMI process structure in B2B and B2C firms

The findings of this study proposes that the ***structure of BMI processes*** in the digital transformation differs conceptually between B2C- and B2B-manufacturing firms. To the best of the authors' knowledge, such differences have not yet been identified in the BMI literature. Contrary to the existing literature, we theorize that the impact of NPD-related path dependency and organizational structures is not only reflected in the set-up of gates, but also in the design of process phases. However, the influence of path dependency seems to be present to a higher degree in the BMI processes of B2B firms than in those of B2C firms.

Figure 8 provides an overview of the two archetypes of digital BMI process models identified in this study. The derived process models are based on the cross-case analysis and include process characteristics and details that will be discussed in this section. It is evident that the BMI process in B2C firms is subdivided into three stages; however, the phases at the front-end are rather blurred. Based on our case study results, we propose that after an analysis of the ecosystem and the stakeholder needs, business model ideas are developed in the ideation phase. The business model will then be developed during the design phase. This also includes the design of an MVP, which allows the firm to get in touch with the customer in order to receive feedback on BM ideas. After the management decision at the main gate, a business model idea reaches the scaling phase. The business model

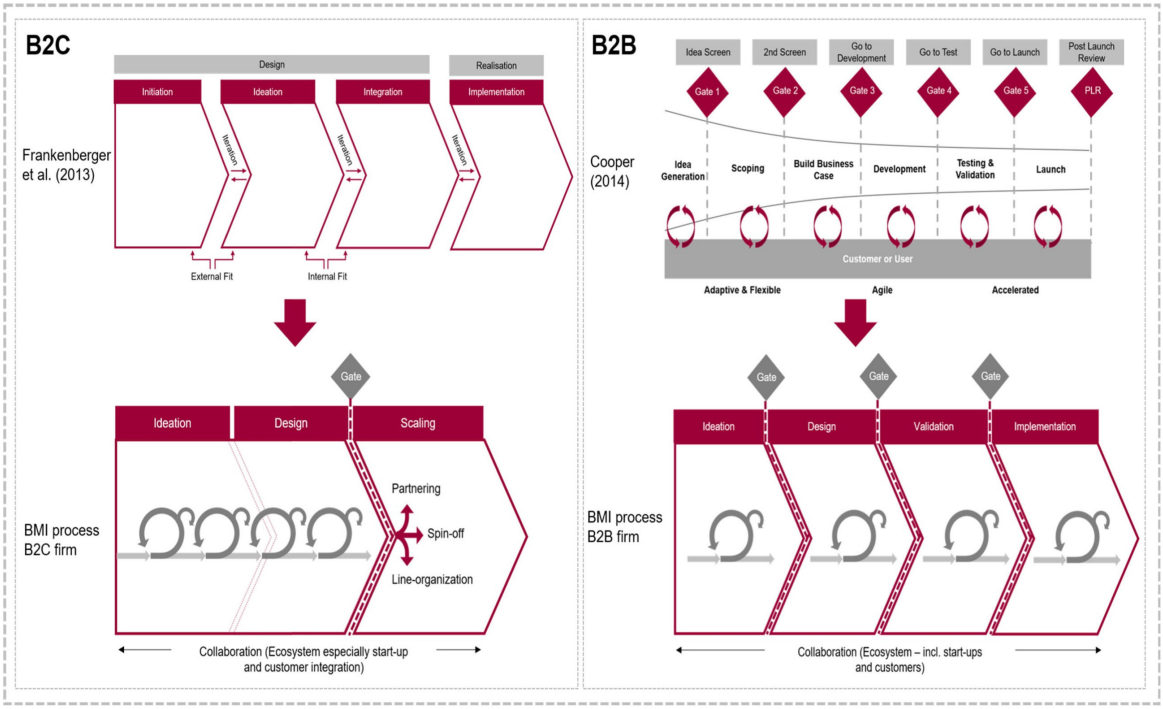

Figure 8. Overview of the two archetypes of BMI process models. [Colour figure can be viewed at wileyonlinelibrary.com]

will then be rolled-out and scaled either in a spin-off, within the organization, or in the context of a partnership.

Furthermore, we propose that the digital BMI process in B2B firms can be subdivided into four phases. Similar to the other BMI process type, the business model will be developed based on an analysis of the ecosystem and stakeholder needs. The idea reaches the second stage after the management approves it. In the second stage, the business model will be developed based on an MVP. Feedback on the prototype is critical for the second gate. In the third process phase, the business model concept will be quantitatively validated. This means that a substantial business case needs to be developed. Based on qualitative and quantitative feedback, the management can then decide at gate three whether the BM concept will be implemented.

The analysis reveals that gates play a conceptually distinct role in the digital BMI processes of B2B and B2C firms. Similar to the NPD Stage-Gate process of Cooper (1990), requirements and deliverables in BMI processes of B2B firms need to be fulfilled in order to pass through a gate. Both B2B case studies support the view stated by de Brentani and Kleinschmidt (2004, p. 324) that in regard to innovation projects such as 'NPD, senior managers must play a central role, getting involved in such activities as project review…' Expert 6 ties such behavior to traditional hierarchical management guarding against risk if a major change is occurring. Based on criticisms and contemporary NPD requirements that include project-specific gates and overlapping activities leading to less linearity and more experimentation, Cooper (2014) integrated these practices into a next-generation NPD process. Although BMI researchers consider a similar BMI approach in the digital transformation important (Burmeister et al., 2016), the BMI processes of the B2B case firms resemble more traditional NPD patterns.

The role and frequency of gates in the BMI processes reflect traditional NPD innovation approach symptoms (Cooper, 2008, 2014). Regarding BMI in B2B firms, our empirical evidence is consistent with the attributes of organizational path dependency put forth by Sydow et al. (2009). The B2B firms in this study display symptoms of a lock-in situation, not being able to adjust their traditional stage-gate product innovation proceedings. Although Expert 12 from Firm D diagnoses 'such dilemmas […] often in manufacturing firms,' this study shows that organizational structures and NPD-related path dependency is reflected in the BMI process differently depending on whether it is a B2B or a B2C firm.

The B2C cases in our study reveal only one decision point at the end of the front-end BMI process section. Consistent with the second gate in a digital BMI process identified by Tesch et al. (2017), decisions are made about whether the digital business model should be scaled. This can happen either

within the organization, via parting, or through a spin-off. In line with Goffin and Mitchell (2017) and Svahn et al. (2017), our findings show that a spin-off and, consequently, an autonomous environment are related to radical and digital innovation ideas. The reduced number of formal gates in the BMI processes of the B2C firms is consistent with the call of Svahn et al. (2017, p. 240) related to digital innovation, who claim that 'firms must develop managerial practices and systems that recognize creativity and differentiation at the expense of prevailing authority structures and integration arrangements.' Unlike the B2B firms, we theorize that the B2C firms were more able to break away from the NPD-related path (Sydow et al., 2009). Expert 3 from Firm A describes it as a next 'maturity' stage. Such a process design not only reflects an improvement of gate definitions (Cooper, 2014), but also reveals a BMI process that is more similar to an NSD process, whereby formal decision points are avoided and flexibility fostered (e.g., de Jong et al., 2003). Since numerous physical products become more software-based and complemented or substituted by services this seems a logical tendency.

The findings show a potential NPD-path dependent impact on the BMI processes of B2B and B2C firms in the initial and finishing stages. In contrast to previous studies that identify an *analysis phase* as the initial stage among BMI processes (e.g., Wirtz and Daiser, 2018), our findings show that the processes – in B2C and B2B firms – begin with an *ideation phase*. Similar to Frankenberger et al. (2013), we find that these activities are about understanding stakeholder needs and problems prior to the generation of ideas. However, the findings show that these activities happen in one phase rather than two separate ones. The contrary design and naming of the initial process phase may be attributed to the historical NPD path of the manufacturing firms and NPD process models that mainly started with an idea generation phase (e.g., Cooper, 1990, 2014).

4.2.2. BMI process characteristics and the role of the customer type in B2B and B2C firms

B2B firms address the implementation of business models as the closing stage, while B2C firms consider ***scaling*** as the success milestone of digital BMI. A potential explanation for the difference in the findings between B2B and B2C firms is the varying competitive impact of startups and entrepreneurial firms in B2B and B2C contexts, which are using the internet or digital technologies such as platforms to develop scalable digital business models (Stampfl et al., 2013). Based on Gassmann et al. (2017), such platform business models can be applied to other industries: This is taking place, for example, in the automotive industry with the development of mobility platforms. A similar argument for the discrepancy comes from Expert 4, who explains: 'The B2C market has been disrupted much easier than the B2B market…the change will also happen in the B2B market with platforms, etc.' Taking into account the path dependency of organizations expressed earlier in this study, B2B customers are more likely to be characterized by rigidity and inflexibility and are not as dynamic as end customers, who experience platform-based digital services in their daily routines (e.g., Sydow et al., 2009). Expert 1 states: 'One single customer is moving faster than a whole organization.' Thus, B2C firms need to react to the dynamic of the B2C market more quickly than B2B firms focusing on scalable business models such as platform services (Lund and Nielsen, 2018).

Furthermore, BMI processes in B2C firms are ***agile*** and iterative in nature and follow a trial and error approach. It seems that the framework of digital BMI process models in B2C firms are an enhancement of recent BMI models such as that of Frankenberger et al. (2013). Consistent with the classification of Wirtz et al. (2016), process models of B2B firms are laid out in a linear fashion, while models in B2C firms show a semi-structured process approach.

5. Conclusion

This paper investigated how BMI processes in the context of the digital transformation of manufacturing firms are organized, what digital process characteristics need to be considered when designing a BMI process, and how the BMI process could be influenced by NPD-related path dependency and process characteristics. Relying on a multiple case study approach, we propose that the design of BMI processes in the digital age differs conceptually between B2C- and B2B-manufacturing firms. Consistent with Cooper (2016), the process models of B2B firms can be characterized as 'hybrid models' combining stage-gate structure and agility. Such an approach is consistent with the concern raised by Burmeister et al. (2016), who state that manufacturing firms might miss central opportunities if digital BMI is only regarded as an extension of NPD. In B2C firms, however, BMI processes seem to follow a semi-structured approach that considers agility and trial and error across the phases. BMI processes in B2C firms

do not indicate NPD-related path dependency and organizational structures to such a degree. B2C firms receive feedback from their customers much quicker. As a result, agile methods can result more quickly in an entire solution than in B2B firms. In contrast, a more traditional stage-gate process may persist longer in B2B firms due to the lower degree of customer dynamics. In addition, B2C firms are characterized by a stronger service orientation than B2B firms. Hence, the findings are consistent with previous findings in literature that indicate that firms with a stronger service focus are less likely to adopt formalized stage-gate processes (Schultz et al., 2019). Similar to the BMI models in B2B firms, the processes of B2C firms show one gate between the front-end and back-end part. However, unlike in B2B firms, management decides if a spin-off, the setup of a partnership, or a hand-over to the line management will take place dependent on the necessary environmental setting enabling successful scaling. It appears that practitioners in B2C firms used recent process models such as that of Frankenberger et al. (2013) as a starting point and refined it based on digital process characteristic requirements of the digital transformation. We propose that three digital process characteristics can be identified in BMI:

1. Both archetypes of digital BMI process models consider agility and rapid prototyping. While B2B firms practice this characteristic only within stages, BMI processes in B2C firms tend to follow an experimental and iterative approach across stages.
2. Collaboration has been identified as a critical characteristic. Both archetypes of digital BMI process models reveal that the ecosystem needs to be included in the innovation process. The complexity of digital BMI makes it unlikely that one single firm will own all capabilities necessary for developing a successful innovation. In particular, the customer acts as a critical partner in the process. Firms also work closely with startups.
3. Scalability, which was only identified in the digital BMI processes of B2C firms, is an important process characteristic in these firms.

In sum, we theorize that the design of BMI processes in manufacturing firms in the context of digital transformation is a balancing act between adapting to digital BMI requirements and managing the impact of NPD-related path dependency and hierarchal (control) structures in large manufacturing firms. However, the findings show that the latter is likely to be reflected to a higher degree in the BMI processes of B2B firms than in those of B2C firms due to different degrees of customer dynamics.

The aim of the paper is to contribute to the BMI literature by providing a comprehensive analysis of BMI processes and to design a process model fulfilling the requirements of the digital transformation. In doing so, this study responds to a call for research broadly expressed by researchers (e.g., Schneider and Spieth, 2013; Burmeister et al., 2016; Wirtz and Daiser, 2018). This study reveals – to the best of our knowledge – findings not yet addressed in the existing BMI process literature. By identifying two archetypes of digital BMI processes, the analysis exposed a difference in considering process-related digital BMI in B2C and B2B firms. Hence, the call for research (e.g., Björkdahl and Holmén, 2013; Wirtz et al., 2016) on the design of standard BMI processes in incumbent firms cannot be answered on a generic level. While BMI processes in B2C firms show a three-stage process following a semi-structured approach, BMI processes in B2B firms reveal similarities with NPD hybrid models (Cooper, 2016) combining stage-gate structure and agility. This also demonstrates that the findings of Bucherer et al. (2012) need to be adapted since similarities between NPD and BMI processes in B2C firms in regard to high-level process steps cannot clearly be identified. BMI processes in B2C firms show, rather, parallels with NSD models (e.g., de Jong et al., 2003) following an experimental approach. Furthermore, our results are consistent with the findings of Tesch et al. (2017), who found that gates play a significant role in digital BMI processes. However, we propose that only one gate seems to be relevant in BMI processes of B2C firms, while a gate is defined between every stage in the models of B2B firms. Hence, our analysis provides a new explanation of challenges addressed by Svahn et al. (2017) in regard to digital innovations: manufacturing firms need to tackle NPD-related path dependency and hierarchical structures when designing digital BMI. Finally, the derived BMI process models differ from those of Frankenberger et al. (2013). While their analysis was conducted across industries, this study reveals manufacturing industry specifics (Burmeister et al., 2016). Hence, our findings are not consistent with Wirtz and Daiser (2018). The derived BMI processes show that one cannot 'speak of an overall BMI process (one size fits all approach)' (Wirtz and Daiser, 2018, p. 53). Rather than seven stages, the BMI process of the B2C firms in our cases consists of three phases, while the process in B2B firms contains four stages.

The paper also has direct implications for management practice. In particular, this study derived two archetypes of BMI processes applicable in B2C

or B2B firms and therefore contributed to the lack of appropriate BMI frameworks that support BMI in organizations (e.g., Taran et al., 2016). These frameworks can provide helpful inspirations to managers (Frankenberger et al., 2013; Wirtz and Daiser, 2018). This is particularly necessary for firms in the manufacturing sector as they often mistakenly regard BMI as an extension of the NPD process and therefore miss specific opportunities in the digital transformation (Burmeister et al., 2016).

Due to limitations of our research due to the case study design (generalizability) and the context of our study (large manufacturing firms in Germany), future research could expand the derived findings with evidence from other sectors or small- and medium-sized firms in order to reveal possible differences. In addition, digital transformation in the manufacturing context is not specifically a phenomenon in Germany; high-tech countries such as the USA and China face similar challenges (Burmeister et al., 2016). Future research could reveal possible differences or similarities in procedural digital BMI between diverse countries. The differences between BMI processes in B2C and B2B manufacturing firms raise a number of important questions: Are such differences in BMI processes only a phenomenon in the manufacturing sector? How are these differences reflected in the innovativeness and firm performance of B2C and B2B firms? What factors other than path dependency such as cost cutting or individual understanding of managers and employees who make sense of innovation methods (Christiansen and Varnes, 2009) are influencing the different set-ups? Future research could examine how the two proposed archetypes of BMI process design are reflected in the success rate of digital BMI compared to other BMI approaches. Finally, this study aimed to examine the BMI process as a whole. Future research could investigate specific process phases and activities in detail.

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